

Evidence Synthesis
Number 82

**Behavioral Counseling to Prevent Skin Cancer: Systematic
Evidence Review to Update the 2003 U.S. Preventive Services
Task Force Recommendation**

Prepared for:

Agency for Healthcare Research and Quality
U.S. Department of Health and Human Services
540 Gaither Road
Rockville, MD 20850
www.ahrq.gov

Contract Number: HHS-290-2007-10057-I, Task Order Number 3

Prepared by:

Oregon Evidence-based Practice Center
Center for Health Research, Kaiser Permanente
3800 North Interstate Avenue
Portland OR, 97227

Investigators:

Jennifer S. Lin, MD, MCR
Michelle Eder, PhD
Sheila Weinmann, PhD
Sarah P. Zuber, MSW
Tracy L. Beil, MS
Daphne Plaut, MLS
Kevin Lutz, MFA

AHRQ Publication No. 11-05152-EF-1
February 2011

This report is based on research conducted by the Oregon Evidence-based Practice Center (EPC) under contract to the Agency for Healthcare Research and Quality (AHRQ), Rockville, MD (Contract No. HHS-290-2007-10057-I). The findings and conclusions in this document are those of the author(s), who are responsible for its content, and do not necessarily represent the views of AHRQ. No statement in this report should be construed as an official position of AHRQ or of the U.S. Department of Health and Human Services.

The information in this report is intended to help clinicians, employers, policymakers, and others make informed decisions about the provision of health care services. This report is intended as a reference and not as a substitute for clinical judgment.

This report may be used, in whole or in part, as the basis for the development of clinical practice guidelines and other quality enhancement tools, or as a basis for reimbursement and coverage policies. AHRQ or U.S. Department of Health and Human Services endorsement of such derivative products may not be stated or implied.

Suggested Citation: Lin JS, Eder M, Weinmann S, Zuber SP, Beil TL, Plaut D, Lutz K. Behavioral Counseling to Prevent Skin Cancer: Systematic Evidence Review to Update the 2003 U.S. Preventive Services Task Force Recommendation. Evidence Synthesis No. 82. AHRQ Publication No. 11-05152-EF-1. Rockville, MD: Agency for Healthcare Research and Quality; February 2011.

Structured Abstract

Purpose: We conducted this systematic evidence review of five key questions to assist the U.S. Preventive Services Task Force (USPSTF) in updating its 2003 recommendation on behavioral counseling to prevent skin cancer (melanoma, basal cell carcinoma, and squamous cell carcinoma).

Data Sources: We first conducted a comprehensive search for systematic reviews from 2001 until March 2008. Using three existing systematic reviews, we developed separate searches for each key question. We searched MEDLINE and the Cochrane Central Register of Controlled Trials from 2001 through December 2008 for key questions 1 to 3; from the end search dates of existing systematic reviews through December 2008 for key question 4 (if no existing systematic review was identified, we searched from 1966 through December 2008); and from 1966 through December 2008 for key question 5. We also obtained articles from outside experts and by reviewing bibliographies of relevant articles and existing systematic reviews.

Study Selection: We reviewed a total of 5,387 abstracts and 324 complete articles. There were a total of 57 unique studies included in this review: 10 examining the effectiveness and harms of counseling interventions; 32 examining the epidemiologic link between sun exposure, indoor tanning, or sunscreen use and skin cancer; and 16 examining the potential harms of sun-protective behaviors.

Data Extraction: Two investigators independently reviewed abstracts and articles against a set of a priori inclusion criteria, and also independently critically appraised each study using design-specific quality criteria based on USPSTF methods and the Newcastle-Ottawa quality criteria for cohort and case-control studies. One investigator abstracted data from included studies into evidence tables and a second investigator checked the data.

Data Synthesis: We found 10 fair- or good-quality randomized controlled trials (RCTs) that examined the impact of primary care relevant skin cancer counseling interventions on sun-protective behaviors, two of which examined community-based interventions with a component of counseling in primary care. In adults (n=6,225), primary care relevant counseling with computer support increased composite scores measuring sun-protective behaviors at 6 to 24 months. In young adults (n=563), brief appearance-focused behavioral interventions decreased normative indoor tanning behaviors at 6 months and decreased ultraviolet (UV) exposure, as objectively measured by skin pigmentation at 12 months. In young adolescents (n=819), primary care counseling with computer support, similar to those used in adults, decreased midday sun exposure and increased sunscreen use at 12 and 24 months. In parents of newborns (n=728), primary care counseling integrated into sequential well-child care visits increased composite scores measuring sun-protective behaviors at 36 months. Successful interventions ranged from single low-intensity interventions (e.g., 15-minute single session, booklet, video) to multiple in-person or phone-based counseling. No significant harms, including physical activity and sedentary behaviors, were reported in these trials.

We found mainly fair-quality cohort and case-control studies examining the relationship between sun exposure and skin cancer (11 studies for squamous cell and basal cell carcinoma, 18 studies for melanoma). We found that increasing intermittent (or recreational) sun exposure is associated

with an increased risk for squamous cell and basal cell carcinoma and melanoma. This association is more consistent in studies with the timing of intermittent sun exposure in childhood. Fewer studies examined the association of total and chronic (or occupational) sun exposure. These studies do not suggest a strong association between total or chronic sun exposure and skin cancer. However, some evidence suggests that total sun exposure in childhood is associated with an increased risk for melanoma and occupational sun exposure may be associated with a decreased risk for melanoma.

We found very few studies that examined the relationship between indoor tanning and risk for squamous cell or basal cell carcinoma, after adjusting for all important confounders. Results generally suggest no association. However, a slightly larger body of higher quality evidence suggests that “regular” or “early” use of indoor tanning devices may increase the risk for developing melanoma. Most of these studies used crude measures of indoor tanning device exposure.

Based on one fair-quality trial, regular sunscreen use may prevent squamous cell carcinoma but not basal cell carcinoma. Case-control studies that suggest sunscreen use reduces the risk for basal cell carcinoma have major limitations. Based on five fair-quality studies, sunscreen use has no clear protective or harmful effect on the risk for melanoma, although the case-control studies examining this risk have major limitations.

Few harms were found in 16 fair-quality studies examining the potential harms of sun-protective behaviors. In school-aged children (n=1,615), sun-protective behaviors do not increase risk for sedentary behaviors or increase in body mass index. Based on three good-quality trials (n=516), use of sunscreen with a higher sun protection factor can increase duration of intentional sun exposure in sun bathers. However, three other fair- to good-quality trials (n=2,520) suggest that sunscreen use in general does not appear to increase sun exposure in adults or children. In adults (n=153), sunscreen use does not lead to vitamin D deficiency. In a cohort of women living at high latitudes (n=2,016), however, those who avoided direct sun exposure were at risk for vitamin D deficiency during the winter and spring months. Four of seven fair- or good-quality studies that examined the relationship between sun exposure and risk for cancer suggest that sun exposure in predominantly white persons may be inversely related to risk for advanced breast and prostate cancer and non-Hodgkin lymphoma, after adjusting for well-established risk factors. However, none of these trials adjusted for dietary vitamin D intake or measured vitamin D status.

Limitations: The main limitations for the trial evidence supporting counseling to prevent skin cancer are the small number of trials in children and the unclear clinical significance of small changes in composite scores measuring sun-protective behaviors. Major concerns about the internal validity of the observational literature include the complex nature of measuring sun exposure and sunscreen use, inconsistent and inadequate adjustment for important confounders, and use of study designs complicated by recall bias. Results from the observational literature examining indoor tanning device use and sunscreen use may not be applicable to today’s products due to changes in indoor tanning devices and sunscreens over time. Most of the counseling trials and all of the epidemiologic studies include exclusively or predominantly white populations.

Conclusions: A limited number of RCTs suggest that primary care relevant behavioral counseling can minimally increase sun protection composite scores in adults and their newborns,

decrease indoor tanning and objectively measured pigmentation in college students, and decrease midday sun exposure and increase sunscreen use in young adolescents. The clinical significance of small changes in sun protection composite scores is unclear. Many of the counseling interventions incorporated computerized support that could generate tailored feedback. Evidence, mostly from case-control studies, suggests that intermittent sun exposure, especially in childhood, is associated with an increased risk for skin cancer. Regular sunscreen use can prevent squamous cell carcinoma, but it is unclear if it can prevent basal cell carcinoma or melanoma. Therefore, behavioral counseling to promote skin cancer prevention should focus on improving multiple behaviors to reduce UV exposure and not improving sunscreen use alone. There is some evidence to suggest that regular and early use of indoor tanning devices may increase the risk for melanoma. However, sunscreen and indoor tanning technologies have changed substantially over the past 20 to 30 years.

Contents

I. Introduction	1
Scope and Purpose.....	1
Background	1
Condition Definition	1
Burden of Preventable Illness	2
Risk Factors and High-Risk Groups	2
Current Practice	3
Previous USPSTF Recommendation	4
II. Methods	5
Terminology	5
Key Questions and Analytic Framework	5
Literature Search Strategy	5
Article Review and Data Abstraction.....	6
Literature Synthesis.....	7
USPSTF Involvement.....	8
III. Results	9
Key Question 1: Is There Direct Evidence That Counseling Patients in Sun-Protective Behaviors Reduces Intermediate Outcomes or Skin Cancer?.....	9
Key Question 2: Do Primary Care Relevant Counseling Interventions Change Sun-Protective Behaviors?.....	9
Adults	9
Young Adults	11
Children and Adolescents	12
Key Question 3: Do Primary Care Relevant Counseling Interventions Have Adverse Effects?.....	14
Key Question 4: Is Sun Exposure, Indoor Tanning, or Sunscreen Use Associated With Skin Cancer Outcomes?	14
Sun Exposure	15
Indoor Tanning.....	17
Sunscreen Use.....	18
Key Question 5: Are Sun-Protective Behaviors Associated With Adverse Effects?.....	19
Reduced Physical Activity.....	19
Increased Sun Exposure.....	19
Vitamin D Deficiency.....	20
Increased Cancer Risk.....	21
IV. Discussion	23
Summary of Findings	23
Effectiveness of Counseling to Promote Sun-Protective Behaviors.....	23
Harms of Counseling and Practicing Sun-Protective Behaviors	24
Association Between Sun Exposure, Sunscreen Use, or Indoor Tanning and Skin Cancer	25
Limitations.....	26
Emerging Issues and Future Research.....	29
Conclusions	30
References	31

Tables and Figures

Figure 1. Analytic Framework and Key Questions	39
Table 1. Search Strategies for Key Questions Based on Existing Systematic Reviews Identified	40
Table 2. Effectiveness of Primary Care Feasible Counseling to Increase Sun-Protective Behaviors	41
Table 3. Association Between Sun Exposure and Skin Cancer	45
Table 4. Association Between Indoor Tanning and Skin Cancer	53
Table 5. Association Between Sunscreen Use and Skin Cancer	56
Table 6. Adverse Outcomes of Sun-Protective Behaviors.....	58
Table 7. Summary of Evidence By Key Question.....	67

Appendixes

Appendix A

Table 1. Search Strategies
Table 2. Inclusion and Exclusion Criteria
Table 3. Quality Rating Criteria
Figure 1. Search Results and Article Flow

Appendix B

Table 1. Evidence Table for Effectiveness and Adverse Effects of Counseling for Sun Protective Behaviors
Table 2. Studies Excluded From the Review for Key Question 1
Table 3. Studies Excluded From the Review for Key Question 2
Table 4. Studies Excluded From the Review for Key Question 3

Appendix C

Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer
Table 2. Studies Excluded From the Review for Key Question 4
Table 3. Evidence Table for Adverse Effects of Sun-Protective Behaviors
Table 4. Studies Excluded From the Review for Key Question Five

Appendix D

Table 1. Ongoing Trials

Appendix E

Glossary and Abbreviations

I. Introduction

Scope and Purpose

This report was written to support the U.S. Preventive Services Task Force (USPSTF) in updating its 2003 recommendation on counseling for skin cancer prevention. The 2003 report found a single counseling trial, in the context of a community-based educational intervention, that examined the effectiveness of increasing sun-protective behaviors.¹ Given the multimodal nature of this intervention, however, the contribution of the office-based counseling component could not be isolated. In addition to the counseling literature, the previous report also examined the association between sun-protective behaviors and melanoma. This report found that determining the efficacy of sun avoidance and use of protective clothing for the prevention of melanoma is complex. The evidence did support the hypothesis that intermittent sunburn in childhood is a preventable risk factor. However, no trials linking sun avoidance or use of protective clothing to a decrease in skin cancer incidence were identified. Finally, the report found one trial showing a modest benefit of sunscreen in preventing squamous cell carcinoma. A meta-analysis of case-control studies, however, showed that sunscreen use was not associated with an increased or decreased risk for melanoma.

The primary evidence gaps identified by the 2003 USPSTF recommendation were uncertainty about whether clinician counseling is effective in changing patient behaviors to reduce skin cancer and uncertainty about potential harms of sun-protective behaviors. Additionally, the USPSTF noted that only fair-quality evidence linked sunscreen use or use of indoor tanning to skin cancer outcomes. Therefore, this review focuses on new trial evidence for counseling interventions to prevent skin cancer conducted in primary care, and also reexamines previous trials that were not conducted in primary care but may be considered feasible for primary care adoption or represent community interventions to which primary care can refer patients.² The early detection of skin cancer with skin self-examination is addressed in the recently updated evidence review on skin cancer screening.³ This review also examines the harms directly associated with counseling interventions, epidemiologic associations between key behaviors in counseling interventions (i.e., decreased sun exposure, sunlamp or tanning bed avoidance, and sunscreen use) and relevant skin cancer outcomes, and the potential harms associated with these sun-protective behaviors.

Background

Condition Definition

The three major types of skin cancer are melanoma, squamous cell carcinoma, and basal cell carcinoma.⁴ There are four major subtypes of cutaneous melanoma: superficial spreading, nodular, lentigo maligna, and acral lentiginous.¹ Some melanomas are not easily classified into a single category and may have overlapping features.

Burden of Preventable Illness

Skin cancer is the most common cancer in the United States. Over 1 million persons are diagnosed annually in the United States with cutaneous malignant melanoma, squamous cell carcinoma, or basal cell carcinoma.⁴ While melanoma is less common than basal cell and squamous cell carcinoma, it is also more deadly.⁴ Incidence rates of melanoma have also been increasing worldwide. Age-adjusted incidence rates of melanoma among white Americans have risen from approximately 8.7 per 100,000 in 1975 to 26.4 per 100,000 in 2005.⁵ An estimated 62,480 persons were expected to develop melanoma in 2008, which means 1 in 52 men and 1 in 77 women will develop this potentially lethal cancer during their lifetimes.⁶ Several factors may contribute to increasing incidence rates, including increased exposure to carcinogenic factors (i.e., ultraviolet [UV] exposure), increased public awareness of the warning signs of melanoma, and increased screening by clinicians.⁷⁻⁹ Mortality rates are more than 5-fold lower than incidence rates, but depend upon stage at diagnosis.¹⁰ Five-year survival of melanoma is 99 percent if diagnosed at a localized stage, but only 65 percent or 15 percent if diagnosed at a regional or distant stage, respectively.¹⁰

Of the approximately 1.3 million cases of skin cancer diagnosed each year, about 800,000 to 900,000 are basal cell carcinoma, and 200,000 to 300,000 are squamous cell carcinoma.⁴ While squamous cell cancer accounts for less than 0.1 percent of all cancer deaths, it does have the potential to metastasize and may account for a significant proportion of mortality from skin cancer in older persons and immunosuppressed persons.¹¹ In contrast, survival rates for those with basal cell carcinoma are indistinguishable from those of the general population.¹¹ On the basis of mortality, squamous cell and basal cell carcinoma are often not considered important problems. Because of their high and rising incidence, however, squamous cell and basal cell carcinoma pose a significant economic burden. Based on 1995 Medicare claims data, it was estimated that squamous cell and basal cell carcinoma are the fifth most costly type of malignant cancer to treat (behind lung, prostate, colon, and breast cancer), and represented approximately 4.5 percent of costs associated with management of all types of cancer.¹²

Risk Factors and High-Risk Groups

Cutaneous melanoma, basal cell carcinoma, and squamous cell carcinoma have well-known host and environmental risk factors. Skin cancer is approximately 10 times more common among Caucasians than among deeply pigmented ethnic groups. Other host factors include history of previous melanoma, family history of skin cancer, and immunosuppression.^{4,13,14} Several phenotypic characteristics are associated with skin cancer risk, including hair and eye color (through correlation with skin phenotype), freckles, and tendency to sunburn.^{13,15} As with other types of cancer, skin cancer incidence increases with age, but is also one of the most common types of cancer in young people.^{4,13} Men are 1.5 to 3 times more likely than women to develop skin cancer, depending on age and type of skin cancer.^{4,13} The role of genetic factors in the etiology of melanoma is complicated. Several genes that cause increased chromosomal sensitivity to sun damage may explain the role of family history as a risk factor for melanoma.⁷ A history of melanoma in first-degree relatives is a strong predictor of melanoma, and about 10 percent of all people with melanoma have a family history of melanoma. Gene mutations have been found in anywhere from about 10 to 40 percent of families with a high rate of melanoma. In

addition, two inherited conditions, xeroderma pigmentosum and basal cell nevus syndrome, confer high risk for skin cancer.⁴

Exposure to solar UV radiation is the most important environmental risk factor for all types of skin cancer.¹⁶ UV radiation from the sun is approximately 95% UVA and 5% UVB. In addition to sunlight, indoor tanning is a source of UV exposure. The composition of UV exposure in indoor tanning has changed over time, however, in that earlier sunlamps primarily emitted UVB radiation, and more recent tanning beds emit higher rates of UVA radiation. Sunscreens, used to protect against UV exposure, have likewise changed over time as well, in that UVA protection was not added to sunscreens until 1989. Other environmental factors include exposure to coal tar, pitch, creosote, arsenic, or radium.⁴

Intermediate outcomes of sun exposure and skin cancer, such as sunburn, acquired nevi, and actinic keratoses, have been established. Sunburn, an inflammatory response to UV radiation, is strongly related to the risk for melanoma. Studies have shown that people with a history of sunburns have double the risk for melanoma.^{13,17,18} The correlation of sunburns with melanoma may be direct or may be because sunburn is a marker of both sun sensitivity and intermittent sun exposure.^{13,17} Actinic keratoses, another form of skin damage caused by sun exposure, are also a confirmed risk factor for skin cancer.^{11,15} At least 60 percent of squamous cell carcinoma cases arise from existing actinic keratoses.¹⁹⁻²¹ Nevi (i.e., moles) are most likely caused by a combination of genetic and environmental factors, particularly sun exposure. The number of common and atypical nevi significantly increases the risk for melanoma.^{7,13,22,23}

Current Practice

It is hypothesized that sun exposure should be more easily modifiable through behavioral intervention than many other cancer risk factors and that changes in behavior should have an impact on decreasing cancer incidence.¹ Strategies for the primary prevention of skin cancer by limiting UV exposure include avoiding midday sun, wearing protective clothing and broad-brimmed hats, applying sunscreen, and avoiding indoor tanning.¹³ The American Cancer Society recommends protection from exposure to UV radiation, monthly skin self-examinations, and screening during periodic checkups.⁴ The Task Force on Community Preventive Services recommends educational and policy approaches in primary schools to improve children's sun-protective "covering up" behavior.²⁴

The frequency of routine primary care counseling for skin cancer prevention varies across studies. Three recent studies report rates from as low as 22 percent to as high as 76 percent. Specifically, the American Academy of Pediatrics Periodic Survey found that more than 90 percent of pediatricians believed that skin cancer is a significant public health problem, but only 22 percent reported counseling most patients in all age groups. The most common intervention named by pediatricians was advising sunscreen with a sun protection factor (SPF) of ≥ 15 .²⁵ Another study of pediatricians in Texas found that 76 percent routinely recommend sunscreen, 53 percent routinely recommend protective clothing, and 46 percent routinely recommend limiting midday sun exposure.²⁶ A third study showed that primary care physicians, when confronted with a standardized patient at high risk for skin cancer, did not ask questions about skin type or sun exposure habits and only 67 percent recommended sunscreen, 7 percent discussed sunscreen types or procedures for effective use, and 13 percent counseled other skin-protective behaviors.²⁷

Recent studies suggest that Americans' sun-protective behaviors must be improved. A cross-sectional study from all 50 states of 10,079 boys and girls ages 12 to 18 years found that the prevalence of sunscreen use was 34 percent. Nearly 10 percent used a tanning bed during the prior year. Girls were more likely than boys to use sunscreen and much more likely than boys to report tanning bed use. Furthermore, the majority had at least one sunburn during the prior summer (83 percent), and 36 percent had three or more sunburns.²⁸ Among 28,235 adults participating in the 2005 National Health Interview Survey (NHIS), over 50 percent reported infrequent use of sunscreen, approximately 20 percent of adults aged 18 to 20 years reported use of an indoor tanning device in the past year, and over 40 percent of adults aged 18 to 49 years reported a sunburn during the past year.²⁹

Previous USPSTF Recommendation

In October 2003, the USPSTF concluded that the evidence is insufficient to recommend for or against routine counseling by primary care clinicians to prevent skin cancer (I recommendation). At the time, the USPSTF found insufficient evidence to determine whether clinician counseling is effective in changing patient behaviors to reduce skin cancer risk. Counseling parents may increase the use of sunscreen for children, but there was little evidence to determine the effects of counseling on other preventive behaviors (such as wearing protective clothing, reducing excessive sun exposure, avoiding indoor tanning, or practicing skin self-examination) and little evidence on potential harms.

II. Methods

Terminology

See Appendix E for definitions of terms and abbreviations.

Key Questions and Analytic Framework

We developed an analytic framework with five primary key questions (KQs) based on the previous review and a scan of new primary and secondary research conducted since the previous review (Figure 1).

KQ 1: Is there direct evidence that counseling patients in sun-protective behaviors (decreasing sun exposure, avoidance of indoor tanning, and using sunscreen) reduces intermediate outcomes (sunburns, nevi, or actinic keratoses) or skin cancer (melanoma, squamous cell carcinoma, or basal cell carcinoma)?

KQ 2: Do primary care relevant counseling interventions change sun-protective behaviors (decreasing sun exposure, avoidance of indoor tanning, and using sunscreen)?

KQ 3: Do primary care relevant counseling interventions have adverse effects?

KQ 4: Is sun exposure (intentional or unintentional), indoor tanning, or sunscreen use associated with skin cancer outcomes?

KQ 5: Are sun-protective behaviors associated with adverse effects (e.g., increased time spent in the sun, reduced physical activity, dysphoric mood, vitamin D deficiency)?

For KQ 4, we did not find studies meeting our inclusion criteria that examined a decrease in sun exposure (e.g., with use of protective clothing, avoidance of midday sun exposure) and skin cancer outcomes. Therefore, we included studies examining the relationship between sun exposure (intentional and unintentional) and skin cancer. We did not examine the association between UV exposure or sun-protective behaviors and intermediate outcomes (e.g., sunburns, nevi, or actinic keratoses). Epidemiologic links between intermediate health outcomes and skin cancer are also not reviewed in this report.

Literature Search Strategy

We searched for relevant systematic reviews published from 2001 to March 2008 in MEDLINE, Cochrane Database of Systematic Reviews, Database of Abstracts of Reviews of Effects, and Clinical Evidence or by the National Institute for Health and Clinical Excellence, Institutes of Medicine, and Agency for Healthcare Research and Quality (AHRQ). Fifteen relevant systematic reviews, in addition to the previous evidence report, were assessed for quality and their potential for answering KQs or identifying primary research for answering KQs. We developed separate

literature searches and terms for each KQ (Appendix A Table 1) based on our assessment of the prior evidence report and the subsequent systematic review literature (Table 1).^{17,22,30-42} We identified 5,387 abstracts through MEDLINE and Cochrane Central Register of Controlled Trials (search dates are provided in Table 1).

For KQs 1 to 3, we searched only for randomized and nonrandomized controlled trials. For KQs 4 and 5, we searched for observational studies and trials. The search for KQs 1 to 3 updated the prior 2002 report. The KQ 4 search began with two more recent, fair-quality systematic reviews with comprehensive literature searches examining the association between indoor tanning devices and skin cancer³⁰ and sunscreen use and melanoma.³¹ When we did not have existing systematic reviews and the question was not systematically reviewed in the prior report, we used 1966 as our search start date. We evaluated all studies included in the previous report¹ against the inclusion and exclusion criteria for the current review. We also obtained articles from outside experts and by reviewing bibliographies of other relevant articles and existing systematic reviews. All searches were limited to articles in the English language.

Article Review and Data Abstraction

We reviewed all abstracts for potential inclusion for any of the KQs using the inclusion/exclusion criteria described in Appendix A Table 2. For KQs 1 to 3, examining the trial literature for the effectiveness and harms of behavioral counseling interventions to prevent skin cancer, we included only those counseling interventions that were conducted in primary care settings, judged to be feasible for delivery in primary care, or widely available for referral from primary care. In general, primary care relevant counseling interventions involved individual-level participant identification, a primary care practitioner or related clinical staff, and individual or small-group format with a limited number of sessions or was viewed as connected to the health care system. Behavioral counseling interventions that included an active component of community outreach, use of community members (e.g., opinion leaders, peer facilitators), use of community programs (e.g., worksite programs, school programs), use of social marketing, or use of public policy changes were not considered primary care relevant. Given the paucity of trial literature in this field, however, we also considered multimodal interventions if the intervention clearly involved primary care. We also required that trials evaluating counseling interventions be conducted in populations representative of primary care patients. Therefore, we excluded studies that exclusively enrolled participants with current or past history of malignant or premalignant skin lesions, or persons with syndromes at risk for skin cancer (e.g., persons with inherited or acquired immunodeficiency, xeroderma pigmentosum, albinism, basal cell nevus syndrome, exposure to arsenic, recessive dystrophic epidermolysis bullosa, medical exposure to psoralen or UVA treatment, familial atypical mole and melanoma syndrome, or more than 100 melanocytic nevi). We did, however, include persons at increased risk based on skin phenotype or family history of skin cancer. For KQs 1 to 3, included trials were conducted in English-speaking countries that are culturally similar to the United States.

For KQ 2, trials had to report behavioral outcomes 3 months or later after the counseling intervention. Behavioral outcomes included self-reported or directly observed measures of sun protection (e.g., limitation/avoidance of midday sun, use of sun-protective clothing, use of sunscreen, or limitation/avoidance of indoor tanning). We did not include behavioral outcomes,

including skin self-examinations, because secondary prevention was not in this review's scope and is addressed in a separate report.³ We also excluded trials that only reported outcomes related to knowledge, attitudes, self-esteem, or ability changes (skills).

For KQs 4 and 5, we had limited a priori exclusion criteria. However, we did exclude studies that focused on populations with syndromes at risk for skin cancer, as described above. We included trials and cohort studies when available. Due to the paucity of trial and cohort studies, we also considered nested case-control studies and population-based case-control studies. We excluded cross-sectional studies that were ecologic analyses and hospital-based case-control studies, as hospital-based controls are not generally representative of the community and hospital-based cases can introduce considerable selection bias.^{43,44} Outcomes for KQ 5 included potentially significant clinical harms (e.g., paradoxical increase in sun exposure, reduced physical activity, dysphoric mood, vitamin D deficiency, increased incidence of other types of cancer).

Two investigators independently screened 5,387 abstracts for potential inclusion, including all abstracts for KQs 1 to 3, and every fifth abstract (20 percent sample) for KQs 4 and 5. There were a total of four discrepancies between the two reviewers for the 480 dual-reviewed abstracts for KQs 4 and 5 (agreement of 99.2 percent). None of these four abstracts was included in the final review. Therefore, we feel confident that no relevant articles were missed by having a second investigator dual review only a subset of the abstracts.

We reviewed a total of 60 articles for KQs 1 to 3 and 264 articles for KQs 4 and 5. Two investigators independently rated all articles meeting inclusion criteria for quality assessment using the USPSTF's study-design specific quality criteria, which was supplemented by the Newcastle-Ottawa Scale for assessing cohort and case-control studies (Appendix A Table 3). The USPSTF has defined a three-category quality rating of "good," "fair," and "poor" based on these criteria. In general, a good-quality study meets all criteria well. A fair-quality study does not meet, or it is not clear that it meets, at least one criterion, but it has no known important limitation that could invalidate its results. A poor-quality study has important limitations.² All poor-quality studies were excluded. Case series and case reports were not included unless they addressed fatal harms. Listings of all excluded articles are included in Appendix B Tables 2–4 and Appendix C Tables 2 and 4. A flow chart of reviewed abstracts and articles is included in Appendix A Figure 1.

We found no trials for KQ 1. This review included 14 articles representing 10 unique trials for KQs 2 and 3; 56 articles representing 32 unique studies for KQ 4; and 18 articles representing 16 unique trials for KQ 5. One primary reviewer abstracted relevant information into standardized evidence tables for each included article (Appendix B Table 1 and Appendix C Tables 1 and 3). A second reviewer checked the abstracted data for accuracy and completeness.

Literature Synthesis

We found no data for KQ 1. For KQs 2 and 3, we were unable to conduct quantitative synthesis, primarily due to the heterogeneity of populations addressed and counseling intervention methods. Instead, we qualitatively synthesized our results stratified by the populations addressed: adults, young adults, adolescents, and parents and children. The Results section and corresponding summary tables reflect these qualitative summaries.

Similarly, for KQs 4 and 5, we were unable to pool estimates of associations due to the heterogeneity in measurement of exposures and outcomes. Instead, we qualitatively synthesized our results stratified by type of exposure addressed (sun exposure, indoor tanning, and sunscreen use) or type of adverse effect.

USPSTF Involvement

The authors worked with three USPSTF liaisons at key points throughout the review process to develop and refine the scope, analytic framework, and KQs; to resolve issues around the review process; and to finalize the evidence synthesis. AHRQ funded this research under a contract to support the work of the USPSTF. AHRQ had no role in study selection, quality assessment, or synthesis, although AHRQ staff provided project oversight, reviewed the draft evidence synthesis, and assisted in external review of the draft evidence synthesis. This systematic evidence review was revised based on comments from five expert reviewers.

III. Results

Key Question 1: Is There Direct Evidence That Counseling Patients in Sun-Protective Behaviors Reduces Intermediate Outcomes or Skin Cancer?

We found no trials directly examining whether behavioral counseling interventions can reduce skin cancer or intermediate outcomes (e.g., sunburns, nevi, and actinic keratoses). One trial, by Crane and colleagues, included both self-reported behavioral outcomes and number of nevi on skin examination as outcome measures. As only 38 percent of participants were examined, this study was excluded for poor quality for this KQ.⁴⁵ Another trial, by Glazebrook and colleagues, included self-reported sunburn in the composite sun-protective behavior score, but was not reported separately.⁴⁶ Both these trials are included in KQ 2.

Key Question 2: Do Primary Care Relevant Counseling Interventions Change Sun-Protective Behaviors?

We found eight unique trials examining primary care relevant counseling interventions to increase sun-protective behaviors (Table 2). Given the limited number of trials, especially in adolescents and children, we discuss two additional trials that were multimodal community-based interventions to prevent skin cancer and included primary care counseling as one component (Table 2).^{47,48} One of these two trials was included in the previous review.⁴⁷ Only one trial explicitly targeted decreased use or avoidance of indoor tanning.⁴⁹

Adults

Summary of findings. We found four fair-quality randomized controlled trials (RCTs) evaluating primary care conducted or relevant behavioral counseling interventions to prevent skin cancer in adults.^{46,50-52} Three trials were conducted in the United States,⁵⁰⁻⁵² and one trial was conducted in the United Kingdom.⁴⁶ The counseling interventions conducted in the United States were coupled with in-office computer support using the transtheoretical model to generate printed stage-based, tailored feedback.⁵⁰⁻⁵² Two of these counseling interventions with computer support targeted multiple behaviors in addition to sun protection and were called “Expert System” interventions.^{51,52} The trial conducted in the United Kingdom used a self-directed computer station in a primary care practice to deliver the counseling intervention.⁴⁶

Overall, three of the four trials (n=6,225) showed that primary care relevant counseling combined with computer support can modestly impact self-reported sun-protective behaviors, as measured by composite behavior scores.^{46,51,52} Populations studied included predominantly middle-aged white men and women. One trial (n=589) included only persons with high-risk skin characteristics,⁴⁶ and the other trials did not report the participants’ sun sensitivity or skin type. Interventions ranged from a single low-intensity intervention (approximately one 15-minute

session) to multiple (three or four) in-person counseling or, phone sessions followed by tailored written feedback.

These trials, however, have a few important limitations. The trial by Glazebrook and colleagues had only a 6-month followup. In addition, all three trials had small but statistically significant differences in followup between the intervention and control groups. Most importantly, these three trials all showed a difference in composite scores measuring self-reported sun protection behaviors. The differences in these scores, though statistically significant, were small, and it is unclear if these small differences would translate into clinically meaningful behavior change to prevent skin cancer. In addition, the true feasibility and cost of implementing the in-office computer support to generate individual tailored feedback in primary care is not clear.

One trial conducted among siblings of patients with melanoma (n=494) failed to show any statistically significant changes in sun-protective behaviors at 12 months in those receiving individual telephone counseling (four 15-minute sessions) conducted by a health educator with computer support and tailored printed materials, compared with those receiving usual care.⁵⁰ This trial used different outcome measures than the other trials (i.e., percent tanned by the end of last summer, routine use of sunscreen with SPF 15 or higher). It is unclear if the nonsignificant findings are a result of trial design issues (e.g., choice of study population, number of participants, choice of outcome measures) or due to lack of efficacy of the intervention itself. Additionally, this trial had low followup at 12 months (approximately 64 percent).

Additional study details. One fair-quality trial randomly assigned 10 primary care practices in Nottinghamshire, United Kingdom, to have a computer workstation that delivered a brief 10- to 15-minute self-directed counseling session, called the “Skinsafe” program.⁴⁶ This Skinsafe intervention, based on the health belief model, was organized into eight sections, designed to be completed in a single session, to inform users about the dangers of excessive sun exposure, sun-protective behaviors, skin characteristics that are at risk for developing skin cancer, early signs of melanoma, how to reduce risk for melanoma, and how to check skin for suspicious lesions. Across the 10 sites, 589 persons with “high-risk” skin characteristics (mean age, 38 years; mostly women) were either given a prescription for the Skinsafe program or received usual care. Persons at the five primary care practices in the intervention group had statistically significantly higher sun-protection behavior scores at 6-month followup (mean difference, 0.33 [95% CI, 0.09–0.57]).

Two fair-quality trials by Prochaska and colleagues randomly assigned adults at risk for sun exposure, as defined by their stage of change in the transtheoretical model, to receive telephone-based counseling and written survey assessments with tailored, mailed feedback using computerized support (the Expert System intervention).^{51,52} The Expert System intervention, based on the transtheoretical model, is designed to use computerized support to deliver stage-based, tailored communications to inform persons about how to reduce sun exposure by limiting sun exposure to 15 minutes a day or always using SPF 15 or higher sunscreen. While the duration of the phone or written assessments were not described, they were administered at 0, 6, 12, and 24 months, followed by a three- to five-page tailored, mailed feedback at 0, 6, and 12 months. In the 2005 trial, adults from 79 different nonhospital-based primary care practices (n=5,407) who were age 45 years on average, about 30 percent male, and overwhelmingly white were randomly assigned to receive the Expert System intervention or assessment only.⁵¹ Among the subset of individuals (n=3,834) who were at risk for sun exposure (defined as being in the precontemplation, contemplation, or preparation stage of change), those in the intervention group

had a very small, but statistically significant, increase in sun avoidance and sunscreen use behaviors at 12 and 24 months, as measured by a four-item Sun Protection Scale. In the 2004 trial, the participants (n=2,460), while similar in age, sex, and race distribution to the 2005 trial, were recruited through schools (parents of children in the ninth grade).⁵² Among the subset of parents (n=1,802) at risk for sun exposure, those in the intervention group had a very small, but statistically significant, difference in sunscreen use at 12 and 24 months using the same four-item Sun Protection Scale, but not sun avoidance.

The final trial in adults was a fair-quality cluster RCT among siblings of melanoma patients identified through dermatologists at teaching hospitals in the Boston area.⁵⁰ These siblings (n=494) were approximately 47 percent male and 100 percent white, and 85 percent had “fair” skin. Siblings were randomly assigned to receive either usual care or four sessions of telephone-based counseling by a health educator with computer-generated tailored materials at 0, 1, 3, and 5 months. At 6- and 12-month followup, there were no statistically significant differences between the intervention and control groups in tanning behavior (as measured by percent tanned by the end of last summer) or in routine sunscreen use.

Young Adults

Summary of findings. We found two fair-quality RCTs evaluating primary care relevant behavioral counseling interventions to prevent skin cancer in young adults in college.^{49,53} Both of these trials used “appearance-based” behavioral interventions that emphasized the photoaging effects of UV exposure and cultural norms regarding tanning and appearing tan instead of a primarily “health-based” message about skin cancer prevention. In one RCT, young university women who self-reported an intention to tan indoors (n=430) received either a professionally produced booklet with an appearance-focused approach aimed at reducing indoor tanning or were assigned to a control group of assessment only. This intervention appeared to statistically significantly reduce the normative increases in indoor tanning during the 3 months of heaviest use, by over 35 percent at 6-month followup.⁴⁹ In another RCT (n=133), mostly female college students were randomly assigned to view a brief video with or without a UV facial photo or to a control group of assessment only. At 12 months, the persons who viewed the video had a “moderate” decrease in objectively measured skin pigmentation.⁵³ The change in pigmentation was judged “moderate” based on the authors’ report of the Cohen d statistic.

Both these trials, however, have a few important limitations. The trial by Hillhouse and colleagues had only a 6-month followup and was conducted among young women who self-identified with the intention to indoor tan. The trial by Mahler and colleagues had a fairly small number of participants randomly assigned to four different intervention groups, in a two-by-two factorial design. Followup was only 63 percent for the results reported, and results were not reported with a true control group. It appears that the UV facial photo, however, did not have an intervention effect, and the authors of the paper state that none of the primary analyses indicated any significant interaction between the video and UV photo interventions. Finally, participants in the Mahler study received course credit for their participation in the trial.

Additional study details. One fair-quality RCT conducted in two U.S. universities randomly assigned young women (n=430) to receive either a professionally produced booklet with an appearance-focused message aimed at reducing indoor tanning or assessment only.⁴⁹ This booklet had five sections addressing the history of tanning and the context for tanning norms,

analysis of tanning and image norms, effects of UV radiation on skin, effects of indoor tanning, and indoor tanning guidelines. Women were age 19 years on average and selected based on a self-reported intention to tan indoors. Approximately one third of the participants had fair or medium skin type. At 6 months, with over 90 percent followup, women in the intervention group had statistically significantly less than normative increases in indoor tanning during the 3 months of heaviest use, by over 35 percent (6.8 events vs. 10.9 events over past 3 months; $p < 0.001$).

One fair-quality trial RCT in a Southern California university randomly assigned participants ($n=133$) in a two-by-two factorial design to receive either a brief video session, a UV facial photo, both, or assessment only.⁵³ The interventions included an 11-minute videotaped slideshow on photoaging of the skin due to UV exposure and effective practices for reducing photoaging, a UV facial photograph using a modified instant camera, and a natural-light instant photograph. Participants were about 80 percent female, 45 percent white, and had a mean age of 20 years. This trial evaluated both self-reported behaviors and objectively measured skin pigmentation using skin reflectance spectrophotometry. At 12 months, the trial had 80 percent followup for self-reported behavior outcomes and 70 percent followup for spectrophotometry readings, but only 63 percent had followup at both 5 and 12 months and were therefore included in the final results. Results were reported for the video groups versus no video groups. Since the UV facial photo is not necessarily primary care feasible and the photo intervention did not appear to have a significant effect on self-reported or objectively measured outcomes, it is not discussed further (see Appendix B Table 1 for details). At 12 months, those persons who received the video session had lighter pigmentation as measured by one of two skin reflectance measures. This change was statistically significant, and based on the reported Cohen d statistic, was considered “moderate.” There did not appear to be any statistically significant difference between the groups in the self-reported eight-item composite measure of sun-protective behaviors.

Children and Adolescents

Summary of findings. We found only two fair-quality RCTs evaluating primary care relevant behavioral counseling interventions to prevent skin cancer in children and adolescents.^{45,54} Participants in both these trials were predominantly white. In one trial ($n=819$), young adolescents who were randomly assigned to brief counseling by their primary care providers coupled with an Expert System intervention had both higher self-reported composite sun protection scores and greater likelihood of avoiding or limiting midday sun exposure or using sunscreen on the face or sun-exposed areas at 24 months. The other cluster RCT was conducted in a large managed-care organization in which parents of newborns ($n=728$) received either usual care or sun protection counseling integrated into four sequential well-child care visits, at the discretion of the primary care provider.⁴⁵ Patients randomly assigned to receive the intervention had small but statistically significant higher self-reported composite sun protection scores at 36 months compared with those in control practices. However, the clinical significance of these higher scores is unclear, given the very small numerical differences and the lack of statistically significant differences in each of the seven sun-protection questions (with the exception of “shade use”) that contributed to the composite score.

Because we found only two trials in children and adolescents, we discuss two additional fair-quality trials in adolescents and children that primarily examined community-based interventions to prevent skin cancer but included a counseling component conducted in primary care.^{47,48} One of these trials was included in the prior report.⁴⁷ Both of these trials show that multimodal

community-based interventions to promote sun-protective behaviors in predominantly white neighborhoods and delivered through primary care practices, schools and/or day care centers, recreational facilities, and other community venues can improve directly observed and self-reported sun-protective behaviors in grade school and middle school children over 2 years of followup. Although these two trials were well-conducted community-level interventions, both trials followed the communities', rather than the individuals', behaviors, so the children and adolescents observed at baseline were not the same individuals at followup. Additionally, given the design of the intervention, it is impossible to determine the relative effect of each component, such as counseling in primary care.

Additional study details. The only fair-quality trial in adolescents was conducted in children aged 11 to 15 years attending one of six San Diego primary care clinics.⁵⁴ Participants (n=819) were age 13 years on average, 47 percent male, and 58 percent white, with 25 percent reporting high sun sensitivity (based on ability to tan, skin and hair color). Patients were randomly assigned to receive either a “Sun Smart” or physical activity and diet intervention, both using an Expert System intervention. The interventions consisted of brief counseling by primary care providers, interactive computer sessions, telephone assessments at 3, 6, 15, and 18 months, printed tailored feedback, mailed information, and sunscreen samples. The control group was matched in intensity, but did not receive the 2- to 3-minute primary care counseling. At 24 months, adolescents receiving sun protection counseling appeared to be approximately 5 to 10 percent (exact numbers not reported) more likely to report “always” or “often” avoiding midday sun exposure, limiting midday sun exposure, using sunscreen on face, and using sunscreen on sun-exposed areas. However, there were no significant differences between the two groups in self-report of wearing a shirt or staying in the shade.

The only fair-quality trial in younger children was conducted in parents and infants attending one of 14 primary care clinics part of a large managed-care organization in Colorado.⁴⁵ The majority of parents (n=728) were aged 30 to 39 years, nearly all were female, and about 76 percent were white, with the majority (75 percent) self-reporting fair to medium white skin. Parents and infants were randomly assigned to receive sun protection promotion at four consecutive well-child visits (at ages 2, 6, 18, and 36 months) or to usual care visits. The intervention included counseling at the discretion of the provider and packets of information, as well as a sun hat, sunglasses, and sunscreen samples. Although the intervention group had a small but statistically significant improvement in the seven-item Sun Protection Practice score at 36 months, these behavior changes were not significant when looked at individually (e.g., clothing use, midday sun avoidance, limiting time in sun, hat use, sunglasses use, sunscreen use). The measure “use of shade” was statistically significantly increased by 7 percent among the intervention group at 24 months (p=0.04), but was no longer statistically significant at the end of the trial (p=0.06).

Two fair-quality cluster RCTs evaluated a multicomponent community-based intervention, “SunSafe,” which included some counseling in primary care.^{47,48} The SunSafe intervention included training primary care clinicians to incorporate sun protection messages into well visits, as well as providing patient education materials to supplement sun-protection curriculum delivered through schools, recreational areas/facilities, and other community venues. One trial targeted adolescents entering sixth through eighth grade at beaches and swimming pools in geographically distinct towns in New Hampshire and Vermont.⁴⁸ Cross-sections of the adolescent population were assessed at baseline (n=797) and at 1 (n=637) and 2 years (n=493). Participants at baseline and followup did not represent a single cohort. Participants at baseline

were in sixth grade, approximately 45 percent male, and mostly white. As compared with adolescents in schools and communities without the SunSafe intervention, adolescents in the intervention communities were observed to have a greater percentage of body surface area protected at 24 months (66.1 vs. 56.8 percent; $p < 0.01$) and more frequently reported sunscreen use (47.0 vs. 13.8 percent; $p < 0.001$). The other trial targeted children aged 2 to 9 years and their caregivers visiting beaches in 10 geographically distinct towns in New Hampshire.⁴⁷ Cross-sections of the communities were assessed at baseline ($n=865$) and 12 months ($n=1,065$). Participants were about one half male and overwhelmingly white. There was no statistically significant difference in observed sun-protective behaviors (use of sun-protective behaviors or protection by shade) between children in the intervention and control communities at 12 months. As compared with children in communities without the SunSafe intervention, those children in the intervention communities reported using sunscreen more frequently at 12 months (approximately 17 percent difference; $p=0.011$).

Key Question 3: Do Primary Care Relevant Counseling Interventions Have Adverse Effects?

Of the 10 trials examining primary care relevant counseling interventions to prevent skin cancer, we found no evidence for a paradoxical decrease in sun-protective behaviors. In one trial, the skin cancer counseling intervention was an attention control intervention for a physical activity and diet counseling intervention.⁵⁴⁻⁵⁶ In this trial, adolescent girls and boys ($n=395$) with a mean age of 13 years received skin cancer counseling in a primary care practice. There was no clinically or statistically significant effect on self-reported measures of sedentary behaviors (mean hours per day), 7-day physical activity recall (moderate and vigorous activity, mean minutes per week), or number of days per week active (refer to Appendix B Table 1 for more details).

Key Question 4: Is Sun Exposure, Indoor Tanning, or Sunscreen Use Associated With Skin Cancer Outcomes?

In total, we found 56 articles representing 32 unique fair- or good-quality studies that evaluated the association of sun exposure, indoor tanning, or sunscreen use with skin cancer, the majority of which were case-control studies. We did not find any studies meeting our inclusion criteria that examined the association between a decrease in an individual's sun exposure (e.g., due to protective clothing or avoidance of midday sun exposure) and skin cancer outcomes. Therefore, in this KQ, we discuss the relationship between sun exposure and skin cancer outcomes. We found only one good-quality trial, the Nambour Skin Cancer Prevention Trial,⁵⁷⁻⁶¹ which was reported in multiple publications and included in the prior report.¹ We found seven fair- or good-quality cohort studies, one of which was a cohort derived from the Nambour Skin Cancer Prevention Trial. We included 25 fair- or good-quality population-based case-control studies,

two of which were nested case-control studies. In this section, we discuss the results for each exposure (sun exposure, indoor tanning, and sunscreen use) separately. Sun exposure is discussed by type of exposure: “intermittent,” which includes predominantly measures of recreational sun exposure; “chronic,” which includes occupational measures or weekday measures of sun exposure; or “total,” which includes cumulative estimates of sun exposure. However, it is important to note that measures of sun exposure within these categories vary greatly between studies. In addition, when possible, we categorized exposures by timing: in childhood (generally before age 19 or 20 years), in the recent past (ranging from past 5 to 20 years), or over the entire lifetime. Given the considerable heterogeneity in study characteristics and measurement of exposure variables, we did not attempt a quantitative summary of results. The reported odds and risk ratios are to illustrate a general estimate of the magnitude of association (e.g., between the highest and lowest risk groups). However, odds and risk ratios should not be compared between studies, because they used very different measures of exposure and choice of reference groups. Individual study details, including quality assessment, are available in Tables 3–5 and Appendix C Table 1.

Sun Exposure

Summary of findings. Based on 11 primarily fair-quality cohort and case-control studies, increasing intermittent (or recreational) sun exposure in childhood and over one’s lifetime is associated with an increased risk for both squamous cell and basal cell carcinoma (range OR, 1.27 to 3.86). The evidence is more consistent for intermittent sun exposure in childhood leading to an increased risk for squamous cell and basal cell carcinoma than in adulthood (range OR, 1.42 to 3.86). While there are fewer studies that examined the association of total (or cumulative) and chronic (or occupational) sun exposure, existing studies did not suggest a strong association between total or chronic sun exposure and squamous cell or basal cell carcinoma.

There were 18 fair-quality studies examining the association between sun exposure and melanoma. Based on mainly case-control studies, it appears that both total and chronic sun exposure are not strongly associated with melanoma. However, some evidence suggests that total sun exposure in childhood is associated with an increased risk for melanoma (range OR, 1.81 to 4.4), and occupational sun exposure may be associated with a decreased risk for melanoma. Case-control studies examining the risk for melanoma and intermittent sun exposure are inconsistent, but some studies suggest that increasing recreational sun exposure increases the risk for melanoma (range OR, 1.3 to 5.0). However, the evidence is more consistent for recreational sun exposure in childhood leading to an increased risk for melanoma than in adulthood (range OR, 1.7 to 3.5).

Measures of intermittent, chronic, and total sun exposure, delineation of levels of exposure, and reference groups for each measure varied largely between studies, making it difficult to make comparisons across studies. We did not quantitatively pool risk estimates.

Study details. A total of five fair- or good-quality cohort studies and six fair- or good-quality case-control studies examined the association between sun exposure and squamous cell or basal cell carcinoma, using different measures of total (or cumulative) sun exposure, intermittent (or recreational) sun exposure, and chronic (or occupational) sun exposure (Table 3).

None of the three case-control studies that examined total sun exposure showed a statistically significant association between total sun exposure and squamous cell or basal cell carcinoma,⁶²⁻⁶⁴

even after adjusting for skin phenotype.^{62,63} None of the two cohort studies (n=3,612)^{61,65} or three case-control studies^{62,64,66} that examined chronic or occupational sun exposure showed a statistically significant association between occupational sun exposure and squamous cell or basal cell carcinoma. All but two of these studies adjusted for skin phenotype.^{61,64}

The largest number of studies examined intermittent or recreational sun exposure and the risk for squamous cell or basal cell carcinoma (five cohort and six case-control studies)(Table 3). Of the cohort studies, the largest three were conducted in the United States (Nurses' Health Study: n=107,900 for squamous cell carcinoma, n=73,366 for basal cell carcinoma; Health Professionals Study: n=44,591).⁶⁷⁻⁶⁹ These studies suggest that women who report not spending regular time outdoors in the summer are at decreased risk for squamous cell (RR, 0.7 [CI, 0.4–1.1]) and basal cell carcinoma (RR, 0.73 [CI, 0.59–0.90]),^{67,68} and men who had frequent sun exposure in the summer as a teenager are at increased risk for basal cell carcinoma (range RR, 1.30 to 1.42).⁶⁹ In two smaller cohort studies from Australia (n=3,612), recreational sun exposure, measured as mainly indoors, indoors and outdoors, or mainly outdoors, was not significantly associated with risk for squamous cell or basal cell carcinoma.^{61,65} Five of the six case-control studies adjusted for skin phenotype.^{62,63,66,70,71} In these studies, increasing recreational sun exposure in childhood increased risk for basal cell carcinoma (range OR, 1.82 to 2.6),^{62,70} but the association between lifetime increase in recreational sun exposure and squamous cell or basal cell carcinoma was not as consistent.^{62,63,66,70,71} The largest case-control study, nested within the Nurses' Health Study, suggests an increase in squamous cell (OR, 2.15 [CI, 1.45–3.19]) and basal cell carcinoma (OR, 2.05 [CI, 1.38–3.06]) with the highest categorization of lifetime recreational sun exposure.⁷¹ A smaller case-control study also suggests an increased risk for basal cell carcinoma with increasing recreational sun exposure;⁶² however, the other case-control studies do not.^{63,66,70} Only one study stratified results by skin type. This study showed an interaction between sun exposure and basal cell carcinoma, with a higher risk seen in those persons with a lesser ability to tan.⁶²

One fair-quality cohort study and 17 fair- or good-quality case-control studies examined the association between sun exposure and melanoma, using different measures of total, intermittent, and chronic sun exposure. Six case-control studies included some measure of total sun exposure, either in childhood, in the recent past, or over the lifetime.⁷²⁻⁷⁷ These studies showed mixed results, with two studies finding a statistically significant association between total lifetime sun exposure and melanoma (range OR, 2.20 to 2.63).^{73,74} The other four studies did not find this association.^{72,75-77} One study that presented results stratified by skin type suggests that those who tan easily have a decreased risk for melanoma with increasing total lifetime sun exposure.⁷² All three studies that examined total sun exposure in childhood showed a statistically significant association between increasing sun exposure and melanoma (range OR, 1.81 to 4.4).^{74,76,77} Eight case-control studies included some measure of chronic or occupational sun exposure.^{72,73,75,76,78-81} Two of these studies suggest that occupational sun exposure is associated with an increased risk for melanoma. Both of these studies, however, used crude measures of occupational sun exposure (yes/no, none/sometimes/often).^{78,79} The confidence intervals in one of these studies, though statistically significant, were extremely wide due to the very small number of cases.⁷⁸ In contrast, five of the remaining six studies suggest that occupational sun exposure is inversely associated with melanoma risk.^{72,73,75,76,80}

One fair-quality cohort study and 13 fair-quality case-control studies examined the association between intermittent or recreational sun exposure and melanoma. A large (n=106,379) fair-

quality cohort study from Norway and Sweden showed no significant association between frequency of sunbathing vacations in childhood or as an adult and risk for melanoma.⁸² Of the eight case-control studies that examined lifetime recreational sun exposure,^{71,73,75,79,83-86} five studies showed that increasing recreational sun exposure was associated with melanoma risk (range OR, 1.3 to 5.0);^{71,73,75,79,84} all but one adjusted for skin phenotype.⁸⁴ Only one of these studies presented results stratified by skin type, which suggested an interaction between a lesser ability to tan and an increased risk for melanoma.⁷¹ Of the three case-control studies that did not show a statistically significant association between lifetime recreational sun exposure and melanoma risk, two from Sweden used a crude dichotomous measure of recreational sun exposure, and one from Denmark lost statistical significance after adjusting for important confounders including skin phenotype. All three case-control studies that examined recreational sun exposure during childhood suggest that increasing sunbathing behavior in childhood is associated with an increased risk for melanoma (range OR, 1.7 to 3.5).^{81,84,87} Only one study presented results stratified by skin type, which suggested an interaction between a lesser ability to tan and an increased risk for melanoma.⁸⁷

Indoor Tanning

Summary of findings. We found very few studies that examined the relationship between exposure to indoor tanning devices and risk for squamous cell and basal cell carcinoma, after adjusting for all important confounders. Results generally suggest no association. However, a slightly larger body of higher-quality evidence suggests that “regular” or “early” use of indoor tanning devices may increase the risk for developing melanoma (range OR, 1.55 to 2.3). Most of these studies used crude measures of indoor tanning exposure.

Study details. We found only five fair-quality case-control studies that examined the association between indoor tanning and the risk for squamous cell or basal cell carcinoma (Table 4).^{64,66,70,71,88} Two of these studies were conducted in Canada during the early 1980s. The remaining studies were conducted in the 1990s. Four of the five studies used only a crude dichotomous measure (ever/never) of indoor tanning, and none of these studies found a statistically significant association between ever and never use.^{64,66,70,71} Three of these studies adjusted for both skin phenotype and sun exposure.^{66,70,71} One fair-quality case-control study that was slightly larger and had a slightly higher proportion of exposed individuals showed a statistically significant association between indoor tanning and risk for squamous cell or basal cell carcinoma, with greater risk for those who reported early first use (before age 20 years).⁸⁸ However, this study only adjusted for skin phenotype and did not adjust for sun exposure.

We found one fair-quality cohort study and 10 fair-quality case-control studies that examined the association between indoor tanning and melanoma.^{71,79,80,82,83,85,86,89-92} The cohort study, derived from the Norwegian-Swedish Women’s Lifestyle and Health Cohort Study, found that women who reported solarium use one time or more per month during ages 10 to 39 years had an increased risk for melanoma (RR, 1.55 [CI, 1.04–2.32]), after adjusting for important confounders including skin phenotype and intermittent sun exposure.⁸² Of the 10 case-control studies, three studies were conducted in the early to mid-1980s.^{80,83,90} Only one of the 10 case-control studies conducted a separate analysis for sunlamps (used mostly pre-1980 and with higher UVB content) and tanning beds (used mostly post-1980 and with higher UVA content).⁹² Five of the 10 studies did not find any association between ever or never use of indoor tanning and melanoma.^{79,80,83,89,91} Only one of these studies adjusted for both skin phenotype and some

measure of sun exposure.⁸⁹ This study by Chen and colleagues also examined measures of total sunlamp use and age at first use, but did not find any statistically significant association between these measures and melanoma. Of the four studies that found a statistically significant association between indoor tanning exposure and melanoma, only two adjusted for both skin phenotype and some measure of sun exposure,^{71,85} while one adjusted for skin phenotype and number of sunburns⁸⁵ and one adjusted for only skin phenotype.⁹⁰ These studies suggest that regular or higher frequency indoor tanning or use at a younger age may increase risk for melanoma. The one study that examined sunlamp and tanning bed exposure separately found a statistically significant trend ($p=0.02$) for frequent sunlamp use (≥ 6 times) and melanoma risk (OR, 1.54 [CI, 0.93–2.57]), but not for frequent tanning bed use (≥ 10 times) and melanoma risk (OR, 1.25 [CI, 0.79–1.98]).⁹² However, the study investigators stated that while no association with tanning bed use was found, sufficient lag time may not have elapsed to assess a potential effect, given the more recent use of tanning beds.

Sunscreen Use

Summary of findings. Based on one trial, regular sunscreen use may prevent squamous cell carcinoma (RR, 0.65 [CI, 0.45–0.94]). It is unclear whether regular sunscreen use prevents basal cell carcinoma; case-control studies that suggest sunscreen use reduces the risk for basal cell carcinoma have major limitations. Based on five fair-quality studies, sunscreen use has no clear protective or harmful effect on the risk for melanoma. However, the case-control studies examining this risk have major limitations.

Study details. We found one RCT ($n=1,621$) examining whether regular sunscreen use can prevent squamous cell or basal cell carcinoma (Table 5).⁵⁷⁻⁵⁹ Based on this trial, individuals randomly assigned to regular sunscreen use had a decreased risk for squamous cell carcinoma after 8 years of followup (RR, 0.65 [CI, 0.45–0.94]). No statistically significant decrease in risk was seen for basal cell carcinoma. Although this was a good-quality RCT, at 8 years a substantial proportion of participants had only passive followup with pathology records. Two fair-quality cohort studies ($n=181,266$) derived from the Nurses' Health Study did not show a decrease in squamous cell or basal cell carcinoma risk with sunscreen use after adjusting for skin phenotype and sun exposure.^{67,68} However, both of these studies used only a crude dichotomous measure of sunscreen use. While two fair-quality case-control studies suggest a protective effect of sunscreen for basal cell carcinoma, both used crude measures of sunscreen use, and neither study adjusted for sun exposure.^{62,64}

We found one fair-quality cohort study and four fair-quality case-control studies that examined the association between sunscreen use and melanoma.^{79,80,85,86,93} One cohort study ($n=178,155$) and one case-control study found no significant association between a crude dichotomous measure of sunscreen use and risk for melanoma.^{79,93} Three case-control studies found a statistically significant association between sunscreen use and melanoma, but were inconsistent. One study found a protective effect for women who reported always using sunscreen compared with women who reported sometimes or never using sunscreen, after adjusting for skin phenotype and sunburn but not sun exposure.⁸⁰ Two studies in Sweden found a statistically significant harmful effect of sunscreen, such that persons who reported always or almost always using sunscreen were at increased risk for melanoma, after adjusting for both skin phenotype and sun exposure.^{85,86}

Key Question 5: Are Sun-Protective Behaviors Associated With Adverse Effects?

We found 16 fair- or good-quality studies that directly examined the potential harms of sun-protective behaviors (Table 6).⁹⁴⁻¹⁰⁷ Of these, one fair-quality trial examined whether adherence to sun-protective behaviors in children reduces physical activity;⁹⁴ six fair- or good-quality trials examined whether sunscreen use leads to increased sun exposure;^{95-97,108-110} two fair-quality studies examined the effect of sun exposure or sunscreen on vitamin D levels;^{98,99} and seven fair- or good-quality studies examined the relationship between sun exposure and risk for breast cancer, colon cancer, prostate cancer, or lymphoma. We found no studies that examined the effect of sun-protective behaviors on mood (for individual study details, refer to Appendix C Table 3).

Reduced Physical Activity

Limited trial evidence suggests that there is no increased risk for sedentary behaviors or increase in body mass index (BMI) in children who reduced their amount of midday sun exposure. Based on one fair-quality cluster nonrandomized trial (n=1,615) in Australia, grade school children who received a 4-year sun protection curriculum beginning at age 6 years had the same mean BMI at 4- and 6-year followup as children receiving a standard health education curriculum.⁹⁴ In addition, there was no difference in self-reported total time spent outdoors between the children in the intervention and control schools. Although the counseling intervention in this trial was not primary care relevant, this study does show that children who practice sun-protective behavior as a result of school-based education do not decrease the total time spent outdoors or show an increase in BMI. This trial's findings are consistent with those observed in the sun protection counseling arm of the trial by Norman and colleagues, which found no difference in self-reported measures of sedentary behavior or physical activity in adolescents before and 12 months after counseling.⁵⁴

Increased Sun Exposure

Two good-quality trials suggest that use of higher SPF (SPF 30) sunscreen increases intentional sun exposure, although not risk for sunburn, in young adult sunbathers. However, based on two other trials in adults and two fair-quality trials in children, sunscreen use in general does not appear to increase sun exposure. We found two small but good-quality double-blind RCTs (n=149) conducted in Europe that examined whether sunscreen use encourages longer sun exposure in healthy student volunteers on vacation.^{95,96} In these trials, persons randomly assigned to higher SPF sunscreen (SPF 30) had increased self-reported sun exposure from sunbathing (approximately 19 to 25 percent) compared with those using SPF 10 sunscreen. However, there was no significant difference in sunburns between the two groups, and the greatest differences in total number of sunbathing hours was in those who did not have sunburns. Another similarly designed fair-quality RCT (n=367) conducted in France was designed to determine whether higher SPF sunscreens have an impact on sun exposure behavior and to determine the impact of actual versus perceived SPF protection.⁹⁷ Adults in this trial were randomly assigned into one of three arms: SPF 12 sunscreen labeled as “basic protection,” SPF 40 sunscreen labeled as “basic

protection,” or SPF 40 sunscreen labeled as “high protection.” Adults blinded to SPF who received SPF 40 sunscreen did not have increased sun exposure from sunbathing, but did have an increase in sunburns compared with those who received SPF 12 sunscreen (14 percent vs. 24 percent, respectively; $p=0.06$). However, this is complicated by the fact that persons who received SPF 12 sunscreen labeled as “basic protection” used three times as much sunscreen on average compared with those who received SPF 40 sunscreen. In addition, there was no difference in self-reported sun bathing or sunburns between the adults who received SPF 40 sunscreen labeled as “basic” or “high” protection. Allocation concealment may have been threatened in this trial, and in addition, patients in this trial, compared with the other two trials by Autier and colleagues, were older (mean age, 39 years) and generally spent fewer hours sunbathing (13 to 14 hours/week vs. approximately 2.5 to 3 hours/day). The largest trial ($n=1,621$), the Nambour Skin Cancer Prevention Trial, randomly assigned persons (mean age, 49 years) to receive SPF 15 sunscreen or placebo sunscreen and did not find any difference at 4.5 years in self-reported time spent outdoors or ambient UV exposure, as measured by polysulphone badges worn by a random subset of participants ($n=175$).^{57,108} Two fair-quality trials in grade school and nursery school children ($n=2,345$) did not find any difference at 3 years in self-reported time spent outdoors or time spent on sunny vacations between those students who received high SPF sunscreen or no sunscreen.^{109,110}

Vitamin D Deficiency

Due to the inclusion criteria for this review, we only found two studies examining sun-protective behaviors and possible harms of vitamin D deficiency (see the Discussion section for additional information). In one fair-quality trial, sunscreen use did not significantly decrease vitamin D levels or cause vitamin D deficiency.⁹⁸ In a fair-quality cohort study, vitamin D levels were greatly influenced by sun exposure, and women living at high latitudes who avoided direct sun exposure were at increased risk for vitamin D deficiency during the winter and spring months.⁹⁹ A placebo-controlled RCT in Australia investigated whether regular sunscreen use in adults put individuals at risk for vitamin D deficiency.⁹⁸ Participants ($n=153$) were randomly assigned to SPF 17 sunscreen or placebo cream over the summer. At 7 months there was no statistically significant change in 25-hydroxyvitamin D3 levels between the two groups. More importantly, no one in the sunscreen group developed vitamin D deficiency. A cohort study nested within a multicenter RCT in Denmark (Danish Osteoporosis Prevention Study) assessed the prevalence of vitamin D deficiency in perimenopausal women and the relative influences of sun exposure and vitamin D intake on measured levels of 25-hydroxyvitamin D3.⁹⁹ Healthy Danish women ($n=2,016$) were interviewed to determine their sun exposure and sunbed use and were given diet records to determine their vitamin D intake. Overall, only 7 percent of the population had vitamin D deficiency (3 percent during the summer through autumn and 11 percent during the winter through spring). However, those avoiding direct sunshine and not taking vitamin D supplements were at increased risk for vitamin D deficiency compared with those who had occasional or regular sun exposure (32.8 percent vs. 17.6 percent and 9.8 percent, respectively). Although the data are not reported, the authors state that “most of the women with low serum 25-hydroxyvitamin D3 values were only deficient for part of the year.” According to the study authors, no cutaneous vitamin D production occurs from October to April at Denmark’s latitude, thus the maintenance of vitamin D is dependent on vitamin D intake and stores built up during the previous summer.

Increased Cancer Risk

Sun exposure, through the production of vitamin D, may be protective against some types of cancer. Based on a sparse body of fair- or good-quality cohort and case-control studies, it appears that sun exposure in lighter pigmented persons may be inversely related to risk for advanced breast and prostate cancer after adjusting for well-established risk factors, and that intermittent sun exposure may be inversely related to risk for nonHodgkin lymphoma. None of these studies adjusted for vitamin D intake or measured vitamin D status. We did not identify any studies examining the association between reduction in sun exposure and risk for developing cancer other than skin cancer.

Breast cancer. Two observational studies, one fair-quality retrospective cohort study and one good-quality case-control study, examined the possible protective role of sun exposure in relation to breast cancer.^{100,107} The analytic cohort was derived from the NHANES I Epidemiologic Follow-up Study, and included women ages 25 to 74 years with adequate followup and available dietary and dermatologic data.¹⁰⁰ There was a nonstatistically significant trend of decreasing risk for breast cancer in relation to increasing levels of combined recreational and occupational sun exposure ($p=0.06$), after adjusting for age, education, age at menarche, age at menopause, BMI, frequency of alcohol consumption, and physical activity. This trend was most prominent within a stratified analysis across region of residence, although statistical significance of these trends was not reported. However, adjustment for dietary vitamin D intake appeared to attenuate this trend ($p=0.08$). While none of the analyses adjusted for skin type, the analytic cohort was restricted to white women. In a large, well-done case-control study by the same group of investigators, the associations between sun exposure, vitamin D receptor gene polymorphism, and breast cancer risk were examined in a multiethnic population in California.¹⁰⁷ Using either measures of observed skin pigmentation or a sun exposure index, increasing sun exposure was statistically significantly associated with a decreased risk for advanced breast cancer. In persons with the lightest skin type (by tertile), the highest sun exposure groups (by quartile) had an adjusted relative risk reduction of 0.53 (CI, 0.31–0.91) based on a sun exposure index ($p=0.01$). The analysis adjusted for age, race, education, family history of breast cancer, personal history of benign breast disease, number of full-term pregnancies, breastfeeding, height, alcohol consumption, BMI, menopausal status, and history of hormone therapy use. This magnitude of risk reduction and trend in risk reduction was not observed in persons with medium- or dark-skin type or with localized breast cancer.

Prostate cancer. We found one fair-quality study designed to evaluate the association between sun exposure and prostate cancer.¹⁰⁵ This case-control study was conducted by the same group of investigators and was similar in design and methodology to the previously well-done case-control study on breast cancer risk.¹⁰⁷ However, this case-control analysis was limited to white persons because there was insufficient data to permit race-specific analyses. The findings in this case-control study were similar to those of the breast cancer study, with a statistically significant inverse trend between sun exposure (using both observed skin pigmentation and a sun exposure index) and risk for advanced prostate cancer. In nonHispanic whites, the highest sun exposure groups (by quintile) had an adjusted relative risk reduction of 0.51 (CI, 0.33–0.80) based on a sun exposure index ($p=0.02$). The analysis adjusted for age, family history of prostate cancer, and month of pigmentation measurement. However, there was no statistically significant trend between self-reported measures of lifetime outdoor activities or lifetime outdoor jobs and risk for advanced prostate cancer.

Colon cancer. We found only one fair-quality case-control study designed to evaluate the association between sun exposure and colon cancer.¹⁰¹ In this study, participants who were identified through a large health maintenance organization across three regions in the United States were interviewed to assess dietary intake and calcium and vitamin D intake, as well as sun exposure. Neither sun exposure nor dietary vitamin D intake were statistically significantly associated with risk for colon cancer after adjusting for age, BMI, family history of colon cancer, aspirin and/or nonsteroidal anti-inflammatory drug use, energy intake, long-term vigorous activity, fiber, and calcium. None of the analyses adjusted for skin type, although approximately 91 percent of the population was white.

NonHodgkin lymphoma. Three fair-quality case-control studies examined the association between sun exposure and nonHodgkin lymphoma. The largest case-control study, conducted in Denmark and Sweden, assessed the association between UV exposure (sun and sunbed/lamps) and lymphoma (both nonHodgkin lymphoma and Hodgkin lymphoma).¹⁰⁴ Cases and controls were identified through national population registries and were interviewed by telephone to determine host factors, sun exposure and sunbed/lamp use, and self-reported skin cancer. Cases with other hematologic malignancy or immunosuppression (from organ transplantation or HIV) were excluded. After adjusting for age, sex, country, and skin type, increasing sun exposure (as measured by self-reported sunbathing, sunny vacations, or sunburn history) was statistically significantly associated with decreasing risk for nonHodgkin lymphoma. In addition, increasing indoor tanning use was also statistically significantly associated with decreasing risk for nonHodgkin lymphoma. Similar, albeit weaker, trends were found for Hodgkin lymphoma. Another case-control study conducted in Australia found a similar statistically significant association between self-reported measures of nonoccupational sun exposure (by quartile), as measured by sun exposure on nonworking days and vacation sun exposure, and risk for nonHodgkin lymphoma after adjusting for age, sex, state, and skin type.^{102,103} However, sun exposure on working days or lifetime occupational sun exposure was not significantly associated with risk for nonHodgkin lymphoma. Neither of these two studies assessed or adjusted for dietary vitamin D intake. The third case-control study, conducted in four geographic areas in the United States, was designed to examine the association between sun exposure or dietary vitamin D intake and nonHodgkin lymphoma in a predominately white population.¹⁰⁶ This study used in-person interviews and mailed questionnaires to ascertain sun exposure and dietary intake, and had noticeably lower response rates than the other two case-control studies. In this study, there was no statistically significant association between midday sun exposure, use of sunlamps or sunbeds, or history of blistering sunburns and risk for nonHodgkin lymphoma, after adjusting for age, sex, ethnicity, and state (latitude). Other than a measure of “blistering sunburns,” this study did not report on intermittent versus chronic sun exposure. This study assessed, but did not adjust for, dietary vitamin D intake, presumably because the study did not find a statistically significant association between dietary vitamin D and risk for nonHodgkin lymphoma. In addition, this study adjusted for ethnicity but not skin type.

Melanoma. As discussed in KQ 4, five fair-quality studies, one cohort and four case-control, examined the association between sunscreen use and risk for melanoma. Of these, two of the case-control studies conducted in Sweden found a statistically significant harmful effect of sunscreen, such that persons who reported always or almost always using sunscreen were at increased risk for melanoma, after adjusting for both skin phenotype and sun exposure.^{85,86}

IV. Discussion

Summary of Findings

In 2003, the USPSTF concluded that there was insufficient evidence to recommend for or against routine counseling by primary care clinicians to prevent skin cancer. At the time of this recommendation, only a single trial that evaluated primary care skin cancer counseling was available, and this was part of a larger community-based intervention. Therefore, the contribution of office-based counseling could not be isolated. In addition, there was uncertainty about potential harms of counseling to encourage sun-protective behaviors, and limited evidence examining the effect of sunscreen or indoor tanning use on skin cancer risk. We summarize our findings according to the evidence gaps identified by the 2003 USPSTF recommendation.

Effectiveness of Counseling to Promote Sun-Protective Behaviors

Although we did not find any studies examining whether counseling interventions could reduce skin cancer or intermediate outcomes (e.g., sunburns, nevi, or actinic keratoses), we found 10 fair- or good-quality RCTs that examined the impact of primary care relevant skin cancer counseling interventions on sun-protective behaviors. In two of these trials, however, the counseling delivered through primary care was a small part of a much larger coordinated multimodal, community-based intervention, and thus will not be discussed further.

In adults (n=6,225), primary care relevant counseling with computer support can increase composite scores measuring sun-protective behaviors at 6 to 24 months. In young adults (n=563), brief appearance-focused behavioral interventions can decrease normative indoor tanning behaviors at 6 months, and decrease UV exposure, as objectively measured by skin pigmentation, at 12 months. In young adolescents (n=819), primary care counseling with computer support, similar to that used in adults, can decrease midday sun exposure and increase sunscreen use at 12 and 24 months. In parents of newborns (n=728), primary care counseling integrated into sequential well-child care visits can increase composite scores measuring sun-protective behaviors at 36 months. It is important to note that the trials in adults only reported composite sun protection scores and not changes in individual behavior. It is unclear if the small, but statistically significant, differences in composite scores of self-reported sun-protective behaviors translate into clinically meaningful behavior change that will prevent skin cancer. All but one trial used self-reported behavioral outcomes and therefore could be affected by social desirability bias. However, it appears that self-reported skin cancer risk behaviors are subject to minimal social desirability bias.¹¹¹

Most of these trials were conducted in exclusively or predominantly white populations. Only one trial in young adolescents and one trial in college students reported inclusion of a sizeable nonwhite population. However, this restriction is reasonable, given the much higher incidence of skin cancer in white persons. In addition, one trial in the United Kingdom included only persons with “high-risk” skin characteristics (e.g., red hair, multiple nevi, history of sunburn as a child, freckling, family history of melanoma, or fair sun-sensitive skin),⁴⁶ and one trial included only young women who expressed intention to indoor tan.⁴⁹ Three trials used a low-intensity

intervention: a single 15-minute self-directed session on a computer workstation “prescribed” by their primary care provider, an appearance-focused booklet aimed at decreasing indoor tanning, or an appearance-focused video on the effects of photoaging on skin. The remaining trials examined high-intensity counseling interventions with about four sessions (either in person or by telephone), many of which included computerized support. Although all trials reported the theoretical underpinnings of the intervention, they are described in varying detail. As such, it is often unclear if the intervention was guided by theory only or empirical data as well (see Appendix B Table 1 for details on intervention theory).

Harms of Counseling and Practicing Sun-Protective Behaviors

Overall, we found little evidence that sun-protective counseling or practicing sun-protective behaviors causes significant harms. Of the 10 trials examining the effectiveness of counseling interventions to improve sun-protective behaviors, we found no evidence that primary care relevant counseling interventions or community-based interventions involving primary care counseling paradoxically decrease sun-protective behavior. In addition, based on two trials, there is no evidence to suggest that sun-protective behavioral counseling in children or adolescents negatively impacts physical activity or BMI.^{54,94}

Based on limited but good-quality trial evidence, it appears that higher SPF sunscreen use can increase intentional sun exposure in young adults on sunbathing vacations compared with lower SPF sunscreen use (but not sunburns). However, other fair- to good-quality trial evidence suggests that sunscreen use in general does not appear to increase sun exposure in adults or children. Two case-control studies suggest an increased risk for melanoma with sunscreen use, although other studies found no association or a protective effect. However, these studies have major methodological limitations, including the use of very crude measures of sunscreen use and lack of adequate adjustment for confounding by indication.

Due to the inclusion criteria for this review, we only included two studies examining sun-protective behaviors and possible harms of vitamin D deficiency. From one fair-quality trial, it appears that regular sunscreen use does not lead to vitamin D deficiency.⁹⁸ One cohort study suggests that vitamin D levels are greatly influenced by sun exposure and that women living at high latitudes may be at risk for vitamin D deficiency during the winter and spring months.⁹⁹ However, the study investigators state that “most of the women with low serum 25-hydroxyvitamin D₃ were only deficient for part of the year.” A recent full report on vitamin D and cancer from the World Health Organization International Agency for Research on Cancer includes a detailed discussion of the complex relationship between serum 25-hydroxyvitamin D levels and sun exposure, and the multiple variables that potentially affect endogenous vitamin D production.¹¹² Cutaneous vitamin D synthesis, however, varies significantly among individuals. In general, this synthesis happens relatively quickly, and prolonged sun exposure does not result in continuous increases in vitamin D synthesis, so that maximum vitamin D synthesis occurs at subthermogenic UV doses.¹¹² According to best estimates, during sunny summer days at approximately 40 degrees latitude, a fair-skinned person could achieve maximum cutaneous vitamin D synthesis with 5 to 10 minutes midday sun exposure to the face and forearms a few times a week. Longer exposure, approximately 30 minutes, is needed for darker-skinned persons or with less-intense sun exposure (e.g., cloudy days).¹¹² In addition, this report recognizes the importance of exogenous vitamin D found in diet, and that fortified foods and supplements are important sources of vitamin D in the winter when skin synthesis of vitamin D is insufficient.¹¹²

Finally, it has been hypothesized that vitamin D production may be protective against certain types of cancer through vitamin D receptor-dependent or independent mechanisms. The few case-control studies published on this topic suggest that sun exposure and intermittent sun exposure in lighter pigmented persons may be inversely related to risk for advanced breast cancer, prostate cancer, and nonHodgkin lymphoma. However, this literature is very sparse, and the case-control studies have important methodological limitations, including the adequate measurement of sun exposure and lack of adjustment for vitamin D intake. Furthermore, none of the studies directly assessed vitamin D status, and the relationship between sun exposure and vitamin D status is not direct. Given the limited number of published studies, it is likely that this body of literature is significantly affected by publication bias.¹¹²

Association Between Sun Exposure, Sunscreen Use, or Indoor Tanning and Skin Cancer

We did not find any studies meeting our inclusion criteria that examined whether a change in sun exposure (e.g., due to protective clothing or avoidance of midday sun) resulted in a decrease in skin cancer outcomes. We found mainly fair-quality cohort and case-control studies examining the relationship between sun exposure and skin cancer (11 studies for squamous cell and basal cell carcinoma, 18 studies for melanoma). We found that increasing intermittent (or recreational) sun exposure is associated with an increased risk for squamous cell and basal cell carcinoma (range OR, 1.27 to 3.86). Case-control studies examining the risk for melanoma with intermittent sun exposure are inconsistent, but some studies suggest that increasing recreational sun exposure increases the risk for melanoma (range OR, 1.3 to 5.0). However, the evidence is more consistent for intermittent sun exposure in childhood leading to an increased risk for both melanoma and squamous cell and basal cell carcinoma. Fewer studies examined the association of total or chronic (or occupational) sun exposure. These studies do not suggest a strong association between total or chronic sun exposure and skin cancer. However, some evidence suggests that total sun exposure in childhood is associated with an increased risk for melanoma and occupational sun exposure may be associated with a decreased risk for melanoma. Our findings are consistent with a fair-quality systematic review by Gandini and colleagues that found a positive association for intermittent sun exposure and an inverse association for high levels of occupational or chronic sun exposure.¹⁷ Unlike our review, the meta-analysis by Gandini and colleagues included both population-based and nonpopulation-based case-control studies.

We found very limited evidence (a limited number of studies using crude measures of indoor tanning exposure) that exposure to indoor tanning devices may increase the risk for squamous cell and basal cell carcinoma, after adjusting for all important confounders. Results generally suggest no association. However, a slightly larger body of higher quality evidence suggests that “regular” or “early” use of indoor tanning may increase the risk for developing melanoma (range OR, 1.55 to 2.3). Most of these studies used crude measures of indoor tanning exposure. The one study that examined sunlamp (earlier technology) and tanning bed (more recent technology) exposure separately found a statistically significant trend ($p=0.02$) for frequent sunlamp use (≥ 6 times) and melanoma risk (OR, 1.54 [CI, 0.93–2.57]), but not for frequent tanning bed use (≥ 10 times) and melanoma risk (OR, 1.25 [CI, 0.79–1.98]).⁹² However, the study investigators state that although no association with tanning bed use was found, sufficient lag time may not have elapsed to assess a potential effect, given the more recent use of tanning beds. Our findings are consistent with a fair-quality systematic review and meta-analysis by the International Agency

for Research on Cancer on artificial UV light and skin cancer that found evidence to suggest that first use of indoor tanning equipment before age 35 years increases risk for melanoma.³⁰ This review estimated the risk for melanoma at 1.15 (CI, 1.00–1.31) based on “ever use” in 19 studies, and at 1.75 (CI, 1.35–2.26) based on first exposure during youth in 7 studies. The risk for squamous cell carcinoma, based on “ever use” in three studies, was 2.25 (CI, 1.08–4.70), and not significant for basal cell carcinoma. Unlike our review, the meta-analysis included both population-based and nonpopulation-based case-control studies.

Based on one fair-quality trial, regular sunscreen use may prevent squamous cell carcinoma (RR, 0.65 [CI, 0.45–0.94]) but not basal cell carcinoma. Case-control studies that suggest sunscreen use reduces the risk for basal cell carcinoma have major limitations. Based on one fair-quality cohort (n=178,155) and four fair-quality case-control studies, there is no clear protective or harmful effect of sunscreen use on the risk for melanoma. This finding is consistent with a fair-quality systematic review and meta-analysis by Dennis and colleagues that found no association between melanoma and sunscreen use.³¹ This meta-analysis, however, did not report any sensitivity analyses. The primary research, nonrandomized studies examining sunscreen use, included in both our report and the meta-analysis by Dennis and colleagues, have major methodological limitations, including the use of very crude measures of sunscreen use and lack of adequate adjustment for confounding by indication.

Limitations

Given the purview of the USPSTF and the scope of our evidence report, we did not review community-based behavioral interventions to promote sun-protective behaviors (e.g., those conducted in schools, recreational, or occupational settings or media campaigns), as these were not considered feasible to implement in primary care or referable from primary care. However, interested readers can refer to the Task Force on Community Preventive Services’ recommendations and evidence report on interventions to prevent skin cancer.^{24,113,114}

There are two major limitations in the body of evidence evaluating the effectiveness of primary care relevant counseling to prevent skin cancer. The first limitation is the generalizability of the interventions to current primary care practice. Based on rigorous trial evidence, many of the effective counseling interventions to promote sun-protective behaviors incorporated computerized support providing tailored patient education. This type of computerized support is not necessarily widely available, and the implementation of this type of support would require additional effort and cost. It is also unclear if this type of support is essential to the effectiveness of the interventions. Only one trial specifically evaluated counseling to reduce indoor tanning, and none of the trials using composite behavior scores included indoor tanning. Both trials in young adults used “appearance-focused” behavioral interventions. It is possible that different counseling messages will be effective in differently aged populations. Second, many of the counseling trials used composite sun behavior scores. It is unclear if these small changes in scores represent meaningful changes in sun-protection behavior that would reduce skin cancer or even prevent a number of sunburns. In addition, only two trials addressed skin cancer prevention counseling in children and adolescents, which based on the epidemiological evidence, is the ideal time to intervene on sun-protective behaviors. Although most of the counseling trials were conducted in predominantly white populations, this is not really a limitation for this body of

literature, as white persons represent a higher risk population. One counseling trial in young adolescents and one trial in college students included a sizeable proportion of nonwhite participants. However, given that practically all of the epidemiologic studies included exclusively or predominantly white individuals, it is unclear if sun-protective behavior counseling will have similar benefits in nonwhite populations, especially given the lower incidence of skin cancer in nonwhite populations.

The epidemiological evidence examining skin cancer risk with sun exposure, indoor tanning, and sunscreen use has numerous limitations. The internal validity of the observational literature is threatened by the complex and variable nature of measuring sun exposure and sunscreen use, omission of adjustment for important confounders in many studies, and problems with recall bias for determining true exposure in case-control studies. The literature as a whole may also be influenced by publication bias. The generalizability of the observational literature addressing indoor tanning and sunscreen use is limited by the inclusion of outdated indoor tanning devices and sunscreen formulations.

Even though we limited our included studies to fair- or good-quality cohort and population-based case-control studies, this body of evidence had some consistent limitations in internal validity. Most of the cohort studies (and all of the large cohort studies) included were derived from larger cohort studies that were not primarily designed to address skin cancer-related behaviors, and therefore use fairly crude measures of exposure. In addition, a few of these cohort studies were not true inception cohort studies, meaning the cohorts were defined by those persons who answered relevant questions and did not have missing data. Even narrowing our inclusion criteria to population-based case-control studies, it is possible that cases were not necessarily representative of the whole spectrum of the examined disease in the general population. For example, many case-control studies were interview studies that excluded cases of death. This means that cases with the most aggressive cancer or advanced disease were likely underrepresented. Case-control studies often reported different ways of calculating participation rates; therefore, comparison of participation rates across studies is difficult, although we excluded studies reporting extremely poor participation rates. Also, some case-control studies excluded different types of melanoma, again making comparisons across studies difficult. In addition, melanoma research is now beginning to distinguish among types of melanoma by somatic gene mutations, and is finding differences in risk factors for the different types of melanoma. Evidence to suggest that melanomas at different body sites are associated with distinct patterns of sun exposure support this hypothesis.¹¹⁵ However, we did not examine cross-sectional studies or studies without true controls, and we did not include selected studies that may elucidate this association. One included case-control study presented site-specific melanoma outcomes; however, associations between different measures of sun exposure and site-specific melanoma outcomes did not seem to differ in this study (Appendix C Table 1).⁷³

Perhaps the biggest limitation in interpreting this body of evidence is the complexity and variability in the measurement of sun exposure and important confounders, particularly for sun exposure and sunscreen use. Sun exposure is extremely complex to measure, even when broken down into total, intermittent, and chronic sun exposure. There was a large amount of heterogeneity in the actual measurement of sun exposure between studies, the categorization of levels of exposure, and the choice of reference groups. Sun-exposure measurement was defined differently, was assessed differently (e.g., objectively measured pigmentation, interview, questionnaire), and was often used in different periods of life. Complexity of measurement

ranged from sun exposure indexes accounting for some aspect of measured ambient UV exposure, to cumulative hours to very broad categories (e.g., mainly indoors, indoors and outdoors, or mainly outdoors). In general, the measurement of indoor tanning or sunscreen use was crude. Measurement of sunscreen use rarely included important details, such as SPF, amount, frequency and duration, and year, as sunscreen formulations have changed over time. Likewise, measurement of indoor tanning use rarely included important details, such as rationale or motivation of use, frequency and duration, and year, as indoor tanning devices have changed over time as well.

Adjustment for important confounders and stratification to examine effect modification also varied across studies; however, studies examining sun exposure generally adjusted for age, sex, and some measure of skin phenotype or sun sensitivity. Although some studies did not adjust for sun sensitivity (i.e., skin type, ability to tan, or susceptibility to burn), most adjusted for some measure of skin phenotype in general (e.g., skin color, hair/eye color). Only four studies presented results stratified by skin phenotype, and these studies suggest an interaction between skin phenotype and skin cancer.^{36,71,87,116} Therefore, simply adjusting for skin type as a confounder in logistic regression may not be adequate to understand the effect of sun exposure in at-risk (e.g., poor tanners) populations. Lack of adequate adjustment and lack of stratification for skin phenotype or sun sensitivity may be an explanation for the lack of association or the inverse association reported with occupational sun exposure, as persons at low risk for skin cancer due to skin pigmentation are over-represented in outdoor workers. In addition, though most studies examining indoor tanning and sunscreen use adjusted for age, sex, and skin phenotype, not all adjusted for sun exposure. For sunscreen use, confounding by indication is extremely important and was generally not well adjusted for. Some studies also may have over-adjusted for confounding, such as adjusting for nevi, freckling, or sunburn history, as these are likely intermediate steps in carcinogenesis or surrogates for sun exposure.

The retrospective assessment of sun exposure, and in some cases important confounders, is subject to significant recall bias. This recall bias may have been less of a problem in earlier studies, such as in the 1980s when there was less public knowledge about the potential harms of UV exposure. As a corollary, assessment of past exposure, especially in childhood or the distant past, are subject to imprecision. Therefore, since most of this evidence is case-control studies, it is subject to these limitations.

Given these numerous limitations, we caution against lending much confidence to quantitative risk estimates. Given the extreme heterogeneity in the measurement of exposure, confounders, and, in some instances, outcomes (i.e., types of skin cancer), we did not attempt quantitative synthesis of risk estimates. It is also important to consider that, even though the epidemiological literature may show a statistically significant association trend in risk (e.g., from the lowest to highest percentile), people might not change their behavior to this degree (e.g., from that of the highest to that of the lowest percentile), so the estimates presented in the epidemiological literature are intended to describe primarily the strength of an observed association and dose response, important criteria for causality. These limitations also apply to the case-control studies examining the association between sun exposure and cancer other than skin cancer.

While it is also likely that this body of literature is subject to publication bias, the direction of bias may not be consistent. For example, studies showing a positive association between sun exposure and melanoma might be more likely to be published, while studies showing a positive association between sunscreen use and melanoma might be less likely to be published.

In addition to the limitations in the internal validity of this body of evidence, there are also important limitations in the generalizability of associations observed for indoor tanning and sunscreen use, both of which have changed in the recent past. Indoor tanning devices before 1980 had higher UVB content, and after 1980 had higher UVA content.⁹² Furthermore, modern tanning beds have undergone technological advances to enrich UVB that allow shorter duration of exposure. However, in practice, the proportion of UVB output of indoor tanning devices varies.³⁰ Therefore, the potential harm of indoor tanning has changed during the period of all of the included studies, and adolescent or early adulthood sunbed exposure in observational studies may not be generalizable to the current exposure from indoor tanning devices. Likewise, sunscreen formulations have also changed drastically over time. SPF was introduced in 1978 and protection for UVA was not added until 1989, and UV sun exposure is approximately 5% UVB and 95% UVA.³⁰ In addition, sunscreen formulations have also improved over time, offering higher level SPF and water resistance.

Due to the scope of this report, we did not examine the evidence between sun exposure, indoor tanning, or sunscreen use and outcomes other than skin cancer (e.g., nevi, premalignant lesions, or evidence of photoaging of the skin). We acknowledge that, therefore, we may have missed other potentially informative bodies of literature for skin cancer prevention. Due to the scope of our report and our inclusion criteria, our report does not discuss key bodies of literature on the relationship of sun exposure and vitamin D, and vitamin D and cancer risk. Interested readers should refer to the recent report by the International Agency for Research on Cancer.¹¹²

Emerging Issues and Future Research

More primary care relevant counseling trials to promote sun-protective behaviors, including those that address indoor tanning, are needed, especially in children, adolescents, and young adults. Trials of low-intensity interventions, such as the 15-minute self-administered computer session or an appearance-focused video or booklet, should be replicated in other populations. In addition to using self-reported measures of avoidance of midday sun, use of protective clothing, and use of sunscreen, trials should also consistently include measures of indoor tanning and sunburns. Trials using composite behavioral scores would be strengthened if they also provided the proportion of individuals whose behavior changed as recommended. In 2005, the National Cancer Institute and the Emory Prevention Research Center convened a workshop for skin cancer prevention investigators in the United States to develop a consensus-based set of core measures to assess UV exposure, sun-protective behaviors, and nonsolar tanning behavior.^{117,118} These measures should be used consistently so as to understand their validity and reliability across different settings and populations. In addition to using these consensus-based self-reported measures, objective measures, such as dosimeters or visual observation of participant behavior, would also strengthen this body of literature.

More studies, and better designed studies, that examine the potential effect of sunscreen use and decreased sun exposure on vitamin D and other diseases hypothesized to be affected by vitamin D (e.g., cancer, autoimmune disease, bone-related disease) are needed. Trial evidence suggests that sunscreen is effective in reducing risk for squamous cell carcinoma, but it is unclear if regular sunscreen use prevents basal cell carcinoma or melanoma. However, nonrandomized studies examining sunscreen use have serious methodological limitations. It is therefore

important to determine if the increase in recreational sun exposure, even if it does not increase risk for sunburns, has clinically important sequelae. Currently, the epidemiologic literature supporting an association between sun exposure and breast and prostate cancer and nonHodgkin lymphoma is sparse and has serious methodological limitations. Therefore, more studies are needed that account for the measurement of sun exposure, adjustment for important confounders, and direct assessment of vitamin D levels, if possible. Currently, there is no evidence to suggest that sun-protective behavior messages aimed at reducing prolonged or intense sun exposure and sunburns cause significant harm, such as vitamin D deficiency or increasing risk for cancer. In addition, more studies with more detailed assessment of sunscreen and indoor tanning use are needed. It is important that these studies consistently adjust for both important host and environmental factors. Survey instruments to assess these types of exposure need to be reliable and validated. The body of evidence would be strengthened if studies used the same or comparable measurements to facilitate comparison across studies. It will likely take decades to see a potential protective effect of regular sunscreen use on melanoma risk or the potential harms of current tanning beds. Therefore, studies evaluating current sunscreen formulations will continue to be necessary over time.

Conclusions

A limited number of RCTs suggest that primary care relevant behavioral counseling can minimally increase composite scores measuring self-reported sun-protective behaviors in adults and their newborns, decrease self-reported indoor tanning use and objectively measured pigmentation in college students, and decrease self-reported midday sun exposure and increase sunscreen use in young adolescents. The clinical significance of small changes in sun protection composite scores is unclear. Many of the counseling interventions incorporated computerized support that could generate tailored feedback.

Primary care counseling to prevent skin cancer and the practice of sun-protective behaviors to limit intense or prolonged sun exposure do not appear to have significant harms, but methodologically rigorous studies examining the potential harms of vitamin D deficiency are lacking. There is evidence, mostly from case-control studies, to suggest that intermittent sun exposure, especially in childhood or adolescence, may increase risk for all types of skin cancer. Regular sunscreen use can decrease the incidence of squamous cell carcinoma, but it is unclear if it can prevent basal cell carcinoma or melanoma. Based on a limited number of studies, it appears that regular and early use of indoor tanning may increase the risk for melanoma. These risks, however, may not apply to current devices, since tanning devices have changed significantly over the past 20 to 30 years. Therefore, behavioral counseling to promote skin cancer prevention should focus on improving multiple behaviors to reduce UV exposure and not improving sunscreen use alone.

One counseling trial in young adolescents and one trial in college students included a sizeable proportion of nonwhite participants. However, given that practically all of the epidemiologic studies included exclusively or predominantly white persons, it is unclear if sun-protective behavior counseling will have similar benefits in nonwhite populations, especially given the lower incidence of skin cancer in nonwhite populations.

References

1. Helfand M, Pyle Krages K. Counseling to Prevent Skin Cancer: A Summary of the Evidence. AHRQ Pub. No. 03–521B. Rockville, MD, Agency for Healthcare Research and Quality; 2003.
2. U.S. Preventive Services Task Force. U.S. Preventive Services Task Force Procedure Manual. AHRQ Publication No. 08-05118-EF. Rockville, MD: Agency for Healthcare Research and Quality; 2008. Accessed at <http://www.uspreventiveservicestaskforce.org/uspstf08/methods/procmanual.htm> on 13 January 2011.
3. Wolff T, Tal E, Miller T. Screening for skin cancer: an update of the evidence for the U.S. Preventive Services Task Force. *Ann Intern Med.* 2009;150:194-198.
4. American Cancer Society. Skin Cancer Facts. Atlanta, GA: American Cancer Society; 2008. Accessed at <http://www.cancer.org/Cancer/CancerCauses/SunandUVExposure/skin-cancer-facts> on 13 January 2011.
5. National Cancer Institute. Table XVI-2: melanoma of the skin (invasive) age-adjusted SEER incidence rates by year, race, and sex. In: Ries LA, Melbert D, Krapcho M, et al (eds). SEER Cancer Statistics Review, 1975–2005. Bethesda, MD: National Cancer Institute; 2008. Accessed at http://seer.cancer.gov/csr/1975_2005/results_merged/sect_16_melanoma.pdf on 13 January 2011.
6. Jemal A, Siegel R, Ward E, et al. Cancer statistics, 2008. *CA Cancer J Clin.* 2008;58:71-96.
7. Berwick M, Wiggins C. The current epidemiology of cutaneous malignant melanoma. *Front Biosci.* 2006;11:1244-1254.
8. Linos E, Swetter SM, Cockburn MG, Colditz GA, Clarke CA. Increasing burden of melanoma in the United States. *J Invest Dermatol.* 2009;129:1666-1674.
9. Purdue MP, Freeman LE, Anderson WF, Tucker MA. Recent trends in incidence of cutaneous melanoma among US Caucasian young adults. *J Invest Dermatol.* 2008;128:2905-2908.
10. National Cancer Institute. SEER Stat Fact Sheet: Melanoma of the Skin. Bethesda, MD: National Cancer Institute; 2010. Accessed at <http://seer.cancer.gov/statfacts/html/melan.html> on 13 January 2011.
11. Helfand M, Gorman AK, Mahon S, Chan BK, Swanson N. Actinic Keratoses. Rockville, MD: Agency for Healthcare Research and Quality; 2001.
12. Housman TS, Feldman SR, Williford PM, et al. Skin cancer is among the most costly of all cancers to treat for the Medicare population. *J Am Acad Dermatol.* 2003;48:425-429.
13. Markovic SN, Erickson LA, Rao RD, et al. Malignant melanoma in the 21st century, part 1: epidemiology, risk factors, screening, prevention, and diagnosis. *Mayo Clin Proc.* 2007;82:364-380.
14. Titus-Ernstoff L, Perry AE, Spencer SK, Gibson JJ, Cole BF, Ernstoff MS. Pigmentary characteristics and moles in relation to melanoma risk. *Int J Cancer.* 2005;116:144-149.
15. Gandini S, Sera F, Cattaruzza MS et al. Meta-analysis of risk factors for cutaneous melanoma, III: family history, actinic damage and phenotypic factors. *Eur J Cancer.* 2005;41:2040-2059.

16. International Agency for Research on Cancer. Solar and Ultraviolet Radiation. Lyon, France: International Agency for Research on Cancer, World Health Organization; 1992. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Vol 55.
17. Gandini S, Sera F, Cattaruzza MS, et al. Meta-analysis of risk factors for cutaneous melanoma, II: sun exposure. *Eur J Cancer*. 2005;41:45-60.
18. Dennis LK, VanBeek MJ, Beane Freeman LE, Smith BJ, Dawson DV, Coughlin JA. Sunburns and risk for cutaneous melanoma: does age matter? A comprehensive meta-analysis. *Ann Epidemiol*. 2008;18:614-627.
19. Marks R, Rennie G, Selwood TS. Malignant transformation of solar keratoses to squamous cell carcinoma. *Lancet*. 1988;1:795-797.
20. Mittelbronn MA, Mullins DL, Ramos-Caro FA, Flowers FP. Frequency of pre-existing actinic keratosis in cutaneous squamous cell carcinoma. *Int J Dermatol*. 1998;37:677-681.
21. Dinehart SM, Nelson-Adesokan P, Cockerell C, Russell S, Brown R. Metastatic cutaneous squamous cell carcinoma derived from actinic keratosis. *Cancer*. 1997;79:920-923.
22. Gandini S, Sera F, Cattaruzza MS, et al. Meta-analysis of risk factors for cutaneous melanoma, I: common and atypical naevi. *Eur J Cancer*. 2005;41:28-44.
23. Bauer J, Garbe C. Acquired melanocytic nevi as risk factor for melanoma development: a comprehensive review of epidemiological data. *Pigment Cell Res*. 2003;16:297-306.
24. Saraiya M, Glanz K, Briss PA, et al. Interventions to prevent skin cancer by reducing exposure to ultraviolet radiation: a systematic review. *Am J Prev Med*. 2004;27:422-466.
25. Balk SJ, O'Connor KG, Saraiya M. Counseling parents and children on sun protection: a national survey of pediatricians. *Pediatrics*. 2004;114:1056-1064.
26. Gritz ER, Tripp MK, de Moor CA, Eicher SA, Mueller NH, Spedale JH. Skin cancer prevention counseling and clinical practices of pediatricians. *Pediatr Dermatol*. 2003;20:16-24.
27. Hornung RL, Hansen LA, Sharp LK, Poorsattar SP, Lipsky MS. Skin cancer prevention in the primary care setting: assessment using a standardized patient. *Pediatr Dermatol*. 2007;24:108-112.
28. Geller AC, Colditz G, Oliveria S, et al. Use of sunscreen, sunburning rates, and tanning bed use among more than 10,000 US children and adolescents. *Pediatrics*. 2002;109:1009-1014.
29. Coups EJ, Manne SL, Heckman CJ. Multiple skin cancer risk behaviors in the U.S. population. *Am J Prev Med*. 2008;34:87-93.
30. The association of use of sunbeds with cutaneous malignant melanoma and other skin cancers: a systematic review. *Int J Cancer*. 2006;120:1116-1122.
31. Dennis LK, Beane Freeman LE, VanBeek MJ. Sunscreen use and the risk for melanoma: a quantitative review. *Ann Intern Med*. 2003;139:966-978.
32. Elwood JM, Jopson J. Melanoma and sun exposure: an overview of published studies. *Int J Cancer*. 1997;73:198-203.
33. English DR, Armstrong BK, Kricger A, Winter MG, Heenan PJ, Randell PL. Demographic characteristics, pigmentary and cutaneous risk factors for squamous cell carcinoma of the skin: a case-control study. *Int J Cancer*. 1998;76:628-634.
34. Gallagher RP, Spinelli JJ, Lee TK. Tanning beds, sunlamps, and risk for cutaneous malignant melanoma. *Cancer Epidemiol Biomarkers Prev*. 2005;14:562-566.
35. Gorham ED, Mohr SB, Garland CF, Chaplin G, Garland FC. Do sunscreens increase risk for melanoma in populations residing at higher latitudes? *Ann Epidemiol*. 2007;17:956-963.

36. Krickler A, Armstrong BK, English DR, Heenan PJ. A dose-response curve for sun exposure and basal cell carcinoma. *Int J Cancer*. 1995;60:482-488.
37. Nelemans PJ, Rampen FH, Ruitter DJ, Verbeek AL. An addition to the controversy on sunlight exposure and melanoma risk: a meta-analytical approach. *J Clin Epidemiol*. 1995;48:1331-1342.
38. Oliveria SA, Saraiya M, Geller AC, Heneghan MK, Jorgensen C. Sun exposure and risk for melanoma. *Arch Dis Child*. 2006;91:131-138.
39. Rosso S, Zanetti R, Pippione M, Sancho-Garnier H. Parallel risk assessment of melanoma and basal cell carcinoma: skin characteristics and sun exposure. *Melanoma Res*. 1998;8:573-583.
40. Westerdahl J, Olsson H, Masback A, et al. Use of sunbeds or sunlamps and malignant melanoma in southern Sweden. *Am J Epidemiol*. 1994;140:691-699.
41. Westerdahl J, Olsson H, Masback A, Ingvar C, Jonsson N. Is the use of sunscreens a risk factor for malignant melanoma? *Melanoma Res*. 1995;5:59-65.
42. Westerdahl J, Ingvar C, Masback A, Jonsson N, Olsson H. Risk for cutaneous malignant melanoma in relation to use of sunbeds: further evidence for UV-A carcinogenicity. *Br J Cancer*. 2000;82:1593-1599.
43. Bastuji-Garin S, Diepgen TL. Cutaneous malignant melanoma, sun exposure, and sunscreen use: epidemiological evidence. *Br J Dermatol*. 2002;146:Suppl-30.
44. Koepsell T, Weiss N. *Epidemiologic Methods: Studying the Occurrence of Illness*. New York: Oxford University Press; 2003.
45. Crane LA, Deas A, Mokrohsy ST, et al. A randomized intervention study of sun protection promotion in well-child care. *Prev Med*. 2006;42:162-170.
46. Glazebrook C, Garrud P, Avery A, Coupland C, Williams H. Impact of a multimedia intervention "Skinsafe" on patients' knowledge and protective behaviors. *Prev Med*. 2006;42:449-454.
47. Dietrich AJ, Olson AL, Sox CH, et al. A community-based randomized trial encouraging sun protection for children. *Pediatrics*. 1998;102:E64.
48. Olson AL, Gaffney C, Starr P, Gibson JJ, Cole BF, Dietrich AJ. SunSafe in the middle school years: a community-wide intervention to change early-adolescent sun protection. *Pediatrics*. 2007;119:e247-e256.
49. Hillhouse J, Turrisi R, Stapleton J, Robinson J. A randomized controlled trial of an appearance-focused intervention to prevent skin cancer. *Cancer*. 2008;113:3257-3266.
50. Geller AC, Emmons KM, Brooks DR, et al. A randomized trial to improve early detection and prevention practices among siblings of melanoma patients. *Cancer*. 2006;107:806-814.
51. Prochaska JO, Velicer WF, Redding C, et al. Stage-based expert systems to guide a population of primary care patients to quit smoking, eat healthier, prevent skin cancer, and receive regular mammograms. *Prev Med*. 2005;41:406-416.
52. Prochaska JO, Velicer WF, Rossi JS, et al. Multiple risk expert systems interventions: impact of simultaneous stage-matched expert system interventions for smoking, high-fat diet, and sun exposure in a population of parents. *Health Psychol*. 2004;23:503-516.
53. Mahler HI, Kulik JA, Gerrard M, Gibbons FX. Long-term effects of appearance-based interventions on sun protection behaviors. *Health Psychol*. 2007;26:350-360.
54. Norman GJ, Adams MA, Calfas KJ, et al. A randomized trial of a multicomponent intervention for adolescent sun protection behaviors. *Arch Pediatr Adolesc Med*. 2007;161:146-152.

55. Patrick K, Calfas KJ, Norman GJ, et al. Randomized controlled trial of a primary care and home-based intervention for physical activity and nutrition behaviors: PACE+ for adolescents. *Arch Pediatr Adolesc Med.* 2006;160:128-136.
56. Rosenberg DE, Norman GJ, Sallis JF, Calfas KJ, Patrick K. Covariation of adolescent physical activity and dietary behaviors over 12 months. *J Adolesc Health.* 2007;41:472-478.
57. Green A, Williams G, Neale R, et al. Daily sunscreen application and betacarotene supplementation in prevention of basal-cell and squamous-cell carcinomas of the skin: a randomised controlled trial. *Lancet.* 1999;354:723-729.
58. Green A, Battistutta D, Hart V, et al. The Nambour Skin Cancer and Actinic Eye Disease Prevention Trial: design and baseline characteristics of participants. *Control Clin Trials.* 1994;15:512-522.
59. Pandeya N, Purdie DM, Green A, Williams G. Repeated occurrence of basal cell carcinoma of the skin and multifailure survival analysis: follow-up data from the Nambour Skin Cancer Prevention Trial. *Am J Epidemiol.* 2005;161:748-754.
60. van der Pols JC, Williams GM, Pandeya N, Logan V, Green AC. Prolonged prevention of squamous cell carcinoma of the skin by regular sunscreen use. *Cancer Epidemiol Biomarkers Prev.* 2006;15:2546-2548.
61. Neale RE, Davis M, Pandeya N, Whiteman DC, Green AC. Basal cell carcinoma on the trunk is associated with excessive sun exposure. *J Am Acad Dermatol.* 2007;56:380-386.
62. Kricger A, Armstrong BK, English DR, Heenan PJ. Pigmentary and cutaneous risk factors for non-melanocytic skin cancer—a case-control study. *Int J Cancer.* 1991;48:650-662.
63. English DR, Armstrong BK, Kricger A, Winter MG, Heenan PJ, Randell PL. Case-control study of sun exposure and squamous cell carcinoma of the skin. *Int J Cancer.* 1998;77:347-353.
64. Rosso S, Joris F, Zanetti R. Risk for basal and squamous cell carcinomas of the skin in Sion, Switzerland: a case-control study. *Tumori.* 1999;85:435-442.
65. Green A, Battistutta D, Hart V, Leslie D, Weedon D. Skin cancer in a subtropical Australian population: incidence and lack of association with occupation. The Nambour Study Group. *Am J Epidemiol.* 1996;144:1034-1040.
66. Gallagher RP, Hill GB, Bajdik CD, et al. Sunlight exposure, pigmentation factors, and risk for nonmelanocytic skin cancer, II: squamous cell carcinoma. *Arch Dermatol.* 1995;131:164-169.
67. Grodstein F, Speizer FE, Hunter DJ. A prospective study of incident squamous cell carcinoma of the skin in the Nurses' Health Study. *J Natl Cancer Inst.* 1995;87:1061-1066.
68. Hunter DJ, Colditz GA, Stampfer MJ, Rosner B, Willett WC, Speizer FE. Risk factors for basal cell carcinoma in a prospective cohort of women. *Ann Epidemiol.* 1990;1:13-23.
69. van Dam RM, Huang Z, Rimm EB, et al. Risk factors for basal cell carcinoma of the skin in men: results from the health professionals follow-up study. *Am J Epidemiol.* 1999;150:459-468.
70. Gallagher RP, Hill GB, Bajdik CD, et al. Sunlight exposure, pigmentary factors, and risk for nonmelanocytic skin cancer, I: basal cell carcinoma. *Arch Dermatol.* 1995;131:157-163.
71. Han J, Colditz GA, Hunter DJ. Risk factors for skin cancers: a nested case-control study within the Nurses' Health Study. *Int J Epidemiol.* 2006;35:1514-1521.

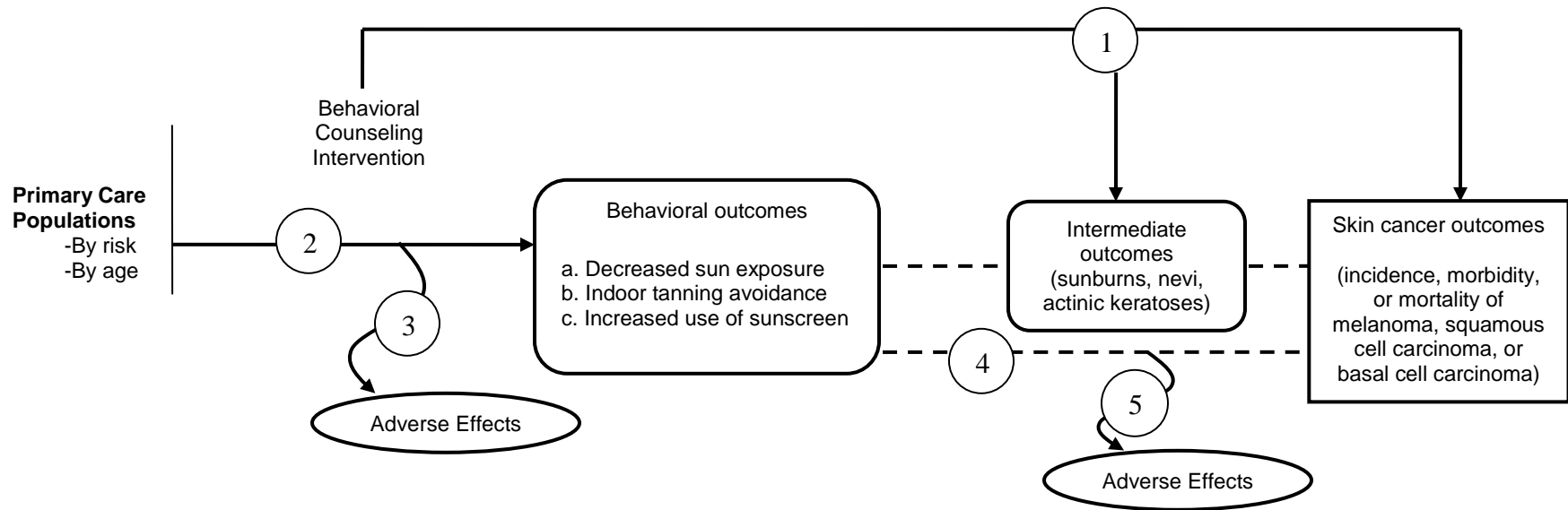
72. White E, Kirkpatrick CS, Lee JA. Case-control study of malignant melanoma in Washington state, I: constitutional factors and sun exposure. *Am J Epidemiol.* 1994;139:857-868.
73. Berwick M, Begg CB, Fine JA, Roush GC, Barnhill RL. Screening for cutaneous melanoma by skin self-examination. *J Natl Cancer Inst.* 1996;88:17-23.
74. Shors AR, Solomon C, McTiernan A, White E. Melanoma risk in relation to height, weight, and exercise (United States). *Cancer Causes Control.* 2001;12:599-606.
75. Gallagher RP, Elwood JM, Hill GB. Risk factors for cutaneous malignant melanoma: the Western Canada Melanoma Study. *Recent Results Cancer Res.* 1986;102:38-55.
76. Tabenkin H, Tamir A, Sperber AD, Shapira M, Shvartzman P. A case-control study of malignant melanoma in Israeli kibbutzim. *Isr Med Assoc J.* 1999;1:154-157.
77. Green AC, O'Rourke MG. Cutaneous malignant melanoma in association with other skin cancers. *J Natl Cancer Inst.* 1985;74:977-980.
78. Garbe C, Kruger S, Stadler R, Guggenmoos-Holzmann I, Orfanos CE. Markers and relative risk in a German population for developing malignant melanoma. *Int J Dermatol.* 1989;28:517-523.
79. Fargnoli MC, Piccolo D, Altobelli E, Formicone F, Chimenti S, Peris K. Constitutional and environmental risk factors for cutaneous melanoma in an Italian population: a case-control study. *Melanoma Res.* 2004;14:151-157.
80. Holly EA, Aston DA, Cress RD, Ahn DK, Kristiansen JJ. Cutaneous melanoma in women, I: exposure to sunlight, ability to tan, and other risk factors related to ultraviolet light. *Am J Epidemiol.* 1995;141:923-933.
81. Le Marchand L, Saltzman BS, Hankin JH, et al. Sun exposure, diet, and melanoma in Hawaii Caucasians. *Am J Epidemiol.* 2006;164:232-245.
82. Veierod MB, Weiderpass E, Thorn M, et al. A prospective study of pigmentation, sun exposure, and risk for cutaneous malignant melanoma in women. *J Natl Cancer Inst.* 2003;95:1530-1538.
83. Osterlind A, Tucker MA, Stone BJ, Jensen OM. The Danish case-control study of cutaneous malignant melanoma, II: importance of UV-light exposure. *Int J Cancer.* 1988;42:319-324.
84. Zanetti R, Franceschi S, Rosso S, Colonna S, Bidoli E. Cutaneous melanoma and sunburns in childhood in a southern European population. *Eur J Cancer.* 1992;28A:1172-1176.
85. Westerdahl J, Ingvar C, Masback A, Olsson H. Sunscreen use and malignant melanoma. *Int J Cancer.* 2000;87:145-150.
86. Westerdahl J, Olsson H, Ingvar C. At what age do sunburn episodes play a crucial role for the development of malignant melanoma? *Eur J Cancer.* 1994;30A:1647-1654.
87. Weinstock MA, Colditz GA, Willett WC, et al. Melanoma and the sun: the effect of swimsuits and a "healthy" tan on the risk for nonfamilial malignant melanoma in women. *Am J Epidemiol.* 1991;134:462-470.
88. Karagas MR, Stannard VA, Mott LA, Slattery MJ, Spencer SK, Weinstock MA. Use of tanning devices and risk for basal cell and squamous cell skin cancers. *J Natl Cancer Inst.* 2002;94:224-226.
89. Chen YT, Dubrow R, Zheng T, Barnhill RL, Fine J, Berwick M. Sunlamp use and the risk for cutaneous malignant melanoma: a population-based case-control study in Connecticut, USA. *Int J Epidemiol.* 1998;27:758-765.

90. Walter SD, King WD, Marrett LD. Association of cutaneous malignant melanoma with intermittent exposure to ultraviolet radiation: results of a case-control study in Ontario, Canada. *Int J Epidemiol.* 1999;28:418-427.
91. Bataille V, Boniol M, De Vries E, et al. A multicentre epidemiological study on sunbed use and cutaneous melanoma in Europe. *Eur J Cancer.* 2005;41:2141-2149.
92. Clough-Gorr KM, Titus-Ernstoff L, Perry AE, Spencer SK, Ernstoff MS. Exposure to sunlamps, tanning beds, and melanoma risk. *Cancer Causes Control.* 2008;19:659-669.
93. Cho E, Rosner BA, Feskanich D, Colditz GA. Risk factors and individual probabilities of melanoma for whites. *J Clin Oncol.* 2005;23:2669-2675.
94. Milne E, Simpson JA, Johnston R, Giles CB, English DR. Time spent outdoors at midday and children's body mass index. *Am J Public Health.* 2007;97:306-310.
95. Autier P, Dore JF, Negrier S, et al. Sunscreen use and duration of sun exposure: a double-blind, randomized trial. *J Natl Cancer Inst.* 1999;91:1304-1309.
96. Autier P, Dore JF, Reis AC, et al. Sunscreen use and intentional exposure to ultraviolet A and B radiation: a double blind randomized trial using personal dosimeters. *Br J Cancer.* 2000;83:1243-1248.
97. Dupuy A, Dunant A, Grob JJ. Randomized controlled trial testing the impact of high-protection sunscreens on sun-exposure behavior. *Arch Dermatol.* 2005;141:950-956.
98. Marks R, Foley PA, Jolley D, Knight KR, Harrison J, Thompson SC. The effect of regular sunscreen use on vitamin D levels in an Australian population: results of a randomized controlled trial. *Arch Dermatol.* 1995;131:415-421.
99. Brot C, Vestergaard P, Kolthoff N, Gram J, Hermann AP, Sorensen OH. Vitamin D status and its adequacy in healthy Danish perimenopausal women: relationships to dietary intake, sun exposure and serum parathyroid hormone. *Br J Nutr.* 2001;86:S97-S103.
100. John EM, Schwartz GG, Dreon DM, Koo J. Vitamin D and breast cancer risk: the NHANES I epidemiologic follow-up study, 1971-1975 to 1992. National Health and Nutrition Examination Survey. *Cancer Epidemiol Biomarkers Prev.* 1999;8:399-406.
101. Kampman E, Slattery ML, Caan B, Potter JD. Calcium, vitamin D, sunshine exposure, dairy products and colon cancer risk (United States). *Cancer Causes Control.* 2000;11:459-466.
102. Hughes AM, Armstrong BK, Vajdic CM, et al. Pigmentary characteristics, sun sensitivity and non-Hodgkin lymphoma. *Int J Cancer.* 2004;110:429-434.
103. Hughes AM, Armstrong BK, Vajdic CM, et al. Sun exposure may protect against non-Hodgkin lymphoma: a case-control study. *Int J Cancer.* 2004;112:865-871.
104. Smedby KE, Hjalgrim H, Melbye M, et al. Ultraviolet radiation exposure and risk for malignant lymphomas. *J Natl Cancer Inst.* 2005;97:199-209.
105. John EM, Schwartz GG, Koo J, Van Den BD, Ingles SA. Sun exposure, vitamin D receptor gene polymorphisms, and risk for advanced prostate cancer. *Cancer Res.* 2005;65:5470-5479.
106. Hartge P, Lim U, Freedman DM, et al. Ultraviolet radiation, dietary vitamin D, and risk for non-Hodgkin lymphoma (United States). *Cancer Causes Control.* 2006;17:1045-1052.
107. John EM, Schwartz GG, Koo J, Wang W, Ingles SA. Sun exposure, vitamin D receptor gene polymorphisms, and breast cancer risk in a multiethnic population. *Am J Epidemiol.* 2007;166:1409-1419.
108. Green A, Williams G, Neale R, Battistutta D. Betacarotene and sunscreen use. *Lancet.* 1999;354:2163-2164.

109. Gallagher RP, Rivers JK, Lee TK, Bajdik CD, McLean DI, Coldman AJ. Broad-spectrum sunscreen use and the development of new nevi in white children: a randomized controlled trial. *JAMA*. 2000;283:2955-2960.
110. Bauer J, Büttner P, Wiecker TS, Luther H, Garbe C. Interventional study in 1,232 young German children to prevent the development of melanocytic nevi failed to change sun exposure and sun protective behavior. *Int J Cancer*. 2005;116:755-761.
111. Turrisi R, Stapleton J, Mallett K, Hillhouse J. Methods in skin cancer prevention: using a question-driven approach to guide the choice of assessment approaches.[comment]. *Arch Dermatol*. 2006;142:1348-1350.
112. International Agency for Research on Cancer. Vitamin D and Cancer. Lyon, France: International Agency for Research on Cancer, World Health Organization; 2008. IARC Monographs on the Evaluation of Carcinogenic Risks to Humans, Vol 5.
113. Task Force on Community Preventive Services. Recommendations to prevent skin cancer by reducing exposure to ultraviolet radiation. *Am J Prev Med*. 2004;27:467-470.
114. Saraiya M, Glanz K, Briss P, et al. Preventing skin cancer: findings of the Task Force on Community Preventive Services on reducing exposure to ultraviolet light. *MMWR Recomm Rep*. 2003;52(RR-15):1-12.
115. Whiteman DC, Stickley M, Watt P, Hughes MC, Davis MB, Green AC. Anatomic site, sun exposure, and risk for cutaneous melanoma. *J Clin Oncol*. 2006;24:3172-3177.
116. Kricker A, Armstrong BK, English DR, Heenan PJ. Does intermittent sun exposure cause basal cell carcinoma? A case-control study in Western Australia. *Int J Cancer*. 1995;60:489-494.
117. Glanz K, Yaroch AL, Dancel M, et al. Measures of sun exposure and sun protection practices for behavioral and epidemiologic research. *Arch Dermatol*. 2008;144:217-222.
118. Lazovich D, Stryker JE, Mayer JA, et al. Measuring nonsolar tanning behavior: indoor and sunless tanning. *Arch Dermatol*. 2008;144:225-230.
119. Saraiya M, Hall HI, Thompson T, et al. Skin cancer screening among US adults from 1992, 1998, and 2000 National Health Interview Surveys. *Prev Med*. 2004;39:308-314.
120. Huncharek M, Kupelnick B. Use of topical sunscreens and the risk for malignant melanoma: a meta-analysis of 9067 patients from 11 case-control studies. *Am J Public Health*. 2002;92:1173-1177.
121. Gefeller O, Pfahlberg A. Sunscreen use and melanoma: a case of evidence-based prevention? *Photodermatol Photoimmunol Photomed*. 2002;18:153-156.
122. Grant WB. A meta-analysis of second cancers after a diagnosis of nonmelanoma skin cancer: additional evidence that solar ultraviolet-B irradiance reduces the risk for internal cancers. *J Steroid Biochem Mol Biol*. 2007;103:668-674.
123. Autier P, Boniol M, Dore JF. Sunscreen use and increased duration of intentional sun exposure: still a burning issue. *Int J Cancer*. 2007;121:1-5.
124. De Haes P, Garmyn M, Verstuyf A et al. 1,25-dihydroxyvitamin D3 and analogues protect primary human keratinocytes against UVB-induced DNA damage. *J Photochem Photobiol B*. 2005;78:141-148.
125. Dietrich AJ, Olson AL, Sox CH, Tosteson TD, Grant-Petersson J. Persistent increase in children's sun protection in a randomized controlled community trial. *Prev Med*. 2000;31:569-574.

126. Grant-Petersson J, Dietrich AJ, Sox CH, Winchell CW, Stevens MM. Promoting sun protection in elementary schools and child care settings: the SunSafe Project. *J Sch Health.* 1999;69:100-106.
127. Vlajinac HD, Adanja BJ, Lazar ZF, et al. Risk factors for basal cell carcinoma. *Acta Oncol.* 2000;39:611-616.
128. Bajdik CD, Gallagher RP, Astrakianakis G, Hill GB, Fincham S, McLean DI. Non-solar ultraviolet radiation and the risk for basal and squamous cell skin cancer. *Br J Cancer.* 1996;73:1612-1614.
129. Osterlind A, Tucker MA, Hou-Jensen K, Stone BJ, Engholm G, Jensen OM. The Danish case-control study of cutaneous malignant melanoma, I: importance of host factors. *Int J Cancer.* 1988;42:200-206.
130. Lea CS, Scotto JA, Buffler PA, Fine J, Barnhill RL, Berwick M. Ambient UVB and melanoma risk in the United States: a case-control analysis. *Ann Epidemiol.* 2007;17:447-453.
131. Chen YT, Dubrow R, Holford TR, et al. Malignant melanoma risk factors by anatomic site: a case-control study and polychotomous logistic regression analysis. *Int J Cancer.* 1996;67:636-643.
132. Walter SD, Marrett LD, From L, Hertzman C, Shannon HS, Roy P. The association of cutaneous malignant melanoma with the use of sunbeds and sunlamps. *Am J Epidemiol.* 1990;131:232-243.
133. Green A, Bain C, McLennan R, Siskind V. Risk factors for cutaneous melanoma in Queensland. In: Gallagher RP (ed). *Epidemiology of Malignant Melanoma.* Heidelberg, Germany: Springer-Verlag; 1986:76-97.
134. Solomon CC, White E, Kristal AR, Vaughan T. Melanoma and lifetime UV radiation. *Cancer Causes Control.* 2004;15:893-902.
135. Elwood JM, Gallagher RP, Hill GB, Pearson JC. Cutaneous melanoma in relation to intermittent and constant sun exposure—the Western Canada Melanoma Study. *Int J Cancer.* 1985;35:427-433.
136. Elwood JM, Gallagher RP, Hill GB, Spinelli JJ, Pearson JC, Threlfall W. Pigmentation and skin reaction to sun as risk factors for cutaneous melanoma: Western Canada Melanoma Study. *Br Med J.* 1984;288:99-102.
137. Harris RP, Helfand M, Woolf SH, et al. Current methods of the US Preventive Services Task Force: a review of the process. *Am J Prev Med.* 2001;20:21-35.
138. National Institute for Health and Clinical Excellence. *The Guidelines Manual.* London: National Institute for Health and Clinical Excellence; 2006.
139. Wells GA, Shea B, O'Connell D, Peterson J, Welch V, Losos M, Tugwell P. *The Newcastle-Ottawa Scale (NOS) for Assessing the Quality of Nonrandomised Studies in Meta-Analyses.* Ottawa, Ontario: Ottawa Hospital Research Institute; 2008. Accessed at http://www.ohri.ca/programs/clinical_epidemiology/oxford.asp on 13 January 2011.
140. Green A, Siskind V, Bain C, Alexander J. Sunburn and malignant melanoma. *Br J Cancer.* 1985;51:393-397.
141. Green A. Sun exposure and the risk for melanoma. *Australas J Dermatol.* 1984;25:99-102.
142. Rosso S, Sera F, Segnan N, Zanetti R. Sun exposure prior to diagnosis is associated with improved survival in melanoma patients: results from a long-term follow-up study of Italian patients. *Eur J Cancer.* 2008;44:1275-1281.

Figure 1. Analytic Framework and Key Questions



Key Questions

1. Is there direct evidence that counseling patients on sun-protective behaviors (decreasing sun exposure, avoidance of indoor tanning, and using sunscreen) reduces intermediate outcomes (sunburns, nevi, or actinic keratoses) or skin cancer (melanoma or squamous cell or basal cell carcinoma) ?
2. Does primary care relevant counseling change sun-protective behaviors (decreasing sun exposure, avoidance of indoor tanning, and using sunscreen)?
3. Do primary care relevant counseling interventions have adverse effects?
4. Is sun exposure (intentional or unintentional), indoor tanning, or sunscreen use associated with skin cancer outcomes?
5. Are sun-protective behaviors associated with adverse effects (increased time spent in the sun, reduced physical activity, dysphoric mood, or vitamin D deficiency)?

Table 1. Search Strategies for Key Questions Based on Existing Systematic Reviews Identified

Key Question(s)	Outcome of interest	Primary existing systematic review used	Other systematic review(s) used to locate primary research	Search dates*
KQ 1–3	N/A	Helfand 2003 ¹	Saraiya 2004 ¹¹⁹	2001 through Dec 2008
KQ 4a Sun exposure	Melanoma	Helfand 2003 ¹	Gandini 2005 ¹⁷	2001 through Dec 2008
	Squamous cell or basal cell carcinoma	None	None	1966 through Dec 2008
KQ 4b Indoor tanning	Melanoma, squamous cell and basal cell carcinoma	IARC 2006 ³⁰	Gallagher 2005 ³⁴	2005 through Dec 2008
KQ 4c Sunscreen use	Melanoma	Dennis 2003 ³¹	Huncharek 2002 ¹²⁰ Gefeller 2002 ¹²¹	2002 through Dec 2008
	Squamous cell or basal cell carcinoma	None	None	1966 through Dec 2008
KQ 5	N/A	None	Helfand 2003 ¹ Grant 2007 ¹²² Autier 2007 ¹²³	1966 through Dec 2008

*Start date for search is 1 year prior to the end search date used in the primary existing systematic review used.

Abbreviations: KQ=key question; N/A=not applicable; none=no SER located; IARC=International Agency for Research on Cancer

Table 2. Effectiveness of Primary Care Feasible Counseling to Increase Sun-Protective Behaviors

Trial, Design, Quality	Setting, Population, Characteristics	Intervention	Efficacy
Adults			
Glazebrook 2006 ⁴⁶ Cluster RCT by practice Fair	PC practices in UK N: 589 Age: mean 38 yrs Male: 20% Risk: 100% with high risk characteristic, not specified	IG: "Skinsafe program": single 10- to15-min session using a self-directed computer workstation in the practice CG: Usual care, details not given	Mean score on Sun Protection Behavior Scale at 6 months <i>Pre-, post- (complete case analysis), post- (missing values imputed)</i> IG: 4.60 (SD, 1.82), 5.70 (SD, 1.51), 5.36 (SD, 1.72) CG: 4.66 (SD, 1.55), 5.30 (SD, 1.57), 5.06 (SD, 1.59) Complete case analysis: p=0.007 Missing values imputed: p=0.004 <i>Mean difference between IG and CG p value</i> Complete case analysis: 0.33 (95% CI, 0.09–0.57) Missing values at follow-up replaced by baseline values: 0.30 (95% CI, 0.10–0.51)
Geller 2006 ⁵⁰ Cluster RCT by sibling relationship Fair	Home-based, patients recruited from dermatologists in US N: 494 Age: 58% 18–50 yrs Male: 47% Risk: 85% fair skin type, 100% white	IG: Four 10- to 15-min telephone sessions with health educator and computer-generated tailored materials CG: Usual care	% tanned by end of last summer at 12 months IG: 25.7 CG: 35.6 Adjusted OR, 0.72 (95% CI, 0.47–1.09) % routinely use sunscreen with SPF 15+ at 12 months IG: 67.4 CG: 66.1 Adjusted OR, 0.96 (95% CI, 0.67–1.38)
Prochaska 2005 ⁵¹ RCT Fair	Home-based, patients recruited from PC practices in US N: 5407, subset of 3834 at risk for sun exposure Age: mean 45 yrs Male: 30% Risk: sun sensitivity NR, 96.7% white	IG: Four telephone sessions of unknown duration and written survey assessments with computer-generated tailored materials CG: Assessment only	Mean score on Sun Avoidance Subscale of Sun Protection Behavior Scale at baseline, 12 months, and 24 months IG: 12.7 (SD, 3.6), 13.5 (SD, 3.5), 13.7 (SD, 3.5) CG: 12.4 (SD, 3.7), 12.9 (SD, 3.6), 12.9 (SD, 3.6) p<0.005 Mean score on Sunscreen Use Subscale of Sun Protection Behavior Scale at baseline, 12 months, and 24 months IG: 8.6 (SD, 3.9), 9.8 (SD, 3.8), 10.0 (SD, 3.9) CG: 8.5 (SD, 3.9), 8.9 (SD, 3.9), 9.2 (SD, 3.9) p<0.0001
Prochaska 2004 ¹²⁴ RCT Fair	Home-based, patients recruited from schools in US N: 2460, subset of 1802 at risk for sun exposure Age: mean 42 yrs Male: 25% Risk: Sun sensitivity NR, 92% white	IG: Four telephone sessions of unknown duration and written survey assessments with computer-generated tailored materials CG: Assessment only	Mean score on Sun Avoidance Subscale of Sun Protection Behavior Scale at baseline, 12 months, and 24 months IG: 12.65 (SD, 3.86), 13.71 (SD, 3.52), 13.99 (SD, 3.39) CG: 12.60 (SD, 3.90), 13.22 (SD, 3.64), 13.35 (SD, 3.73) p>0.05 Mean score on Sunscreen Use Subscale of Sun Protection Behavior Scale at baseline, 12 months, and 24 months IG: 8.32 (SD, 4.00), 9.96 (SD, 3.87), 10.21 (SD, 3.94) CG: 8.16 (SD, 3.99), 9.29 (SD, 3.98), 9.18 (SD, 3.82) p<0.05

Table 2. Effectiveness of Primary Care Feasible Counseling to Increase Sun-Protective Behaviors

Trial, Design, Quality	Setting, Population, Characteristics	Intervention	Efficacy																																								
Young adults																																											
Hillhouse 2008 ⁴⁹ RCT Fair	Universities (2) in US N: 430 Age: mean 19 yrs Male: 0% Risk: Self-reported intention to indoor tan, approximately 1/3 fair skin	IG: Professionally produced booklet with appearance-focused intervention to reduce indoor tanning CG: Assessment only, details not given	Indoor tanning in past 3 months <i>Mean at baseline, 6 months</i> IG: 4.67 (SE, 0.60), 6.80 (SE, 0.93) CG: 4.48 (SE, 0.55), 10.90 (SE, 0.93) p<0.001																																								
Mahler 2007 ⁵³ RCT Fair	University in US N: 133 Age: mean 20 yrs Male: 20% Risk: Sun sensitivity NR, 45% white	IG: Appearance-focused intervention with UV facial photo, 11-min videotape with photoaging information, or both CG: Assessment only, details not given	Skin color using skin reflectance spectrophotometry at 12 months <i>(b* higher is more tan; L* higher is lighter; L* scale results in figure, exact numbers NR)</i> <table border="1"> <thead> <tr> <th></th> <th>Video (n=38)</th> <th>No video (n=46)</th> <th>p</th> </tr> </thead> <tbody> <tr> <td>Higher exposure site, b* scale</td> <td>0.82 (0.28)</td> <td>0.90 (0.25)</td> <td>NS</td> </tr> <tr> <td>Lower exposure site, b* scale</td> <td>0.32 (0.28)</td> <td>0.39 (0.25)</td> <td>NS</td> </tr> <tr> <td>Higher exposure site, L* scale</td> <td>~ 1.6 (NR)</td> <td>~ -0.6 (NR)</td> <td>sig</td> </tr> <tr> <td>Lower exposure site, L* scale</td> <td>~ 2.3 (NR)</td> <td>~ 0.9 (NR)</td> <td>sig</td> </tr> <tr> <td colspan="4">Sun exposure z-score, adjusted for baseline</td> </tr> <tr> <td>Intentional exposure</td> <td>-0.12(0.16)</td> <td>0.10 (0.14)</td> <td>NS</td> </tr> <tr> <td>Incidental exposure</td> <td>-0.23 (0.16)</td> <td>0.28 (0.15)</td> <td>sig</td> </tr> <tr> <td colspan="4">Sun Protection Behavior Scale z-score, adjusted for baseline</td> </tr> <tr> <td>Sun protection index</td> <td>-0.02 (0.10)</td> <td>-0.07 (0.09)</td> <td>NS</td> </tr> </tbody> </table>		Video (n=38)	No video (n=46)	p	Higher exposure site, b* scale	0.82 (0.28)	0.90 (0.25)	NS	Lower exposure site, b* scale	0.32 (0.28)	0.39 (0.25)	NS	Higher exposure site, L* scale	~ 1.6 (NR)	~ -0.6 (NR)	sig	Lower exposure site, L* scale	~ 2.3 (NR)	~ 0.9 (NR)	sig	Sun exposure z-score, adjusted for baseline				Intentional exposure	-0.12(0.16)	0.10 (0.14)	NS	Incidental exposure	-0.23 (0.16)	0.28 (0.15)	sig	Sun Protection Behavior Scale z-score, adjusted for baseline				Sun protection index	-0.02 (0.10)	-0.07 (0.09)	NS
	Video (n=38)	No video (n=46)	p																																								
Higher exposure site, b* scale	0.82 (0.28)	0.90 (0.25)	NS																																								
Lower exposure site, b* scale	0.32 (0.28)	0.39 (0.25)	NS																																								
Higher exposure site, L* scale	~ 1.6 (NR)	~ -0.6 (NR)	sig																																								
Lower exposure site, L* scale	~ 2.3 (NR)	~ 0.9 (NR)	sig																																								
Sun exposure z-score, adjusted for baseline																																											
Intentional exposure	-0.12(0.16)	0.10 (0.14)	NS																																								
Incidental exposure	-0.23 (0.16)	0.28 (0.15)	sig																																								
Sun Protection Behavior Scale z-score, adjusted for baseline																																											
Sun protection index	-0.02 (0.10)	-0.07 (0.09)	NS																																								
Adolescents																																											
Norman 2007 ⁵⁴ Patrick 2006 ⁵⁵ Rosenberg 2007 ⁵⁶ RCT Fair	PC practices in US N: 819 Age: mean 13 yrs Male: 46% Risk: 25% high sun sensitivity, 58.4% white	IG: Two 20-min interactive computer sessions with computer-generated tailored materials, four follow-up telephone sessions of unknown duration, and 2–3 min counseling by primary care providers CG: Attention control on physical activity and diet intervention, except no brief counseling by primary care providers	Sun Protection Behavior Scale score at 6, 12, and 24 months Adjusted sample means: IG with statistically significant increase in sun protection scores compared with CG, with trajectory of scores flattening (but still statistically significant) between 12 and 24 months <i>(results in figure, exact numbers NR)</i> Sun protection behaviors at 24 months <i>(results in figure, exact numbers NR)</i> % response "often" or "always" <table border="1"> <thead> <tr> <th></th> <th>IG</th> <th>CG</th> <th>p</th> </tr> </thead> <tbody> <tr> <td>Wear a shirt?</td> <td>~84</td> <td>~85</td> <td>NS</td> </tr> <tr> <td>Stay in shade?</td> <td>~44</td> <td>~45</td> <td>NS</td> </tr> <tr> <td>Avoid sun exposure midday?</td> <td>~40</td> <td>~30</td> <td>p<0.05</td> </tr> <tr> <td>Limit sun exposure midday?</td> <td>~38</td> <td>~31</td> <td>p<0.05</td> </tr> <tr> <td>Use sunscreen?</td> <td>~55</td> <td>~48</td> <td>p<0.05</td> </tr> <tr> <td>Use sunscreen on face?</td> <td>~62</td> <td>~48</td> <td>p<0.05</td> </tr> <tr> <td>Use sunscreen on all sun exposed areas?</td> <td>~56</td> <td>~40</td> <td>p<0.05</td> </tr> </tbody> </table>		IG	CG	p	Wear a shirt?	~84	~85	NS	Stay in shade?	~44	~45	NS	Avoid sun exposure midday?	~40	~30	p<0.05	Limit sun exposure midday?	~38	~31	p<0.05	Use sunscreen?	~55	~48	p<0.05	Use sunscreen on face?	~62	~48	p<0.05	Use sunscreen on all sun exposed areas?	~56	~40	p<0.05								
	IG	CG	p																																								
Wear a shirt?	~84	~85	NS																																								
Stay in shade?	~44	~45	NS																																								
Avoid sun exposure midday?	~40	~30	p<0.05																																								
Limit sun exposure midday?	~38	~31	p<0.05																																								
Use sunscreen?	~55	~48	p<0.05																																								
Use sunscreen on face?	~62	~48	p<0.05																																								
Use sunscreen on all sun exposed areas?	~56	~40	p<0.05																																								

Table 2. Effectiveness of Primary Care Feasible Counseling to Increase Sun-Protective Behaviors

Trial, Design, Quality	Setting, Population, Characteristics	Intervention	Efficacy
Olson 2007 ⁴⁸ Cluster RCT by school	Geographically distinct towns in US N: 797 Age: 98% in 6th grade Male: 43% Risk: 28% usually or always burn; 94% white	IG: Multimodal education with individual counseling during well visits (PC practices), classroom curriculum and group activities (schools), announcements and team policies (athletic and recreational facilities), posted information (community venues) CG: No intervention	Body surface area covered (by direct observation and interview) Adjusted mean percentage* at baseline and 24 months IG: 71.8 (SE, 1.6), 66.1 (SE, 1.5) CG: 73.7 (SE, 1.4), 56.8 (SE, 2.3) p<0.01 *Adjusted for sex, skin reaction to sun, UV level, year of observation, and temperature % any sunscreen use at baseline, 12 months, and 24 months IG: 58.0, 47.0, 47.0 CG: 65.8, 59.6, 13.8 p <0.05, p<0.01, p<0.001
Children and their parents			
Crane 2006 ⁴⁵ Cluster RCT by practice Fair	PC practices in US N: 728 Age: 30% of parents aged 20–29 yrs, 59% aged 30–39 yrs Male (parents): 100% Risk: 40% of parents with painful burn, no to light tan; 76% parents white	IG: Assessment and counseling by PC providers at 4 well-child visits and written information for parents CG: Usual care	Sun protection behaviors at 12, 24, and 36 months <i>% response "frequently" or "always"</i> Clothing use? IG: 51.0, 38.4, 24.2; p=0.22 CG: 43.8, 32.4, 25.5 Midday sun avoidance? IG: 70.6, 63.2, 64.2; p=0.14 CG: 64.9, 62.0, 59.0 Limit time in sun? IG: 48.9, 38.1, 32.1; p=0.97 CG: 47.5, 35.4, 34.3 Shade use? IG: 90.0, 79.2, 72.6; p=0.03 CG: 87.3, 71.9, 65.2 Hat use? IG: 61.9, 61.9, 57.3; p=0.08 CG: 60.8, 56.1, 47.4 Sunglasses use? IG: 5.2, 24.2, 39.4; p=0.22 CG: 8.3, 22.3, 29.9 Sunscreen use? IG: 90.0, 92.4, 94.2; p=0.46 CG: 87.9, 92.2, 93.1 Sun protection practice score at 12, 24, and 36 months IG: 18.55, 18.52, 18.18; p=0.04 CG: 18.40, 18.05, 17.71

Table 2. Effectiveness of Primary Care Feasible Counseling to Increase Sun-Protective Behaviors

Trial, Design, Quality	Setting, Population, Characteristics	Intervention	Efficacy
Dietrich 1998 ⁴⁷ Dietrich 2000 ¹²⁵ Grant-Petersson 1999 ¹²⁶ Cluster RCT by town Fair	Geographically distinct towns in US N: 865 Age: 38% aged <5 yrs Male: 52% Risk: 54% burn easily, implied 99% white	IG: Multimodal education with individual counseling during well child and illness visits (PC practices), classroom curriculum (schools and day care centers), posted information and sunscreen (beach areas) CG: No intervention	Sun-protective behaviors at baseline and 12 months* <i>Any protective clothing (by observation)</i> IG: 0.30, 0.24 CG: 0.26, 0.18 Difference of change (IG-CG): 0.02; p=0.78 <i>Protection by shade (by observation)</i> IG: 0.14, 0.14 CG: 0.18, 0.24 Difference of change (IG-CG): -0.06; p=0.38 <i>Sunscreen used on ≥1 body area (self report)</i> IG: 0.57, 0.75 CG: 0.65, 0.66 Difference of change (IG-CG): 0.17; p=0.011 <i>Protection on ≥1 body area by sunscreen, clothes, and/or shade (self report)</i> IG: 0.78, 0.87 CG: 0.85, 0.80 Difference of change (IG-CG): 0.13; p=0.029 <i>Protection on all 3 body areas by any means (self report)</i> IG: 0.53, 0.74 CG: 0.66, 0.72 Difference of change (IG-CG): 0.15; p=0.18 *All values corrected by age, sex, ease with which child burns, and weather conditions at time of interview

RCT=randomized controlled trial; N=number; IG=intervention group; CG=control group; UK=United Kingdom; US=United States; PC=primary care; CI=confidence interval; SD=standard deviation; SE=standard error; OR=odds ratio; NR=not reported; UV=ultraviolet; SPF=sun protection factor; NS=not significant; sig=significant

Table 3. Association Between Sun Exposure and Skin Cancer

Study reference, USPSTF quality rating	Design, Setting, Population	Total Sun Exposure (RR or OR)*	Intermittent Sun Exposure (RR or OR [95% CI])*	Chronic Sun Exposure (RR or OR)*	Adjustments reported
Squamous cell or basal cell carcinoma					
Grodstein 1995 ⁶⁷ Nurses' Health Study Good	Cohort US (11 states) n=107,900	NR	SCC, regular time outdoors in summer Yes (use sunscreen): reference Yes (no sunscreen): 0.9 (0.6-1.2) No: 0.7 (0.4-1.1)	NR	Age; smoking; region; natural hair color; reaction to sun; lifetime # of sunburns
Hunter 1990 ⁶⁸ Nurses' Health Study Fair	Analytic cohort US (11 states) n=73,366	NR	BCC, regular time spent outdoors in summer (at least 8 hrs/wk) Yes (use sunscreen): reference Yes (no sunscreen): 0.70 (0.60-0.82) No: 0.73 (0.59-0.90)	NR	Age; time period; region; time spent outdoors in summer and sunscreen use; hair color; childhood tendency to burn; lifetime # of severe and painful sunburns on face and arms
van Dam 1999 ⁶⁹ Health Professionals Follow-up Study Fair	Cohort US (multistate) n=44,591	NR	BCC, frequency outdoors in swimsuit as teenager in summer <1 time/wk: reference 1 time/wk: 1.30 (1.14-1.47) 2 times/wk: 1.34 (1.19-1.52) Several times/wk: 1.36 (1.22-1.52) Daily: 1.42 (1.24-1.63)	NR	Age; time period; hair color; eye color; skin reaction to sun; ancestry; BMI; region of residence
Green 1996 ⁶⁵ Nambour Skin Cancer Study Fair	Cohort Queensland Australia N=2,095	NR	Leisure exposure SCC Mainly indoors: reference Indoors/outdoors: 0.81 (0.37-1.80) Mainly outdoors: 1.29 (0.66-2.52) BCC Mainly indoors: reference Indoors/outdoors: 0.93 (0.63-1.37) Mainly outdoors: 0.85 (0.59-1.21)	Occupational exposure SCC Mainly indoors: reference Indoors/outdoors: 0.82 (0.47-1.43) Mainly outdoors: 1.37 (0.80-2.34) BCC Mainly indoors: reference Indoors/outdoors: 1.07 (0.79-1.46) Mainly outdoors: 1.25 (0.88-1.78)	Age; sex; skin color
Neale 2007 ⁶¹ Fair	Cohort from Nambour Skin Cancer Trial Queensland Australia N=1,517	NR	Leisure exposure BCC (head, trunk respectively) Mainly indoors: reference Indoors/outdoors: 0.93 (0.64-1.35); 1.15 (0.62-2.12) Mainly outdoors: 0.99 (0.60-1.63); 0.84 (0.32-2.17)	Occupational exposure BCC (head, trunk respectively) Mainly indoors: reference Indoors/outdoors: 0.95 (0.60-1.49); 1.07 (0.60-1.93) Mainly outdoors: 0.86 (0.53-1.40); 1.12 (0.60-2.11)	Age; sex
Vlajinac 2000 ¹²⁷ Fair	Case-control Yugoslavia Cases n=200 Controls n=399	NR	BCC # of vacations at seaside before age 10 NS; OR not reported Average # wks per year spent at seaside 0: reference 1-6: NR 7+: 1.81 (1.24-2.64)	NR	NR

Table 3. Association Between Sun Exposure and Skin Cancer

Study reference, USPSTF quality rating	Design, Setting, Population	Total Sun Exposure (RR or OR)*	Intermittent Sun Exposure (RR or OR [95% CI])*	ChronicSun Exposure (RR or OR)*	Adjustments reported
Han 2006 ⁷¹ Nurses' Health Study Fair	Nested case-control US (11 states) SCC n=275 BCC n=283 Control n=804	NR	Total lifetime sun exposure while wearing bathing suit (tertile) SCC Low: reference Intermediate: 1.28 (0.85-1.93) High: 2.15 (1.45-3.19) BCC Low: reference Intermediate: 1.71 (1.14-2.56) High: 2.05 (1.38-3.06)	NR	Age; constitutional susceptibility; family history of skin cancer; # of lifetime severe sunburns which blistered; sunlamp use or tanning salon attendance; geographic region
Rosso 1999 ⁶⁴ Fair	Case-control Valais, Switzerland Cases n=146 Controls n=144	SCC, total # lifetime hrs <5,000: reference -64,200: 1.78 (0.18-17.67) 64,200+: 1.42 (0.53-3.85) BCC, total # lifetime hrs <5,000: reference -15,800: 1.09 (0.62-1.92) -64,200: 0.99 (0.35-2.79) 64,200+: 0.70 (0.20-2.39)	Lifetime hrs at beach on vacation SCC Never: reference 2,260+: 0.78 (0.26-2.40) BCC Never: reference <300: 1.46 (0.52-4.07) -1,140: 1.39 (0.72-2.66) -2,260: 0.92 (0.44-1.91) 2,260+: 1.20 (0.61-2.34)	Lifetime hrs of outdoor work SCC Never: reference -47,900: 1.84 (0.30-11.09) -77,200: 2.02 (0.60-6.78) 77,200+: 1.88 (0.30-11.70) BCC Never: reference -12,000: 0.98 (0.58-1.66) -47,900: 1.30 (0.69-2.46) -77,200: 0.78 (0.52-1.19) 77,200+: 0.90 (0.51-1.59)	Age; sex
Kricker 1991 ⁶² Kricker 1995 ³⁶ Kricker 1995 ¹¹⁶ English 1998 ⁶³ English 1998 ³³ Fair	Case-control Western Australia n=248 (23 w/ BCC + SCC) BCC n=226 SCC n=45 Control n=1,015 BCC control n=1,021 (6 w/SCC) SCC control n=1,064 (49 w/BCC)	BCC <i>Total hrs (thousands) sun exposure 9am to 5pm, whole wk</i> 0-40.5: reference 40.5-56.4: 0.99 (0.61-1.58) 56.4-81.6: 1.42 (0.86-2.35) 81.6+: 0.77 (0.43-1.40) <i>Total hrs (thousands) sun exposure 9am to 5pm, whole wk, age ≥15</i> 0-14.7: reference 14.8-27.7: 1.25 (0.79-1.97) 27.8-49.3: 1.17 (0.72-1.90) 49.4+: 0.86 (0.50-1.51) <i>Total ambient sunlight in accumulated global radiance (mWh cm-2 X 105)</i> 0-8.8: reference 8.8-10.1: 1.32 (0.69-2.55) 10.1-11.4: 1.72 (0.72-4.09) 11.4+: 2.18 (0.82-5.82) SCC <i>Total ambient sunlight in</i>	BCC <i>Intermittent sun exposure, ages 15-19</i> 0-40%: reference 41-58%: 1.49 (0.88-2.52) 59-99%: 1.82 (1.01-3.28) 100%: 3.86 (1.93-7.75) <i>Lifetime hrs sun exposure on holiday</i> 0-602: reference 602-2268: 1.65 (1.01-2.70) 2268-3794: 1.68 (1.00-2.80)3794+: 1.85 (1.09-3.13) <i>Lifetime frequency of sunbathing</i> None: reference 1-200: 1.57 (0.98-2.51) 201-700: 1.08 (0.68-1.72) 701-9000: 1.02 (0.63-1.64) SCC <i>Total hrs sun exposure on nonworking days</i> 0-4,999: reference 5,000-8,499: 2.0 (0.89-4.4) 8,500-13,999: 1.9 (0.86-4.2) 14,000+: 1.3 (0.57-2.9) <i>Lifetime hrs sun exposure on holidays</i> <600: reference 600-2,268: 0.89 (0.44-1.8)	BCC NR SCC <i>Total hrs sun exposure on working days</i> 0-11,499: reference 11,500-19,999: 0.93 (0.42-2.1) 20,000-32,999: 1.7 (0.81-3.8) 33,000+: 1.3 (0.58-2.8)	Age; sex; ability to tan; total sun exposure (for recreational sun exposure)

Table 3. Association Between Sun Exposure and Skin Cancer

Study reference, USPSTF quality rating	Design, Setting, Population	Total Sun Exposure (RR or OR)*	Intermittent Sun Exposure (RR or OR [95% CI])*	ChronicSun Exposure (RR or OR)*	Adjustments reported
		<i>accumulated global radiance (mWh cm-2 X 105)</i> <8.8410: reference 8.8410-10.1399: 1.4 (0.51-3.6) 10.1400-11.4509: 2.7 (0.84-8.6) 11.4510+: 2.3 (0.62-8.3)	2,269-3,793: 1.0 (0.51-2.1) 3,794+: 0.93 (0.44-1.9)		
Gallagher 1995 ^{6b} Bajdik 1996 ^{12b} Fair	Case-control Alberta, Canada Cases n=180 Controls n=406	NR	SCC <i>Mean recreational sun exposure per year, ages 0-19</i> <100/y WBE, <3.8 h/wk summer: reference 100-199/y WBE, 3.8-7.4 h/wk summer: 1.2 (0.6-2.5) 200-332/y WBE, 7.5-12.4 h/wk summer: 1.1 (0.5-2.6) 333+/y WBE, 12.5+ h/wk summer: 1.6 (0.6-4.5) <i>Mean recreational sun exposure per year, lifetime</i> <75/y WBE, <2.8 h/wk summer: reference 75-149/y WBE, 2.8-5.5 h/wk summer: 0.6 (0.3-1.1) 150-224/y WBE, 5.6-8.4 h/wk summer: 0.8 (0.3-1.8) 225+/y WBE, 8.5+ h/wk summer: 0.3 (0.1-0.9) BCC <i>Mean recreational sun exposure per year, ages 0-19</i> <100/y WBE, <3.8 h/wk summer: reference 100-199/y WBE, 3.8-7.4 h/wk summer: 1.1 (0.6-2.0) 200-332/y WBE, 7.5-12.4 h/wk summer: 1.4 (0.7-3.0) 333+/y WBE, 12.5+ h/wk summer: 2.6 (1.1-6.5) <i>Mean recreational sun exposure per year, lifetime</i> <75/y WBE, <2.8 h/wk summer: reference 75-149/y WBE, 2.8-5.5 h/wk summer: 0.9 (0.5-1.7) 150-224/y WBE, 5.6-8.4 h/wk summer: 0.6 (0.3-1.3) 225+/y WBE, 8.5+ h/wk summer: 0.4 (0.2-1.0)	SCC NR BCC <i>Mean lifetime occupational sun exposure per year</i> <15/y WBE, <3.5 h/wk summer: reference 15-59/y WBE, 3.5-13.9 h/wk summer: 1.0 (0.6-1.8) 60-104/y WBE, 14.0-24.9 h/wk summer: 1.3 (0.8-2.3) 105+/y WBE, 25+ h/wk summer: 1.4 (0.8-2.4)	Mother's ethnic origin; hair color; skin color

Table 3. Association Between Sun Exposure and Skin Cancer

Study reference, USPSTF quality rating	Design, Setting, Population	Total Sun Exposure (RR or OR)*	Intermittent Sun Exposure (RR or OR [95% CI])*	Chronic Sun Exposure (RR or OR)*	Adjustments reported
Melanoma					
Veierod 2003 ⁸² Norwegian-Swedish Women's Lifestyle and Health Cohort Study Fair	Cohort Norway & Sweden N=106,379	NR	<i>Annual wks on sunbathing vacation, ages 10-19</i> 0: reference 1 wk/yr: 1.21 (0.80-1.83) 2-3 wks/yr: 1.09 (0.71-1.65) ≥4 wks/yr: 1.67 (1.01-2.74) <i>Annual wks on sunbathing vacation, ages 10-39</i> 0: reference ≥1 wk/yr: 1.56 (0.95-2.56)	NR	Age; region of residence; hair color
Weinstock 1991 ⁸⁷ Nurses' Health Study Fair	Nested case-control US (multistate) Cases n=130 Controls n=300	NR	<i>Annual frequency of swimsuit use outdoors, ages 15-20, by skin type</i> <u>Sun resistant*</u> 0-10: reference 11-30: 0.6 (0.2-1.4) ≥31: 0.3 (0.1-0.8) <u>Sun sensitive**</u> 0-10: reference 11-30: 1.2 (0.6-2.6) ≥31: 3.5 (1.3-9.3) *A priori sun sensitivity score <0.5 **A priori sun sensitivity score ≥0.5	NR	NR
Han 2006 ⁷¹ Nurses' Health Study Fair	Nested case-control US (11 states) Melanoma n=200 Controls n=804		<i>Total lifetime sun exposure while wearing a bathing suit (tertile)</i> Low: reference Intermediate: 1.20 (0.73-1.97) High: 2.37 (1.51-3.73)	NR	Age; constitutional susceptibility; family history of skin cancer; # of lifetime severe sunburns which blistered; sunlamp use or tanning salon attendance; geographic region
White 1994 ⁷² Fair	Case-control Washington, US Cases n= 256 Controls n=273	<i>Avg yearly sun exposure (hrs), previous 10 yrs</i> 0: reference 1-201: 1.16 (0.72-1.87) 202-499: 0.80 (0.45-1.42) 500-2,880: 0.88 (0.47-1.64)	NR	<i>Lifetime occupational sun exposure</i> None: reference <50%: 0.89 (0.60-1.32) ≥50%: 0.64 (0.33-1.23)	Age; sex; education
Osterlind 1988 ⁸³ Osterlind 1988 ¹²⁹ Fair	Case-control East Denmark Cases n= 474 Controls	NR	<i>Sunbathing habits, adjusted for sex, nevi, freckles and hair color</i> Never: reference At some time: 1.6 (1.1-2.4) 1-9 years: 1.9 (0.9-3.9) 10-24 years: 1.6 (1.1-2.5)	NR	Sex; nevi; freckles and hair color; history of sunbathing and sunburning

Table 3. Association Between Sun Exposure and Skin Cancer

Study reference, USPSTF quality rating	Design, Setting, Population	Total Sun Exposure (RR or OR)*	Intermittent Sun Exposure (RR or OR [95% CI])*	ChronicSun Exposure (RR or OR)*	Adjustments reported																																													
	n=926		25-39 years: 1.7 (1.1-2.5) 40+ years: 1.9 (1.3-2.9) <i>Vacations spent in sun, adjusted for history of sunbathing and sunburning</i> Never: reference Sunny: 1.0 (0.8-1.3) Very sunny: 1.4 (1.0-2.1)																																															
Berwick 1996 ⁷³ Lea 2007 ¹³⁰ Chen 1996 ¹³¹ Fair	Case-control Connecticut, US Cases n=650 Controls n=549	<i>Total lifetime sun exposure, adjusted for skin self-exam; total nevi; family history; skin cancer; skin type; eye color; hair color; freckles; ever severely sunburned</i> Light: reference Moderate: 1.26 (0.69-2.29) Heavy: 2.20 (1.21-4.01) Very heavy: 2.63 (1.25-5.54)	<i>Total recreational sun exposure index (by body site), adjusted for sex; age; skin color; # of nevi on arms; skin type</i> <table border="1"> <thead> <tr> <th></th> <th>Head/neck</th> <th>Upper limb</th> <th>Lower limb</th> <th>Trunk</th> </tr> </thead> <tbody> <tr> <td>Level 1</td> <td>reference</td> <td>reference</td> <td>reference</td> <td>reference</td> </tr> <tr> <td>Level 2</td> <td>1.5 (0.7-3.3)</td> <td>0.9 (0.4-1.8)</td> <td>1.0 (0.5-2.2)</td> <td>1.7 (1.0-2.9)</td> </tr> <tr> <td>Level 3</td> <td>1.0 (0.7-2.1)</td> <td>1.0 (0.5-2.0)</td> <td>1.2 (0.6-2.7)</td> <td>1.4 (0.7-2.2)</td> </tr> <tr> <td>Level 4</td> <td>2.6 (1.2-5.6)</td> <td>2.4 (1.2-4.8)</td> <td>2.7 (1.2-5.8)</td> <td>2.7 (1.6-4.5)</td> </tr> </tbody> </table> # vacations, age 0-15 0: reference 1-14: 1.1 (0.8-1.7) 15-90: 0.9 (0.5-1.4)		Head/neck	Upper limb	Lower limb	Trunk	Level 1	reference	reference	reference	reference	Level 2	1.5 (0.7-3.3)	0.9 (0.4-1.8)	1.0 (0.5-2.2)	1.7 (1.0-2.9)	Level 3	1.0 (0.7-2.1)	1.0 (0.5-2.0)	1.2 (0.6-2.7)	1.4 (0.7-2.2)	Level 4	2.6 (1.2-5.6)	2.4 (1.2-4.8)	2.7 (1.2-5.8)	2.7 (1.6-4.5)	<i>Total yrs in outdoor jobs (by body site)</i> <table border="1"> <thead> <tr> <th></th> <th>Head/neck</th> <th>Upper limb</th> <th>Lower limb</th> <th>Trunk</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>reference</td> <td>reference</td> <td>reference</td> <td>reference</td> </tr> <tr> <td><5</td> <td>0.8 (0.4-1.5)</td> <td>0.7 (0.4-1.4)</td> <td>0.7 (0.3-1.3)</td> <td>0.7 (0.5-1.1)</td> </tr> <tr> <td>5+</td> <td>0.5 (0.2-1.1)</td> <td>0.6 (0.2-1.1)</td> <td>0.3 (0.1-0.9)</td> <td>0.9 (0.6-1.3)</td> </tr> </tbody> </table>		Head/neck	Upper limb	Lower limb	Trunk	0	reference	reference	reference	reference	<5	0.8 (0.4-1.5)	0.7 (0.4-1.4)	0.7 (0.3-1.3)	0.7 (0.5-1.1)	5+	0.5 (0.2-1.1)	0.6 (0.2-1.1)	0.3 (0.1-0.9)	0.9 (0.6-1.3)	Sex; age; skin self-exam; total nevi; family history skin cancer; skin type; eye color; hair color; freckles; ever severely sunburned
	Head/neck	Upper limb	Lower limb	Trunk																																														
Level 1	reference	reference	reference	reference																																														
Level 2	1.5 (0.7-3.3)	0.9 (0.4-1.8)	1.0 (0.5-2.2)	1.7 (1.0-2.9)																																														
Level 3	1.0 (0.7-2.1)	1.0 (0.5-2.0)	1.2 (0.6-2.7)	1.4 (0.7-2.2)																																														
Level 4	2.6 (1.2-5.6)	2.4 (1.2-4.8)	2.7 (1.2-5.8)	2.7 (1.6-4.5)																																														
	Head/neck	Upper limb	Lower limb	Trunk																																														
0	reference	reference	reference	reference																																														
<5	0.8 (0.4-1.5)	0.7 (0.4-1.4)	0.7 (0.3-1.3)	0.7 (0.5-1.1)																																														
5+	0.5 (0.2-1.1)	0.6 (0.2-1.1)	0.3 (0.1-0.9)	0.9 (0.6-1.3)																																														
Walter 1999 ⁹⁰ Walter 1990 ¹³² Fair	Case-control Ontario, Canada Cases n=583 Controls n=608	NR	<i>Beach vacation, past 5 yrs</i> No: reference Yes: 1.04 (0.82-1.32)	NR	Age; sex; reaction to initial summer sun exposure																																													
Green 1985 ⁷⁷ Green 1986 ¹³³ Fair	Case-control Queensland, Australia Cases n=183 (excludes lentigo maligna) Controls n=183	<i>Total lifetime # hrs of sun exposure, adjusted for age, nevi on arms, hair color, and sunburn propensity</i> <2,000: reference 2,000-100,000: 3.2 (0.9-12.4) >100,000: 5.3 (0.9-30.8) <i>Total # hrs sun exposure, adjusted for age and nevi on arms</i> <u>Lifetime</u> <2000: reference 2000-: 2.3 (1.0-5.1)	<i>Recreational hrs on beach, adjusted for nevi on arms and age</i> <u>Lifetime</u> 0: reference 1-: 0.6 (0.2-1.4) 500-: 0.3 (0.1-0.8) 5000-: 1.3 (0.4-4.3) <u>Ages 10-19</u> 0: reference 1-: 1.1 (0.6-2.0) 500-: 0.8 (0.4-1.9)	NR	Age; nevi on the arms; hair color; and sunburn propensity																																													

Table 3. Association Between Sun Exposure and Skin Cancer

Study reference, USPSTF quality rating	Design, Setting, Population	Total Sun Exposure (RR or OR)*	Intermittent Sun Exposure (RR or OR [95% CI])*	ChronicSun Exposure (RR or OR)*	Adjustments reported
		50,000-: 1.7 (0.4-7.8) <u>Ages 10-19 years</u> <500: reference 500-: 1.0 (0.5-2.0) 5000-: 4.4 (1.8-184.5)			
Shors 2001 ⁷⁴ Soloman 2004 ¹³⁴ Fair	Case-control Washington, US Cases n=386 Controls n=727	<i>Lifetime avg days spent >4 hrs in the sun</i> 1stt quartile: reference 2nd quartile: 1.3 (0.86-1.9) 3rd quartile: 1.4 (0.92-2.0) 4th quartile: 1.4 (0.95-2.0) <i>Lifetime overall UV exposure (includes time in sun, erythemat exposure)</i> <u>Men</u> 1st quartile: reference 2nd quartile: 0.51 (0.23-0.80) 3rd quartile: 0.67 (0.31-1.03) 4th quartile: 1.24 (0.62-1.86) <u>Women</u> 1st quartile: reference 2nd quartile: 1.35 (0.64-2.05) 3rd quartile: 2.45 (1.23-3.68) 4th quartile: 1.99 (0.95-3.03)	NR	NR	Age; income; tendency to sunburn; #of sunburns ages 2-10
Garbe 1989 ⁷⁸ Fair	Case-control Germany Cases n= 200 Controls n=200	NR	NR	<i>Occupational sun exposure</i> None: reference Sometimes: 1.18 (0.56-2.48) Nearly every time: 11.62 (2.13-63.33)	NR
Gallagher 1986 ⁷⁵ Elwood 1985 ¹³⁵ Elwood 1984 ¹³⁶ Western Canada Melanoma Study Fair	Case-control Western Canada Cases n= 595 Controls n=595	<i>Total hrs annual sun exposure</i> <49: reference 50-99: 1.5 (0.8-2.7) 100-149: 1.5 (0.9-2.7) 150-199: 1.6 (0.9-2.9) 200-299: 1.0 (0.6-1.7) 300-399: 1.1 (0.6-1.9) 400-499: 1.6 (0.9-2.7) 500+: 1.2 (0.7-2.0)	<i>Total hrs recreational exposure in summer</i> <1: reference 1-19: 1.1 (0.7-1.6) 20-79: 1.7 (1.2-2.5) 80-159: 1.8 (1.2-2.7) 160+: 1.7 (1.1-2.7) <i>Total hrs vacation in summer</i> <1: reference 1-6: 0.9 (0.7-1.3) 7-19: 0.9 (0.6-1.4) 20-39: 1.9 (1.3-3.0) 40+: 1.5 (1.0-2.3) <i># sunny vacations per decade of life</i>	<i>Occupational, hrs/summer season</i> <1: reference 1-99: 1.8 (1.2-2.5) 100-199: 1.0 (0.7-1.5) 200-399: 0.9 (0.6-1.4) 400+ : 0.9 (0.6-1.5)	Hair color; skin color; freckling; ethnic origin

Table 3. Association Between Sun Exposure and Skin Cancer

Study reference, USPSTF quality rating	Design, Setting, Population	Total Sun Exposure (RR or OR)*	Intermittent Sun Exposure (RR or OR [95% CI])*	Chronic Sun Exposure (RR or OR)*	Adjustments reported
			0: reference <1: 1.1 (1.0-1.1) 1-3: 1.3 (1.1-1.5) 4+: 1.7 (1.2-2.3)		
Fargnoli 2004 ⁷⁹ Fair	Case-control Central Italy Cases n=100 Controls n=200	NR	<i>Hrs recreational sun exposure per year</i> <60: reference 60-120: 0.761 (0.420-1.378) 120-240: 1.641 (0.799-3.370) >240: 5.010 (2.110-11.891)	<i>Occupational sun exposure</i> No: reference Yes: 2.57 (1.40-4.73)	Hair color; eye color; skin type
Holly 1995 ⁸⁰ Fair	Case-control San Francisco, US Cases n=452 Controls n=930	NR	<i>Time spent outdoors on weekends, past 10 years</i> None: reference <1/4 of time: 0.72 (0.35-1.4) 1/4 - 1/2 of time: 0.71 (0.37-1.4) 1/2 - 3/4 of time: 0.86 (0.42-1.8) ≥3/4 of time: 0.84 (0.37-1.9) <i>Frequency of sunbathing in typical year, past 10 years</i> Never: reference <Once/month: 0.75 (0.52-1.1) Once/month: 0.57 (0.36-0.89) 2-3 times/month: 0.67 (0.46-0.98) ≥Once/week: 0.79 (0.56-1.1)	<i>Time spent outdoors on weekday, past 10 years</i> None: reference <1/4 of time: 0.71 (0.49-1.0) 1/4 - 1/2 of time: 0.83 (0.53-1.3) ≥1/2 of time: 0.83 (0.46-1.5)	None
Tabenkin 1999 ⁷⁶ Fair	Case-control Israel Cases n=168 Controls n=325	# hrs sun exposure, ages 6-13 Statistically significant difference; OR not reported # hrs sun exposure, ages 14-18, 18-21, and >21 NS; OR not reported	NR	<i>Occupational sun exposure age >21</i> No: 2.44 (1.01-5.91) Yes: reference	NR
Zanetti 1992 ⁸⁴ Fair	Case-control Turin, Italy Cases n=260 Controls n=416	NR	<i># weeks of sunny vacation in childhood</i> 0: reference 1-59: 2.8 (1.6-4.6) ≥60: 1.7 (1.0-2.9) <i># sunny vacations in lifetime</i> 0: reference 1-29: 0.9 (0.5-1.6) 30-59: 1.6 (0.9-2.8) 60-89: 1.6 (0.9-2.9) 90-119: 1.5 (0.8-2.7) ≥120: 2.3 (1.4-3.8)	NR	Age; sex

Table 3. Association Between Sun Exposure and Skin Cancer

Study reference, USPSTF quality rating	Design, Setting, Population	Total Sun Exposure (RR or OR)*	Intermittent Sun Exposure (RR or OR [95% CI])*	Chronic Sun Exposure (RR or OR)*	Adjustments reported
Westerdahl 1994 ⁸⁶ Westerdahl 1994 ⁴⁰ Westerdahl 1995 ⁴¹ Fair	Case-control Sweden Cases n=400 Controls n=640	NR	<i>Frequent sunbathing during summer</i> No: reference Yes: 1.2 (0.9-1.7)	NR	Exposure to sunbeds or sunlamps; history of sunburns; hair color; # of raised nevi; history of malignant melanoma in immediate family
Westerdahl 2000 ⁸⁵ Fair	Case-control Sweden Cases n=558 Controls n=891	NR	<i>Frequency of sunbathing in summer, stratified by sunscreen use</i> <u>Use of sunscreen</u> <u>Never</u> <u>Ever</u> <15 times reference 1.3 (0.8-2.2) ≥15 times 0.9 (0.5-1.8) 1.2 (0.7-2.0)	NR	Sunburns age >19; skin phototype; hair color
LeMarchand 2006 ⁸¹ Fair	Case-control Hawaii, US Cases n=278 Controls n=278	NR	<i># hrs during summer in bathing suit, ages 8-10</i> <u>Men</u> 0: reference 1-32: 1.2 (0.6-2.3) 33-80: 0.9 (0.4-1.8) ≥80: 2.0 (0.9-4.4) <u>Women</u> 0: reference 1-20: 2.1 (0.8-5.4) 21-64: 1.4 (0.5-3.7) ≥65: 3.4 (1.2-9.1) <i># hrs during summer in bathing suit, past 5 yrs</i> <u>Men</u> 0: reference 1-12: 1.4 (0.6-3.0) 13-24: 1.9 (0.8-4.4) ≥25: 2.5 (1.2-5.4) <u>Women</u> 0: reference 1-8: 2.1 (0.8-5.6) 9-20: 4.8 (1.7-13.4) ≥21: 3.3 (1.1-10.10)	<i>Lifetime # f hours worked outdoors</i> <u>Men</u> ≤438: reference 439-1,644: 1.0 (0.5-2.0) 1,645-3,360: 0.7 (0.4-1.5) ≥3,361: 1.3 (0.7-2.7) <u>Women</u> 0: reference 1-330: 1.3 (0.6-3.8) 331-864: 1.8 (0.8-4.2) ≥865: 1.2 (0.5-3.0)	Height; education; hair color; ability to tan; drinking status

*Adjusted unless otherwise stated.

US=United States; N=sample size; CI=confidence interval; SCC=squamous cell carcinoma; RR=relative risk; BCC=basal cell carcinoma; OR=odds ratio; WBE=whole body equivalent; NS=not significant; NR=not reported

Table 4. Association Between Indoor Tanning and Skin Cancer

Study, USPSTF quality	Design, Setting, Years	Population	Ever use (RR or OR [95% CI])*	Frequency of use (RR or OR [95% CI])*	Adjustments reported
Squamous cell or basal cell carcinoma					
Han 2006 ⁷¹ Nurses' Health Study Fair	Nested case-control US (11 states) 1989-1998/2000	Cases SCC n=275 BCC n=283 Controls n=804	SCC: 1.44 (0.93-2.24) BCC: 1.32 (0.87-2.03)	NR	Age; constitutional susceptibility; family history of skin cancer; # of lifetime severe sunburns which blistered; cumulative sun exposure while wearing a bathing suit; geographic region
Gallagher 1995 ⁶⁶ Bajdik 1996 ¹²⁸ Fair	Case-control Alberta, Canada 1983-1984	Cases SCC n=180 BCC n=226 Controls SCC n=406 BCC n=406	SCC: 1.4 (0.7-2.7) BCC: 1.2 (0.7-2.2)	NR	Age; ethnic origin; skin and hair color; lifetime occupational sun exposure
Rosso 1999 ⁶⁴ Fair	Case-control Valais, Switzerland 1994-1996	Cases n=146 Controls n=144	SCC: Not calculated BCC: 1.24 (0.53-2.88)	NR	Age; sex
Karagas 2002 ⁶⁸ Fair	Case-control New Hampshire and bordering regions 1993-1995	Cases n=896 (BCC n=603, SCC n=293) Controls n=540	SCC: 2.5 (1.7-3.8) BCC: 1.5 (1.1-2.1)	Age at first tanning device use SCC: <20: 3.6 (1.9-6.9) 20-35: 2.8 (1.4-5.5) BCC: <20: 1.8 (1.0-3.0) 20-35: 1.4 (0.8-2.3)	NR
Melanoma					
Veierod 2003 ⁸² Norwegian-Swedish Women's Lifestyle and Health Cohort Study Fair	Cohort Norway & Sweden 1992-1992 ~8 year follow-up	n=106,379	Ages 10-19: 1.52 (0.56-4.12)	Frequent use (1+ per month), ages 10-39: 1.55 (1.04-2.32)	Age; region of residence; hair color; corresponding # of age-specific sunburns and weeks spent on annual summer vacations
Han 2006 ⁷¹ Nurses' Health Study Fair	Nested case-control US (11 states) 1989-1998/2000	Cases melanoma n=200 Controls n=804	2.06 (1.30-3.26)	NR	Age; constitutional susceptibility; family history of skin cancer; # of lifetime severe sunburns which blistered; cumulative sun exposure while wearing a bathing suit; geographic region
Osterlind 1988 ⁸³ Osterlind 1988 ¹²⁹ Fair	Case-control East Denmark 1982-1985	Cases n=474 Controls n=926	0.7 (0.5-1.0)	NR	NR

Table 4. Association Between Indoor Tanning and Skin Cancer

Study, USPSTF quality	Design, Setting, Years	Population	Ever use (RR or OR [95% CI])*	Frequency of use (RR or OR [95% CI])*	Adjustments reported
Berwick 1996 ⁷³ Chen 1998 ⁸⁹ Fair	Case-control Connecticut, US 1987-1989	Cases n=624 Controls n=512	1.13 (0.82-1.54)	<i>Total lifetime # sunlamp uses</i> <10 times: 1.25 (0.84-1.84) ≥10 times: 1.15 (0.60-2.20) <i>Age at first use of sunlamp</i> <25: 1.35 (0.88-2.08) 25-45: 1.02 (0.61-1.70)	Sex; age; cutaneous phenotype index; total recreational sun exposure index
Walter 1999 ⁹⁰ Walter 1990 ¹³² Fair	Case-control Ontario, Canada 1984-1986	Cases n=583 Controls n=608	1.54 (1.16-2.05)	See appendix for sex-stratified, age-adjusted only OR for 1) total lifetime # minutes use, and 2) age at first use	Sex; age; reaction to initial summer sun exposure; potential confounders
Bataille 2005 ⁹¹ Fair	Case-control Sweden, The Netherlands, UK, Belgium, France 1998-2001	Cases n=597 Controls n=622	0.90 (0.71-1.14) Age <15: 1.82 (0.92-3.62)	<i>Total lifetime # hours use</i> <10: 0.95 (0.71-1.25) 10-30: 0.75 (0.50-1.11) 31-60: 0.75 (0.43-1.30) 61-100: 1.10 (0.55-2.24) >100: 1.19 (0.73-1.93)	Age; sex; skin phototype
Fagnoli 2004 ⁷⁹ Fair	Case-control Central Italy 2000-2001	Cases n=100 Controls n=200	0.63 (0.25-1.63)	NR	Hair color; eye color; skin type for pigmentation factors
Holly 1995 ⁸⁰ Fair	Case-control San Francisco, US 1981-1986	Cases n=452 Controls n=930	0.94 (0.74-1.2)	NR	None
Westerdahl 1994 ⁸⁶ Westerdahl 1994 ⁴⁰ Westerdahl 1995 ⁴¹ Fair	Case-control Sweden 1988-1990	Cases n=400 Controls n=640	Age <30: 2.7 (0.7-9.8)	<i># times per year use</i> <i>age <30 years</i> 1-10: 2.0 (0.5-8.0) >10: 7.7 (1.0-63.6) <i>age 30-60 years</i> 1-10: 1.0 (0.7-1.6) 10: 1.4 (0.7-2.7)	History of sunburns; blond/fair and red hair color; raised nevi; history of frequent sunbathing during summer
Westerdahl 2000 ⁸⁵ Westerdahl 2000 ⁴² Fair	Case-control Sweden 1995-1997	Cases n=571 Controls n=913	Sometimes use: 1.1 (0.8-1.4) Regular use: 1.8 (1.2-2.7)	<i>Total lifetime # uses</i> 1-125: 2.8 (1.0-7.8) 126-250: 3.1 (1.3-7.1) >250: 1.5 (0.7-3.2) <i>Age at first use</i> ≤35: 2.3 (1.2-4.2) >35: 1.6 (0.9-2.9)	Hair color; # raised nevi; skin type; # of sunburns

Table 4. Association Between Indoor Tanning and Skin Cancer

Study, USPSTF quality	Design, Setting, Years	Population	Ever use (RR or OR [95% CI])*	Frequency of use (RR or OR [95% CI])*	Adjustments reported
Clough-Gorr 2008 ⁹² Fair	Case-control New Hampshire, US 1995-1998	Cases n=423 Controls n=678	Sunlamp use: 1.39 (1.00-1.96) Tanning bed use: 1.14 (0.80-1.61)	<i>Frequency of sunlamp use</i> <6 times: 1.29 (0.84-1.99) 6+ times: 1.54 (0.93-2.57) <i>Age at first sunlamp use</i> ≤20: 1.23 (0.81-1.88) >20: 1.71 (1.00-2.92) <i>Frequency of tanning bed use</i> <10 times: 1.05 (0.67-1.64) 10+ times: 1.25 (0.79-1.98) <i>Age at first tanning bed use</i> ≤20: 1.78 (0.76-4.15) >20: 1.08 (0.75-1.55)	Age; sex; family history of melanoma; hair color; freckles; sun sensitivity; total sun exposure hours

*Adjusted unless otherwise stated.

US=United States; N=sample size; CI=confidence interval; SCC=squamous cell carcinoma; RR=relative risk; BCC=basal cell carcinoma; OR=odds ratio

Table 5. Association Between Sunscreen Use and Skin Cancer

Study, USPSTF quality	Design, Setting, Years	Population	Ever use (RR or OR [95% CI])*	Frequency of use (RR or OR [95% CI])*	Adjustments reported
Squamous cell or basal cell carcinoma					
Green 1999 ⁵⁷ Green 1994 ⁵⁸ van der Pols 2006 ⁶⁰ Nambour Skin Cancer Prevention Trial Good for 4-yr f/u Fair for 8-yr f/u	RCT Queensland, Australia 1992 Up to 8-yr follow-up	n=1,621	<i>Regular sunscreen use (vs. usual sunscreen use)</i> <u>1993-1996</u> SCC: 0.88 (0.50-1.56) BCC: 1.03 (0.73-1.46) <u>1993-2004</u> SCC: 0.65 (0.45-0.94) BCC: 1.02 (0.78-1.35)	NR	NR
Grodstein 1995 ⁶⁷ Nurses' Health Study Good	Cohort US (11 states) 1982-1990 8-yr follow-up	n=107,900	<i># of persons who spent regular time outdoors (never use)</i> SCC: 0.9 (0.6-1.2)	NR	Age; smoking; region; natural hair color; reaction to sun; lifetime # of sunburns
Hunter 1990 ⁶⁸ Nurses' Health Study Fair	Analytic cohort US (11 states) 1982-1990 4-yr follow-up	n=73,366	<i># of persons who spent regular time outdoors (never use)</i> BCC: 0.70 (0.60-0.82)	NR	Age; time period; region; time spent outdoors in summer and sunscreen habit; hair color; childhood tendency to burn; lifetime # of severe and painful sunburns on face and arms
Kricker 1991 ⁶² Kricker 1995 ³⁶ Kricker 1995 ¹¹⁶ Fair	Case-control Western Australia 1987	BCC cases n=226 BCC controls n=1,021 (6 cases of SCC)	NR	<i>Use of SPF 10+ ≥half the time</i> 1-9 years: 1.92 (1.17-3.13) 10+ years: 1.25 (0.82-1.90)	Age; sex; ability to tan; site
Rosso 1999 ⁶⁴ Fair	Case-control Valais, Switzerland 1994-1996	Cases n=146 Controls n=144	<i>Ever use</i> SCC: 1.63 (0.41-6.53) BCC: 1.69 (1.14-2.05)	NR	Age; sex
Melanoma					
Cho 2005 ⁹³ Nurses' Health Study I & II, Health Professionals Follow-up Study Fair	Analytic cohort US (multistate) 1986 for NHS 1992 for HPS Up to 14-yr follow-up	n=178,155	NR	NR	NR
Fargnoli 2004 ⁷⁹ Fair	Case-control Central Italy 2000-2001	Cases n=100 Controls n=200	Ever use: 0.63 (0.25-1.63)	NR	Hair color; eye color; skin type for pigmentation factors

Table 5. Association Between Sunscreen Use and Skin Cancer

Study, USPSTF quality	Design, Setting, Years	Population	Ever use (RR or OR [95% CI])*	Frequency of use (RR or OR [95% CI])*	Adjustments reported
Holly 1995 ⁸⁰ Fair	Case-control San Francisco, CA 1981-1986	Cases (calc) n=452 Controls n=930	Sometimes use: 1.5 (1.1-2.2) Never use: 2.1 (1.5-3.0)	NR	History of sunburn ages ≤12 yrs; skin reaction after few days of sun exposure; hair color; # of large nevi; complexion; age; maternal ethnicity; history of skin cancer
Westerdahl 1994 ⁸⁶ Westerdahl 1994 ⁴⁰ Westerdahl 1995 ⁴¹ Fair	Case-control Sweden 1988-1990	Cases n=400 Controls n=640	Sometimes use: 1.3 (0.9-1.9) Almost always use: 1.8 (1.1-2.8)	NR	History of sunburns; history of frequent sunbathing during summer; outdoor employment during summer; host factors (raised nevi, hair color, eye color, freckling)
Westerdahl 2000 ⁸⁵ Westerdahl 2000 ⁴² Fair	Case-control Sweden 1995-1997	Cases n=558 Controls n=891	Sometimes use: 1.3 (0.9-1.9) Always initially, and sometimes use: 0.9 (0.6-1.5) Always use: 1.8 (1.1-2.9)	# yrs of regular sunscreen use 1-20: 4.3 (0.8-21.9) >20: 1.7 (0.5-5.6)	Hair color; history of sunburns; frequency of sunbathing during summer; duration of each sunbathing occasion

*Adjusted unless otherwise stated

US=United States; N=sample size; CI=confidence interval; SCC=squamous cell carcinoma; RR=relative risk; BCC=basal cell carcinoma; OR=odds ratio; NHS=Nurses' Health Study; NPS=Professionals Follow-up Study; NR=not reported

Table 6. Adverse Outcomes of Sun-Protective Behaviors

Study, Design, Quality	Setting (country), Population description	Study objective, Intervention or exposure	Measurement of adverse outcome
Decreased physical activity			
Milne 2007 ⁹⁴ Cluster CCT by school Fair	Australia N: 1615 children (33 schools) Age: 5-6 years at baseline Sex: NR Skin phenotype: NR	To determine if adherence to sun safety could have a detrimental effect on children's body mass index IG (high- and moderate-intensity): specially designed sun protection curriculum administered over 4 consecutive years beginning at age 6; curriculum integrated into a range of subjects, including physical education; children in high-intensity intervention group were sent program materials over summer vacation and offered low-cost sun-protective swimwear CG: standard Western Australian health education curriculum	Difference in z score* 4 years IG high-intensity: -0.08 (95% CI, -0.22 to 0.06) IG moderate-intensity: 0.01 (95% CI, -0.12 to 0.14) CG: reference 6 years IG high-intensity: -0.11 (95% CI, -0.27 to 0.05) IG moderate-intensity: 0.05 (95% CI, -0.09 to 0.20) CG: reference * adjusted for sex, ethnicity, parent education, z score at baseline Relative difference in total time spent outdoors* 4 years IG high-intensity: 0.90 (95% CI, 0.78 to 1.05) IG moderate-intensity: 1.0 (95% CI, 0.87 to 1.15) CG: reference 6 years IG high-intensity: 0.98 (95% CI, 0.83 to 1.15) IG moderate-intensity: 0.94 (95% CI, 0.81 to 1.09) CG: reference * adjusted for sex, ethnicity, parent education, tendency to burn, total time spent outdoors at baseline
Increased sun exposure (with sunscreen use)			
Autier 1999 ⁹⁵ RCT Good	France and Switzerland N: 87 Age: 18-24 yrs Sex: 41% male Skin phenotype: 2% skin type I 33% skin type II 65% skin type III 0% skin type IV	To determine if sunscreen use encourages longer sun exposure duration IG1: SPF 10 sunscreen IG2: SPF 30 sunscreen	Mean sun exposure (hours) per participant 2 months IG1: 58.2 (95% CI, 52.0 to 64.4) IG2: 72.6 (95% CI, 63.5 to 81.7); p=0.011 2 months, daily sun exposure IG1: 4.0 (95% CI, 3.3 to 4.7) IG2: 4.6 (95% CI, 3.9 to 5.3); p≤0.0001 2 months, daily outdoor activity IG1: 3.6 (95% CI, 2.9 to 4.3) IG2: 3.8 (95% CI, 3.0 to 4.6); p=0.62 2 months, daily sunbathing IG1: 2.6 (95% CI, 2.1 to 3.1) IG2: 3.1 (95% CI, 2.5 to 3.7); p=0.0013 # of sunburns or skin-reddening episodes IG1: 159 IG2: 159; p=0.99 # of sunburns IG1: 42 IG2: 34; p=0.90

Table 6. Adverse Outcomes of Sun-Protective Behaviors

Study, Design, Quality	Setting (country), Population description	Study objective, Intervention or exposure	Measurement of adverse outcome
Autier 2000 ⁹⁶ RCT Good	France and Belgium N: 62 randomized, 58 analyzed Age: 18-24 years Sex: 26% male Skin phenotype: 5% skin type I 53% skin type II 41% skin type III 0% skin type IV	To determine if sunscreen use encourages longer sun exposure duration IG1: SPF 10 sunscreen IG2: SPF 30 sunscreen	Median time spent (hours) per day sunbathing IG1: 2.4 IG2: 3.0 % change: +25%; p=0.054 Median UVB exposure (joules/m²) per day IG1: 841 IG2: 984 % change: +17%; p=0.15 Median UVA exposure (kjoules/m²) per day IG1: 136 IG2: 125 % change: -8%; p=0.50
Dupuy 2005 ⁹⁷ RCT Good	France N: 367 randomized, 359 analyzed Age: 39 years Sex: 18% male Skin phenotype: 35% fair complexion 15% neither fair nor dark 49% dark complexion	To determine if high-SPF sunscreen has an impact on sun-exposure behavior; to determine the impact of actual high-SPF protection and the impact of the impression of being well protected IG1: high protection label, SPF 40 sunscreen IG2: basic protection label, SPF 40 sunscreen CG: basic protection label, SPF 12 sunscreen	Mean total sun exposure (hours) per participant at 1 week IG1: 14.2 (SD, 7.6) IG2: 12.9 (SD,7.2) CG: 14.6 (SD,6.7) Label comparison (IG1 vs. IG2): p=0.13 SPF comparison (IG2 vs. CG): p=0.06 Proportion with sunburn at 1 week IG1: 0.15 IG2: 0.14 CG: 0.24 Label comparison (IG1 vs. IG2): p=0.80 SPF comparison (IG2 vs. CG): p=0.06 Label comparison (IG1 vs. IG2): OR, 0.91 (95% CI, 0.43 to 1.91) SPF comparison (IG2 vs. CG): OR, 1.96 (95% CI, 0.98 to 3.92)
Green 1999 ^{57,108} RCT Good	Australia N: 1621 Age: 49 years Sex: 44% male Skin phenotype: ~21% burn only ~68% burn/tan ~11% tan only	To investigate effectiveness of daily sunscreen application and dietary betacarotene supplement in reducing the incidence of basal cell and squamous cell carcinoma; secondary endpoint included sun exposure IG1: SPF 15 sunscreen plus betacarotene IG2: SPF 15 sunscreen and placebo tablet IG3: 30 mg betacarotene and placebo cream CG: Placebo cream and placebo tablet	Spent <50% of weekend outdoors in previous summer 4.5 years IG1 and IG2: 79.3% (549/692); p=NR IG3 and CG: 77.4% (535/691) Median ambient UV exposure from polysuphone badges (n=175) <i>Over summer (range)</i> IG1 and IG2: 2.8% (0-32.2); p=0.55 IG3 and CG: 3.5% (0-23.8) <i>Over winter</i> IG1 and IG2: 6.5% (0-36.2); p=0.36 IG3 and CG: 7.1% (1.0-35.8)

Table 6. Adverse Outcomes of Sun-Protective Behaviors

Study, Design, Quality	Setting (country), Population description	Study objective, Intervention or exposure	Measurement of adverse outcome
Gallagher 2002 ¹⁰⁹ RCT Fair	Canada N: 458 Age: 51% 6-7 yrs, 49% 9-10 yrs Sex: NR Skin reflectance: ~33% dark ~33% medium ~33% light	To determine whether use of broad-spectrum, high-SPF sunscreen attenuates development of nevi in white children; secondary endpoint included sun exposure IG: SPF 30 sunscreen plus advice CG: no advice, no placebo	Median UV exposure from 1993 to 1996 <i>Time spent outdoors</i> IG: 357.0; p=NR CG: 361.5 <i>Vacation sun exposure</i> IG: 962.5; p=NR CG: 962.5 <i>Total sunlight exposure for whole body, adjusted for clothing coverage</i> IG: 1252.2; p=NR CG: 1214.3
Bauer 2005 ¹¹⁰ Cluster RCT Fair	Germany N: 1887 Age: 4.3 years Sex: 51% male Skin phenotype: 10.1% skin type I	To determine if children receiving education or education and sunscreen develop less incident nevi; secondary endpoint included sun exposure and sun protection habits IG1: education and SPF 25 sunscreen IG2: education only CG: control	Sun exposure in 2001 and changes between 1998 and 2001 <i>Median time (weeks) on holiday in sunny climates</i> IG1: 4 (IQR, 2 to 7.5); p=0.021 IG2: 6 (IQR, 2 to 8) CG: 5 (IQR, 2 to 8) <i>Median difference in hours/day sun exposure during sunny holiday</i> IG1: 0 (IQR, -1 to 1); p=0.061 IG2: 0 (IQR, -1 to 1) CG: 0 (IQR, -1 to 1) <i>Mean difference in hours/day outdoors at home</i> IG1: 0.15 (SD, 1.12); p=0.353 IG2: 0.14 (SD, 1.13) CG: 0.24 (SD, 1.09)
Vitamin D deficiency			
Marks 1995 ⁹⁸ RCT Fair	Australia N: 153 randomized, 113 analyzed Age: 52% ages <70 years Sex: 41% male Skin phenotype: 27% burn 50% burn/tan 23% tan	To determine if regular use of sunscreen may put individuals at risk for vitamin D deficiency IG: SPF 17 sunscreen; participants were given specific instructions on application of sunscreen and were given other sun-protective behavior instructions CG: placebo cream, participants were given same instructions	Mean change in vitamin D levels at 7 months <i>25-hydroxyvitamin D (nmol/L)</i> IG: 11.8 (95% CI, 7.6 to 15.9); 21% change CG: 12.8 (95% CI, 8.4 to 17.1); 25% change p=0.75 <i>1,25-hydroxyvitamin D (nmol/L)</i> IG: 1.3 (95% CI, -2.3 to 4.9); 1% change CG: 10.8 (95% CI, 6.7 to 14.8); 14% change p=0.0009 Change in vitamin D levels at 7 months by age, sex, and skin type No statistically significant changes Also reported: "no person using sunscreen developed serum vitamin D levels below the reference range over the period of the study."

Table 6. Adverse Outcomes of Sun-Protective Behaviors

Study, Design, Quality	Setting (country), Population description	Study objective, Intervention or exposure	Measurement of adverse outcome																								
Brot 2001 ⁹⁹ Cohort, prospective Fair	Denmark N: 2016 Age: 45-58 years Sex: 0% male Skin phenotype: NR	To assess prevalence of vitamin D deficiency in perimenopausal women; to estimate relative influences of sun exposure and vitamin D intake on 25-hydroxyvitamin D concentration All participants were interviewed by two physicians to determine sun exposure (never, occasionally, regularly) and sunbed use (no, yes)	Prevalence of low vitamin D status during winter and spring <i>Mean 25-hydroxyvitamin D serum level (nmol/L)</i> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th colspan="2" style="text-align: center;"><u>Vitamin supplement</u></th> </tr> <tr> <th></th> <th style="text-align: center;">No</th> <th style="text-align: center;">Yes</th> </tr> </thead> <tbody> <tr> <td>Never</td> <td style="text-align: center;">36.5</td> <td style="text-align: center;">45.3</td> </tr> <tr> <td>Occasionally</td> <td style="text-align: center;">41.5</td> <td style="text-align: center;">49.3</td> </tr> <tr> <td>Regularly</td> <td style="text-align: center;">53.5</td> <td style="text-align: center;">62.3</td> </tr> </tbody> </table> <i>Percent of subgroup with low 25-hydroxyvitamin D status (≤25 nmol/L)</i> <table border="1" style="margin-left: auto; margin-right: auto;"> <tbody> <tr> <td>Never</td> <td style="text-align: center;">32.8</td> <td style="text-align: center;">12.9</td> </tr> <tr> <td>Occasionally</td> <td style="text-align: center;">17.6</td> <td style="text-align: center;">10.7</td> </tr> <tr> <td>Regularly</td> <td style="text-align: center;">9.8</td> <td style="text-align: center;">2.8</td> </tr> </tbody> </table>		<u>Vitamin supplement</u>			No	Yes	Never	36.5	45.3	Occasionally	41.5	49.3	Regularly	53.5	62.3	Never	32.8	12.9	Occasionally	17.6	10.7	Regularly	9.8	2.8
	<u>Vitamin supplement</u>																										
	No	Yes																									
Never	36.5	45.3																									
Occasionally	41.5	49.3																									
Regularly	53.5	62.3																									
Never	32.8	12.9																									
Occasionally	17.6	10.7																									
Regularly	9.8	2.8																									
Increased cancer risk (due to protective nature of vitamin D)																											
John 1999 ¹⁰⁰ Cohort, retrospective Fair	US N: 5009 analyzed Age: 25-74 years Sex: 0% male Skin phenotype: NR	To examine possible protective role of vitamin D (dietary or sun exposure) on breast cancer risk In-person interviews; medical exams to determine usual sunlight exposure, sun-induced skin damage, residential sunlight exposure, and dietary and supplemental vitamin D intake	Sun exposure and breast cancer risk <i>Recreational sun exposure (# cases)</i> Rare or never: 40 (age-adj RR, 1.0; mv-adj RR, 1.0) Occasional: 55 (age-adj RR, 0.70 [95% CI, 0.46-1.06]; mv-adj RR, 0.65 [95% CI, 0.43-0.98]) Frequent: 60 (age-adj RR, 0.70 [95% CI, 0.47-1.05]; mv-adj RR, 0.66 [95% CI, 0.44-0.99]) p=0.12 (trend=0.08) <i>Occupational sun exposure (# cases)</i> Rare or never: 81 (age-adj RR, 1.0; mv-adj RR, 1.0) Occasional: 44 (age-adj RR, 1.05 [95% CI, 0.73-1.51]; mv-adj RR, 1.06 [95% CI, 0.73-1.53]) Frequent: 29 (age-adj RR, 0.60 [95% CI, 0.39-0.91]; mv-adj RR, 0.64 [95% CI, 0.41-0.98]) p=0.03 (trend=0.07) <i>Combined recreational and occupational sun exposure (# cases)</i> Low: 32 (age-adj RR, 1.0; mv-adj RR, 1.0) Medium: 99 (age-adj RR, 0.67 [95% CI, 0.45-1.01]; mv-adj RR, 0.81 [95% CI, 0.56-1.17]) High: 23 (age-adj RR, 0.50 [95% CI, 0.29-0.86]; mv-adj RR, 0.67 [95% CI, 0.42-1.06]) p=0.01 (trend=0.06) <i>Sun exposure and dietary vitamin D (# cases)</i> Low sun + <200 IU: 71 (age-adj RR, 1.0; mv-adj RR, 1.0) Low sun + ≥200 IU: 18 (age-adj RR, 0.79 [95% CI, 0.57-1.11]; mv-adj RR, 0.75 [95% CI, 0.54-1.06]) High sun + <200 IU: 65 (age-adj RR, 0.78 [95% CI, 0.46-1.31]; mv-adj RR, 0.77 [95% CI, 0.46-1.29]) High sun + ≥200 IU: 22 (age-adj RR, 0.72 [95% CI, 0.45, 1.17]; mv-adj RR, 0.71 [95% CI, 0.44-1.14]) p=0.11 (trend=0.08) Sunlight exposure by region of residence (low, medium, or high solar radiation) <i>Combined recreational and occupational sun exposure (# cases)</i> <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th></th> <th style="text-align: center;">Low Solar</th> <th style="text-align: center;">Medium Solar</th> <th style="text-align: center;">High Solar</th> </tr> </thead> <tbody> <tr> <td>Low:</td> <td style="text-align: center;">15 (RR, 1.0)</td> <td style="text-align: center;">9 (RR, 1.0)</td> <td style="text-align: center;">8 (RR, 1.0)</td> </tr> <tr> <td>Med:</td> <td style="text-align: center;">44 (RR, 0.53 [0.29-0.97])</td> <td style="text-align: center;">34 (RR, 0.83 [0.39-1.76])</td> <td style="text-align: center;">19 (RR, 0.54 [0.23-1.25])</td> </tr> <tr> <td>High:</td> <td style="text-align: center;">9 (RR, 0.40 [0.17-0.94])</td> <td style="text-align: center;">10 (RR, 0.77 [0.31-1.93])</td> <td style="text-align: center;">4 (RR, 0.35 [0.10-1.20])</td> </tr> </tbody> </table> Multivariate-adjusted RR: adjusted for age, education, age at menarche, age at menopause, BMI, alcohol consumption, physical activity, and calcium		Low Solar	Medium Solar	High Solar	Low:	15 (RR, 1.0)	9 (RR, 1.0)	8 (RR, 1.0)	Med:	44 (RR, 0.53 [0.29-0.97])	34 (RR, 0.83 [0.39-1.76])	19 (RR, 0.54 [0.23-1.25])	High:	9 (RR, 0.40 [0.17-0.94])	10 (RR, 0.77 [0.31-1.93])	4 (RR, 0.35 [0.10-1.20])								
	Low Solar	Medium Solar	High Solar																								
Low:	15 (RR, 1.0)	9 (RR, 1.0)	8 (RR, 1.0)																								
Med:	44 (RR, 0.53 [0.29-0.97])	34 (RR, 0.83 [0.39-1.76])	19 (RR, 0.54 [0.23-1.25])																								
High:	9 (RR, 0.40 [0.17-0.94])	10 (RR, 0.77 [0.31-1.93])	4 (RR, 0.35 [0.10-1.20])																								

Table 6. Adverse Outcomes of Sun-Protective Behaviors

Study, Design, Quality	Setting (country), Population description	Study objective, Intervention or exposure	Measurement of adverse outcome																																																		
Kampman 2000 ¹⁰¹ Case-control Fair	US N: 1983 cases, 2400 controls Age: 65 years Sex: 54% male Skin phenotype: NR	To evaluate sources of inconsistency in the association between calcium and vitamin D (dietary or sun exposure) and colon cancer risk In-person interviews asking participants to recall behaviors 2 years before date of selection to determine dietary intake, supplement use, and sun exposure	<p>Association between sun exposure (per quintile) and colon cancer</p> <table border="1"> <thead> <tr> <th colspan="2"></th> <th colspan="3">Men</th> <th colspan="3">Women</th> </tr> <tr> <th></th> <th>Quintile</th> <th># Cases</th> <th>OR [95% CI]</th> <th>Quintile</th> <th># Cases</th> <th>OR [95% CI]</th> </tr> </thead> <tbody> <tr> <td>Low</td> <td>236</td> <td>260</td> <td>1.0 [N/A]</td> <td>196</td> <td>239</td> <td>1.0 [N/A]</td> </tr> <tr> <td>2</td> <td>224</td> <td>264</td> <td>1.0 [0.8-1.3]</td> <td>198</td> <td>203</td> <td>1.3 [1.0-1.7]</td> </tr> <tr> <td>3</td> <td>230</td> <td>252</td> <td>1.1 [0.8-1.4]</td> <td>155</td> <td>231</td> <td>0.9 [0.7-1.2]</td> </tr> <tr> <td>4</td> <td>211</td> <td>273</td> <td>0.9 [0.7-1.2]</td> <td>171</td> <td>216</td> <td>1.1 [0.8-1.5]</td> </tr> <tr> <td>High</td> <td>185</td> <td>235</td> <td>0.9 [0.7-1.1]</td> <td>160</td> <td>216</td> <td>1.0 [0.8-1.4]</td> </tr> </tbody> </table> <p>Multivariate-adjusted OR: adjusted for age, BMI, family history, aspirin or nonsteroidal anti-inflammatory drug use, energy intake, physical activity, fiber, and calcium</p>			Men			Women				Quintile	# Cases	OR [95% CI]	Quintile	# Cases	OR [95% CI]	Low	236	260	1.0 [N/A]	196	239	1.0 [N/A]	2	224	264	1.0 [0.8-1.3]	198	203	1.3 [1.0-1.7]	3	230	252	1.1 [0.8-1.4]	155	231	0.9 [0.7-1.2]	4	211	273	0.9 [0.7-1.2]	171	216	1.1 [0.8-1.5]	High	185	235	0.9 [0.7-1.1]	160	216	1.0 [0.8-1.4]
		Men			Women																																																
	Quintile	# Cases	OR [95% CI]	Quintile	# Cases	OR [95% CI]																																															
Low	236	260	1.0 [N/A]	196	239	1.0 [N/A]																																															
2	224	264	1.0 [0.8-1.3]	198	203	1.3 [1.0-1.7]																																															
3	230	252	1.1 [0.8-1.4]	155	231	0.9 [0.7-1.2]																																															
4	211	273	0.9 [0.7-1.2]	171	216	1.1 [0.8-1.5]																																															
High	185	235	0.9 [0.7-1.1]	160	216	1.0 [0.8-1.4]																																															
Hughes 2004 ¹⁰³ Hughes 2004 ¹⁰² Case-control Fair	Australia N: 704 cases, 694 controls Age: 73% <50 years Sex: 54% male Skin phenotype: 27% cases, 29% controls have ability to deeply tan 44% cases, 42% controls have ability to moderately tan 21% cases, 42% controls have ability to mildly tan 8% cases, 6% controls have no ability to tan	To determine if high levels of sun exposure are associated with increased risk for nonHodgkin lymphoma Brief paper questionnaire and telephone interview to determine sun exposure; three measures of ambient solar irradiance were assigned to each residential location for each subject using latitude/longitude coordinates; socioeconomic status assessed using census data	<p>Sun exposure (years) and nonHodgkin lymphoma risk (per quartile)</p> <p><i>During the past decade</i></p> <p>Lowest: OR, 1.0 25-50%: OR, 0.72 (95% CI, 0.53-0.98) 50-75%: OR, 0.66 (95% CI, 0.48-0.91) Highest: OR, 0.65 (95% CI, 0.46-0.91) p=0.01</p> <p><i>Lifetime occupational sun exposure</i></p> <p>Lowest: OR, 1.0 25-50%: OR, 1.03 (95% CI, 0.76-1.40) 50-75%: OR, 1.04 (95% CI, 0.76-1.43) Highest: OR, 1.21 (95% CI, 0.87-1.69) p=0.30</p> <p>Vacation sun exposure (years) and nonHodgkin lymphoma risk</p> <p><i>During the past decade</i></p> <p>Lowest: OR, 1.0 25-50%: OR, 0.98 (95% CI, 0.72-1.32) 50-75%: OR, 0.82 (95% CI, 0.60-1.12) Highest: OR, 0.60 (95% CI, 0.43-0.85) p=0.003</p> <p>Multivariate-adjusted OR: adjusted for age, sex, state, ethnicity, skin color, and ability to tan</p>																																																		

Table 6. Adverse Outcomes of Sun-Protective Behaviors

Study, Design, Quality	Setting (country), Population description	Study objective, Intervention or exposure	Measurement of adverse outcome																																																																																																																																																																																		
<p>Smedby 2005¹⁰⁴</p> <p>Case-control</p> <p>Fair</p>	<p>Denmark and Sweden</p> <p>N: 3740 cases, 3187 controls</p> <p>Age: median 59 years</p> <p>Sex: 56% male</p> <p>Skin phenotype: 17% cases, 15% controls skin type I 20% cases, 25% controls skin type II 28% cases, 31% controls skin type III 32% cases, 29% controls skin type IV</p>	<p>To determine if UV exposure (sun and sunbeds) is associated with increased lymphoma risk</p> <p>Telephone interview to determine host factors and exposure (sun and sunbed/lamps), as well as self-reported skin cancer</p>	<p>Sun exposure and lymphoma risk</p> <table border="1"> <thead> <tr> <th></th> <th># controls</th> <th>nonHodgkin lymphoma (OR [95% CI])</th> <th>Hodgkin lymphoma (OR [95% CI])</th> </tr> </thead> <tbody> <tr> <td colspan="4"><i>Sunbathing in past 5-10 years</i></td> </tr> <tr> <td>Never</td> <td>799</td> <td>946 (1.0 [N/A])</td> <td>122 (1.0 [N/A])</td> </tr> <tr> <td>≤Once/wk</td> <td>1013</td> <td>938 (0.9 [0.7-1.0])</td> <td>236 (0.8 [0.6-1.0])</td> </tr> <tr> <td>2 to 3 times/wk</td> <td>666</td> <td>555 (0.8 [0.7-0.9])</td> <td>141 (0.7 [0.5-1.0])</td> </tr> <tr> <td>≥4 times/wk</td> <td>666</td> <td>581 (0.7 [0.6-0.9])</td> <td>118 (0.7 [0.5-1.0])</td> </tr> <tr> <td colspan="4">p<0.001 (trend=0.06)</td> </tr> <tr> <td colspan="4"><i>Sunbathing at age 20 years</i></td> </tr> <tr> <td>Never</td> <td>434</td> <td>568 (1.0 [N/A])</td> <td>49 (1.0 [N/A])</td> </tr> <tr> <td>≤Once/wk</td> <td>931</td> <td>918 (0.8 [0.7-0.9])</td> <td>84 (0.8 [0.5-1.2])</td> </tr> <tr> <td>2 to 3 times/wk</td> <td>674</td> <td>635 (0.7 [0.6-0.9])</td> <td>50 (0.6 [0.4-1.0])</td> </tr> <tr> <td>≥4 times/wk</td> <td>653</td> <td>642 (0.7 [0.6-0.9])</td> <td>73 (0.9 [0.6-1.4])</td> </tr> <tr> <td colspan="4">p=0.001 (trend=0.84)</td> </tr> <tr> <td colspan="4"><i>Sun vacations abroad</i></td> </tr> <tr> <td>Never</td> <td>830</td> <td>910 (1.0 [N/A])</td> <td>146 (1.0 [N/A])</td> </tr> <tr> <td>1 to 5 times</td> <td>1002</td> <td>1000 (1.0 [0.9-1.1])</td> <td>234 (0.8 [0.6-1.0])</td> </tr> <tr> <td>6 to 20 times</td> <td>919</td> <td>822 (0.9 [0.8-1.0])</td> <td>177 (0.7 [0.5-0.9])</td> </tr> <tr> <td>>20 times</td> <td>410</td> <td>305 (0.7 [0.6-0.8])</td> <td>60 (0.8 [0.6-1.2])</td> </tr> <tr> <td colspan="4">p<0.001 (trend=0.06)</td> </tr> <tr> <td colspan="4"><i>Sunbed/sunlamp use</i></td> </tr> <tr> <td>Never</td> <td>1254</td> <td>1317 (1.0 [N/A])</td> <td>203 (1.0 [N/A])</td> </tr> <tr> <td><10 times</td> <td>742</td> <td>790 (1.0 [0.9-1.2])</td> <td>134 (0.8 [0.6-1.0])</td> </tr> <tr> <td>10 to 49 times</td> <td>765</td> <td>643 (0.9 [0.8-1.0])</td> <td>161 (0.7 [0.5-0.9])</td> </tr> <tr> <td>≥50 times</td> <td>377</td> <td>270 (0.8 [0.7-1.0])</td> <td>116 (0.7 [0.5-0.9])</td> </tr> <tr> <td colspan="4">p=0.01 (trend=0.004)</td> </tr> <tr> <td colspan="4">History of sun burn and lymphoma risk</td> </tr> <tr> <td colspan="4"><i>Sunburn in past 5-10 years</i></td> </tr> <tr> <td>Never</td> <td>2001</td> <td>2121 (1.0 [N/A])</td> <td>308 (1.0 [N/A])</td> </tr> <tr> <td><1/year</td> <td>702</td> <td>590 (0.9 [0.8-1.0])</td> <td>186 (0.8 [0.6-1.0])</td> </tr> <tr> <td>1/year</td> <td>319</td> <td>224 (0.8 [0.6-0.9])</td> <td>78 (0.7 [0.5-0.9])</td> </tr> <tr> <td>≥2/year</td> <td>134</td> <td>96 (0.8 [0.6-1.1])</td> <td>34 (0.7 [0.4-1.0])</td> </tr> <tr> <td colspan="4">p=0.003 (trend=0.006)</td> </tr> <tr> <td colspan="4"><i>Sunburn at age 20 years</i></td> </tr> <tr> <td>Never</td> <td>1077</td> <td>1208 (1.0 [N/A])</td> <td>108 (1.0 [N/A])</td> </tr> <tr> <td><1/year</td> <td>804</td> <td>929 (1.0 [0.9-1.2])</td> <td>79 (0.9 [0.7-1.3])</td> </tr> <tr> <td>1/year</td> <td>485</td> <td>420 (0.8 [0.7-0.9])</td> <td>38 (0.8 [0.5-1.1])</td> </tr> <tr> <td>≥2/year</td> <td>305</td> <td>211 (0.6 [0.5-0.8])</td> <td>27 (0.8 [0.5-1.3])</td> </tr> <tr> <td colspan="4">p<0.001 (trend=0.14)</td> </tr> <tr> <td colspan="4"><i>Sunburn in childhood</i></td> </tr> <tr> <td>Never</td> <td>1570</td> <td>1747 (1.0 [N/A])</td> <td>283 (1.0 [N/A])</td> </tr> <tr> <td><1/year</td> <td>546</td> <td>461 (0.8 [0.7-1.0])</td> <td>156 (0.9 [0.7-1.2])</td> </tr> <tr> <td>1/year</td> <td>358</td> <td>284 (0.8 [0.6-0.9])</td> <td>79 (0.9 [0.7-1.3])</td> </tr> <tr> <td>≥2/year</td> <td>219</td> <td>172 (0.7 [0.6-0.9])</td> <td>39 (0.7 [0.5-1.1])</td> </tr> <tr> <td colspan="4">p<0.001 (trend=0.14)</td> </tr> </tbody> </table> <p>Multivariate-adjusted OR: adjusted for age, sex, country, and skin type</p>				# controls	nonHodgkin lymphoma (OR [95% CI])	Hodgkin lymphoma (OR [95% CI])	<i>Sunbathing in past 5-10 years</i>				Never	799	946 (1.0 [N/A])	122 (1.0 [N/A])	≤Once/wk	1013	938 (0.9 [0.7-1.0])	236 (0.8 [0.6-1.0])	2 to 3 times/wk	666	555 (0.8 [0.7-0.9])	141 (0.7 [0.5-1.0])	≥4 times/wk	666	581 (0.7 [0.6-0.9])	118 (0.7 [0.5-1.0])	p<0.001 (trend=0.06)				<i>Sunbathing at age 20 years</i>				Never	434	568 (1.0 [N/A])	49 (1.0 [N/A])	≤Once/wk	931	918 (0.8 [0.7-0.9])	84 (0.8 [0.5-1.2])	2 to 3 times/wk	674	635 (0.7 [0.6-0.9])	50 (0.6 [0.4-1.0])	≥4 times/wk	653	642 (0.7 [0.6-0.9])	73 (0.9 [0.6-1.4])	p=0.001 (trend=0.84)				<i>Sun vacations abroad</i>				Never	830	910 (1.0 [N/A])	146 (1.0 [N/A])	1 to 5 times	1002	1000 (1.0 [0.9-1.1])	234 (0.8 [0.6-1.0])	6 to 20 times	919	822 (0.9 [0.8-1.0])	177 (0.7 [0.5-0.9])	>20 times	410	305 (0.7 [0.6-0.8])	60 (0.8 [0.6-1.2])	p<0.001 (trend=0.06)				<i>Sunbed/sunlamp use</i>				Never	1254	1317 (1.0 [N/A])	203 (1.0 [N/A])	<10 times	742	790 (1.0 [0.9-1.2])	134 (0.8 [0.6-1.0])	10 to 49 times	765	643 (0.9 [0.8-1.0])	161 (0.7 [0.5-0.9])	≥50 times	377	270 (0.8 [0.7-1.0])	116 (0.7 [0.5-0.9])	p=0.01 (trend=0.004)				History of sun burn and lymphoma risk				<i>Sunburn in past 5-10 years</i>				Never	2001	2121 (1.0 [N/A])	308 (1.0 [N/A])	<1/year	702	590 (0.9 [0.8-1.0])	186 (0.8 [0.6-1.0])	1/year	319	224 (0.8 [0.6-0.9])	78 (0.7 [0.5-0.9])	≥2/year	134	96 (0.8 [0.6-1.1])	34 (0.7 [0.4-1.0])	p=0.003 (trend=0.006)				<i>Sunburn at age 20 years</i>				Never	1077	1208 (1.0 [N/A])	108 (1.0 [N/A])	<1/year	804	929 (1.0 [0.9-1.2])	79 (0.9 [0.7-1.3])	1/year	485	420 (0.8 [0.7-0.9])	38 (0.8 [0.5-1.1])	≥2/year	305	211 (0.6 [0.5-0.8])	27 (0.8 [0.5-1.3])	p<0.001 (trend=0.14)				<i>Sunburn in childhood</i>				Never	1570	1747 (1.0 [N/A])	283 (1.0 [N/A])	<1/year	546	461 (0.8 [0.7-1.0])	156 (0.9 [0.7-1.2])	1/year	358	284 (0.8 [0.6-0.9])	79 (0.9 [0.7-1.3])	≥2/year	219	172 (0.7 [0.6-0.9])	39 (0.7 [0.5-1.1])	p<0.001 (trend=0.14)			
	# controls	nonHodgkin lymphoma (OR [95% CI])	Hodgkin lymphoma (OR [95% CI])																																																																																																																																																																																		
<i>Sunbathing in past 5-10 years</i>																																																																																																																																																																																					
Never	799	946 (1.0 [N/A])	122 (1.0 [N/A])																																																																																																																																																																																		
≤Once/wk	1013	938 (0.9 [0.7-1.0])	236 (0.8 [0.6-1.0])																																																																																																																																																																																		
2 to 3 times/wk	666	555 (0.8 [0.7-0.9])	141 (0.7 [0.5-1.0])																																																																																																																																																																																		
≥4 times/wk	666	581 (0.7 [0.6-0.9])	118 (0.7 [0.5-1.0])																																																																																																																																																																																		
p<0.001 (trend=0.06)																																																																																																																																																																																					
<i>Sunbathing at age 20 years</i>																																																																																																																																																																																					
Never	434	568 (1.0 [N/A])	49 (1.0 [N/A])																																																																																																																																																																																		
≤Once/wk	931	918 (0.8 [0.7-0.9])	84 (0.8 [0.5-1.2])																																																																																																																																																																																		
2 to 3 times/wk	674	635 (0.7 [0.6-0.9])	50 (0.6 [0.4-1.0])																																																																																																																																																																																		
≥4 times/wk	653	642 (0.7 [0.6-0.9])	73 (0.9 [0.6-1.4])																																																																																																																																																																																		
p=0.001 (trend=0.84)																																																																																																																																																																																					
<i>Sun vacations abroad</i>																																																																																																																																																																																					
Never	830	910 (1.0 [N/A])	146 (1.0 [N/A])																																																																																																																																																																																		
1 to 5 times	1002	1000 (1.0 [0.9-1.1])	234 (0.8 [0.6-1.0])																																																																																																																																																																																		
6 to 20 times	919	822 (0.9 [0.8-1.0])	177 (0.7 [0.5-0.9])																																																																																																																																																																																		
>20 times	410	305 (0.7 [0.6-0.8])	60 (0.8 [0.6-1.2])																																																																																																																																																																																		
p<0.001 (trend=0.06)																																																																																																																																																																																					
<i>Sunbed/sunlamp use</i>																																																																																																																																																																																					
Never	1254	1317 (1.0 [N/A])	203 (1.0 [N/A])																																																																																																																																																																																		
<10 times	742	790 (1.0 [0.9-1.2])	134 (0.8 [0.6-1.0])																																																																																																																																																																																		
10 to 49 times	765	643 (0.9 [0.8-1.0])	161 (0.7 [0.5-0.9])																																																																																																																																																																																		
≥50 times	377	270 (0.8 [0.7-1.0])	116 (0.7 [0.5-0.9])																																																																																																																																																																																		
p=0.01 (trend=0.004)																																																																																																																																																																																					
History of sun burn and lymphoma risk																																																																																																																																																																																					
<i>Sunburn in past 5-10 years</i>																																																																																																																																																																																					
Never	2001	2121 (1.0 [N/A])	308 (1.0 [N/A])																																																																																																																																																																																		
<1/year	702	590 (0.9 [0.8-1.0])	186 (0.8 [0.6-1.0])																																																																																																																																																																																		
1/year	319	224 (0.8 [0.6-0.9])	78 (0.7 [0.5-0.9])																																																																																																																																																																																		
≥2/year	134	96 (0.8 [0.6-1.1])	34 (0.7 [0.4-1.0])																																																																																																																																																																																		
p=0.003 (trend=0.006)																																																																																																																																																																																					
<i>Sunburn at age 20 years</i>																																																																																																																																																																																					
Never	1077	1208 (1.0 [N/A])	108 (1.0 [N/A])																																																																																																																																																																																		
<1/year	804	929 (1.0 [0.9-1.2])	79 (0.9 [0.7-1.3])																																																																																																																																																																																		
1/year	485	420 (0.8 [0.7-0.9])	38 (0.8 [0.5-1.1])																																																																																																																																																																																		
≥2/year	305	211 (0.6 [0.5-0.8])	27 (0.8 [0.5-1.3])																																																																																																																																																																																		
p<0.001 (trend=0.14)																																																																																																																																																																																					
<i>Sunburn in childhood</i>																																																																																																																																																																																					
Never	1570	1747 (1.0 [N/A])	283 (1.0 [N/A])																																																																																																																																																																																		
<1/year	546	461 (0.8 [0.7-1.0])	156 (0.9 [0.7-1.2])																																																																																																																																																																																		
1/year	358	284 (0.8 [0.6-0.9])	79 (0.9 [0.7-1.3])																																																																																																																																																																																		
≥2/year	219	172 (0.7 [0.6-0.9])	39 (0.7 [0.5-1.1])																																																																																																																																																																																		
p<0.001 (trend=0.14)																																																																																																																																																																																					

Table 6. Adverse Outcomes of Sun-Protective Behaviors

Study, Design, Quality	Setting (country), Population description	Study objective, Intervention or exposure	Measurement of adverse outcome																																																																																																																																																				
John 2005 ¹⁰⁵ Case-control Fair	US N: 450 cases, 455 controls Age: median 65 years Sex: 100% male Skin phenotype: NR	To determine if sun exposure is associated with increased risk for advanced prostate cancer In-person interviews and structured questionnaires; exam including skin pigmentation measurement with portable reflectometer and DNA sample (blood or mouthwash); and solar radiation level by state of residence, as assessed by National Weather Service stations	<p>Sun exposure and risk for advanced prostate cancer</p> <table border="1"> <thead> <tr> <th></th> <th># cases</th> <th># controls</th> <th>age-adj OR (95% CI)</th> <th>mv-adj OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td colspan="5"><i>Lifetime outdoor activities (hours/week)</i></td> </tr> <tr> <td><2.7</td> <td>85</td> <td>91</td> <td>1.0 (N/A)</td> <td>1.0 (N/A)</td> </tr> <tr> <td>2.7-5.6</td> <td>99</td> <td>91</td> <td>1.16 (0.77-1.75)</td> <td>1.15 (0.76-1.73)</td> </tr> <tr> <td>5.7-10.4</td> <td>92</td> <td>91</td> <td>1.08 (0.72-1.64)</td> <td>1.09 (0.72-1.65)</td> </tr> <tr> <td>10.5-19.8</td> <td>94</td> <td>91</td> <td>1.11 (0.73-1.67)</td> <td>1.10 (0.73-1.67)</td> </tr> <tr> <td>≥19.9</td> <td>80</td> <td>91</td> <td>0.94 (0.62-1.44)</td> <td>0.95 (0.62-1.45)</td> </tr> <tr> <td colspan="5">p=0.8</td> </tr> <tr> <td colspan="5"><i>Lifetime outdoor jobs (hours/week)</i></td> </tr> <tr> <td>0</td> <td>123</td> <td>120</td> <td>1.0 (N/A)</td> <td>1.0 (N/A)</td> </tr> <tr> <td><1.4</td> <td>84</td> <td>84</td> <td>0.99 (0.67-1.47)</td> <td>0.96 (0.65-1.43)</td> </tr> <tr> <td>1.4-5.6</td> <td>100</td> <td>83</td> <td>1.19 (0.81-1.75)</td> <td>1.20 (0.81-1.77)</td> </tr> <tr> <td>5.7-14.7</td> <td>81</td> <td>84</td> <td>0.94 (0.63-1.40)</td> <td>0.95 (0.64-1.41)</td> </tr> <tr> <td>≥14.8</td> <td>62</td> <td>84</td> <td>0.73 (0.48-1.10)</td> <td>0.73 (0.48-1.11)</td> </tr> <tr> <td colspan="5">p=0.3</td> </tr> <tr> <td colspan="5"><i>Facultative pigmentation</i></td> </tr> <tr> <td>Light</td> <td>100</td> <td>90</td> <td>1.0 (N/A)</td> <td>1.0 (N/A)</td> </tr> <tr> <td>2</td> <td>107</td> <td>90</td> <td>1.08 (0.73-1.61)</td> <td>1.08 (0.73-1.62)</td> </tr> <tr> <td>3</td> <td>86</td> <td>91</td> <td>0.85 (0.56-.28)</td> <td>0.83 (0.55-1.26)</td> </tr> <tr> <td>4</td> <td>86</td> <td>91</td> <td>0.85 (0.56-1.28)</td> <td>0.83 (0.55-1.26)</td> </tr> <tr> <td>Dark</td> <td>68</td> <td>90</td> <td>0.68 (0.44-1.03)</td> <td>0.66 (0.43-1.01)</td> </tr> <tr> <td colspan="5">p=0.03</td> </tr> <tr> <td colspan="5"><i>Sun exposure index</i></td> </tr> <tr> <td>Low</td> <td>106</td> <td>89</td> <td>1.0 (N/A)</td> <td>1.0 (N/A)</td> </tr> <tr> <td>2</td> <td>93</td> <td>90</td> <td>0.85 (0.57-1.28)</td> <td>0.87 (0.58-1.30)</td> </tr> <tr> <td>3</td> <td>89</td> <td>92</td> <td>0.81 (0.54-1.21)</td> <td>0.80 (0.53-1.20)</td> </tr> <tr> <td>4</td> <td>103</td> <td>91</td> <td>0.94 (0.63-1.40)</td> <td>0.95 (0.64-1.42)</td> </tr> <tr> <td>High</td> <td>56</td> <td>90</td> <td>0.52 (0.33-0.80)</td> <td>0.51 (0.33-0.80)</td> </tr> <tr> <td colspan="5">p=0.02</td> </tr> </tbody> </table> <p>Multivariate-adjusted OR: adjusted for age, family history of prostate cancer, +/- month of pigmentation measurements</p>					# cases	# controls	age-adj OR (95% CI)	mv-adj OR (95% CI)	<i>Lifetime outdoor activities (hours/week)</i>					<2.7	85	91	1.0 (N/A)	1.0 (N/A)	2.7-5.6	99	91	1.16 (0.77-1.75)	1.15 (0.76-1.73)	5.7-10.4	92	91	1.08 (0.72-1.64)	1.09 (0.72-1.65)	10.5-19.8	94	91	1.11 (0.73-1.67)	1.10 (0.73-1.67)	≥19.9	80	91	0.94 (0.62-1.44)	0.95 (0.62-1.45)	p=0.8					<i>Lifetime outdoor jobs (hours/week)</i>					0	123	120	1.0 (N/A)	1.0 (N/A)	<1.4	84	84	0.99 (0.67-1.47)	0.96 (0.65-1.43)	1.4-5.6	100	83	1.19 (0.81-1.75)	1.20 (0.81-1.77)	5.7-14.7	81	84	0.94 (0.63-1.40)	0.95 (0.64-1.41)	≥14.8	62	84	0.73 (0.48-1.10)	0.73 (0.48-1.11)	p=0.3					<i>Facultative pigmentation</i>					Light	100	90	1.0 (N/A)	1.0 (N/A)	2	107	90	1.08 (0.73-1.61)	1.08 (0.73-1.62)	3	86	91	0.85 (0.56-.28)	0.83 (0.55-1.26)	4	86	91	0.85 (0.56-1.28)	0.83 (0.55-1.26)	Dark	68	90	0.68 (0.44-1.03)	0.66 (0.43-1.01)	p=0.03					<i>Sun exposure index</i>					Low	106	89	1.0 (N/A)	1.0 (N/A)	2	93	90	0.85 (0.57-1.28)	0.87 (0.58-1.30)	3	89	92	0.81 (0.54-1.21)	0.80 (0.53-1.20)	4	103	91	0.94 (0.63-1.40)	0.95 (0.64-1.42)	High	56	90	0.52 (0.33-0.80)	0.51 (0.33-0.80)	p=0.02				
	# cases	# controls	age-adj OR (95% CI)	mv-adj OR (95% CI)																																																																																																																																																			
<i>Lifetime outdoor activities (hours/week)</i>																																																																																																																																																							
<2.7	85	91	1.0 (N/A)	1.0 (N/A)																																																																																																																																																			
2.7-5.6	99	91	1.16 (0.77-1.75)	1.15 (0.76-1.73)																																																																																																																																																			
5.7-10.4	92	91	1.08 (0.72-1.64)	1.09 (0.72-1.65)																																																																																																																																																			
10.5-19.8	94	91	1.11 (0.73-1.67)	1.10 (0.73-1.67)																																																																																																																																																			
≥19.9	80	91	0.94 (0.62-1.44)	0.95 (0.62-1.45)																																																																																																																																																			
p=0.8																																																																																																																																																							
<i>Lifetime outdoor jobs (hours/week)</i>																																																																																																																																																							
0	123	120	1.0 (N/A)	1.0 (N/A)																																																																																																																																																			
<1.4	84	84	0.99 (0.67-1.47)	0.96 (0.65-1.43)																																																																																																																																																			
1.4-5.6	100	83	1.19 (0.81-1.75)	1.20 (0.81-1.77)																																																																																																																																																			
5.7-14.7	81	84	0.94 (0.63-1.40)	0.95 (0.64-1.41)																																																																																																																																																			
≥14.8	62	84	0.73 (0.48-1.10)	0.73 (0.48-1.11)																																																																																																																																																			
p=0.3																																																																																																																																																							
<i>Facultative pigmentation</i>																																																																																																																																																							
Light	100	90	1.0 (N/A)	1.0 (N/A)																																																																																																																																																			
2	107	90	1.08 (0.73-1.61)	1.08 (0.73-1.62)																																																																																																																																																			
3	86	91	0.85 (0.56-.28)	0.83 (0.55-1.26)																																																																																																																																																			
4	86	91	0.85 (0.56-1.28)	0.83 (0.55-1.26)																																																																																																																																																			
Dark	68	90	0.68 (0.44-1.03)	0.66 (0.43-1.01)																																																																																																																																																			
p=0.03																																																																																																																																																							
<i>Sun exposure index</i>																																																																																																																																																							
Low	106	89	1.0 (N/A)	1.0 (N/A)																																																																																																																																																			
2	93	90	0.85 (0.57-1.28)	0.87 (0.58-1.30)																																																																																																																																																			
3	89	92	0.81 (0.54-1.21)	0.80 (0.53-1.20)																																																																																																																																																			
4	103	91	0.94 (0.63-1.40)	0.95 (0.64-1.42)																																																																																																																																																			
High	56	90	0.52 (0.33-0.80)	0.51 (0.33-0.80)																																																																																																																																																			
p=0.02																																																																																																																																																							

Table 6. Adverse Outcomes of Sun-Protective Behaviors

Study, Design, Quality	Setting (country), Population description	Study objective, Intervention or exposure	Measurement of adverse outcome																																																																																																																																																				
Hartge 2006 ¹⁰⁶ Case-control Fair	US N: 551 cases, 462 controls Age: 35% <55 years Sex: 53% male Skin phenotype: 5% cases, 4% controls dark 56% cases, 55% controls medium 39% cases, 41% controls light	To determine if UV exposure is associated with risk for nonHodgkin lymphoma In-person interviews plus mailed questionnaire to determine demographic, diet, and sun exposure history; measurements of solar radiation obtained from Robertson-Berger meters, located in many states	<p>Sun exposure and risk for nonHodgkin lymphoma</p> <table border="1"> <thead> <tr> <th></th> <th># cases</th> <th># controls</th> <th>OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td colspan="4"><i>Exposure to midday sun (hours) in last 10 years</i></td> </tr> <tr> <td><7</td> <td>216</td> <td>159</td> <td>1.0 (N/A)</td> </tr> <tr> <td><14</td> <td>145</td> <td>126</td> <td>0.85 (0.62-1.18)</td> </tr> <tr> <td><28</td> <td>131</td> <td>123</td> <td>0.75 (0.54-1.05)</td> </tr> <tr> <td>≥28</td> <td>59</td> <td>51</td> <td>0.73 (0.46-1.15)</td> </tr> <tr> <td colspan="4">p=0.07</td> </tr> <tr> <td colspan="4"><i>Exposure to midday sun (hours) during teen years</i></td> </tr> <tr> <td><7</td> <td>62</td> <td>46</td> <td>1.0 (N/A)</td> </tr> <tr> <td><14</td> <td>89</td> <td>68</td> <td>0.97 (0.59-1.61)</td> </tr> <tr> <td><28</td> <td>185</td> <td>155</td> <td>0.81 (0.52-1.27)</td> </tr> <tr> <td>≥28</td> <td>211</td> <td>187</td> <td>0.75 (0.48-1.18)</td> </tr> <tr> <td colspan="4">p=0.12</td> </tr> <tr> <td colspan="4"><i>Exposure to midday sun (hours) during 20s</i></td> </tr> <tr> <td><7</td> <td>143</td> <td>107</td> <td>1.0 (N/A)</td> </tr> <tr> <td><14</td> <td>143</td> <td>124</td> <td>0.86 (0.60-1.22)</td> </tr> <tr> <td><28</td> <td>156</td> <td>132</td> <td>0.83 (0.58-1.18)</td> </tr> <tr> <td>≥28</td> <td>105</td> <td>94</td> <td>0.75 (0.50-1.11)</td> </tr> <tr> <td colspan="4">p=0.15</td> </tr> <tr> <td colspan="4"><i>Exposure to midday sun during 30s</i></td> </tr> <tr> <td><7</td> <td>183</td> <td>137</td> <td>1.0 (N/A)</td> </tr> <tr> <td><14</td> <td>135</td> <td>135</td> <td>0.75 (0.54-1.04)</td> </tr> <tr> <td><28</td> <td>145</td> <td>112</td> <td>0.95 (0.68-1.33)</td> </tr> <tr> <td>≥28</td> <td>68</td> <td>66</td> <td>0.78 (0.50-1.19)</td> </tr> <tr> <td colspan="4">p=0.44</td> </tr> <tr> <td colspan="4"><i>Sunlamp or sunbed use</i></td> </tr> <tr> <td>Never</td> <td>401</td> <td>338</td> <td>1.0 (N/A)</td> </tr> <tr> <td><5 times</td> <td>32</td> <td>33</td> <td>0.78 (0.46-1.32)</td> </tr> <tr> <td>5-9 times</td> <td>32</td> <td>25</td> <td>0.90 (0.52-1.58)</td> </tr> <tr> <td>≥10 times</td> <td>84</td> <td>66</td> <td>0.90 (0.61-1.30)</td> </tr> <tr> <td colspan="4">p=0.49</td> </tr> <tr> <td colspan="4"><i>History of blistering sunburns</i></td> </tr> <tr> <td>Never</td> <td>224</td> <td>177</td> <td>1.0 (N/A)</td> </tr> <tr> <td>Once</td> <td>117</td> <td>103</td> <td>0.87 (0.62-1.23)</td> </tr> <tr> <td>2-4 times</td> <td>114</td> <td>84</td> <td>1.02 (0.72-1.46)</td> </tr> <tr> <td>≥5 times</td> <td>92</td> <td>96</td> <td>0.68 (0.47-0.97)</td> </tr> <tr> <td colspan="4">p=0.10</td> </tr> </tbody> </table> <p>Multivariate-adjusted OR: NR</p>		# cases	# controls	OR (95% CI)	<i>Exposure to midday sun (hours) in last 10 years</i>				<7	216	159	1.0 (N/A)	<14	145	126	0.85 (0.62-1.18)	<28	131	123	0.75 (0.54-1.05)	≥28	59	51	0.73 (0.46-1.15)	p=0.07				<i>Exposure to midday sun (hours) during teen years</i>				<7	62	46	1.0 (N/A)	<14	89	68	0.97 (0.59-1.61)	<28	185	155	0.81 (0.52-1.27)	≥28	211	187	0.75 (0.48-1.18)	p=0.12				<i>Exposure to midday sun (hours) during 20s</i>				<7	143	107	1.0 (N/A)	<14	143	124	0.86 (0.60-1.22)	<28	156	132	0.83 (0.58-1.18)	≥28	105	94	0.75 (0.50-1.11)	p=0.15				<i>Exposure to midday sun during 30s</i>				<7	183	137	1.0 (N/A)	<14	135	135	0.75 (0.54-1.04)	<28	145	112	0.95 (0.68-1.33)	≥28	68	66	0.78 (0.50-1.19)	p=0.44				<i>Sunlamp or sunbed use</i>				Never	401	338	1.0 (N/A)	<5 times	32	33	0.78 (0.46-1.32)	5-9 times	32	25	0.90 (0.52-1.58)	≥10 times	84	66	0.90 (0.61-1.30)	p=0.49				<i>History of blistering sunburns</i>				Never	224	177	1.0 (N/A)	Once	117	103	0.87 (0.62-1.23)	2-4 times	114	84	1.02 (0.72-1.46)	≥5 times	92	96	0.68 (0.47-0.97)	p=0.10			
	# cases	# controls	OR (95% CI)																																																																																																																																																				
<i>Exposure to midday sun (hours) in last 10 years</i>																																																																																																																																																							
<7	216	159	1.0 (N/A)																																																																																																																																																				
<14	145	126	0.85 (0.62-1.18)																																																																																																																																																				
<28	131	123	0.75 (0.54-1.05)																																																																																																																																																				
≥28	59	51	0.73 (0.46-1.15)																																																																																																																																																				
p=0.07																																																																																																																																																							
<i>Exposure to midday sun (hours) during teen years</i>																																																																																																																																																							
<7	62	46	1.0 (N/A)																																																																																																																																																				
<14	89	68	0.97 (0.59-1.61)																																																																																																																																																				
<28	185	155	0.81 (0.52-1.27)																																																																																																																																																				
≥28	211	187	0.75 (0.48-1.18)																																																																																																																																																				
p=0.12																																																																																																																																																							
<i>Exposure to midday sun (hours) during 20s</i>																																																																																																																																																							
<7	143	107	1.0 (N/A)																																																																																																																																																				
<14	143	124	0.86 (0.60-1.22)																																																																																																																																																				
<28	156	132	0.83 (0.58-1.18)																																																																																																																																																				
≥28	105	94	0.75 (0.50-1.11)																																																																																																																																																				
p=0.15																																																																																																																																																							
<i>Exposure to midday sun during 30s</i>																																																																																																																																																							
<7	183	137	1.0 (N/A)																																																																																																																																																				
<14	135	135	0.75 (0.54-1.04)																																																																																																																																																				
<28	145	112	0.95 (0.68-1.33)																																																																																																																																																				
≥28	68	66	0.78 (0.50-1.19)																																																																																																																																																				
p=0.44																																																																																																																																																							
<i>Sunlamp or sunbed use</i>																																																																																																																																																							
Never	401	338	1.0 (N/A)																																																																																																																																																				
<5 times	32	33	0.78 (0.46-1.32)																																																																																																																																																				
5-9 times	32	25	0.90 (0.52-1.58)																																																																																																																																																				
≥10 times	84	66	0.90 (0.61-1.30)																																																																																																																																																				
p=0.49																																																																																																																																																							
<i>History of blistering sunburns</i>																																																																																																																																																							
Never	224	177	1.0 (N/A)																																																																																																																																																				
Once	117	103	0.87 (0.62-1.23)																																																																																																																																																				
2-4 times	114	84	1.02 (0.72-1.46)																																																																																																																																																				
≥5 times	92	96	0.68 (0.47-0.97)																																																																																																																																																				
p=0.10																																																																																																																																																							

Table 6. Adverse Outcomes of Sun-Protective Behaviors

Study, Design, Quality	Setting (country), Population description	Study objective, Intervention or exposure	Measurement of adverse outcome									
John 2007 ¹⁰⁷ Case-control Good	US N: 1786 cases, 2127 controls Age: 40% ages 50-64 years Sex: 0% male Skin phenotype: NR	To determine if sun exposure is associated with increased risk for breast cancer In-person interviews and structured questionnaires, plus exam including measurement of skin pigmentation with portable reflectometer and DNA sample (blood or mouthwash)	Sun exposure and risk for advanced breast cancer									
			Light pigment cases controls OR (95%CI)			Medium pigment cases controls OR (95%CI)			Dark pigment cases controls OR (95%CI)			
			<i>Lifetime outdoor activities (hours/week by quartile)</i>									
			Low	37	153	1.0 (N/A)	43	180	1.0 (N/A)	49	174	1.0 (N/A)
			2	41	167	0.97 (0.58-1.62)	47	154	1.17 (0.72-1.91)	52	180	1.01 (0.65-1.59)
			3	59	188	1.29 (0.80-2.09)	55	169	1.23 (0.76-1.97)	61	165	1.31 (0.84-2.03)
			High	37	180	0.86 (0.51-1.45)	36	175	0.77 (0.46-1.29)	50	153	1.14 (0.72-1.81)
			p	0.90			0.82			0.36		
			<i>Facultative pigmentation</i>									
			Light	55	171	1.0 (N/A)	48	171	1.0 (N/A)	53	169	1.0 (N/A)
			2	48	183	0.73 (0.45-1.17)	54	161	1.22 (0.76-1.98)	48	169	0.89 (0.52-1.55)
			3	35	167	0.56 (0.33-0.94)	38	180	0.86 (0.51-1.46)	56	169	1.00 (0.56-1.81)
			Dark	37	173	0.54 (0.32-0.94)	41	171	1.07 (0.62-1.85)	57	174	1.00 (0.55-1.81)
			p	0.02			0.88			0.81		
			<i>Sun exposure index</i>									
			Low	56	174	1.0 (N/A)	47	172	1.0 (N/A)	50	171	1.0 (N/A)
			2	47	174	0.78 (0.49-1.26)	55	173	1.29 (0.80-2.08)	52	170	1.15 (0.73-1.82)
			3	37	171	0.62 (0.37-1.04)	35	167	0.90 (0.53-1.55)	59	168	1.39 (0.89-2.17)
			High	35	175	0.53 (0.31-0.91)	44	171	1.26 (0.74-2.15)	53	172	1.28 (0.81-2.05)
			p	0.01			0.68			0.20		
			Sun exposure and risk for localized breast cancer									
			<i>Lifetime outdoor activities (hours/week by quartile)</i>									
			Low	85	153	1.0 (n/a)	97	180	1.0 (n/a)	101	174	1.0 (n/a)
			2	91	167	0.95 (0.65-1.40)	70	154	0.79 (0.53-1.17)	89	180	0.80 (0.56-1.15)
			3	103	188	0.89 (0.61-1.29)	129	169	1.35 (0.94-1.93)	96	165	0.94 (0.66-1.35)
			High	107	180	1.05 (0.72-1.54)	92	175	1.02 (0.70-1.50)	64	153	0.70 (0.47-1.04)
			p	0.85			0.20			0.18		
			<i>Facultative pigmentation</i>									
Light	95	171	1.0 (N/A)	101	171	1.0 (N/A)	73	169	1.0 (N/A)			
2	109	183	1.18 (0.82-1.71)	118	161	1.34 (0.93-1.94)	87	169	1.22 (0.76-1.97)			
3	97	167	1.10 (0.75-1.61)	90	180	1.04 (0.70-1.54)	88	169	1.20 (0.71-2.01)			
Dark	89	173	1.11 (0.74-1.67)	81	177	1.12 (0.73-1.71)	102	174	1.40 (0.83-2.33)			
p	0.72			0.80			0.24					
<i>Sun exposure index</i>												
Low	104	174	1.0 (N/A)	108	172	1.0 (N/A)	75	171	1.0 (N/A)			
2	103	174	1.09 (0.76-1.58)	107	173	1.12 (0.78-1.62)	99	170	1.43 (0.97-2.10)			
3	87	171	0.96 (0.65-1.41)	90	167	1.01 (0.68-1.49)	87	168	1.30 (0.88-1.93)			
High	96	175	1.10 (0.74-1.63)	84	171	1.06 (0.71-1.60)	89	172	1.11 (0.74-1.67)			
p	0.81			0.86			0.74					
Multivariate-adjusted OR: adjusted for age, race/ethnicity, education, family history of breast cancer, personal history of breast disease, age at menarche, # full-term pregnancies, breastfeeding, BMI, height, physical activity, and alcohol consumption												

CCT=controlled clinical trial; RCT=randomized controlled trial; IG=intervention group; CG=control group; BMI=body mass index; UK=United Kingdom; US=United States; SPF=sun protection factor; PC=primary care; calc=calculated; NR=not reported; CI=confidence interval; OR=odds ratio; RR=relative risk; mv=multivariate; adj=adjusted; #=number; N/A=not applicable; nmol=nanomole; L=liter; IU=international unit

Table 7. Summary of Evidence By Key Question

# of studies	Design	Limitations	Consistency	Applicability	Overall Quality	Summary of Findings
KQ1. Is there direct evidence that counseling patients in sun-protective behaviors reduces intermediate outcomes or skin cancer?						
No direct evidence was found.						
KQ2. Do primary care relevant counseling interventions change sun-protective behaviors?						
<i>Adults</i>						
4 (n=8,950)	RCT	Unclear clinical significance of small changes in composite scores in absence of statistically significant differences in individual self-reported outcomes.	Consistent. 1 trial was conducted in a different population and used different outcome measures; no significant change in behavior reported.	Successful interventions all included computerized support and were conducted in predominantly white populations.	Fair	3 of 4 trials (n=6,225) showed that primary care feasible counseling with computer support can increase self-reported sun-protective behaviors, as measured by composite behavior scores at 6 to 12 months of follow-up. Interventions ranged from a single low-intensity intervention (15-min session) to multiple (<4) in-person or phone counseling, followed by tailored written feedback.
<i>Adolescents and college students</i>						
3 (n=1,382)	RCT	Only 1 trial in young adolescents, and 2 smaller trials in college students.	Trial in young adolescents consistent with adult trials. 2 trials in college students used appearance-focused intervention compared with health-based message in other interventions.	Intervention in adolescents included computerized support; appearance-focused interventions involved a professionally produced booklet and a video with or without UV photos. College students were explicit indoor tanners in 1 trial, and received course credit in another.	Fair	1 trial in young adolescents (n=819) showed that brief primary care counseling, coupled with interactive computer sessions, phone follow-up, and tailored written feedback can moderately increase self-reported sun-protective behaviors at 24 months of follow-up. In 2 trials in predominantly young college women (n=563), appearance-focused interventions decreased self-reported frequency of indoor tanning and objectively measured UV exposure (by skin reflectance spectrophotometry) at 6 to 12 months of follow-up. Interventions included a professional produced booklet in 1 trial and a short video (with or without a UV photo) in another.
<i>Parents and children</i>						
1 (n=728)	RCT	Only 1 trial. Unclear clinical significance of small changes in composite scores in absence of statistically significant differences in individual self-reported outcomes.	Only 1 trial. Consistent with trials conducted in adults and adolescents.	Intervention was integrated into 4 consecutive well-child visits and was conducted in a predominantly white population.	Fair	1 trial showed that primary care counseling with written information and samples of sun protection products integrated into consecutive well-child visits can increase self-reported sun-protective behaviors, as measured by a composite behavior score at 36 months. However, individual self-reported outcomes were generally not statistically significant.
<i>Community-based interventions with primary care counseling</i>						
2 (n=1,662)	Cluster RCT	Unable to assess the contribution of primary care counseling to the entire community-based intervention. Outcomes were assessed on the community level, and not per individual.	Consistent. Both trials were conducted by the same group of study investigators.	Primary care counseling was one component of a multifaceted community-based approach. Interventions were conducted in predominantly white communities.	Fair	2 trials showed that a multifaceted community-based intervention to promote sun-protective behaviors, including primary care counseling with temporary tattoos and stickers, integrated into well-child and illness visits can increase directly observed measures of body surface area protection in adolescents and self-reported measures of sunscreen use in adolescents and grade school children at 12 to 24 months follow-up.

Table 7. Summary of Evidence By Key Question

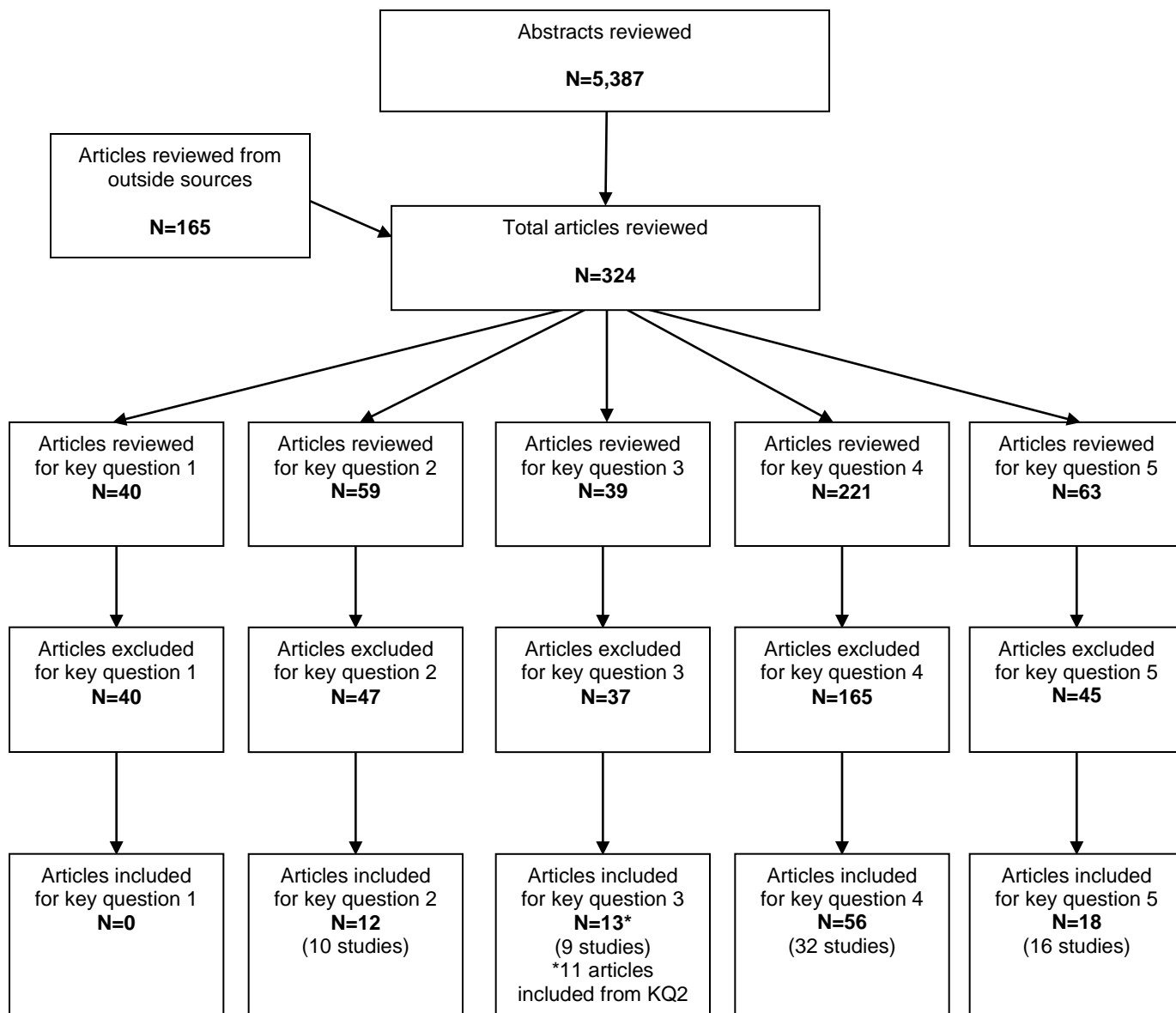
# of studies	Design	Limitations	Consistency	Applicability	Overall Quality	Summary of Findings
KQ3. Do primary care relevant counseling interventions have adverse effects?						
10 (n=12,722)	RCT and cluster RCT	Only 1 trial examined adverse outcomes other than decrease in sun protection behaviors.	Consistent with trial conducted in schools examining sedentary behaviors (see KQ5).	Interventions were conducted in predominantly white populations.	Fair	Of the 10 trials included in KQ2, there was no evidence for a paradoxical decrease in sun-protective behaviors. In the trial conducted in adolescents (n=819), there were no statistically significant changes in self-reported measures of physical activity or sedentary behaviors.
KQ4. Is sun exposure (intentional or unintentional), indoor tanning, or sunscreen use associated with skin cancer outcomes?						
<i>Sun exposure (intentional or unintentional)</i>						
6 (n=335,848) 22 (n=18,240)	Cohort Case-control	Very large variation in measures of sun exposure, delineation of levels of exposure, and use of reference groups. Very complex exposure to measure well. Cohort studies were not primarily designed to examine sun exposure. All case-control studies subject to recall bias. Variation in latitudes of countries of included studies.	No major inconsistencies. Large variation in measurement of sun exposure makes direct comparisons across studies difficult.	Body of evidence not able to detail what level of reduction in sun exposure would be necessary to decrease skin cancer risk. Unlikely that persons can change sun behavior from highest to lowest percentile. Most studies included predominantly white populations.	Fair	SCC and BCC (11 studies): Based mostly on fair-quality cohort and case-control studies, there is an increased risk for both SCC and BCC with increasing recreational sun exposure (range OR, 1.3-3.9). Evidence is more consistent for sun exposure in childhood leading to an increased risk. Fewer studies examine the association of total or occupational sun exposure and do not suggest a strong association of exposure with SCC or BCC. Melanoma (18 studies): Case-control literature does not show strong association of total and occupational sun exposure with melanoma. However, some evidence suggests that total childhood sun exposure is associated with melanoma risk (range OR, 1.8-4.4) and occupational sun exposure may be associated with a decreased risk for melanoma. Case-control studies examining the risk for recreational sun exposure are inconsistent, but some studies suggest that increasing recreational sun exposure increases the risk for melanoma (range OR, 1.3-5.0). The evidence is more consistent for recreational sun exposure in childhood leading to an increased risk for melanoma (range OR, 1.7-3.5).
<i>Indoor tanning</i>						
1 (n=106,379) 14 (n=13,675)	Cohort Case-control	Crude measures of indoor tanning. Cohort study was not primarily designed to examine UV exposure. Case-control studies are subject to recall bias.	No major inconsistencies. Inconsistent adjusting for important confounders.	Sunlamps or tanning bed use assessed in studies may not be equivalent to currently available indoor tanning devices. Most studies included predominantly white populations.	Fair to poor	SCC and BCC (5 studies): We found very limited evidence (limited # of studies using crude measures of exposure) examining indoor tanning and the risk for SCC and BCC, after adjusting for important confounders. Melanoma (11 studies): There is some evidence to suggest that "regular" or "early" use of indoor tanning may increase the risk for melanoma (range RR, 1.6-2.3), after adjusting for important confounders.
<i>Sunscreen use</i>						
1 (n=1621) 3 (n=359,421) 6 (n=5708)	Trial Cohort Case-control	Crude measure of sunscreen use. Cohort studies were not primarily designed to examine sun exposure or sunscreen use. Difficult exposure to measure. Case-control studies are subject to recall bias.	Inconsistencies in studies examining sunscreen use and risk for melanoma. Inconsistent adjusting for important confounders.	Sunscreen use assessed in studies may not be equivalent to currently available sunscreens. Most studies included predominantly white populations.	Fair to poor	SCC and BCC (5 studies): Based on 1 fair trial (n=1621), regular sunscreen use can prevent SCC (RR, 0.65 [95% CI, 0.45-0.94]). It is unclear if sunscreen use prevents BCC; case-control studies that suggest a protective effect have major limitations. Melanoma (5 studies): Based on limited studies, there does not appear to be a clear protective or harmful effect of sunscreen use on the risk for melanoma.

Table 7. Summary of Evidence By Key Question

# of studies	Design	Limitations	Consistency	Applicability	Overall Quality	Summary of Findings
KQ5. Are sun-protective behaviors associated with adverse effects?						
<i>Reduced physical activity</i>						
1 (n=1615)	Trial	Only 1 trial.	Only 1 trial. Consistent with trial included in KQ3.	Conducted in Australia.	Fair	Based on 1 cluster nonRCT, grade-school children who received a 4-year sun protection curriculum in school had no difference in mean BMI or self-reported time spent outdoors compared to children in control schools.
<i>Increased sun exposure</i>						
6 (n=4,482)	Trial	Three trials reported secondary outcomes of sun exposure but were not primarily designed to determine the effect of sunscreen use on sun exposure. Variation in measures of sun exposure.	Inconsistencies in trials based on populations studied.	None were conducted in US. Trials that found increases in intentional sun exposure with higher SPF sunscreen were conducted in young persons on sunbathing vacations.	Fair	Based on 2 good-quality RCTs, higher SPF sunscreen use, compared with low SPF sunscreen use, can increase intentional sun exposure, though not risk for sunburn, in young adults on sunbathing vacations. One similarly designed fair-quality RCT in a slightly older population did not find increased intentional sun exposure with higher SPF use. Based on 1 good-quality large RCT, there was no difference in self-reported time spent outdoors or objectively measured ambient UV exposure among adults who received SPF 15 sunscreen versus placebo cream.
<i>Vitamin D deficiency</i>						
1 (n=153) 1 (n=2016)	Trial Cohort	Only 1 trial examining sunscreen use and 1 trial examining sun exposure.	Only 1 trial per category.	Sunscreen trial conducted in Australia. Cohort study conducted in Denmark (high latitude country).	Fair to poor	Based on 1 trial, sunscreen use (SPF 17) does not lead to vitamin D deficiency, although it can decrease vitamin D levels in adults. Based on 1 cohort study, vitamin D levels are greatly influenced by sun exposure, and women living at high latitudes who avoid direct sun exposure are at increased risk for vitamin D deficiency during the winter and spring months.
<i>Increased cancer risk</i>						
1 (n=5009) 8 (n=21,028)	Cohort Case-control	Only 1 study examining prostate cancer risk, 1 study examining colon cancer risk. Sun exposure is a complex exposure to measure well.	Inconsistencies when examining association between sun exposure and risk for breast cancer and nonHodgkin lymphoma. Variation in sun exposure measurement makes direct comparisons across studies difficult.	Unable to determine level of reduction in sun exposure that might increase risk for other types of cancer. Unlikely that persons can change sun behaviors from highest to lowest percentile. Most studies included predominantly white populations.	Poor	Based on very limited evidence, it appears that sun exposure may be positively associated with risk for advanced breast and prostate cancer, after adjusting for well-established risk factors. Intermittent sun exposure may be inversely related to risk for nonHodgkin lymphoma. Two case-control studies conducted in Sweden found that persons who reported always or almost always using sunscreen were at increased risk for melanoma, after adjusting for both skin phenotype and sun exposure.

KQ=key question; RCT=randomized controlled trial; SCC=squamous cell carcinoma; BCC=basal cell carcinoma; BMI=body mass index; US=United States; SPF=sun protection factor; RR=relative risk; OR=odds ratio; CI=confidence interval; UV=ultraviolet

Appendix A Figure 1. Search Results and Article Flow



Appendix A Table 1. Search Strategies

Key Questions 1 to 3

Database: Ovid MEDLINE(R), Cochrane Central Controlled Trials Registry

Search Period: 1996 to December 2008>

Search Strategy:

-
- 1 Skin Neoplasms/ (30148)
 - 2 Melanoma/ (20680)
 - 3 Hutchinson's Melanotic Freckle/ (234)
 - 4 melanoma\$.ti,ab. (27508)
 - 5 lentigo maligna.ti,ab. (270)
 - 6 Carcinoma, Basal Cell/ (3871)
 - 7 Carcinoma, Squamous Cell/ (32609)
 - 8 neoplasms, basal cell/ (223)
 - 9 neoplasms, squamous cell/ (591)
 - 10 skin cancer.ti,ab. (4103)
 - 11 (carcinoma and (skin or cutaneous)).ti,ab. (6804)
 - 12 Nevus/ (1187)
 - 13 Nevus, Pigmented/ (1794)
 - 14 (nevus or naevus or nevi or naevi).ti,ab. (4385)
 - 15 Keratosis/ (1517)
 - 16 keratos#.s.ti,ab. (1866)
 - 17 Sunburn/ (880)
 - 18 Sunburn\$.ti,ab. (839)
 - 19 Sunscreening Agents/ (1645)
 - 20 sunscreen\$.ti,ab. (1386)
 - 21 Sunlight/ (3594)
 - 22 Ultraviolet Rays/ (18712)
 - 23 sunlamp\$.ti,ab. (67)
 - 24 tanning.ti,ab. (609)
 - 25 sunbed\$.ti,ab. (97)
 - 26 photoprotection.ti,ab. (592)
 - 27 sun protecti\$.ti,ab. (751)
 - 28 sun awareness.ti,ab. (25)
 - 29 sun safety.ti,ab. (57)
 - 30 sun exposure.ti,ab. (1438)
 - 31 or/1-30 (105418)
 - 32 Health Promotion/ (21101)
 - 33 Health Education/ (15625)
 - 34 Patient Education as Topic/ (30487)
 - 35 Preventive Health Services/ (3856)
 - 36 Consumer Health Information/ (66)
 - 37 Counseling/ (9180)
 - 38 Directive Counseling/ (261)
 - 39 Behavior Therapy/ (5865)
 - 40 Health Behavior/ (13466)
 - 41 Physician's Role/ (10481)
 - 42 Teaching Materials/ (2315)
 - 43 Parents/ed [Education] (2509)
 - 44 counsel\$.ti,ab. (24396)
 - 45 advice.ti,ab. (12052)
 - 46 advise.ti,ab. (2322)
 - 47 behavio\$ intervention\$.ti,ab. (2012)
 - 48 prevention intervention\$.ti,ab. (1189)
 - 49 or/32-48 (129549)
 - 50 31 and 49 (1282)
 - 51 limit 50 to (clinical trial or controlled clinical trial or meta analysis or randomized controlled trial) (123)
 - 52 meta-analysis as topic/ (6066)
 - 53 clinical trials as topic/ or controlled clinical trials as topic/ or randomized controlled trials as topic/ (98957)
 - 54 (control\$ adj3 trial\$.ti,ab. (54622)
 - 55 random\$.ti,ab. (269819)

Appendix A Table 1. Search Strategies

- 56 clinical trial\$.ti,ab. (80740)
- 57 or/52-56 (391015)
- 58 50 and 57 (193)
- 59 51 or 58 (224)
- 60 limit 59 to english language (216)
- 61 limit 60 to yr="2001 - 2008" (146)

Protective Behaviors

Database: Ovid MEDLINE(R), Cochrane Central Controlled Trials Registry

Search Period: 1950 to December 2008

Search Strategy:

-
- 1 sun exposure.ti,ab. (2123)
 - 2 sun exposed.ti,ab. (1203)
 - 3 Sunburn/ (1851)
 - 4 sunburn\$.ti,ab. (1457)
 - 5 sunbath\$.ti,ab. (270)
 - 6 Sunlight/ (8313)
 - 7 Ultraviolet Rays/ (51710)
 - 8 Solar radiation.ti,ab. (1192)
 - 9 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 (61284)
 - 10 Melanoma/ (51583)
 - 11 melanoma\$.ti,ab. (56926)
 - 12 skin neoplasms/ (73435)
 - 13 skin cancer\$.ti,ab. (8057)
 - 14 10 or 11 or 12 or 13 (121192)
 - 15 9 and 14 (6548)
 - 16 limit 15 to yr="2001 - 2008" (2582)
 - 17 sun exposure.ti,ab. (2123)
 - 18 sun exposed.ti,ab. (1203)
 - 19 Sunburn/ (1851)
 - 20 sunburn\$.ti,ab. (1457)
 - 21 sunbath\$.ti,ab. (270)
 - 22 Sunlight/ (8313)
 - 23 Ultraviolet Rays/ (51710)
 - 24 Solar radiation.ti,ab. (1192)
 - 25 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 (61284)
 - 26 Neoplasms, Basal Cell/ (284)
 - 27 Carcinoma, Basal Cell/ (11126)
 - 28 basal cell carcinoma.ti,ab. (5179)
 - 29 Neoplasms, Squamous Cell/ (644)
 - 30 Carcinoma, Squamous Cell/ (79676)
 - 31 squamous cell carcinoma.ti,ab. (33038)
 - 32 nonmelanom\$.ti,ab. (1148)
 - 33 non melanom\$.ti,ab. (901)
 - 34 26 or 27 or 28 or 29 or 30 or 31 or 32 or 33 (96164)
 - 35 25 and 34 (2035)
 - 36 limit 35 to yr="1966 - 2008" (2021)
 - 37 Neoplasms, Basal Cell/ (284)
 - 38 Carcinoma, Basal Cell/ (11126)
 - 39 basal cell carcinoma.ti,ab. (5179)
 - 40 Neoplasms, Squamous Cell/ (644)
 - 41 Carcinoma, Squamous Cell/ (79676)
 - 42 squamous cell carcinoma.ti,ab. (33038)
 - 43 Melanoma/ (51583)
 - 44 melanoma\$.ti,ab. (56926)
 - 45 nonmelanom\$.ti,ab. (1148)
 - 46 non melanom\$.ti,ab. (901)
 - 47 Skin Neoplasms/ (73435)

Appendix A Table 1. Search Strategies

48 skin cancer.ti,ab. (6709)
49 37 or 38 or 39 or 40 or 41 or 42 or 43 or 44 or 45 or 46 or 47 or 48 (199909)
50 sunlamp\$.ti,ab. (256)
51 sunbed\$.ti,ab. (155)
52 tanning bed\$.ti,ab. (63)
53 tanning booth\$.ti,ab. (17)
54 tanning salon\$.ti,ab. (57)
55 tanning device\$.ti,ab. (32)
56 artificial light.ti,ab. (425)
57 artificial UV.ti,ab. (104)
58 indoor tanning.ti,ab. (67)
59 50 or 51 or 52 or 53 or 54 or 55 or 56 or 57 or 58 (1085)
60 49 and 59 (288)
61 limit 60 to yr="2005 - 2008" (64)
62 Sunscreening Agents/ (2763)
63 sunscreen\$.ti,ab. (2199)
64 62 or 63 (3384)
65 Melanoma/ (51583)
66 melanoma\$.ti,ab. (56926)
67 skin neoplasms/ (73435)
68 skin cancer\$.ti,ab. (8057)
69 65 or 66 or 67 or 68 (121192)
70 64 and 69 (1216)
71 limit 70 to yr="2002 - 2008" (499)
72 Sunscreening Agents/ (2763)
73 sunscreen\$.ti,ab. (2199)
74 72 or 73 (3384)
75 Neoplasms, Basal Cell/ (284)
76 Carcinoma, Basal Cell/ (11126)
77 basal cell carcinoma.ti,ab. (5179)
78 Neoplasms, Squamous Cell/ (644)
79 Carcinoma, Squamous Cell/ (79676)
80 squamous cell carcinoma.ti,ab. (33038)
81 nonmelanom\$.ti,ab. (1148)
82 non melanom\$.ti,ab. (901)
83 75 or 76 or 77 or 78 or 79 or 80 or 81 or 82 (96164)
84 75 and 83 (284)
85 limit 84 to yr="1966 - 2008" (282)
86 16 or 36 or 61 or 71 or 85 (4258)
87 (clinical trial or controlled clinical trial or meta analysis or randomized controlled trial).pt. (514646)
88 Meta-Analysis as Topic/ (8243)
89 clinical trials as topic/ or controlled clinical trials as topic/ or randomized controlled trials as topic/ (193771)
90 (control\$ adj3 trial\$.ti,ab. (75931)
91 random\$.ti,ab. (408387)
92 clinical trial\$.ti,ab. (118671)
93 observational.ti,ab. (29208)
94 (cohort adj (study or studies)).ti,ab. (35294)
95 cohort analys\$.ti,ab. (1638)
96 cohort studies/ (84711)
97 retrospective\$.ti,ab. (206916)
98 Retrospective Studies/ (297957)
99 longitudinal\$.ti,ab. (86086)
100 Longitudinal Studies/ (51243)
101 (follow up adj (study or studies)).ti,ab. (27678)
102 Follow-Up Studies/ (367133)
103 prospective\$.ti,ab. (259500)
104 Prospective Studies/ (243484)
105 database\$.ti,ab. (82828)
106 nonrandomi\$.ti,ab. (4953)
107 population\$.ti,ab. (640534)
108 case control\$.ti,ab. (42298)
109 case-control studies/ (97627)

Appendix A Table 1. Search Strategies

- 110 Cross-Sectional Studies/ (88036)
- 111 cross sectional.ti,ab. (77621)
- 112 systematic\$ review\$.ti,ab. (14698)
- 113 systematic\$ overview\$.ti,ab. (329)
- 114 quantitative\$ review\$.ti,ab. (331)
- 115 quantitative\$ overview\$.ti,ab. (61)
- 116 (meta analy\$ or metaanaly\$).ti,ab. (21215)
- 117 evidence based review\$.ti,ab. (516)
- 118 morbidity/ or incidence/ or prevalence/ or mortality/ or "cause of death"/ or survival rate/ (353096)
- 119 (morbidity or incidence or prevalen\$ or mortality or survival).ti,ab. (1122388)
- 120 (epidemiology or etiology or genetics or mortality or statistics numerical data).fs. (4167223)
- 121 (epidemiol\$ or etiolog\$ or aetiolog\$).ti,ab. (322045)
- 122 Risk Factors/ (350233)
- 123 risk factor\$.ti,ab. (189335)
- 124 Skin/re [Radiation Effects] (7487)
- 125 associated.ti,ab. (1365964)
- 126 association\$.ti,ab. (442678)
- 127 or/87-126 (6674934)
- 128 86 and 127 (3591)
- 129 limit 128 to english language (3333)
- 130 limit 129 to humans (2908)
- 131 limit 129 to animals (736)
- 132 131 not 130 (409)
- 133 129 not 132 (2924)
- 134 from 133 keep 1-500 (500)

Harms

Database: Ovid MEDLINE(R), Cochrane Central Controlled Trials Registry

Search Period: 1950 to December 2008

Search Strategy:

-
- 1 Sunscreening Agents/ (2766)
 - 2 sunscreen\$.ti,ab. (2207)
 - 3 Protective Clothing/ (3781)
 - 4 protective cloth\$.ti,ab. (921)
 - 5 (((hat or hats) and (wear\$ or wore or brim\$)) or (use\$ adj3 hat) or (use\$ adj3 hats)).ti,ab. (306)
 - 6 TINOSORB FD.ti,ab. (1)
 - 7 TINOSORB FR.ti,ab. (0)
 - 8 ((UV absorb\$ or photoprotect\$ or UV protect\$) and (laundry or detergent\$)).ti,ab. (32)
 - 9 sun protect\$.ti,ab. (1228)
 - 10 photoprotect\$.ti,ab. (1347)
 - 11 ((seek\$ or sun or sunscreen\$) and shade).ti,ab. (305)
 - 12 ((avoid\$ or minimiz\$ or minimis\$) and (sun exposure or midday sun)).ti,ab. (221)
 - 13 (avoid\$ and (sunlamp\$ or sunbed\$ or tanning bed\$ or tanning booth\$ or tanning salon\$ or tanning device\$ or indoor tanning or artificial light or artificial UV)).ti,ab. (34)
 - 14 1 or 2 or 3 or 4 or 5 or 6 or 7 or 8 or 9 or 10 or 11 or 12 or 13 (9269)
 - 15 adverse effects.fs. (1016592)
 - 16 harm\$.ti,ab. (48820)
 - 17 adverse\$.ti,ab. (170899)
 - 18 (increas\$ and ((time and sun) or sun exposure)).ti,ab. (1144)
 - 19 ((reduce\$ or reduction) and physical activit\$).ti,ab. (5670)
 - 20 sedentary behavio\$.ti,ab. (414)
 - 21 depression/ (49597)
 - 22 Depressive Disorder/ (47333)
 - 23 mood disorders/ (7539)
 - 24 mood.ti,ab. (27405)
 - 25 vitamin D deficiency/ (4637)
 - 26 (vitamin D adj5 deficien\$).ti,ab. (3478)
 - 27 15 or 16 or 17 or 18 or 19 or 20 or 21 or 22 or 23 or 24 or 25 or 26 (1276195)

Appendix A Table 1. Search Strategies

28 14 and 27 (3105)
29 limit 28 to english language (2770)
30 limit 29 to humans (2542)
31 limit 29 to animals (326)
32 31 not 30 (139)
33 29 not 32 (2631)
34 limit 33 to yr="1966 - 2008" (2627)

Appendix A Table 2. Inclusion and Exclusion Criteria

Definitions of included diseases

Include: skin cancer including: cutaneous melanoma, squamous cell carcinoma of the skin, basal cell carcinoma of the skin

Exclude: acral lentiginous and subungual melanoma, mucosal melanoma, ocular melanoma, and pre-pubertal melanoma (“childhood melanoma”)

Settings

Include:

Key questions 1 to 3: studies performed in primary care (including pediatric, OB/GYN, internal medicine, family practice, military, adolescent, and school-based health clinics) or otherwise generalizable to primary care; studies conducted in English speaking countries, or those otherwise generalizable to the United States

Key questions 4 and 5: any setting

Exclude:

Key questions 1 to 3: settings not generalizable to primary care (e.g., inpatient hospital units, emergency departments, pharmacies, school-based programs, recreational settings, occupational settings, and other community-based settings); trials conducted in developing countries, as defined by the United Nations Human Development Index

Key questions 4 and 5: no a priori exclusion criteria

Populations

Include:

Key questions 1 to 3: populations generalizable to primary care, any age population without current or personal history of malignant or pre-malignant skin lesions

- infants/children and their parent(s) or care giver(s)
- children/adolescents
- adults

Key questions 4 and 5: any population, as long as description of population host and environmental risk factors is provided

Exclude:

Key questions 1 to 3: persons with current or past history of malignant or pre-malignant skin lesions (e.g., Bowen’s disease, actinic keratoses, atypical/dysplastic nevi); persons with syndromes at risk for skin cancer and who therefore have lowered immunity (inherited or acquired immunodeficiency) including: xeroderma pigmentosum, albinism, trauma or burn victims, basal cell nevus syndrome (Gorlin’s syndrome), exposure to arsenic, recessive dystrophic epidermolysis bullosa, psoralen or ultraviolet A treatment, familial atypical mole and melanoma syndrome, strong familial history of melanoma, or numerous melanocytic nevi (>100 nevi)

Key questions 4 and 5: persons with syndromes at risk for skin cancer (see above)

Interventions/Exposures

Include:

Key questions 1 to 3: primary care feasible or referable counseling interventions aimed at changing sun-protective behaviors (decreasing sun exposure, avoidance of sunlamps/tanning beds, or sunscreen use), based on any theoretical foundation (NOTE: primary care feasible or referable interventions that are part of a multicomponent intervention will be included but discussed separately)

- *Primary care feasible or conducted* counseling interventions, either conducted in a primary care research setting or judged to be feasible in “usual” primary care
 - Target: involve individual-level identification of being a patient or in need of intervention
 - Delivery: usually involve primary care physicians, other physicians, nurses, nurse practitioners, physician assistants, or related clinical staff (e.g., health educators,

Appendix A Table 2. Inclusion and Exclusion Criteria

other counselors); **or** the intervention is seen as connected to the health care system by the participant

- Format: to individuals or small groups (i.e., ≤15); does not primarily involve group-level interventions outside the primary care setting; generally does not involve more than eight group sessions and the intervention period is no longer than 12 months
- Location: anywhere, as long as linked to primary care
- *Primary care referable* such that intervention needs to be conducted as part of a health care setting, or is widely available in the community at a national level

Key questions 4 and 5: exposure due to sun, sunlamps/tanning beds, or sunscreen, with description of how exposure is measured

Exclude:

Key questions 1 to 3: noncounseling interventions; counseling interventions focused on secondary prevention (i.e., counseling for skin self-examinations); counseling interventions that are primarily community, nonreferral (e.g., occupational/worksite, recreational, or school-based); social marketing (e.g., media campaigns); policy (e.g., local or state public/health policy)

Key questions 4 and 5: no a priori exclusion criteria

Outcomes

Include:

Key questions 1 and 2: skin cancer incidence or associated morbidity/mortality, intermediate outcomes (sunburn, nevi, actinic keratosis) or behavioral outcomes at ≥3 months after counseling intervention (decreased sun exposure through avoidance of peak hours of sun exposure, wearing protective clothing, avoidance of sunlamps or tanning beds, and use of sunscreen)

Key question 4: skin cancer incidence or associated morbidity/mortality, intermediate outcomes (sunburn, nevi, actinic keratosis)

Key questions 3 and 5: any adverse effects (e.g., paradoxical increase in sun exposure, reduced physical activity, dysphoric mood, vitamin D deficiency, increased incidence of other types of cancer)

Exclude:

Key questions 1 and 2: any trial with >40 percent attrition or no behavioral outcome assessment beyond 3 months; attitude, knowledge, or ability changes

Key question 4: no a priori exclusion criteria

Key questions 3 and 5: opportunity cost of counseling

Study Design

Include:

Key questions 1 to 3: good-quality systematic reviews of trials and individual randomized or controlled clinical trials

Key questions 4 and 5: fair- to good-quality systematic reviews of observational studies, individual randomized or controlled clinical trials (only pertains to KQ4c), and individual observational (cohort, population-based case-control) studies not included in systematic reviews

Exclude: All poor-quality studies as dual reviewed and defined by USPSTF quality criteria

Key questions 1 to 3: any nonexperimental study design, modeling studies

Key questions 4 and 5: ecologic analyses, hospital-based case-control studies, cross-sectional studies, case-series, case reports

Appendix A Table 3. Quality Rating Criteria

Design	USPSTF Quality Rating Criteria ¹³⁷	NICE Methodology Checklists ¹³⁸	Newcastle-Ottawa Quality Assessment Scales ¹³⁹
Systematic reviews and meta-analyses	<ul style="list-style-type: none"> • Comprehensiveness of sources considered/search strategy used • Standard appraisal of included studies • Validity of conclusions • Recency and relevance are especially important for systematic reviews 	<ul style="list-style-type: none"> • Study addresses an appropriate and clearly focused question • Description of the methodology used is included • Literature search is sufficiently rigorous to identify all relevant studies • Study quality is assessed and taken into account • There are enough similarities between the studies selected to make combining them reasonable 	N/A
Case-control studies	<ul style="list-style-type: none"> • Accurate ascertainment of cases • Nonbiased selection of cases/controls with exclusion criteria applied equally to both • Response rate is reported • Diagnostic testing procedures applied equally to each group • Measurement of exposure accurate and applied equally to each group • Appropriate attention to potential confounding variables 	<ul style="list-style-type: none"> • Study addresses an appropriate and clearly focused question • Cases and controls are taken from comparable populations • Same exclusion criteria are used for both cases and controls • Percentage of each group (cases and controls) that participated in the study is reported • Comparison is made between participants and non-participants to establish similarities or differences • Cases are clearly defined and differentiated from controls • It is clearly established that controls are non-cases • Measures have been taken to prevent knowledge of primary exposure influencing case ascertainment • Exposure status is measured in a standard, valid, and reliable way • Main potential confounders are identified and taken into account in the design and analysis • Confidence intervals are provided 	<ul style="list-style-type: none"> • Case definition is adequate • Cases are representative • Controls are from the same population as cases • If cases are first occurrence of outcome, then controls have no history of this outcome • Cases and controls are matched, and/or confounders are adjusted for in the analysis • Same method of exposure ascertainment for cases and controls • Acceptable ascertainment of exposure
Randomized controlled trials (RCTs)	<ul style="list-style-type: none"> • Initial assembly of comparable groups employs adequate randomization, including first concealment and whether potential confounders were distributed equally among groups • Maintenance of comparable groups (includes attrition, crossovers, adherence, contamination) • Important differential loss to follow-up or overall high loss to follow-up • Measurements are equal, reliable, and valid (includes masking of outcome assessment) • Clear definition of the interventions • All important outcomes considered 	<ul style="list-style-type: none"> • Study addresses an appropriate and clearly focused question • Assignment of subjects to treatment groups is randomized • An adequate concealment method is used • Subjects and investigators are kept blind about treatment allocation • Treatment and control groups are similar at start of trial • Only difference between groups is the treatment under investigation • All relevant outcomes are measured in a standard, valid, and reliable way • Percentage of individuals or clusters recruited into each treatment arm that dropped out before study completion is reported • All subjects are analyzed in the groups to which they were randomly allocated (often referred to as intention-to-treat analysis) • When the study is carried out at more than one site, results are comparable for all sites 	N/A

Appendix A Table 3. Quality Rating Criteria

Design	USPSTF Quality Rating Criteria ¹³⁷	NICE Methodology Checklists ¹³⁸	Newcastle-Ottawa Quality Assessment Scales ¹³⁹
Cohort studies	<ul style="list-style-type: none"> • Initial assembly of comparable groups employs consideration of potential confounders with either restriction or measurement for adjustment in the analysis; consideration of inception cohorts • Maintenance of comparable groups (includes attrition, crossovers, adherence, contamination) • Important differential loss to follow-up or overall high loss to follow-up • Measurements are equal, reliable, and valid (includes masking of outcome assessment) • Clear definition of the interventions • All important outcomes considered 	<ul style="list-style-type: none"> • Study addresses an appropriate and clearly focused question • Groups being studied are selected from source populations that are comparable in all respects other than the factor under investigation • Study indicates how many of the people asked to take part did so, in each of the groups being studied • Likelihood that some eligible subjects might have the outcome at time of enrollment is assessed and taken into account in the analysis • Percentage of individuals or clusters recruited into each study arm that dropped out before study completion is reported • Comparison is made between full participants and those lost to follow-up, by exposure status • Outcomes are clearly defined • Assessment of outcome is made blind to exposure status • When blinding is not possible, there is some recognition that knowledge of exposure status could have influenced the assessment of outcome • Measure of assessment of exposure is reliable • Evidence from other sources is used to demonstrate that the method of outcome assessment is valid and reliable • Exposure level or prognostic factor is assessed more than once • Main potential confounders are identified and taken into account in the design and analysis • Confidence intervals are provided 	<ul style="list-style-type: none"> • Exposed cohort is representative of exposed individuals in the community • The non-exposed cohort is drawn from the same community as the exposed cohort • Appropriate ascertainment of exposure • Demonstration that the outcome of interest was not present at the start of the study • Exposed and non-exposed cohorts are matched and/or confounders are adjusted for in the analysis • Adequate assessment of outcomes • Follow-up long enough for outcomes to occur • Follow-up adequate to ensure that losses are not due to exposure or outcomes
Diagnostic accuracy studies	<ul style="list-style-type: none"> • Screening test relevant, available for primary care, and adequately described • Study uses a credible reference standard, performed regardless of test results • Reference standard interpreted independently of screening test • Handles indeterminate results in a reasonable manner • Spectrum of patients included in study • Sample size reported • Administration of reliable screening test 	<ul style="list-style-type: none"> • Nature of the test being studied is clearly specified • Test is compared with an appropriate gold standard • Where no gold standard exists, a validated reference standard is used as a comparator • Patients for testing are selected either as a consecutive series or randomly, from a clearly defined study population • Test and gold standard are measured independently (blind) of each other • Test and gold standard are applied as close together in time as possible • Results are reported for all patients that entered the study • A pre-diagnosis is made and reported 	N/A

Hierarchy of research design

- I: Properly conducted randomized controlled trial
- II-1: Well-designed controlled trial without randomization
- II-2: Well-designed cohort or case-control analytic study
- II-3: Multiple time series with or without the intervention; dramatic results from uncontrolled experiments
- III: Opinions of respected authorities, based on clinical experience; descriptive studies or case reports; reports of expert committees

Appendix B Table 1. Evidence Table for Effectiveness and Adverse Effects of Counseling for Sun Protective Behaviors

Study reference, USPSTF quality rating	Study design, Location, Population	Participant inclusion/exclusion criteria	Baseline demographics			Intervention theory description
Adults						
<p>Glazebrook 2006⁴⁶</p> <p>Fair</p>	<p>Study Design Cluster RCT (by practice)</p> <p>Location 10 primary care practices (5 pairs: 1 rural, 1 urban, 3 suburban), in Nottinghamshire, UK</p> <p>Population Adults with "higher risk skin characteristics"</p>	<p>Inclusion "higher risk skin characteristics"- any one of the following risk factors: red hair, multiple moles, history of sunburn as a child, freckling, family history of melanoma, fair sun-sensitive skin); patients from 'control' family practices were invited to participate if they appeared to match the skin and demographic profile of participants in the intervention group</p> <p>Exclusion NR</p>	<p>N participants, (10 sites randomized) Total: 589 IG: 259 CG: 330 Mean age (SD) Total: NR IG: 38.2 (14.3) CG: 38.4 (15.2) % Male Total: 19.7 (c) IG: 17.4 CG: 21.5 Race % White: NR SES Highest educational level (% with further or higher education) Total: 52.5 (c) IG: 54.1 CG: 51.2 Occupation (% with professional or skilled) Total: 41.3 (c) IG: 39.8 CG: 42.4 High risk % with high risk characteristic, not specified Total: 100.0 % sought advice for suspicious lesion in past year Total: 12.8 (c) IG: 14.2 CG: 11.6</p>			<p>Skinsafe intervention based on the Health Belief Model, developed by multidisciplinary team of health psychologists, dermatologists, and a multimedia developer.</p>
Study intervention			Follow-up	Intermediate outcomes	Behavioral outcomes: sun avoidance, sun protection	Behavioral outcomes: sunscreen use
<p>Intervention IG: Prescription for "Skinsafe program": 8 sections designed to be completed in a single 10-15 minute sitting, using animation, photographs, and simple text to inform users about dangers of excessive sun exposure, how to protect skin from the sun, characteristics of skin at risk, early signs of melanoma, how to reduce risk for melanoma, how to check skin for suspicious lesions CG: Usual care, details not given</p> <p>Format IG: Self-directed computer workstation in quiet area CG: N/A</p> <p>Intensity IG: Approximately 10-15 minute single session CG: N/A</p> <p>Delivery IG: Computer CG: N/A</p>			<p>% followup, @ 6mo IG: 82.6, p=0.02 CG: 74.2</p>	<p>Sunburn is included in sun protective behavior score, NR separately</p>	<p>NR</p>	<p>Use of sunscreen is included in sun protective behavior score, NR separately</p>

Appendix B Table 1. Evidence Table for Effectiveness and Adverse Effects of Counseling for Sun Protective Behaviors

Study reference, USPSTF quality rating	Behavioral outcomes: sunlamps and tanning bed avoidance	Composite behavioral outcomes	Other behavioral outcomes	Adverse outcomes	Other positive outcomes	Comments
Adults						
Glazebrook 2006 ⁴⁶ Fair	NR	<p>Sun protection behavior score (8-item, range 0-8 with higher scores indicating safer behavior) @ 6mo</p> <p>Mean score (SD), pre-, post- (complete case analysis), post- (missing values imputed) IG: 4.60 (1.82); 5.70 (1.51); 5.36 (1.72) CG: 4.66 (1.55), 5.30 (1.57); 5.06 (1.59)</p> <p>Mean difference between IG and CG [95%CI] Complete case analysis: 0.33 [0.09, 0.57], p=0.007 Missing values at followup replaced by baseline values: 0.30 [0.10, 0.51], p=0.004</p>	# of participants checking moles	Specific harms not mentioned, no paradoxical behavior change	Melanoma knowledge, perceived risk	No financial incentives
Study reference, USPSTF quality rating	Study design, Location, Population	Participant inclusion/exclusion criteria	Baseline demographics		Intervention theory description	
Adults						
Geller 2006 ⁵⁰ Fair	<p>Study Design Cluster RCT by sibship</p> <p>Location Home-based by phone, but patient recruited through dermatologists at teaching hospitals (Boston University) Boston area, MA</p> <p>Population Adult siblings of melanoma patients</p>	<p>Inclusion At least 18 years old, being contacted by the 'case' relative</p> <p>Exclusion Current or previous diagnosis of melanoma</p>	<p>N Randomized Total: 494 IG: 237 CG: 257</p> <p>Age % age 18-50 years Total: 58.3 (c) IG: 55.7 CG: 60.6%</p> <p>Male Total: 46.6 IG: 48.1 CG: 45.1</p> <p>Race % White Total: 100%</p> <p>SES Highest educational level (% with at least some college) Total: 76.7 IG: 75.6 CG: 78.0</p> <p>Sun sensitivity Skin type (% fair skin) Total: 84.8 IG: 81.3 CG: 88.0</p>		Intervention based on Social Cognitive Theory, Theory of Planned Behavior, the Health Belief Model, the Precaution Adoption Model, and the Transtheoretical Model	

Appendix B Table 1. Evidence Table for Effectiveness and Adverse Effects of Counseling for Sun Protective Behaviors

Study reference, USPSTF quality rating	Study intervention			Follow-up	Intermediate outcomes	Behavioral outcomes: sun avoidance, sun protection	Behavioral outcomes: sunscreen use
Adults							
Geller 2006 ⁵⁰ Fair	Intervention IG: Initial motivational and goal-setting phone intervention by health educator, computer generated tailored print materials with 3 phone counseling sessions by health educator timed to follow receipt of mailed materials, and linkages to free screening programs CG: Usual care (receipt of written nontailored study materials after completion of 12-month survey) Format IG: Individual phone counseling with computer support CG: N/A Intensity IG: Four 10-15 minute counseling sessions at 0, 1, 3, and 5 months CG: N/A Delivery IG: Health educator (by phone) and computer system CG: N/A			% followup@ 6mo Total: 81.6 IG: 81.9 CG: 81.3 @ 12mo Total: 63.6 IG: 62.9 CG: 64.2	NR	% tanned by end of last summer @ 6mo IG: 36.8 CG: 38.0 @ 12mo IG: 25.7 CG: 35.6 Odds ratio, adjusted [95% CI] 0.72 [0.47, 1.09]	% routinely use sunscreen with SPF15+ @ 6mo IG: 66.7 CG: 64.4 @ 12mo G: 67.4 CG: 66.1 Odds ratio, adjusted [95% CI] 0.96 [0.67, 1.38]
	Behavioral outcomes: sunlamps and tanning bed avoidance	Composite behavioral outcomes	Other behavioral outcomes	Adverse outcomes	Other positive outcomes	Comments	
NR	NR	Skin self-exam and dermatologic skin exam	Specific harms not mentioned, no paradoxical behavior change	Melanoma knowledge, attitudes (confidence, intentions)	Unclear generalizability of siblings with melanoma to general PC population. Minimal financial incentives		
Study reference, USPSTF quality rating	Study design, Location, Population	Participant inclusion/ exclusion criteria	Baseline demographics			Intervention theory description	
Adults							
Prochaska 2005 ⁵¹ Fair	Study Design RCT Location Home-based by phone, but patients recruited through large health insurance organization from 79 non-hospital based primary care practices (family medicine, internal medicine, obstetrics/gynecology)	Inclusion Patients of participating primary care practices, persons at risk (defined as being in precontemplation, contemplation, or preparation stage of change) for at least one of the four health risk behaviors targeted for intervention in the study, women over 50 years could be eligible even if they were in action or maintenance stage for mammography screening because of risk of relapse Exclusion NR	N Randomized Total: 5407, subset of 3834 at risk for sun exposure IG: 2667, subset of 1822 CG: 2740, subset of 2012 Mean age (SD) Total: 44.7 (12.7) IG: 45.8 (13.2) CG: 44.2 (12.5) % Male Total: 30.1 IG: 30.1 CG: 30.1 Race % White Total: 96.7 IG: 96.4 CG: 97.3 SES Mean education, years (SD) Total: 14.5 (3.2) IG: 14.5 (3.2) CG: 14.5 (3.2) Sun sensitivity Total: NR % in precontemplation stage of change for sun exposure			Expert System Intervention, stage-based tailored communications targeting multiple health behavior changes based on the transtheoretical model	

Appendix B Table 1. Evidence Table for Effectiveness and Adverse Effects of Counseling for Sun Protective Behaviors

			Total: 32.1 % in contemplation stage of change for sun exposure Total: 23.9 % in preparation stage of change for sun exposure Total: 44.0			
Study reference, USPSTF quality rating	Study intervention	Followup	Intermediate outcomes	Behavioral outcomes: sun avoidance, sun protection	Behavioral outcomes: sunscreen use	
Adults						
Prochaska 2005⁵¹ Fair	Intervention IG: Phone and written survey assessments with mailed printed tailored feedback using computerized support (3), intervention materials provided for each risk only when subject was identified as at-risk; for reducing sun exposure, focused on limiting sun exposure to 15 min or always using SPF 15 or higher sunscreen CG: Assessment only Format IG: Phone or written assessment followed by tailored feedback generated using expert system computer support CG: N/A Intensity IG: Assessments of unknown duration at 0, 6, 12 and 24 months, 6 and 12 month assessments were mailed (non-responders, ~70% were surveyed by phone), 3 to 5 page mailed feedback reports divided into 5 sections CG: Only had assessments at 0, 12 and 24 months Delivery IG: Assessors (by phone), and computer system CG: N/A	% followup @12mo IG: 75 CG: 82 @ 24mo IG: 71 CG: 78	NR	Sun avoidance subscale of Sun Protection Behavior Scale (subset of n=3834) Mean raw score (SD) @ baseline, 12, 24 mo IG: 12.7 (3.6), 13.5 (3.5), 13.7 (3.5) CG: 12.4 (3.7), 12.9 (3.6), 12.9 (3.6) p<0.005	Sunscreen use subscale of Sun Protection Behavior Scale (subset of n=3834) Mean raw score (SD) @ baseline, 12, 24 mo IG: 8.6 (3.9), 9.8 (3.8), 10.0 (3.9) CG: 8.5 (3.9), 8.9 (3.9), 9.2 (3.9) p<0.0001	
	Behavioral outcomes: sunlamps and tanning bed avoidance	Composite behavioral outcomes	Other behavioral outcomes	Adverse outcomes	Other positive outcomes	Comments
	NR	NR	Movement to the action and maintenance stage of change	Specific harms not mentioned, no paradoxical behavior change	NR	Expert system NOT widely available. There appears to be a larger study context ongoing with practice level intervention
Study reference, USPSTF quality rating	Study design, Location, Population	Participant inclusion/exclusion criteria	Baseline demographics		Intervention theory description	
Adults						
Prochaska 2004⁵² Fair	Study Design RCT Location Home-based by phone, but participants recruited through schools (parents of 9th graders) Population Parents of teenagers	Inclusion Parents (of 9th graders) at risk (defined as being in precontemplation, contemplation, or preparation stage of change) for at least one of the three health risk behaviors targeted for intervention in the study Exclusion NR	N Randomized Total: 2460, subset of 1802 at risk for sun exposure IG: 1209, subset of 863 CG: 1251, subset of 939 Mean age (SD) Total: 42.5 (5.5) IG: 42.7 (5.7) CG: 42.4 (5.4) % Male Total: 25 IG: 24 CG: 25 Race % White Total: 92 IG: 93		Expert System Intervention, stage-based tailored communications targeting multiple health behavior changes based on the transtheoretical model	

Appendix B Table 1. Evidence Table for Effectiveness and Adverse Effects of Counseling for Sun Protective Behaviors

				CG: 91 SES Mean education, years (SD) Total: 14 (3.2) IG: 14 (3.1) CG: 14 (3.2) Sun sensitivity Total: NR % in precontemplation stage of change for sun exposure Total: 36 % in contemplation stage of change for sun exposure Total: 20 % in preparation stage of change for sun exposure Total: 44		
Study reference, USPSTF quality rating	Study intervention	Follow-up	Intermediate outcomes	Behavioral outcomes: sun avoidance, sun protection	Behavioral outcomes: sunscreen use	
Adults						
Prochaska 2004⁵² Fair	Intervention IG: Phone and written survey assessments with subsequent mailed printed tailored feedback using computerized support (3), intervention materials were provided for each risk only when the subject was identified as at-risk; for reducing sun exposure, focused on limiting sun exposure to 15 minutes or always using SPF 15 or higher sunscreen CG: Assessment only Format IG: Phone or written assessment followed by tailored feedback generated using expert system computer support CG: N/A Intensity IG: Assessments of unknown duration at 0, 6, 12 and 24 months, 6 and 12 month assessments were mailed (non-responders were surveyed by phone), 3 to 5 page mailed feedback reports divided into 5 sections CG: Only had assessments at 0, 12 and 24 months Delivery IG: Assessors (by phone), and computer system CG: N/A Other components (multimodal) See computerized support as described above	% followup @ 12mo IG: 71 CG: 78 @ 24mo IG: 67 CG: 74	NR	Sun avoidance subscale of Sun Protection Behavior Scale (subset of n=1784) Mean raw score (SD) @ baseline, 12, 24 mo IG: 12.65 (3.86), 13.71 (3.52), 13.99 (3.39) CG: 12.60 (3.90), 13.22 (3.64), 13.35 (3.73) p for interaction term, p>0.05	Sunscreen use subscale of Sun Protection Behavior Scale (subset of n=1781) Mean raw score (SD) @ baseline, 12, 24 mo IG: 8.32 (4.00), 9.96 (3.87), 10.21 (3.94) CG: 8.16 (3.99), 9.29 (3.98), 9.18 (3.82) p for interaction term, p<0.05	
	Behavioral outcomes: sunlamps and tanning bed avoidance	Composite behavioral outcomes	Other behavioral outcomes	Adverse outcomes	Other positive outcomes	
	NR	NR	Movement to the action and maintenance stage of change	Specific harms not mentioned, no paradoxical behavior change	NR	
					Comments Expert system NOT widely available. These are parents of adolescents involved in another study by Prochaska.	

Appendix B Table 1. Evidence Table for Effectiveness and Adverse Effects of Counseling for Sun Protective Behaviors

Study reference, USPSTF quality rating	Study design, Location, Population	Participant inclusion/exclusion criteria	Baseline demographics		Intervention theory description
<i>Young adults</i>					
Hillhouse 2008 ⁴⁹ Fair	Study Design RCT Location Two universities, US Population Female students (young adults) who reported indoor tanning	Inclusion Female university students who tanned indoors last year or reported an indoor tanning score of 5+ (7-point scale that measured intentions to tan in the next year) on an email screening survey Exclusion NR	N randomized (analyzed) Total: 430 (412) IG: 200 (195) CG: 230 (217) Mean age (SD) Total: NR IG: 18.6 (0.74) CG: 18.7 (0.82) % Male Total: 0 Race % White: NR SES Family SES (% below average) Total: NR IG: 11.9 (c) CG: 11.1 (c) Sun sensitivity % Fitzpatrick skin type I or II Total: NR IG: 34.6 (c) CG: 27.6 (c)		Appearance-focused interventions based on decision-theoretical models of health behaviors and the Jaccard behavioral alternative model to reduce indoor tanning behavior.
Study intervention		Follow-up		Intermediate outcomes	Behavioral outcomes: sun avoidance, sun protection
Intervention IG: Professionally produced booklet with 5 sections: history of tanning and context for tanning norms, analysis of tanning norms and media/peer image norms, effects of UV radiation on skin, effects of indoor tanning, and indoor tanning guidelines emphasizing tanning abstinence as well as harm reduction CG: Assessment only, details NR Format IG: Self-directed booklet CG: N/A Intensity IG: N/A CG: N/A Delivery IG: Self-administered CG: N/A		% followup, @ 6mo IG: 97.5 CG: 94.3		NR	NR
Behavioral outcomes: sunlamps and tanning bed avoidance		Composite behavioral outcomes	Other behavioral outcomes	Adverse Outcomes	Other positive outcomes
Means (SE) of indoor tanning in past 3 months , pre-, post- @ 6mo IG: 4.67 (0.60); 6.80 (0.93) CG: 4.48 (0.55), 10.90 (0.93) P<0.001		NR	NR	Specific harms not mentioned, no paradoxical behavior change	Intention to use indoor tanning, attitudes toward tanning alternatives, and beliefs about tanning and image norms
					Comments \$20 incentive for completed assessments

Appendix B Table 1. Evidence Table for Effectiveness and Adverse Effects of Counseling for Sun Protective Behaviors

Study reference, USPSTF quality rating	Study design, Location, Population	Participant inclusion/exclusion criteria	Baseline demographics	Intervention theory description																																																																					
<i>Young adults</i>																																																																									
Mahler 2007 ⁵³ Fair	<p>Study Design RCT</p> <p>Location University, US</p> <p>Population Undergraduate students</p>	<p>Inclusion At least 18 years old, participants signed up through the Psychology Department participant pool</p> <p>Exclusion Graduating seniors</p>	<p>N Randomized Total: 133 IG (UV photo plus video): 30 IG (UV photo only): 35 IG (video only): 34 CG (no photo or video): 34</p> <p>Mean Age (SD) Total: 20.13 (3.38) Range (18-44 yrs)</p> <p>% Male: 19.5</p> <p>Race % White Total: 45%</p> <p>Family history of skin cancer Total: 27.1%</p> <p>Sun sensitivity NR</p>	Appearance-focused intervention, theory not specified																																																																					
	<p>Study intervention</p> <p>Intervention IG (video): 11-min videotape slide show depicting photo-aging, how UV exposure leads to photoaging, and effective practices for minimizing photoaging (protective clothing, minimum SPF 15 sunscreen) IG (UV photo): UV facial photographs using instant camera modified to include a 315- to 390-mmUV filter and natural-light instant photo</p> <p>Format IG: Individual or in pairs (with partition) CG: Assessment only</p> <p>Intensity IG (video): One session, 11-min videotape slide show IG (UV photo): One session, details NR CG: Details NR</p> <p>Delivery IG/CG: Details NR</p>	<p>Follow-up % followup @ ~5 mo 85% @ 12mo 80% for self-reported behaviors but only 70% for spectrophotometry readings</p> <p>63% had both follow-ups</p> <p>Follow-up by group(s) NR</p>	<p>Intermediate outcomes NR</p>	<p>Behavioral outcomes: sun avoidance, sun protection</p> <p>Results presented for photoaging video groups (n=38) vs. no video groups (n=46) and UV photo (n=42) vs. no photo (n=42) at 12 months Skin color using skin reflectance spectrophotometry (b* higher is more tan; L* higher is lighter, , exact numbers NR)</p> <table border="1"> <thead> <tr> <th></th> <th>Video</th> <th>No video</th> <th>p-value</th> </tr> </thead> <tbody> <tr> <td>Higher exposure site, b* scale</td> <td>0.82 (0.28)</td> <td>0.90 (0.25)</td> <td>NS</td> </tr> <tr> <td>Lower exposure site, b* scale</td> <td>0.32 (0.28)</td> <td>0.39 (0.25)</td> <td>NS</td> </tr> <tr> <td>Higher exposure site, L* scale</td> <td>~ 1.6 (NR)</td> <td>~ -0.6 (NR)</td> <td>sig</td> </tr> <tr> <td>Lower exposure site, L* scale</td> <td>~ 2.3 (NR)</td> <td>~ 0.9 (NR)</td> <td>sig</td> </tr> <tr> <td>Photo</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Higher exposure site, b* scale</td> <td>1.03 (0.26)</td> <td>0.69 (0.26)</td> <td>NS</td> </tr> <tr> <td>Lower exposure site, b* scale</td> <td>0.51 (0.26)</td> <td>0.21 (0.26)</td> <td>NS</td> </tr> <tr> <td>Higher exposure site, L* scale</td> <td>~ 0.9 (NR)</td> <td>~ 0.2 (NR)</td> <td>NS</td> </tr> <tr> <td>Lower exposure site, L* scale</td> <td>~ 2.1 (NR)</td> <td>~ 1.1 (NR)</td> <td>NS</td> </tr> <tr> <td>Sun exposure z-scores adjusted for baseline (SE)</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Video</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Intentional exposure</td> <td>-0.12 (0.16)</td> <td>0.10 (0.14)</td> <td>NS</td> </tr> <tr> <td>Incidental exposure</td> <td>-0.23 (0.16)</td> <td>0.28 (0.15)</td> <td>sig</td> </tr> <tr> <td>Photo</td> <td></td> <td></td> <td></td> </tr> <tr> <td>Intentional exposure</td> <td>0.21 (0.15)</td> <td>-0.24 (0.15)</td> <td>NS</td> </tr> <tr> <td>Incidental exposure</td> <td>0.15 (0.15)</td> <td>-0.11 (0.15)</td> <td>NS</td> </tr> </tbody> </table>		Video	No video	p-value	Higher exposure site, b* scale	0.82 (0.28)	0.90 (0.25)	NS	Lower exposure site, b* scale	0.32 (0.28)	0.39 (0.25)	NS	Higher exposure site, L* scale	~ 1.6 (NR)	~ -0.6 (NR)	sig	Lower exposure site, L* scale	~ 2.3 (NR)	~ 0.9 (NR)	sig	Photo				Higher exposure site, b* scale	1.03 (0.26)	0.69 (0.26)	NS	Lower exposure site, b* scale	0.51 (0.26)	0.21 (0.26)	NS	Higher exposure site, L* scale	~ 0.9 (NR)	~ 0.2 (NR)	NS	Lower exposure site, L* scale	~ 2.1 (NR)	~ 1.1 (NR)	NS	Sun exposure z-scores adjusted for baseline (SE)				Video				Intentional exposure	-0.12 (0.16)	0.10 (0.14)	NS	Incidental exposure	-0.23 (0.16)	0.28 (0.15)	sig	Photo				Intentional exposure	0.21 (0.15)	-0.24 (0.15)	NS	Incidental exposure	0.15 (0.15)	-0.11 (0.15)	NS	<p>Behavioral outcomes: sunscreen use NR</p>
	Video	No video	p-value																																																																						
Higher exposure site, b* scale	0.82 (0.28)	0.90 (0.25)	NS																																																																						
Lower exposure site, b* scale	0.32 (0.28)	0.39 (0.25)	NS																																																																						
Higher exposure site, L* scale	~ 1.6 (NR)	~ -0.6 (NR)	sig																																																																						
Lower exposure site, L* scale	~ 2.3 (NR)	~ 0.9 (NR)	sig																																																																						
Photo																																																																									
Higher exposure site, b* scale	1.03 (0.26)	0.69 (0.26)	NS																																																																						
Lower exposure site, b* scale	0.51 (0.26)	0.21 (0.26)	NS																																																																						
Higher exposure site, L* scale	~ 0.9 (NR)	~ 0.2 (NR)	NS																																																																						
Lower exposure site, L* scale	~ 2.1 (NR)	~ 1.1 (NR)	NS																																																																						
Sun exposure z-scores adjusted for baseline (SE)																																																																									
Video																																																																									
Intentional exposure	-0.12 (0.16)	0.10 (0.14)	NS																																																																						
Incidental exposure	-0.23 (0.16)	0.28 (0.15)	sig																																																																						
Photo																																																																									
Intentional exposure	0.21 (0.15)	-0.24 (0.15)	NS																																																																						
Incidental exposure	0.15 (0.15)	-0.11 (0.15)	NS																																																																						

Appendix B Table 1. Evidence Table for Effectiveness and Adverse Effects of Counseling for Sun Protective Behaviors

Study reference, USPSTF quality rating	Behavioral outcomes: sunlamps and tanning bed avoidance	Composite behavioral outcomes	Other behavioral outcomes	Adverse outcomes	Other positive outcomes	Comments	
Young adults							
Mahler 2007 ⁵³ Fair	NR	Sun protection behavior score z-scores adjusted for baseline (SE) Video no video p-value Index -0.02 (0.10) -0.07 (0.09) NS Photo no photo p-value Index -0.05 (0.09) 0.03 (0.09) NS	Cognitive mediators	Specific harms not mentioned, no paradoxical behavior change	NR	Participants received course credit. Analyses not presented with true control, authors state "none of the primary analyses indicated any significant interactions between the two interventions." Use of Cohen d statistic to help interpret effect size.	
Study reference, USPSTF quality rating	Study design, Location, Population	Participant inclusion/exclusion criteria	Baseline demographics			Intervention theory description	
Adolescents							
Norman 2007 ⁵⁴ Fair	Study Design RCT Location 6 primary care clinics and patient homes, San Diego, CA Population Adolescents aged 11-15	Inclusion Age 11-15 years attending primary care, parental consent Exclusion Health conditions that would limit participation with physical activity or diet recommendations	N Randomized Total: 819 IG: 395 CG: 424 Mean Age (SD) Total: 12.7 (1.3) IG: 12.7 (1.4) CG: 12.7 (1.3) % Male Total: 46.5 IG: 45.3 CG: 47.6 Race % White Total: 58.4 IG: 62.3 CG: 54.7 SES Highest household educational level (% with graduate/professional degree) Total: 36.7 IG: 40.0 CG: 33.7 Sun sensitivity (% with high sensitivity) Total: 25.2 IG: 26.8 CG: 23.6	Sun Smart expert system based on the Social Cognitive Theory and the Transtheoretical Model and included assessment and feedback of the stage of change, decisional balance, self-efficacy, and the processes of change			
	Study intervention	Follow-up	Intermediate outcomes	Behavioral outcomes: sun avoidance, sun protection		Behavioral outcomes: sunscreen use	
	Intervention IG: Brief counseling by primary care providers, interactive computer sessions, phone assessments, printed tailored feedback, a brief printed manual, mailed tip sheets, and samples of SPF 15 sunscreen CG: Physical activity and diet intervention (physical activity, sedentary behavior, total intake of fat, and servings per day of fruits and vegetables) with computerized expert system kiosk in primary care provider's office, monthly phone calls,	% follow-up @ 6mo IG: 93.9 CG: 86.1 @ 12mo IG: 75.2 CG: 83.3 @ 24mo IG: 79.7	NR	Sun Protection Behavior Scale @ 6, 12, and 24 mo adjusted sample means: IG with statistically significant increase in sun protection scores compared with CG, with trajectory of scores flattening (but still statistically significant) between 12 and 24 months Sun protection behaviors @ 24 mo		Sun protection behaviors @ 24 mo % response "often" or "always" Use sunscreen? IG: ~55, NS CG: ~48 Use sunscreen on face? IG: ~62, CI do not overlap	

Appendix B Table 1. Evidence Table for Effectiveness and Adverse Effects of Counseling for Sun Protective Behaviors

	a printed manual, and mail contact Format IG: Individual counseling coupled with expert system computer support CG: Expert system computer support Intensity IG: 2 to 3 minute counseling session, initial 20 minute Sun Smart assessment with 2 page feedback report, and subsequent 3-, 6-, 15-, and 18-month phone followup CG: No counseling session, otherwise matched intensity Delivery IG: Primary care provider (in person), health counselors (by phone), and computer system CG: Health counselors (by phone), and computer system	CG: 80.4		% response "often" or "always" Wear a shirt? IG: ~84, NS CG: ~85 Stay in shade? IG: ~44, NS CG: ~45 Avoid sun exposure midday? IG: ~40, CI do not overlap CG: ~30 Limit sun exposure midday? IG: ~38, CI do not overlap CG: ~31	CG: ~48 Use sunscreen on all sun exposed areas? IG: ~56, CI do not overlap CG: ~40	
Study reference, USPSTF quality rating	Behavioral outcomes: sunlamps and tanning bed avoidance	Composite behavioral outcomes	Other behavioral outcomes	Adverse outcomes	Other positive outcomes	Comments
<i>Adolescents</i>						
Norman 2007 ⁵⁴ Fair	NR	NR	Movement to the action and maintenance stage of change	Specific harms not mentioned, no paradoxical behavior change	NR	Expert system NOT widely available. Financial incentive for completed assessments.
Study reference, USPSTF quality rating	Study design, Location, Population		Participant inclusion/exclusion criteria		Baseline demographics	Intervention theory description
<i>Adolescents</i>						
Patrick 2006 ⁵⁵	For the purposes of analyzing harms this study is a prospective cohort (one arm of a RCT)		see Norman 2007		see Norman 2007	see Norman 2007
Rosenberg 2007 ⁵⁶	Study intervention	Follow-up	Intermediate outcomes	Behavioral outcomes: sun avoidance, sun protection	Behavioral outcomes: sunscreen use	
	see Norman 2007	see Norman 2007	see Norman 2007	see Norman 2007	see Norman 2007	
	Behavioral outcomes: sunlamps and tanning bed avoidance	Composite behavioral outcomes	Other behavioral outcomes	Adverse outcomes	Other positive outcomes	Comments
	see Norman 2007	see Norman 2007	see Norman 2007	12 mo followup Sedentary behaviors, mean hours/day (SD) <i>girls, pre, post, % change</i> IG (skin cancer): 4.2 (3.4), 4.4 (3.7), 4.8% CG (physical activity): 4.3 (3.4), 3.4 (2.6), -21% <i>boys, pre, post, % change</i> IG (skin cancer): 4.2 (2.8), 4.3 (3.5), 2.4% CG (physical activity): 4.2 (3.7), 3.2 (2.6), -24% 7 Day Physical Activity Recall (moderate and vigorous activity), mean minutes/week (SD) <i>girls, pre, post, % change</i> IG (skin cancer): 284.3 (45.8), 313.9 (62.2), 10.4% CG (physical activity): 316.1 (49.2), 324.6 (61.5), 2.7% <i>boys, pre, post, % change</i> IG (skin cancer): 374.0 (55.0), 419.8 (79.2), 12.2% CG (physical activity): 418.4 (54.5), 486.0 (75.3), 16.2% Active, mean days/week (SD) <i>girls, pre, post, % change</i> IG (skin cancer): 3.1 (2.0), 3.3 (2.1), 0.06% CG (physical activity): 3.3 (2.1), 3.4 (2.1), 0.03% <i>boys, pre, post, % change</i> IG (skin cancer): 3.8 (2.1), 3.8 (2.1), 0% CG (physical activity): 4.1 (2.0), 4.4 (2.1), 7.3%	see Norman 2007	Article is same study reported in Norman 2007, but using skin cancer counseling intervention as the control. It is included because it reports on physical activity related outcomes, which were considered as potential harms. Reports outcomes by sex. Rosenberg 2007 reports on the covariation among changes in diet-ary, physical activity, and sedentary behaviors and showed that there was little covariation within or between diet, physical activity, and sedentary behavior domains.

Appendix B Table 1. Evidence Table for Effectiveness and Adverse Effects of Counseling for Sun Protective Behaviors

Study reference, USPSTF quality rating	Study design, Location, Population	Participant inclusion/exclusion criteria	Baseline demographics			Intervention theory description	
<i>Children and parents</i>							
Crane 2006 ⁴⁵ Fair	<p>Study Design Cluster RCT (by office)</p> <p>Location 14 primary care offices of a large managed care organization, Denver/Boulder, CO</p> <p>Population Parents and their infants</p>	<p>Inclusion Parents of children born April to September 1998, parents whose children had dark skin, eye, and hair color were informed that the program may be of minimal benefit to their child</p> <p>Exclusion NR</p>	<p>N, parents and their infants Total: 728 (c) IG: 363 CG: 365</p> <p>Age, of parents (c) % age 20-29 years Total: 29.7 IG: 28.4 CG: 31.0 % age 30-39 years Total: 58.9 IG: 59.2 CG: 58.6</p> <p>% Male, of infants, (<2% male of parents) Total: 50.3 (c) IG: 52.1 CG: 48.5</p> <p>Race, of infants (180 missing), of parents % White Total: 81.9, 76.1 (c) IG: 79.8, 76.0 CG: 84.1, 76.2</p> <p>SES Parent's highest educational level (% with graduate/professional degree) (c) Total: 42.4 IG: 43.8 CG: 41.1</p> <p>Sun sensitivity % with fair to medium white skin, of infants, of parents (c) Total: 78.3, 75.5 IG: 76.9, 77.1 CG: 79.7, 74.0 % with painful burn, no to light tan a week later, of parents (c) Total: 39.8 IG: 40.2 CG: 39.5</p>			<p>Sun protection promotion (Kaiser Kids Sun Care Program) based on informational, expert, and legitimate power of health care providers and the Health Belief Model, designed to be delivered at well-child visits between 2 and 36 months</p>	
	Study intervention	Follow-up	Intermediate outcomes	Behavioral outcomes: sun avoidance, sun protection	Behavioral outcomes: sunscreen use		
	<p>Intervention IG: Assessment and counseling by primary care providers using anticipatory guidance messages (provider orientations, boosters at luncheon meetings) + packets of information for parents including tote bag, sun hat, Skin Cancer Foundation brochures, magnet, age specific tip sheets, sunscreen samples (SPF 30), and UV protective sunglasses CG: usual care, anticipatory guidance at 6 month visit included prompt to discuss sunscreen use, offices were not given provider orientations and boosters</p> <p>Format IG: Counseling, packets of information, and samples for</p>	<p>% followup @ 12mo Total: 86.0 @ 24mo Total: 81.7 @ 36mo Total: 75.3 Completed all 3 follow-ups Total: 64.4 Skin exam @ 36mo Total: 38.5</p>	<p>Tanning (mean difference in b color space between exposed and non-exposed skin) IG: 4.2, p=0.14 CG: 4.6 % with freckling IG: 12.8, p=0.20 CG: 17.1 # of nevi IG: 6.30, p=0.56 CG: 5.64</p>	<p>% response "frequently" or "always" @ 12, 24 and 36 mo clothing use? IG: 51.0, 38.4, 24.2, p=0.22 CG: 43.8, 32.4, 25.5 Midday sun avoidance? IG: 70.6, 63.2, 64.2, p=0.14 CG: 64.9, 62.0, 59.0 Limit time in sun? IG: 48.9, 38.1, 32.1, p=0.97 CG: 47.5, 35.4, 34.3 Shade use? IG: 90.0, 79.2, 72.6, p=0.03</p>	<p>% response "frequently" or "always" @ 12, 24 and 36 mo sunscreen use? IG: 90.0, 92.4, 94.2, p=0.46 CG: 87.9, 92.2, 93.1</p>		

Appendix B Table 1. Evidence Table for Effectiveness and Adverse Effects of Counseling for Sun Protective Behaviors

	parents CG: Usual care Intensity IG: 4 well-child visits (@2, 6, 18, 36 mo) with counseling at discretion of provider, packets of information and samples CG: Usual care at well-child visits Delivery IG: Primary care provider (pediatrician or family physician) CG: Primary care provider (pediatrician or family physician)			CG: 87.3, 71.9, 65.2 Hat use? IG: 61.9, 61.9, 57.3, p=0.08 CG: 60.8, 56.1, 47.4 Sunglasses use? IG: 5.2, 24.2, 39.4, p=0.22 CG: 8.3, 22.3, 29.9		
Study reference, USPSTF quality rating	Behavioral outcomes: sunlamps and tanning bed avoidance	Composite behavioral outcomes	Other behavioral outcomes	Adverse outcomes	Other positive outcomes	Comments
Children and parents						
Crane 2006 ⁴⁵ Fair	NR	Sun protection practice score @ 12mo IG: 18.55, NS CG: 18.40 @ 24mo IG: 18.52, p=0.04 CG: 18.05 @ 36mo IG: 18.18, p=0.05 CG: 17.71 p=0.04 for overall trend	Provider delivery of sun protection advice	Specific harms not mentioned, no paradoxical behavior change	NR	No financial incentives
Study reference, USPSTF quality rating	Study design, Location, Population	Participant inclusion/exclusion criteria	Baseline demographics		Intervention theory description	
Multicomponent interventions						
Olson 2007 ⁴⁸	Study Design Cluster RCT (by school) Location 10 geographically-distinct towns in New Hampshire and Vermont Population Children entering grades 6 to 8 at beaches or swimming pools	Inclusion Towns: separated by at least 20 miles, had not participated in earlier SunSafe project, middle school with grades 6-8 within 1 building, at least 1 primary care practice, freshwater beach or town swimming pool used primarily by local residents Evaluation subjects: children entering grades 6-8 who were at community beaches and swimming pools or attending a school-sponsored function with water activities between 11 am and 3 pm from June to August 2000 Exclusion NR	Baseline N, adolescents Total: 797 (c) IG: 357 (c) CG: 440 (c) Age % in 6th, 7th, and 8th grade Total: 98, 1, 1 IG: 97, 2, 1 CG: 98, 1, 1 % Male Total: 43 (c) IG: 44 CG: 42 Race % White: 94% of all middle school students SES NR Sun sensitivity % usually or always burn Total: 28 (c) IG: 28 (c) CG: 28 (c)	Follow up: 1 yr, 2 yr N, adolescents Total: 637, 493 (c) IG: 404, 352 (c) CG: 233, 141 (c) Age % in 6th, 7th, and 8th grade Total: 1 yr: 0, 90, 10 (c) 2 yr: 0, 0, 100 (c) IG: 1 yr: 0, 89, 11 2 yr: 0, 0, 100 CG: 1 yr: 0, 93, 7 2 yr: 0, 0, 100 % Male Total: 46, 45 (c) IG: 48, 44 CG: 43, 50 Race % White: 94% of all middle school students SES NR Sun sensitivity % usually or always burn Total: 33, 27 (c) IG: 32, 25 (c) CG: 36, 31 (c)	SunSafe multicomponent intervention aimed to (1) educate and activate adults and peers to role model and actively promote sun-protection practices and (2) create a pro-sun protection community environment Targeted school personnel, athletic coaches, lifeguards, and clinicians through schools, athletic and recreational facilities, primary care practices, and other community venues Program materials and training for adult role models emphasized protecting themselves and being an effective role model and educator for teens; teen materials emphasized being protected while having outdoor fun; community environmental cues used to increase awareness of sun protection Socioecologic approach of intervention based on social cognitive theory and education sessions for students and adult role models based on protection motivation theory	

Appendix B Table 1. Evidence Table for Effectiveness and Adverse Effects of Counseling for Sun Protective Behaviors

Study reference, USPSTF quality rating	Study intervention	Follow-up	Intermediate outcomes	Behavioral outcomes: sun avoidance, sun protection	Behavioral outcomes: sunscreen use	
Multicomponent interventions						
<p>Olson 2007⁴⁸</p>	<p>Intervention IG: <u>Primary care practices</u>: clinician training focused on incorporating sun-protection messages into well visits, patient-education materials, posters, temporary tattoos; <u>Schools</u>: curricular activities including EPA's SunWise curricular materials, interactive slide show about UV radiation, skin cancer, and sun-protection strategies, Dermascan viewing, peer-education activities led by 8th- to 12th-grade students; <u>Athletic and recreational facilities</u>: sun protection promotion including pool announcements, sun-protection breaks, team hat/sunscreen policy; <u>Community venues</u>: SunSafe bookmarks at libraries, sun protection posters in local stores CG: no intervention</p> <p>Format IG: Individual counseling during well visits (primary care practices), classroom curriculum and group activities (schools), announcements and team policies (athletic and recreational facilities), posted information (community venues) CG: N/A</p> <p>Intensity IG: NR (primary care practices), curriculum intensity NR, 45-minute group activity, at least 3 activities led by "sun team" (schools), NR (athletic and recreational facilities), N/A (community venues) CG: N/A</p> <p>Delivery IG: Primary care provider (in person), teachers, 8th- to 12-grade students, athletic coaches and lifeguards CG: N/A</p>	<p>N/A: different sample of children at follow-up</p>	<p>NR</p>	<p>Body surface area covered (by direct observation and interview) Adjusted mean percentage (SE) @ baseline and 2 yr follow up IG: 71.8 (1.6), 66.1 (1.5) CG: 73.7 (1.4), 56.8 (2.3) p<0.01 for difference in means at 24 mos</p> <p>Means adjusted for gender, skin reaction to sun, UV level, year of observation, and temperature</p>	<p>Any sunscreen use % @ baseline, 1 yr follow-up, 2 yr follow up IG: 58.0, 47.0, 47.0 CG: 65.8, 59.6, 13.8 p value: <0.05, <0.01, <0.001</p>	
	<p>Behavioral outcomes: sunlamps and tanning bed avoidance</p>	<p>Composite behavioral outcomes</p>	<p>Other behavioral outcomes</p>	<p>Adverse outcomes</p>	<p>Other positive outcomes</p>	<p>Comments</p>
	<p>NR</p>	<p>NR</p>	<p>Predictors of sun protection, number of different sources of advice about sun protection reported by adolescents</p>	<p>Specific harms not mentioned, no paradoxical behavior change</p>	<p>NR</p>	<p>All subjects considered baseline in first year, as were subjects entering 6th grade in subsequent years. Subjects entering 7th or 8th grade in the second year were classified as 1 yr follow up, as were subjects entering 7th grade in the third year. Subjects entering 8th grade in the third year were classified as 2 yr follow up.</p>

Appendix B Table 1. Evidence Table for Effectiveness and Adverse Effects of Counseling for Sun Protective Behaviors

Study reference, USPSTF quality rating	Study design, Location, Population	Participant inclusion/exclusion criteria	Baseline demographics		Intervention theory description
			Baseline	Follow-up	
Multicomponent interventions					
Dietrich 1998 ⁴⁷ Dietrich 2000 ¹²⁵ Grant-Petersson 1999 ¹²⁶ Fair	<p>Study Design Cluster RCT (by community)</p> <p>Location 10 geographically-distinct, lower-income towns in New Hampshire</p> <p>Population Children visiting town freshwater beaches and their caregivers</p>	<p>Inclusion Towns: New Hampshire towns with populations of 4,000-15,000 that included at least 500 children ages 2-9 years; at least 20% of households with 1990 incomes below the federal poverty level; at least 1 elementary school, at least 1 nearby primary care practice serving children, and at least 1 nearby Head Start program; and a freshwater beach used primarily by local residents Evaluation Subjects: Children ages 2-9 years visiting town freshwater beaches between 10 am and 3 pm from last week in June to late August 1995 (upper age limit increased to 11 years for follow-up); children living in town or within 8 miles of its border Caregivers: Adults at beach caring for children meeting eligibility criteria Exclusion Towns: Towns that shared any school or recreational areas with towns already selected Evaluation Subjects: Children in water above their knees</p>	<p>N, children Total: 865 (c) IG: 456 CG: 409</p> <p>Age % age <5 years Total: 38 (c) IG: 39 CG: 36 % age ≥5 years Total: 62 (c) IG: 61 CG: 64</p> <p>% Male Total: 52 (c) IG: 55 CG: 49</p> <p>Race % White:NR (implied 99%)</p> <p>SES at least 20% of households with 1990 incomes below federal poverty level</p> <p>Sun sensitivity % burn easily (caregiver report) Total: 54 (c) IG: 54 CG: 54</p>	<p>N, children Total: 1,065 (c) IG: 561 CG: 504</p> <p>Age % age <5 years Total: 28 (c) IG: 26 CG: 31 % age ≥5 years Total: 72 (c) IG: 74 CG: 69</p> <p>% Male Total: 48 (c) IG: 47 CG: 50</p> <p>Race % White: NR (implied 99%)</p> <p>SES at least 20% of households with 1990 incomes below federal poverty level</p> <p>Sun sensitivity % burn easily (caregiver report) Total: 48 (c) IG: 47 CG: 49</p>	<p>SunSafe multicomponent intervention directed at children, their families, and other caregivers through schools, day care centers, primary care practices, and beach areas</p> <p>Modeled after "Slip, Slop, Slap" and SunSmart programs: all intervention components promoted the same message: avoid sun 11 am to 3 pm, cover up using hats and protective clothing, use sun block with SPF ≥15, and encourage sun protection among family and friends</p>
	Study intervention	Follow-up	Intermediate outcomes	Behavioral outcomes: sun avoidance, sun protection	Behavioral outcomes: sunscreen use
	<p>Intervention IG: <u>Primary care practices</u>: sun protection manual for providers, educational materials to enhance counseling, SunSafe tattoos and stickers to offer at well-child and illness visits during summer; <u>Schools and day care centers</u>: age- and grade-specific sun protection curriculum and 1 parent outreach program; <u>Beach areas</u>: poster display (daily UV index and sun protection), educational pamphlets, free sunscreen CG: No intervention</p> <p>Format IG: Individual counseling during well-child and illness visits (primary care practices), classroom curriculum (schools and day care centers), posted information and sunscreen (beach areas) CG: N/A</p> <p>Intensity IG: NR (primary care practices), min 2 class periods (schools and day care centers), N/A (beach areas) CG: N/A</p> <p>Delivery IG: Primary care provider (in person), teachers (in classroom), lifeguards (beach areas) CG: N/A</p>	N/A: different sample of children at follow-up	NR	<p>Any protective clothing (by direct observation) Mean proportions @ baseline, 12 mo IG: 0.30, 0.24 CG: 0.26, 0.18 Difference of change (IG-CG): 0.02, p=0.78</p> <p>Protection by shade (by direct observation) Mean proportions @ baseline, 12 mo IG: 0.14, 0.14 CG: 0.18, 0.24 Difference of change (IG-CG): -0.06, p=0.38</p> <p>All values corrected by age, sex, ease with which child burns, and weather conditions at time of interviews</p>	<p>Sunscreen used on ≥1 body area Mean proportions @ baseline, 12 mo IG: 0.57, 0.75 CG: 0.65, 0.66 Difference of change (IG-CG): 0.17, p=0.011</p> <p>All values corrected by age, sex, ease with which child burns, and weather conditions at time of interviews</p>

Appendix B Table 1. Evidence Table for Effectiveness and Adverse Effects of Counseling for Sun Protective Behaviors

Study reference, USPSTF quality rating	Behavioral outcomes: sunlamps and tanning bed avoidance	Composite behavioral outcomes	Other behavioral outcomes	Adverse outcomes	Other positive outcomes	Comments
Multicomponent interventions						
Dietrich 1998 ⁴⁷ Dietrich 2000 ¹²⁵ Grant-Petersson 1999 ¹²⁶ Fair	NR	Protection on ≥1 body area by sunscreen, clothes, and/or shade Mean proportions @ baseline, 12 mo IG: 0.78, 0.87 CG: 0.85, 0.80 Difference of change (IG-CG): 0.13, p=0.029 Protection on all 3 body areas by any means Mean proportions @ baseline, 12 mo IG: 0.53, 0.74 CG: 0.66, 0.72 Difference of change (IG-CG): 0.15, p=0.18 All values corrected by age, sex, ease with which child burns, and weather conditions at time of interviews	Effect of intervention on subsets of children protected by sunscreen on one or more body areas (age, sex, ease with which child burns)	Specific harms not mentioned, no paradoxical behavior change	NR	Unable to comment on intervention effect of primary care component, this is truly a community based intervention Unclear validity of results at 2y, reported in followup articles Dietrich 2000

Abbreviations: CG=control group; (c)=calculated; IG=intervention group; N/A=not applicable; NR=not reported; SES=socioeconomic status; SPF=sun protection factor.

Appendix B Table 2. Studies Excluded From the Review for Key Question 1

Reference	Reason for Exclusion
Benjes LS, Brooks DR, Zhang Z, et al. Changing patterns of sun protection between the first and second summers for very young children. <i>Arch Dermatol.</i> 2004;140:925-930.	Setting
Brandberg Y, Bergenmar M, Michelson H, et al. Six-month follow-up of effects of an information programme for patients with malignant melanoma. <i>Patient Educ Couns.</i> 1996;28:201-208.	Population
Branstrom R, Ullen H, Brandberg Y. A randomised population-based intervention to examine the effects of the ultraviolet index on tanning behaviour. <i>Eur J Cancer.</i> 2003;39:968-974.	Study design
Brodkin RH, Altman EM. Controlling malignant melanoma. A focus on pediatricians. <i>Am J Dis Child.</i> 1993;147:875-881.	Study relevance
Buller DB, Buller MK, Beach B, et al. Sunny days, healthy ways: evaluation of a skin cancer prevention curriculum for elementary school-aged children. <i>J Am Acad Dermatol.</i> 1996;35:911-922.	Setting
Buller DB, Hall JR, Powers PJ, et al. Evaluation of the "Sunny Days, Healthy Ways" sun safety CD-ROM program for children in grades 4 and 5. <i>Cancer Prev Control.</i> 1999;3:188-195.	Setting
Crane LA, Schneider LS, Yohn JJ, et al. "Block the sun, not the fun": evaluation of a skin cancer prevention program for child care centers. <i>Am J Prev Med.</i> 1999;17:31-37.	Setting
Dey P, Collins S, Will S, et al. Randomised controlled trial assessing effectiveness of health education leaflets in reducing incidence of sunburn. <i>BMJ.</i> 1995;311:1062-1063.	Setting
Dietrich AJ, Olson AL, Sox CH, et al. Sun protection counseling for children: primary care practice patterns and effect of an intervention on clinicians. <i>Arch Fam Med.</i> 2000;9:155-159.	Study relevance
Geller AC, Cantor M, Miller DR, et al. The Environmental Protection Agency's National SunWise School Program: sun protection education in US schools (1999-2000). <i>J Am Acad Dermatol.</i> 2002;46:683-689.	Setting
Geller AC, Sayers L, Koh HK, et al. The New Moms Project: educating mothers about sun protection in newborn nurseries. <i>Pediatr Dermatol.</i> 1999;16:198-200.	Setting
Gerbert B, Wolff M, Tschann JM, et al. Activating patients to practice skin cancer prevention: response to mailed materials from physicians versus HMOs. <i>Am J Prev Med.</i> 1997;13:214-220.	No relevant outcomes
Girgis A, Sanson-Fisher RW, Tripodi DA, et al. Evaluation of interventions to improve solar protection in primary schools. <i>Health Educ Q.</i> 1993;20:275-287.	Setting
Glanz K, Chang L, Song V, et al. Skin cancer prevention for children, parents, and caregivers: a field test of Hawaii's SunSmart program. <i>J Am Acad Dermatol.</i> 1998;38:413-417.	Setting
Harris JM Jr, Salasche SJ, Harris RB. Using the Internet to teach melanoma management guidelines to primary care physicians. <i>J Eval Clin Pract.</i> 1999;5:199-211.	Study relevance
Harris JM, Salasche SJ, Harris RB. Can Internet-based continuing medical education improve physicians' skin cancer knowledge and skills? <i>J Gen Intern Med.</i> 2001;16:50-56.	Study relevance
Harris RB, Alberts DS. Strategies for skin cancer prevention. <i>Int J Dermatol.</i> 2004;43:243-251.	Study design
Hillhouse JJ, Turrisi R. Examination of the efficacy of an appearance-focused intervention to reduce UV exposure. <i>J Behav Med.</i> 2002;25:395-409.	Study design
Hornung RL, Lennon PA, Garrett JM, et al. Interactive computer technology for skin cancer prevention targeting children. <i>Am J Prev Med.</i> 2000;18:69-76.	Setting
Jackson KM, Aiken LS. Evaluation of a multicomponent appearance-based sun-protective intervention for young women: uncovering the mechanisms of program efficacy. <i>Health Psychol.</i> 2006;25:34-46.	Setting
Johnson EY, Lookingbill DP. Sunscreen use and sun exposure. Trends in a white population. <i>Arch Dermatol.</i> 1984;120:727-731.	Study design
Kiekbusch S, Hannich HJ, Isacson A, et al. Impact of a cancer education multimedia device on public knowledge, attitudes, and behaviors: a controlled intervention study in Southern Sweden. <i>J Cancer Educ.</i> 2000;15:232-236.	Study design

Appendix B Table 2. Studies Excluded From the Review for Key Question 1

Reference	Reason for Exclusion
Lopez-Jornet P, Camacho-Alonso F, Molina MF. Knowledge and attitude towards risk factors in oral cancer held by dental hygienists in the Autonomous Community of Murcia (Spain): a pilot study. <i>Oral Oncol.</i> 2007;43:602-606.	Study relevance
Lowe JB, Balanda KP, Stanton WR, et al. Evaluation of a three-year school-based intervention to increase adolescent sun protection. <i>Health Educ Behav.</i> 1999;26:396-408.	Setting
Mahler HI, Kulik JA, Harrell J, et al. Effects of UV photographs, photoaging information, and use of sunless tanning lotion on sun protection behaviors. <i>Arch Dermatol.</i> 2005;141:373-380.	Study design
Mayer JA, Eckhardt L, Stepanski BM, et al. Promoting skin cancer prevention counseling by pharmacists. <i>Am J Public Health.</i> 1998;88:1096-1099.	Study design
Mayer JA, Slymen DJ, Eckhardt L, et al. Skin cancer prevention counseling by pharmacists: specific outcomes of an intervention trial. <i>Cancer Detect Prev.</i> 1998;22:367-375.	Study relevance
McCormick LK, Masse LC, Cummings SS, et al. Evaluation of a skin cancer prevention module for nurses: change in knowledge, self-efficacy, and attitudes. <i>Am J Health Promot.</i> 1999;13:282-289.	Study relevance
Mikkilineni R, Weinstock MA, Goldstein MG, et al. The impact of the basic skin cancer triage curriculum on provider's skin cancer control practices. <i>J Gen Intern Med.</i> 2001;16:302-307.	Study relevance
Miller DR, Geller AC, Wood MC, et al. The Falmouth Safe Skin Project: evaluation of a community program to promote sun protection in youth. <i>Health Educ Behav.</i> 1999;26:369-384.	Setting
O'Keefe DJ, Jensen JD. The relative persuasiveness of gain-framed and loss-framed messages for encouraging disease prevention behaviors: a meta-analytic review. <i>J Health Commun.</i> 2007;12:623-644.	Study relevance
Patrick K, Calfas KJ, Norman GJ, et al. Randomized controlled trial of a primary care and home-based intervention for physical activity and nutrition behaviors: PACE+ for adolescents. <i>Arch Ped Adolesc Med.</i> 2006;160:128-136.	No relevant outcomes
Richard MA, Martin S, Gouvernet J, et al. Humour and alarmism in melanoma prevention: a randomized controlled study of three types of information leaflet. <i>Br J Dermatol.</i> 1999;140:909-914.	No relevant outcomes
Robinson JK, Rademaker AW. Skin cancer risk and sun protection learning by helpers of patients with nonmelanoma skin cancer. <i>Prev Med.</i> 1995;24:333-341.	Study design
Robinson JK. Behavior modification obtained by sun protection education coupled with removal of a skin cancer. <i>Arch Dermatol.</i> 1990;126:477-481.	Population
Robinson JK. Compensation strategies in sun protection behaviors by a population with nonmelanoma skin cancer. <i>Prev Med.</i> 1992;21:754-765.	Population
Rosenberg DE, Norman GJ, Sallis JF, et al. Covariation of adolescent physical activity and dietary behaviors over 12 months. <i>J Adolesc Health.</i> 2007;41:472-478.	No relevant outcomes
Stanton WR, Janda M, Baade PD, et al. Primary prevention of skin cancer: a review of sun protection in Australia and internationally. <i>Health Promot Int.</i> 2004;19:369-378.	Study relevance
Turrisi R, Hillhouse J, Heavin S, et al. Examination of the short-term efficacy of a parent-based intervention to prevent skin cancer. <i>J Behav Med.</i> 2004;27:393-412.	Study design
Turrisi R, Hillhouse J, Robinson J, et al. Influence of parent and child characteristics on a parent-based intervention to reduce unsafe sun practices in children 9 to 12 years old. <i>Arch Dermatol.</i> 2006;142:1009-1014.	Study design

Appendix B Table 3. Studies Excluded From the Review for Key Question 2

Reference	Reason for exclusion
Benjes LS, Brooks DR, Zhang Z, et al. Changing patterns of sun protection between the first and second summers for very young children. <i>Arch Dermatol.</i> 2004;140:925-930.	Setting
Brandberg Y, Bergenmar M, Michelson H, et al. Six-month follow-up of effects of an information programme for patients with malignant melanoma. <i>Patient Educ Couns.</i> 1996;28:201-208.	Population
Branstrom R, Ullen H, Brandberg Y. A randomised population-based intervention to examine the effects of the ultraviolet index on tanning behaviour. <i>Eur J Cancer.</i> 2003;39:968-974.	Study design
Brodkin RH, Altman EM. Controlling malignant melanoma. A focus on pediatricians. <i>Am J Dis Child.</i> 1993;147:875-881.	Study relevance
Buller DB, Buller MK, Beach B, et al. "Sunny days, healthy ways": evaluation of a skin cancer prevention curriculum for elementary school-aged children. <i>J Am Acad Dermatol.</i> 1996;35:911-922.	Setting
Buller DB, Hall JR, Powers PJ, et al. Evaluation of the "Sunny Days, Healthy Ways" sun safety CD-ROM program for children in grades 4 and 5. <i>Cancer Prev Control.</i> 1999;3:188-195.	Setting
Crane LA, Schneider LS, Yohn JJ, et al. "Block the sun, not the fun": evaluation of a skin cancer prevention program for child care centers. <i>Am J Prev Med.</i> 1999;17:31-37.	Setting
Dey P, Collins S, Will S, et al. Randomised controlled trial assessing effectiveness of health education leaflets in reducing incidence of sunburn. <i>BMJ.</i> 1995;311:1062-1063.	Setting
Dietrich AJ, Olson AL, Sox CH, et al. Sun protection counseling for children: primary care practice patterns and effect of an intervention on clinicians. <i>Arch Fam Med.</i> 2000;9:155-159.	Study relevance
Emmons KM, Geller AC, Viswanath V, et al. The SunWise Policy intervention for school-based sun protection: a pilot study. <i>J Sch Nurs.</i> 2008;24(4):215-221.	No relevant outcomes
Falk M, Anderson C. Prevention of skin cancer in primary healthcare: an evaluation of three different prevention effort levels and the applicability of a phototest. <i>Eur J Gen Pract</i> 2008;14(2):68-75.	Quality
Geller AC, Cantor M, Miller DR, et al. The Environmental Protection Agency's National SunWise School Program: sun protection education in US schools (1999-2000). <i>J Am Acad Dermatol.</i> 2002;46:683-689.	Setting
Geller AC, Sayers L, Koh HK, et al. The New Moms Project: educating mothers about sun protection in newborn nurseries. <i>Pediatr Dermatol.</i> 1999;16:198-200.	Setting
Gerbert B, Wolff M, Tschann JM, et al. Activating patients to practice skin cancer prevention: response to mailed materials from physicians versus HMOs. <i>Am J Prev Med.</i> 1997;13:214-220.	No relevant outcomes
Girgis A, Sanson-Fisher RW, Tripodi DA, et al. Evaluation of interventions to improve solar protection in primary schools. <i>Health Educ Q.</i> 1993;20:275-287.	Setting
Glanz K, Chang L, Song V, et al. Skin cancer prevention for children, parents, and caregivers: a field test of Hawaii's SunSmart program. <i>J Am Acad Dermatol.</i> 1998;38:413-417.	Setting
Greene K, Brinn LS. Messages influencing college women's tanning bed use: statistical versus narrative evidence format and a self-assessment to increase perceived susceptibility. <i>J Health Commun.</i> 2003;8:443-461.	Study design
Harris JM Jr, Salasche SJ, Harris RB. Using the Internet to teach melanoma management guidelines to primary care physicians. <i>J Eval Clin Pract.</i> 1999;5:199-211.	Study relevance
Harris JM, Salasche SJ, Harris RB. Can Internet-based continuing medical education improve physicians' skin cancer knowledge and skills? <i>J Gen Intern Med.</i> 2001;16:50-56.	Study relevance
Harris RB, Alberts DS. Strategies for skin cancer prevention. <i>Int J Dermatol.</i> 2004;43:243-251.	Study design
Hart KM, Demarco RF. Primary prevention of skin cancer in children and adolescents: a review of the literature. <i>J Pediatr Oncol Nurs.</i> 2008;25:67-78.	Study design
Hillhouse JJ, Turrisi R. Examination of the efficacy of an appearance-focused intervention to reduce UV exposure. <i>J Behav Med.</i> 2002;25:395-409.	Study design
Hornung RL, Lennon PA, Garrett JM, et al. Interactive computer technology for skin cancer prevention targeting children. <i>Am J Prev Med.</i> 2000;18:69-76.	Setting

Appendix B Table 3. Studies Excluded From the Review for Key Question 2

Reference	Reason for exclusion
Jackson KM, Aiken LS. Evaluation of a multicomponent appearance-based sun-protective intervention for young women: uncovering the mechanisms of program efficacy. <i>Health Psychol.</i> 2006;25:34-46.	Setting
Johnson EY, Lookingbill DP. Sunscreen use and sun exposure. Trends in a white population. <i>Arch Dermatol.</i> 1984;120:727-731.	Study design
Kiebusch S, Hannich HJ, Isacson A, et al. Impact of a cancer education multimedia device on public knowledge, attitudes, and behaviors: a controlled intervention study in Southern Sweden. <i>J Cancer Educ.</i> 2000;15:232-236.	Study design
Lopez ML, Iglesias JM, del Valle MO, et al. Impact of a primary care intervention on smoking, drinking, diet, weight, sun exposure, and work risk in families with cancer experience. <i>Cancer Causes Control.</i> 2007;18:525-535.	Quality
Lopez-Jornet P, Camacho-Alonso F, Molina MF. Knowledge and attitude towards risk factors in oral cancer held by dental hygienists in the Autonomous Community of Murcia (Spain): a pilot study. <i>Oral Oncol.</i> 2007;43:602-606.	Study relevance
Lowe JB, Balanda KP, Stanton WR, et al. Evaluation of a three-year school-based intervention to increase adolescent sun protection. <i>Health Educ Behav.</i> 1999;26:396-408.	Setting
Mahler HI, Kulik JA, Harrell J, et al. Effects of UV photographs, photoaging information, and use of sunless tanning lotion on sun protection behaviors. <i>Arch Dermatol.</i> 2005;141:373-380.	Study design
Mahler HI, Kulik JA, Butler HA, Gerrard M, Gibbons FX. Social norms information enhances the efficacy of an appearance-based sun protection intervention. <i>Soc Sci Med</i> 2008;67(2):321-329.	Study design
Mayer JA, Eckhardt L, Stepanski BM, et al. Promoting skin cancer prevention counseling by pharmacists. <i>Am J Public Health.</i> 1998;88:1096-1099.	Study design
Mayer JA, Slymen DJ, Eckhardt L, et al. Skin cancer prevention counseling by pharmacists: specific outcomes of an intervention trial. <i>Cancer Detect Prev.</i> 1998;22:367-375.	Study relevance
McCormick LK, Masse LC, Cummings SS, et al. Evaluation of a skin cancer prevention module for nurses: change in knowledge, self-efficacy, and attitudes. <i>Am J Health Promot.</i> 1999;13:282-289.	Study relevance
Mikkilineni R, Weinstock MA, Goldstein MG, et al. The impact of the basic skin cancer triage curriculum on provider's skin cancer control practices. <i>J Gen Intern Med.</i> 2001;16:302-307.	Study relevance
Miller DR, Geller AC, Wood MC, et al. The Falmouth Safe Skin Project: evaluation of a community program to promote sun protection in youth. <i>Health Educ Behav.</i> 1999;26:369-384.	Setting
Patrick K, Calfas KJ, Norman GJ, et al. Randomized controlled trial of a primary care and home-based intervention for physical activity and nutrition behaviors: PACE+ for adolescents. <i>Arch Ped Adolesc Med.</i> 2006;160:128-136.	No relevant outcomes
Richard MA, Martin S, Gouvernet J, et al. Humour and alarmism in melanoma prevention: a randomized controlled study of three types of information leaflet. <i>Br J Dermatol.</i> 1999;140:909-914.	No relevant outcomes
Robinson JK, Rademaker AW. Skin cancer risk and sun protection learning by helpers of patients with nonmelanoma skin cancer. <i>Prev Med.</i> 1995;24:333-341.	Study design
Robinson JK. Behavior modification obtained by sun protection education coupled with removal of a skin cancer. <i>Arch Dermatol.</i> 1990;126:477-481.	Population
Robinson JK. Compensation strategies in sun protection behaviors by a population with nonmelanoma skin cancer. <i>Prev Med.</i> 1992;21:754-765.	Population
Rosenberg DE, Norman GJ, Sallis JF, et al. Covariation of adolescent physical activity and dietary behaviors over 12 months. <i>J Adolesc Health.</i> 2007;41:472-478.	No relevant outcomes
Saraiya M, Glanz K, Briss PA, et al. Interventions to prevent skin cancer by reducing exposure to ultraviolet radiation: a systematic review. <i>Am J Prev Med.</i> 2004;27:422-466.	Used as source document
Stanton WR, Janda M, Baade PD, et al. Primary prevention of skin cancer: a review of sun protection in Australia and internationally. <i>Health Promot Int.</i> 2004;19:369-378.	Study relevance
Turrisi R, Hillhouse J, Heavin S, et al. Examination of the short-term efficacy of a parent-based intervention to prevent skin cancer. <i>J Behav Med.</i> 2004;27:393-412.	Study design

Appendix B Table 3. Studies Excluded From the Review for Key Question 2

Reference	Reason for exclusion
Turrisi R, Hillhouse J, Robinson J, et al. Influence of parent and child characteristics on a parent-based intervention to reduce unsafe sun practices in children 9 to 12 years old. <i>Arch Dermatol.</i> 2006;142:1009-1014.	Study design
van Osch L, Reubsaet A, Lechner L, de Vries H. The formation of specific action plans can enhance sun protection behavior in motivated parents. <i>Prev.Med.</i> 2008;47(1):127-132.	Quality

Appendix B Table 4. Studies Excluded From the Review for Key Question 3

Reference	Reason for Exclusion
Benjes LS, Brooks DR, Zhang Z, et al. Changing patterns of sun protection between the first and second summers for very young children. <i>Arch Dermatol.</i> 2004;140:925-930.	Setting
Brandberg Y, Bergenmar M, Michelson H, et al. Six-month follow-up of effects of an information programme for patients with malignant melanoma. <i>Patient Educ Couns.</i> 1996;28:201-208.	Population
Branstrom R, Ullen H, Brandberg Y. A randomised population-based intervention to examine the effects of the ultraviolet index on tanning behaviour. <i>Eur J Cancer.</i> 2003;39:968-974.	Study design
Brodkin RH, Altman EM. Controlling malignant melanoma. A focus on pediatricians. <i>Am J Dis Child.</i> 1993;147:875-881.	Study relevance
Buller DB, Buller MK, Beach B, et al. "Sunny days, healthy ways": evaluation of a skin cancer prevention curriculum for elementary school-aged children. <i>J Am Acad Dermatol.</i> 1996;35:911-922.	Setting
Buller DB, Hall JR, Powers PJ, et al. Evaluation of the "Sunny Days, Healthy Ways" sun safety CD-ROM program for children in grades 4 and 5. <i>Cancer Prev Control.</i> 1999;3:188-195.	Setting
Crane LA, Schneider LS, Yohn JJ, et al. "Block the sun, not the fun": evaluation of a skin cancer prevention program for child care centers. <i>Am J Prev Med.</i> 1999;17:31-37.	Setting
Dey P, Collins S, Will S, et al. Randomised controlled trial assessing effectiveness of health education leaflets in reducing incidence of sunburn. <i>BMJ.</i> 1995;311:1062-1063.	Setting
Dietrich AJ, Olson AL, Sox CH, et al. Sun protection counseling for children: primary care practice patterns and effect of an intervention on clinicians. <i>Arch Fam Med.</i> 2000;9:155-159.	Study relevance
Geller AC, Sayers L, Koh HK, et al. The New Moms Project: educating mothers about sun protection in newborn nurseries. <i>Pediatr Dermatol.</i> 1999;16:198-200.	Setting
Gerbert B, Wolff M, Tschann JM, et al. Activating patients to practice skin cancer prevention: response to mailed materials from physicians versus HMOs. <i>Am J Prev Med.</i> 1997;13:214-220.	No relevant outcomes
Girgis A, Sanson-Fisher RW, Tripodi DA, et al. Evaluation of interventions to improve solar protection in primary schools. <i>Health Educ Q.</i> 1993;20:275-287.	Setting
Glanz K, Chang L, Song V, et al. Skin cancer prevention for children, parents, and caregivers: a field test of Hawaii's SunSmart program. <i>J Am Acad Dermatol.</i> 1998;38:413-417.	Setting
Harris JM Jr, Salasche SJ, Harris RB. Using the Internet to teach melanoma management guidelines to primary care physicians. <i>J Eval Clin Pract.</i> 1999;5:199-211.	Study relevance
Harris JM, Salasche SJ, Harris RB. Can Internet-based continuing medical education improve physicians' skin cancer knowledge and skills? <i>J Gen Intern Med.</i> 2001;16:50-56.	Study relevance
Harris RB, Alberts DS. Strategies for skin cancer prevention. <i>Int J Dermatol.</i> 2004;43:243-251.	Study design
Hillhouse JJ, Turrisi R. Examination of the efficacy of an appearance-focused intervention to reduce UV exposure. <i>J Behav Med.</i> 2002;25:395-409.	Study design
Hornung RL, Lennon PA, Garrett JM, et al. Interactive computer technology for skin cancer prevention targeting children. <i>Am J Prev Med.</i> 2000;18:69-76.	Setting
Jackson KM, Aiken LS. Evaluation of a multicomponent appearance-based sun-protective intervention for young women: uncovering the mechanisms of program efficacy. <i>Health Psychol.</i> 2006;25:34-46.	Setting
Johnson EY, Lookingbill DP. Sunscreen use and sun exposure. Trends in a white population. <i>Arch Dermatol.</i> 1984;120:727-731.	No relevant outcomes
Kiekbusch S, Hannich HJ, Isacson A, et al. Impact of a cancer education multimedia device on public knowledge, attitudes, and behaviors: a controlled intervention study in Southern Sweden. <i>J Cancer Educ.</i> 2000;15:232-236.	Study design
Lopez-Jornet P, Camacho-Alonso F, Molina MF. Knowledge and attitude towards risk factors in oral cancer held by dental hygienists in the Autonomous Community of Murcia (Spain): a pilot study. <i>Oral Oncol.</i> 2007;43:602-606.	Study relevance

Appendix B Table 4. Studies Excluded From the Review for Key Question 3

Reference	Reason for Exclusion
Lowe JB, Balanda KP, Stanton WR, et al. Evaluation of a three-year school-based intervention to increase adolescent sun protection. <i>Health Educ Behav.</i> 1999;26:396-408.	Setting
Mahler HI, Kulik JA, Harrell J, et al. Effects of UV photographs, photoaging information, and use of sunless tanning lotion on sun protection behaviors. <i>Arch Dermatol.</i> 2005;141:373-380.	Study design
Mayer JA, Eckhardt L, Stepanski BM, et al. Promoting skin cancer prevention counseling by pharmacists. <i>Am J Public Health.</i> 1998;88:1096-1099.	Study design
Mayer JA, Slymen DJ, Eckhardt L, et al. Skin cancer prevention counseling by pharmacists: specific outcomes of an intervention trial. <i>Cancer Detect Prev.</i> 1998;22:367-375.	Study relevance
McCormick LK, Masse LC, Cummings SS, et al. Evaluation of a skin cancer prevention module for nurses: change in knowledge, self-efficacy, and attitudes. <i>Am J Health Promot.</i> 1999;13:282-289.	Study relevance
Mikkilineni R, Weinstock MA, Goldstein MG, et al. The impact of the basic skin cancer triage curriculum on provider's skin cancer control practices. <i>J Gen Intern Med.</i> 2001;16:302-307.	Study relevance
Miller DR, Geller AC, Wood MC, et al. The Falmouth Safe Skin Project: evaluation of a community program to promote sun protection in youth. <i>Health Educ Behav.</i> 1999;26:369-384.	Setting
Richard MA, Martin S, Gouvernet J, et al. Humour and alarmism in melanoma prevention: a randomized controlled study of three types of information leaflet. <i>Br J Dermatol.</i> 1999;140:909-914.	No relevant outcomes
Robinson JK, Rademaker AW. Skin cancer risk and sun protection learning by helpers of patients with nonmelanoma skin cancer. <i>Prev Med.</i> 1995;24:333-341.	Study design
Robinson JK. Behavior modification obtained by sun protection education coupled with removal of a skin cancer. <i>Arch Dermatol.</i> 1990;126:477-481.	Population
Robinson JK. Compensation strategies in sun protection behaviors by a population with nonmelanoma skin cancer. <i>Prev Med.</i> 1992;21:754-765.	Population
Saraiya M, Glanz K, Briss PA, et al. Interventions to prevent skin cancer by reducing exposure to ultraviolet radiation: a systematic review. <i>Am J Prev Med.</i> 2004;27:422-466.	Used as source document
Stanton WR, Janda M, Baade PD, et al. Primary prevention of skin cancer: a review of sun protection in Australia and internationally. <i>Health Promot Int.</i> 2004;19:369-378	Study relevance
Turrisi R, Hillhouse J, Heavin S, et al. Examination of the short-term efficacy of a parent-based intervention to prevent skin cancer. <i>J Behav Med.</i> 2004;27:393-412.	Study design
Turrisi R, Hillhouse J, Robinson J, et al. Influence of parent and child characteristics on a parent-based intervention to reduce unsafe sun practices in children 9 to 12 years old. <i>Arch Dermatol.</i> 2006;142:1009-1014.	Study design

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Skin cancer Study design Location Recruitment strategy	Participant inclusion/ exclusion criteria	Baseline demographics																				
Trials																							
Green 1999 ⁵⁷ Green 1994 ⁵⁸ Pandeya 2005 ⁵⁹ Nambour Skin Cancer Prevention Trial (subgroup of people from Nambour Skin Cancer Study)	Skin cancer: BCC & SCC Study design: Cohort within an RCT Location: Australia Recruitment strategy: Participants in Nambour Skin Cancer and Actinic Eye Disease Prevention Trial were randomly chosen from the 1986 Nambour electoral roll, those who could be contacted in 1992 were invited to be in the Skin Cancer Prevention Trial	Inclusion: Aged 20-69, resident of Nambour, Queensland from electoral roll 1986, who attended a second survey in 1992 Exclusion: Taking vitamin supplements containing betacarotene, already applying sunscreen on a strict daily basis	N= 1,621 Mean age (SD): IG (Sunscreen + betacarotene): 48.5 (12.9) IG (Sunscreen): 48.7 (13.6) IG (Betacarotene): 48.1 (13.6) CG: 49.8 (12.7) Female: IG (Sunscreen + betacarotene): 225 (55.7%) IG (Sunscreen): 233 (57.1%) IG (Betacarotene): 246 (59.1%) CG: 209 (53.2%) Race/ethnicity: NR SES: NR Skin type: <table border="1"> <thead> <tr> <th></th> <th>IG (S+B)</th> <th>IG (S)</th> <th>IG (B)</th> <th>CG</th> </tr> </thead> <tbody> <tr> <td>Always burn</td> <td>88 (21.8%)</td> <td>83 (20.3%)</td> <td>92 (22.1%)</td> <td>77 (19.6%)</td> </tr> <tr> <td>Burn/tan</td> <td>270 (66.8%)</td> <td>282 (69.1%)</td> <td>276 (66.4%)</td> <td>271 (69.0%)</td> </tr> <tr> <td>Only tan</td> <td>46 (11.4%)</td> <td>43 (10.5%)</td> <td>48 (11.5%)</td> <td>45 (11.4%)</td> </tr> </tbody> </table>		IG (S+B)	IG (S)	IG (B)	CG	Always burn	88 (21.8%)	83 (20.3%)	92 (22.1%)	77 (19.6%)	Burn/tan	270 (66.8%)	282 (69.1%)	276 (66.4%)	271 (69.0%)	Only tan	46 (11.4%)	43 (10.5%)	48 (11.5%)	45 (11.4%)
	IG (S+B)	IG (S)	IG (B)	CG																			
Always burn	88 (21.8%)	83 (20.3%)	92 (22.1%)	77 (19.6%)																			
Burn/tan	270 (66.8%)	282 (69.1%)	276 (66.4%)	271 (69.0%)																			
Only tan	46 (11.4%)	43 (10.5%)	48 (11.5%)	45 (11.4%)																			
van der Pols 2006 ⁶⁰	See Green 1999	See Green 1999	See Green 1999																				

Study reference USPSTF quality	Intervention(s) evaluated (description with format, intensity, and delivery if applicable)	Followup	Main outcome measure(s)																																																																					
Trials																																																																								
Green 1999 ⁵⁷ Green 1994 ⁵⁸ Pandeya 2005 ⁵⁹ Nambour Skin Cancer Prevention Trial (subgroup of people from Nambour Skin Cancer Study)	Description: IG (S+B): SPF 15+ broad-spectrum sunscreen and betacarotene tablets IG (S): SPF 15+ broad-spectrum sunscreen and placebo tablets IG (B): Betacarotene tablets plus usual sunscreen use CG: Placebo tablets plus usual sunscreen use Intensity: IG (S+B): sunscreen application to exposed sites every morning and reapplication if heavy sweating, bathing or prolonged exposure; 1 30mg betacarotene tablet per day for 4 years IG (S): sunscreen application to exposed sites every morning and reapplication if heavy sweating, bathing or prolonged exposure; 1 tablet per day for 4 years IG (B): 1 30mg tablet per day for 4 years CG: 1 tablet per day for 4 years Delivery: self-application of sunscreen and tablets self-administered. Received supplies every 3 months at followup clinic visits	4.5 years original trial 85% followup 8 additional years followup 59% active followup 41% passive followup (skin cancer through pathology records only)	Measure Newly treated skin lesions detected at followup clinics in 1994 and 1996 by dermatologists or participants carried treatment cards that they presented to their local doctors who recorded details. Also asked every 3 months whether they had any new skin cancers or other skin lesions treated since last contact. In 2000 they were offered a further full skin exam and followed through December 2004 Results <i>Incidence of skin cancers in terms of people treated for skin cancer and tumours treated on the head, neck, arms, and hands by sunscreen treatment group (through 1996)</i> <table border="1"> <thead> <tr> <th rowspan="2"></th> <th colspan="2">Participants</th> <th colspan="2">Tumors</th> </tr> <tr> <th>Daily Sunscreen</th> <th>No Sunscreen</th> <th>Daily Sunscreen</th> <th>No Sunscreen</th> </tr> </thead> <tbody> <tr> <td>BCC</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Number</td> <td>65</td> <td>63</td> <td>153</td> <td>146</td> </tr> <tr> <td>Incidence/100,000</td> <td>2588</td> <td>2509</td> <td>6092</td> <td>5814</td> </tr> <tr> <td>Rate ratio (95% CI)</td> <td>1.03 (0.73-1.46)</td> <td>1.00</td> <td>1.05 (0.82-1.34)</td> <td>1.0</td> </tr> <tr> <td>SCC</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>Number</td> <td>22</td> <td>25</td> <td>28</td> <td>46</td> </tr> <tr> <td>Incidence/100,000</td> <td>876</td> <td>996</td> <td>1115</td> <td>1832</td> </tr> <tr> <td>Rate ratio (95% CI)</td> <td>0.88 (0.50-1.56)</td> <td>1.0</td> <td>0.61 (0.46-1.81)</td> <td>1.0</td> </tr> </tbody> </table>		Participants		Tumors		Daily Sunscreen	No Sunscreen	Daily Sunscreen	No Sunscreen	BCC					Number	65	63	153	146	Incidence/100,000	2588	2509	6092	5814	Rate ratio (95% CI)	1.03 (0.73-1.46)	1.00	1.05 (0.82-1.34)	1.0	SCC					Number	22	25	28	46	Incidence/100,000	876	996	1115	1832	Rate ratio (95% CI)	0.88 (0.50-1.56)	1.0	0.61 (0.46-1.81)	1.0																				
	Participants		Tumors																																																																					
	Daily Sunscreen	No Sunscreen	Daily Sunscreen	No Sunscreen																																																																				
BCC																																																																								
Number	65	63	153	146																																																																				
Incidence/100,000	2588	2509	6092	5814																																																																				
Rate ratio (95% CI)	1.03 (0.73-1.46)	1.00	1.05 (0.82-1.34)	1.0																																																																				
SCC																																																																								
Number	22	25	28	46																																																																				
Incidence/100,000	876	996	1115	1832																																																																				
Rate ratio (95% CI)	0.88 (0.50-1.56)	1.0	0.61 (0.46-1.81)	1.0																																																																				
van der Pols 2006 ⁶⁰	See Green et al 1999	See Green et al 1999	<i>Incidence per 100,000 (no.) of BCC and SCC on the head, neck, arms, and hands, by sunscreen treatment group (through 2004)</i> <table border="1"> <thead> <tr> <th rowspan="2"></th> <th colspan="3">BCC</th> <th colspan="3">SCC</th> </tr> <tr> <th>Daily Sunscreen</th> <th>No Sunscreen</th> <th>RR (95% CI)</th> <th>Daily Sunscreen</th> <th>No Sunscreen</th> <th>RR (95% CI)</th> </tr> </thead> <tbody> <tr> <td colspan="7"><i>Persons affected</i></td> </tr> <tr> <td>1993-2004</td> <td>1,296 (121)</td> <td>1,270 (119)</td> <td>1.02 (0.78-1.35)</td> <td>546 (51)</td> <td>811 (76)</td> <td>0.65 (0.45-0.94)</td> </tr> <tr> <td>1996-2004</td> <td>1,516 (97)</td> <td>1,494 (96)</td> <td>1.02 (0.75-1.37)</td> <td>625 (40)</td> <td>934 (60)</td> <td>0.65 (0.43-0.98)</td> </tr> <tr> <td>2001-2004</td> <td>1,820 (55)</td> <td>2,085 (63)</td> <td>0.86 (0.59-1.26)</td> <td>695 (21)</td> <td>1,390 (42)</td> <td>0.49 (0.28-0.83)</td> </tr> <tr> <td colspan="7"><i>Total tumors</i></td> </tr> <tr> <td>1993-2004</td> <td>2,474 (231)</td> <td>2,840 (266)</td> <td>0.87 (0.64-1.20)</td> <td>868 (81)</td> <td>1,516 (142)</td> <td>0.59 (0.38-0.90)</td> </tr> <tr> <td>1996-2004</td> <td>2,422 (155)</td> <td>2,770 (178)</td> <td>0.89 (0.64-1.25)</td> <td>953 (61)</td> <td>1,587 (102)</td> <td>0.62 (0.38-0.99)</td> </tr> <tr> <td>2001-2004</td> <td>2,548 (77)</td> <td>3,408 (103)</td> <td>0.75 (0.49-1.14)</td> <td>960 (29)</td> <td>1,952 (59)</td> <td>0.49 (0.27-0.87)</td> </tr> </tbody> </table>		BCC			SCC			Daily Sunscreen	No Sunscreen	RR (95% CI)	Daily Sunscreen	No Sunscreen	RR (95% CI)	<i>Persons affected</i>							1993-2004	1,296 (121)	1,270 (119)	1.02 (0.78-1.35)	546 (51)	811 (76)	0.65 (0.45-0.94)	1996-2004	1,516 (97)	1,494 (96)	1.02 (0.75-1.37)	625 (40)	934 (60)	0.65 (0.43-0.98)	2001-2004	1,820 (55)	2,085 (63)	0.86 (0.59-1.26)	695 (21)	1,390 (42)	0.49 (0.28-0.83)	<i>Total tumors</i>							1993-2004	2,474 (231)	2,840 (266)	0.87 (0.64-1.20)	868 (81)	1,516 (142)	0.59 (0.38-0.90)	1996-2004	2,422 (155)	2,770 (178)	0.89 (0.64-1.25)	953 (61)	1,587 (102)	0.62 (0.38-0.99)	2001-2004	2,548 (77)	3,408 (103)	0.75 (0.49-1.14)	960 (29)	1,952 (59)	0.49 (0.27-0.87)
	BCC				SCC																																																																			
	Daily Sunscreen	No Sunscreen	RR (95% CI)	Daily Sunscreen	No Sunscreen	RR (95% CI)																																																																		
<i>Persons affected</i>																																																																								
1993-2004	1,296 (121)	1,270 (119)	1.02 (0.78-1.35)	546 (51)	811 (76)	0.65 (0.45-0.94)																																																																		
1996-2004	1,516 (97)	1,494 (96)	1.02 (0.75-1.37)	625 (40)	934 (60)	0.65 (0.43-0.98)																																																																		
2001-2004	1,820 (55)	2,085 (63)	0.86 (0.59-1.26)	695 (21)	1,390 (42)	0.49 (0.28-0.83)																																																																		
<i>Total tumors</i>																																																																								
1993-2004	2,474 (231)	2,840 (266)	0.87 (0.64-1.20)	868 (81)	1,516 (142)	0.59 (0.38-0.90)																																																																		
1996-2004	2,422 (155)	2,770 (178)	0.89 (0.64-1.25)	953 (61)	1,587 (102)	0.62 (0.38-0.99)																																																																		
2001-2004	2,548 (77)	3,408 (103)	0.75 (0.49-1.14)	960 (29)	1,952 (59)	0.49 (0.27-0.87)																																																																		

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Other positive outcome measures	Adverse events	Comments															
Trials																		
Green 1999 ⁵⁷ Green 1994 ⁵⁸ Pandeya 2005 ⁵⁹ Nambour Skin Cancer Prevention Trial (subgroup of people from Nambour Skin Cancer Study)	NR	Potential harms noted: contact allergy or skin irritation with daily use of sunscreen (p.726 of Green 1999)	Pandeya 2005 <i>Hazard ratios obtained from the multiple-failure time models for the combined effect of sunscreen intervention on repeated occurrence of basal cell carcinoma (BCC) among 1,621 participants, Nambour Skin Cancer Prevention Trial, 1992-1996</i> Crude <table border="1"> <thead> <tr> <th>Models</th> <th>HR (95% CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td>Time to first episode</td> <td>1.03 (0.77-1.38)</td> <td>0.83</td> </tr> <tr> <td>Andersen-Gill model</td> <td>0.90 (0.66-1.23)</td> <td>0.49</td> </tr> <tr> <td>Wei-Lin-Weissfeld model</td> <td>0.89 (0.65-1.24)</td> <td>0.50</td> </tr> <tr> <td>Prentice-Williams-Peterson</td> <td>0.91 (0.72-1.15)</td> <td>0.42</td> </tr> </tbody> </table>	Models	HR (95% CI)	P	Time to first episode	1.03 (0.77-1.38)	0.83	Andersen-Gill model	0.90 (0.66-1.23)	0.49	Wei-Lin-Weissfeld model	0.89 (0.65-1.24)	0.50	Prentice-Williams-Peterson	0.91 (0.72-1.15)	0.42
Models	HR (95% CI)	P																
Time to first episode	1.03 (0.77-1.38)	0.83																
Andersen-Gill model	0.90 (0.66-1.23)	0.49																
Wei-Lin-Weissfeld model	0.89 (0.65-1.24)	0.50																
Prentice-Williams-Peterson	0.91 (0.72-1.15)	0.42																
van der Pols 2006 ⁶⁰	See Green et al 1999	See Green et al 1999	See Green et al 1999															

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered	Followup
Cohort						
Grodstein 1995 ⁶⁷ Nurses' Health Study	Skin Cancer: SCC Study Design: cohort Location: US (11 states)	Inclusion: Female, registered nurse, 30-55 years of age, with first-incident invasive SCC diagnosed 1982-1990 Exclusion: Diagnosis of in situ SCC (Bowen's disease), any cancer before 1982, start of followup period, and each time period	N= 107,900 Age: 30-55 Sex: 100% Female Skin phenotype: NR <2% cohort African American	Sun exposure, sunscreen use Mailed questionnaires every 2 years	Age, cigarette smoking, region, natural hair color, reaction to sun, and lifetime number of sunburns	8 years 92% (calculated from person-year followup)
Hunter 1990 ⁶⁸ Nurses' Health Study	Skin Cancer: BCC Study Design: cohort Location: US (11 states)	Inclusion: Female, registered nurse, 30-55 years of age Exclusion: Diagnosis of cancer reported on 1980 or previous questionnaire, if information on one or more exposures missing on questionnaire	N= 73,366 Age: 30-55 Sex: 100% Female Skin phenotype: NR <2% cohort African American	Sun exposure, sunscreen use Mailed questionnaires every 2 years	Age, time period, region, time spent outdoors in the summer and sunscreen habit, hair color, childhood tendency to sunburn, and lifetime number of severe and painful sunburns on the face and arms	4 years 100% (because excluded women with missing data)

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sunlamp or sunbed exposure																
Cohort																		
Grodstein 1995 ⁶⁷ Nurses' Health Study	Regular time outdoors and risk of SCC (95% CI) (calc)* <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Age Adjusted RR</th> <th>Multivariate** Adjusted RR</th> </tr> </thead> <tbody> <tr> <td>Yes (use sunscreen)</td> <td>56 (32%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>Yes (no sunscreen)</td> <td>94 (54%)</td> <td>0.7 (0.5-1.0)</td> <td>0.9 (0.6-1.2)</td> </tr> <tr> <td>No</td> <td>25 (14%)</td> <td>0.7 (0.4-1.1)</td> <td>0.7 (0.4-1.1)</td> </tr> </tbody> </table> <p>*Data missing for 22 pts **Adjusted for age, cigarette smoking, region, natural hair color, reaction to sun, and lifetime number of sunburns</p>		Cases	Age Adjusted RR	Multivariate** Adjusted RR	Yes (use sunscreen)	56 (32%)	1.0	1.0	Yes (no sunscreen)	94 (54%)	0.7 (0.5-1.0)	0.9 (0.6-1.2)	No	25 (14%)	0.7 (0.4-1.1)	0.7 (0.4-1.1)	NR
	Cases	Age Adjusted RR	Multivariate** Adjusted RR															
Yes (use sunscreen)	56 (32%)	1.0	1.0															
Yes (no sunscreen)	94 (54%)	0.7 (0.5-1.0)	0.9 (0.6-1.2)															
No	25 (14%)	0.7 (0.4-1.1)	0.7 (0.4-1.1)															
Hunter 1990 ⁶⁸ Nurses' Health Study	Regular time spent outdoors in summer (at least 8 hours/week) (95% CI) <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Age Adjusted RR</th> <th>Multivariate* Adjusted RR</th> </tr> </thead> <tbody> <tr> <td>Yes (usually use sunscreen)</td> <td>265</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>Yes (no sunscreen)</td> <td>377</td> <td>0.59 (0.50-0.69)</td> <td>0.70 (0.60-0.82)</td> </tr> <tr> <td>No</td> <td>129</td> <td>0.71 (0.58-0.88)</td> <td>0.73 (0.59-0.90)</td> </tr> </tbody> </table> <p>p=0.0001 p<0.0001 *Adjusted for age, time period, region, time spent outdoors in summer and sunscreen habit, hair color, childhood tendency to burn, lifetime number of severe and painful sunburns on the face and arms</p>		Cases	Age Adjusted RR	Multivariate* Adjusted RR	Yes (usually use sunscreen)	265	1.0	1.0	Yes (no sunscreen)	377	0.59 (0.50-0.69)	0.70 (0.60-0.82)	No	129	0.71 (0.58-0.88)	0.73 (0.59-0.90)	NR
	Cases	Age Adjusted RR	Multivariate* Adjusted RR															
Yes (usually use sunscreen)	265	1.0	1.0															
Yes (no sunscreen)	377	0.59 (0.50-0.69)	0.70 (0.60-0.82)															
No	129	0.71 (0.58-0.88)	0.73 (0.59-0.90)															

Study reference USPSTF quality	Measurement of sunscreen use	Measurement of sunburn	Comments																				
Cohort																							
Grodstein 1995 ⁶⁷ Nurses' Health Study	See measurement of sun exposure	Number of lifetime sunburns and risk of SCC (95% CI) (calc)* <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Age Adjusted RR</th> <th>Multivariate** Adjusted RR</th> </tr> </thead> <tbody> <tr> <td>None</td> <td>26 (16%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>1-2</td> <td>38 (23%)</td> <td>1.2 (0.7-2.0)</td> <td>1.1 (0.6-1.8)</td> </tr> <tr> <td>3-5</td> <td>39 (24%)</td> <td>2.2 (1.3-3.5)</td> <td>1.7 (1.0-2.8)</td> </tr> <tr> <td>≥6</td> <td>61 (37%)</td> <td>3.4 (2.2-5.3)</td> <td>2.4 (1.5-4.0)</td> </tr> </tbody> </table> <p>p<0.0001 p<0.0001 *Data missing for 33 pts **Adjusted for age, cigarette smoking, region, natural hair color, reaction to sun, and lifetime number of sunburns</p>		Cases	Age Adjusted RR	Multivariate** Adjusted RR	None	26 (16%)	1.0	1.0	1-2	38 (23%)	1.2 (0.7-2.0)	1.1 (0.6-1.8)	3-5	39 (24%)	2.2 (1.3-3.5)	1.7 (1.0-2.8)	≥6	61 (37%)	3.4 (2.2-5.3)	2.4 (1.5-4.0)	
	Cases	Age Adjusted RR	Multivariate** Adjusted RR																				
None	26 (16%)	1.0	1.0																				
1-2	38 (23%)	1.2 (0.7-2.0)	1.1 (0.6-1.8)																				
3-5	39 (24%)	2.2 (1.3-3.5)	1.7 (1.0-2.8)																				
≥6	61 (37%)	3.4 (2.2-5.3)	2.4 (1.5-4.0)																				
Hunter 1990 ⁶⁸ Nurses' Health Study	See measurement of sun exposure	Lifetime number of severe and painful sunburns on the face or arms (95% CI) <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Age Adjusted RR</th> <th>Multivariate* Adjusted RR</th> </tr> </thead> <tbody> <tr> <td>Never</td> <td>127</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>1-2 times</td> <td>216</td> <td>1.40 (1.13-1.75)</td> <td>1.18 (0.94-1.48)</td> </tr> <tr> <td>3-5 times</td> <td>165</td> <td>1.78 (1.42-2.25)</td> <td>1.34 (1.05-1.71)</td> </tr> <tr> <td>6+ times</td> <td>263</td> <td>2.91 (2.37-3.58)</td> <td>1.90 (1.50-2.40)</td> </tr> </tbody> </table> <p>Test for trend p<0.001 p<0.001 *Adjusted for age, time period, region, time spent outdoors in summer and sunscreen habit, hair color, childhood tendency to burn, lifetime number of severe and painful sunburns on the face and arms</p>		Cases	Age Adjusted RR	Multivariate* Adjusted RR	Never	127	1.0	1.0	1-2 times	216	1.40 (1.13-1.75)	1.18 (0.94-1.48)	3-5 times	165	1.78 (1.42-2.25)	1.34 (1.05-1.71)	6+ times	263	2.91 (2.37-3.58)	1.90 (1.50-2.40)	
	Cases	Age Adjusted RR	Multivariate* Adjusted RR																				
Never	127	1.0	1.0																				
1-2 times	216	1.40 (1.13-1.75)	1.18 (0.94-1.48)																				
3-5 times	165	1.78 (1.42-2.25)	1.34 (1.05-1.71)																				
6+ times	263	2.91 (2.37-3.58)	1.90 (1.50-2.40)																				

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered	Followup
Cohort						
van Dam 1999 ⁶⁹ Health Professionals Followup Study	Skin Cancer: BCC Study Design: cohort Location: US	Inclusion: Male, health professionals, 40-75 years of age Exclusion: Any cancer before 1986 or at the beginning of each 2-year time period	N= 44,591 Age: 40-75 Sex: 100% Male Skin phenotype: NR 1.7% Asian 1.0% African American	Sun exposure Mailed questionnaires every 2 years	Age, time period, hair color, eye color, skin reaction to sun, ancestry, BMI, region of residence	8 years 94%
Veierod 2003 ⁸² Norwegian-Swedish Women's Lifestyle and Health Cohort Study	Skin Cancer: Melanoma Study Design: Cohort Location: Norway & Sweden	Inclusion: Female, aged 34-49 years in Norway, aged 30-50 years residing in the Uppsala Health Care Region in Sweden, drawn from population registers Exclusion: women who did not return completed questionnaires or with missing data for exposure or skin type	N= 106,379 Mean age (range): 40.4 (30-50) Sex: 100% Female Skin phenotype: <i>Skin color after repeated skin exposure</i> Deep brown: 16,776 (16%) Brown: 61,423 (59%) Light brown: 23,582 (23%) Never brown: 1531 (1%)	Sun exposure, sunbed exposure Mailed questionnaires	Age, region of residence, hair color, number of sunburns, and weeks on annual summer vacations	8.1 years average 100% (because excluded women with missing data)

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sunlamp or sunbed exposure																																																																																															
Cohort																																																																																																	
van Dam 1999 ⁶⁹ Health Professionals Followup Study	<p>Frequency outdoors in swimsuit as teenager in summer (95% CI)*</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Age Adjusted RR</th> <th>Multivariate** Adjusted RR</th> </tr> </thead> <tbody> <tr> <td><1 time/week</td> <td>557</td> <td>1.00</td> <td>1.00</td> </tr> <tr> <td>1 time/week</td> <td>425</td> <td>1.28 (1.13-1.45)</td> <td>1.30 (1.14-1.47)</td> </tr> <tr> <td>2 times/week</td> <td>499</td> <td>1.29 (1.15-1.46)</td> <td>1.34 (1.19-1.52)</td> </tr> <tr> <td>Several times/week</td> <td>877</td> <td>1.26 (1.13-1.40)</td> <td>1.36 (1.22-1.52)</td> </tr> <tr> <td>Daily</td> <td>347</td> <td>1.29 (1.13-1.48)</td> <td>1.42 (1.24-1.63)</td> </tr> </tbody> </table> <p>*Data missing for 568 cases **Adjusted for age, time period, hair color, eye color, skin reaction to sun, ancestry, BMI, and region of residence</p>		Cases	Age Adjusted RR	Multivariate** Adjusted RR	<1 time/week	557	1.00	1.00	1 time/week	425	1.28 (1.13-1.45)	1.30 (1.14-1.47)	2 times/week	499	1.29 (1.15-1.46)	1.34 (1.19-1.52)	Several times/week	877	1.26 (1.13-1.40)	1.36 (1.22-1.52)	Daily	347	1.29 (1.13-1.48)	1.42 (1.24-1.63)	NR																																																																							
	Cases	Age Adjusted RR	Multivariate** Adjusted RR																																																																																														
<1 time/week	557	1.00	1.00																																																																																														
1 time/week	425	1.28 (1.13-1.45)	1.30 (1.14-1.47)																																																																																														
2 times/week	499	1.29 (1.15-1.46)	1.34 (1.19-1.52)																																																																																														
Several times/week	877	1.26 (1.13-1.40)	1.36 (1.22-1.52)																																																																																														
Daily	347	1.29 (1.13-1.48)	1.42 (1.24-1.63)																																																																																														
Veierod 2003 ⁸² Norwegian-Swedish Women's Lifestyle and Health Cohort Study	<p>Annual weeks on sunbathing vacation, ages 10-19 years</p> <table border="1"> <thead> <tr> <th></th> <th>Frequencies</th> <th>Cases</th> <th>Age Adjusted RR</th> <th>Multivariate* Adjusted RR</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>45,298 (48%)</td> <td>77</td> <td>1.00</td> <td>1.00</td> </tr> <tr> <td>1 wk/yr</td> <td>19,921 (21%)</td> <td>35</td> <td>1.10 (0.74-1.65)</td> <td>1.21 (0.80-1.83)</td> </tr> <tr> <td>2-3 wks/yr</td> <td>20,086 (22%)</td> <td>32</td> <td>1.02 (0.67-1.54)</td> <td>1.09 (0.71-1.65)</td> </tr> <tr> <td>≥4 wks/yr</td> <td>8,113 (9%)</td> <td>20</td> <td>1.56 (0.95-2.55)</td> <td>1.67 (1.01-2.74)</td> </tr> <tr> <td>Trend</td> <td></td> <td></td> <td>p=0.22</td> <td>p=0.12</td> </tr> </tbody> </table> <p>Annual weeks on sunbathing vacation, ages 10-39 years</p> <table border="1"> <thead> <tr> <th></th> <th>Frequencies</th> <th>Cases</th> <th>Age Adjusted RR</th> <th>Multivariate* Adjusted RR</th> </tr> </thead> <tbody> <tr> <td>0, 10-39 yrs</td> <td>15,799 (18%)</td> <td>21</td> <td>1.00</td> <td>1.00</td> </tr> <tr> <td>≥1 wk/yr, 20-29 and/or 30-39 yrs</td> <td>27,851 (31%)</td> <td>53</td> <td>1.42 (0.86-2.36)</td> <td>1.45 (0.87-2.40)</td> </tr> <tr> <td>≥1 wk/yr, 10-19 yrs</td> <td>1,751 (2%)</td> <td>3</td> <td>1.37 (0.41-4.59)</td> <td>1.46 (0.43-4.92)</td> </tr> <tr> <td>≥1 wk/yr, 10-39 yrs</td> <td>43,049 (49%)</td> <td>79</td> <td>1.44 (0.89-2.34)</td> <td>1.56 (0.95-2.56)</td> </tr> <tr> <td>Trend</td> <td></td> <td></td> <td>p=0.27</td> <td>p=0.13</td> </tr> </tbody> </table> <p>*Adjusted for age, region of residence, and hair color</p>		Frequencies	Cases	Age Adjusted RR	Multivariate* Adjusted RR	0	45,298 (48%)	77	1.00	1.00	1 wk/yr	19,921 (21%)	35	1.10 (0.74-1.65)	1.21 (0.80-1.83)	2-3 wks/yr	20,086 (22%)	32	1.02 (0.67-1.54)	1.09 (0.71-1.65)	≥4 wks/yr	8,113 (9%)	20	1.56 (0.95-2.55)	1.67 (1.01-2.74)	Trend			p=0.22	p=0.12		Frequencies	Cases	Age Adjusted RR	Multivariate* Adjusted RR	0, 10-39 yrs	15,799 (18%)	21	1.00	1.00	≥1 wk/yr, 20-29 and/or 30-39 yrs	27,851 (31%)	53	1.42 (0.86-2.36)	1.45 (0.87-2.40)	≥1 wk/yr, 10-19 yrs	1,751 (2%)	3	1.37 (0.41-4.59)	1.46 (0.43-4.92)	≥1 wk/yr, 10-39 yrs	43,049 (49%)	79	1.44 (0.89-2.34)	1.56 (0.95-2.56)	Trend			p=0.27	p=0.13	<p>Solarium use, ages 10-19 years</p> <table border="1"> <thead> <tr> <th></th> <th>Frequencies</th> <th>Cases</th> <th>Age Adjusted RR</th> <th>Multivariate* Adjusted RR</th> </tr> </thead> <tbody> <tr> <td>Never</td> <td>84,185 (98%)</td> <td>152</td> <td>1.00</td> <td>1.00</td> </tr> <tr> <td>Rarely or ≥1 time/mo</td> <td>1,665 (2%)</td> <td>4</td> <td>1.65 (0.61-4.47)</td> <td>1.52 (0.56-4.12)</td> </tr> <tr> <td></td> <td></td> <td></td> <td>p=0.36</td> <td>p=0.44</td> </tr> </tbody> </table> <p>Solarium use, ages 10-39 years</p> <table border="1"> <thead> <tr> <th></th> <th>Frequencies</th> <th>Cases</th> <th>Age Adjusted RR</th> <th>Multivariate* Adjusted RR</th> </tr> </thead> <tbody> <tr> <td>Never/rarely 10-39 yrs</td> <td>65,239 (82%)</td> <td>111</td> <td>1.00</td> <td>1.00</td> </tr> <tr> <td>≥1 1 time/mo 10-19, 20-29, or 30-39 years</td> <td>14,377 (18%)</td> <td>34</td> <td>1.45 (0.98-2.14)</td> <td>1.55 (1.04-2.32)</td> </tr> </tbody> </table> <p>*Adjusted for age, region of residence, hair color, and the corresponding number of age-specific sunburns and weeks on annual summer vacations</p>		Frequencies	Cases	Age Adjusted RR	Multivariate* Adjusted RR	Never	84,185 (98%)	152	1.00	1.00	Rarely or ≥1 time/mo	1,665 (2%)	4	1.65 (0.61-4.47)	1.52 (0.56-4.12)				p=0.36	p=0.44		Frequencies	Cases	Age Adjusted RR	Multivariate* Adjusted RR	Never/rarely 10-39 yrs	65,239 (82%)	111	1.00	1.00	≥1 1 time/mo 10-19, 20-29, or 30-39 years	14,377 (18%)	34	1.45 (0.98-2.14)	1.55 (1.04-2.32)
	Frequencies	Cases	Age Adjusted RR	Multivariate* Adjusted RR																																																																																													
0	45,298 (48%)	77	1.00	1.00																																																																																													
1 wk/yr	19,921 (21%)	35	1.10 (0.74-1.65)	1.21 (0.80-1.83)																																																																																													
2-3 wks/yr	20,086 (22%)	32	1.02 (0.67-1.54)	1.09 (0.71-1.65)																																																																																													
≥4 wks/yr	8,113 (9%)	20	1.56 (0.95-2.55)	1.67 (1.01-2.74)																																																																																													
Trend			p=0.22	p=0.12																																																																																													
	Frequencies	Cases	Age Adjusted RR	Multivariate* Adjusted RR																																																																																													
0, 10-39 yrs	15,799 (18%)	21	1.00	1.00																																																																																													
≥1 wk/yr, 20-29 and/or 30-39 yrs	27,851 (31%)	53	1.42 (0.86-2.36)	1.45 (0.87-2.40)																																																																																													
≥1 wk/yr, 10-19 yrs	1,751 (2%)	3	1.37 (0.41-4.59)	1.46 (0.43-4.92)																																																																																													
≥1 wk/yr, 10-39 yrs	43,049 (49%)	79	1.44 (0.89-2.34)	1.56 (0.95-2.56)																																																																																													
Trend			p=0.27	p=0.13																																																																																													
	Frequencies	Cases	Age Adjusted RR	Multivariate* Adjusted RR																																																																																													
Never	84,185 (98%)	152	1.00	1.00																																																																																													
Rarely or ≥1 time/mo	1,665 (2%)	4	1.65 (0.61-4.47)	1.52 (0.56-4.12)																																																																																													
			p=0.36	p=0.44																																																																																													
	Frequencies	Cases	Age Adjusted RR	Multivariate* Adjusted RR																																																																																													
Never/rarely 10-39 yrs	65,239 (82%)	111	1.00	1.00																																																																																													
≥1 1 time/mo 10-19, 20-29, or 30-39 years	14,377 (18%)	34	1.45 (0.98-2.14)	1.55 (1.04-2.32)																																																																																													

Study reference USPSTF quality	Measurement of sunscreen use	Measurement of sunburn	Comments																												
Cohort																															
van Dam 1999 ⁶⁹ Health Professionals Followup Study	NR	<p>Number lifetime blistering sunburns (95% CI)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Age Adjusted RR</th> <th>Multivariate* Adjusted RR</th> </tr> </thead> <tbody> <tr> <td>None</td> <td>348</td> <td>1.00</td> <td>1.00</td> </tr> <tr> <td>1-2</td> <td>616</td> <td>1.26 (1.10-1.44)</td> <td>1.14 (1.00-1.30)</td> </tr> <tr> <td>3-5</td> <td>641</td> <td>1.45 (1.27-1.65)</td> <td>1.20 (1.05-1.38)</td> </tr> <tr> <td>6-9</td> <td>403</td> <td>1.72 (1.49-1.99)</td> <td>1.33 (1.14-1.54)</td> </tr> <tr> <td>≥10</td> <td>715</td> <td>2.06 (1.81-2.36)</td> <td>1.49 (1.30-1.71)</td> </tr> <tr> <td>Test for trend</td> <td></td> <td>p<0.0001</td> <td>p<0.0001</td> </tr> </tbody> </table> <p>Data missing for 550 cases* Adjusted for age, time period, hair color, eye color, ancestry, skin reaction to sun, and BMI</p>		Cases	Age Adjusted RR	Multivariate* Adjusted RR	None	348	1.00	1.00	1-2	616	1.26 (1.10-1.44)	1.14 (1.00-1.30)	3-5	641	1.45 (1.27-1.65)	1.20 (1.05-1.38)	6-9	403	1.72 (1.49-1.99)	1.33 (1.14-1.54)	≥10	715	2.06 (1.81-2.36)	1.49 (1.30-1.71)	Test for trend		p<0.0001	p<0.0001	
	Cases	Age Adjusted RR	Multivariate* Adjusted RR																												
None	348	1.00	1.00																												
1-2	616	1.26 (1.10-1.44)	1.14 (1.00-1.30)																												
3-5	641	1.45 (1.27-1.65)	1.20 (1.05-1.38)																												
6-9	403	1.72 (1.49-1.99)	1.33 (1.14-1.54)																												
≥10	715	2.06 (1.81-2.36)	1.49 (1.30-1.71)																												
Test for trend		p<0.0001	p<0.0001																												

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sunscreen use	Measurement of sunburn	Comments																																																							
Cohort																																																										
Veierod 2003 ⁸² Norwegian-Swedish Women's Lifestyle and Health Cohort Study	NR	<p>Annual number of sunburns, ages 10-19 years</p> <table border="1"> <thead> <tr> <th></th> <th>Frequencies</th> <th>Cases</th> <th>Age Adjusted RR</th> <th>Multivariate* Adjusted RR</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>21,747 (23%)</td> <td>22</td> <td>1.00</td> <td>1.00</td> </tr> <tr> <td>≤1/year</td> <td>52,452 (55%)</td> <td>94</td> <td>1.80 (1.13-2.86)</td> <td>1.64 (1.03-2.62)</td> </tr> <tr> <td>≥2/year</td> <td>21,273 (22%)</td> <td>55</td> <td>2.70 (1.65-4.44)</td> <td>2.42 (1.46-4.02)</td> </tr> <tr> <td>Trend</td> <td></td> <td></td> <td>p<0.001</td> <td>p<0.001</td> </tr> </tbody> </table> <p>Annual number of sunburns, ages 10-39 years</p> <table border="1"> <thead> <tr> <th></th> <th>Frequencies</th> <th>Cases</th> <th>Age Adjusted RR</th> <th>Multivariate* Adjusted RR</th> </tr> </thead> <tbody> <tr> <td>≤1/yr, 10-39 yrs</td> <td>64,807 (72%)</td> <td>99</td> <td>1.00</td> <td>1.00</td> </tr> <tr> <td>≥2/yr, 20-29 yrs and/or 30-39 yrs</td> <td>5,873 (6%)</td> <td>13</td> <td>1.47 (0.82-2.62)</td> <td>1.54 (0.86-2.75)</td> </tr> <tr> <td>≥2/yr, 10-19 yrs</td> <td>7,357 (8%)</td> <td>20</td> <td>1.82 (1.13-2.95)</td> <td>1.66 (1.02-2.70)</td> </tr> <tr> <td>≥2/yr, 10-39 yrs</td> <td>12,595 (14%)</td> <td>34</td> <td>1.83 (1.24-2.70)</td> <td>1.79 (1.20-2.68)</td> </tr> <tr> <td>Trend</td> <td></td> <td></td> <td>p<0.001</td> <td>p=0.002</td> </tr> </tbody> </table> <p>*Adjusted for age, region of residence, and hair color</p>		Frequencies	Cases	Age Adjusted RR	Multivariate* Adjusted RR	0	21,747 (23%)	22	1.00	1.00	≤1/year	52,452 (55%)	94	1.80 (1.13-2.86)	1.64 (1.03-2.62)	≥2/year	21,273 (22%)	55	2.70 (1.65-4.44)	2.42 (1.46-4.02)	Trend			p<0.001	p<0.001		Frequencies	Cases	Age Adjusted RR	Multivariate* Adjusted RR	≤1/yr, 10-39 yrs	64,807 (72%)	99	1.00	1.00	≥2/yr, 20-29 yrs and/or 30-39 yrs	5,873 (6%)	13	1.47 (0.82-2.62)	1.54 (0.86-2.75)	≥2/yr, 10-19 yrs	7,357 (8%)	20	1.82 (1.13-2.95)	1.66 (1.02-2.70)	≥2/yr, 10-39 yrs	12,595 (14%)	34	1.83 (1.24-2.70)	1.79 (1.20-2.68)	Trend			p<0.001	p=0.002	
	Frequencies	Cases	Age Adjusted RR	Multivariate* Adjusted RR																																																						
0	21,747 (23%)	22	1.00	1.00																																																						
≤1/year	52,452 (55%)	94	1.80 (1.13-2.86)	1.64 (1.03-2.62)																																																						
≥2/year	21,273 (22%)	55	2.70 (1.65-4.44)	2.42 (1.46-4.02)																																																						
Trend			p<0.001	p<0.001																																																						
	Frequencies	Cases	Age Adjusted RR	Multivariate* Adjusted RR																																																						
≤1/yr, 10-39 yrs	64,807 (72%)	99	1.00	1.00																																																						
≥2/yr, 20-29 yrs and/or 30-39 yrs	5,873 (6%)	13	1.47 (0.82-2.62)	1.54 (0.86-2.75)																																																						
≥2/yr, 10-19 yrs	7,357 (8%)	20	1.82 (1.13-2.95)	1.66 (1.02-2.70)																																																						
≥2/yr, 10-39 yrs	12,595 (14%)	34	1.83 (1.24-2.70)	1.79 (1.20-2.68)																																																						
Trend			p<0.001	p=0.002																																																						

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered	Followup
Cohort						
Cho 2005 ⁹³ Nurses' Health Study I & II, Health Professionals Followup Study	<p>Skin Cancer: Melanoma</p> <p>Study Design: Prospective cohort</p> <p>Location: US (multi-state)</p>	<p>Inclusion: Participants in NHS I & II (1986) and the Health Professional Followup Study (1992) with a diagnosis of invasive melanoma including superficial spreading and nodular types</p> <p>Exclusion: Cancer other than nonmelanoma skin cancer, melanoma in situ, non-Whites, missing answers for traditional melanoma risk factors on questionnaire</p>	<p>N=178,155</p> <p>Mean age (range): 25-75</p> <p>Sex: 86% Female</p> <p>Skin phenotype: NR 100% White</p>	<p>Sun exposure, sunscreen exposure</p> <p>Mailed questionnaires, every 2 years</p>	<p>Age, family history of melanoma, number of nevi, hair color, history of severe and painful sunburn</p> <p>also evaluated other potential confounders (but did not make statistically significant contribution to the model): skin reaction to sun, latitude of residence at birth and age 1, and age 30, BMI, height, physical activity, reproductive factors, and use of sunscreen</p>	<p>Up to 14 years</p> <p>100% (because excluded people with missing data)</p>
Green 1996 ⁶⁵ Nambour Skin Cancer Study	<p>Skin Cancer: BCC and SCC</p> <p>Study Design: Cohort</p> <p>Location: Australia</p>	<p>Inclusion: Aged 20-69, resident of Nambour, Queensland from electoral roll 1986</p> <p>Exclusion: NR</p>	<p>N= 2,095 (baseline data provided for n=2049)</p> <p>Age: 20-39: 870 (42%) 40-59: 861 (42%) 60-69: 318 (16%)</p> <p>Sex (calc): 56% Female</p> <p>Skin phenotype: <i>Ability to tan (calc)</i> Always burn: 467 (23%) Burn then tan: 1,263 (62%) Always tan: 319 (16%)</p>	<p>Sun exposure</p> <p>Clinical examination with standardized questionnaires</p>	<p>Age, sex and skin color</p>	<p>6 years</p> <p>80%</p>

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sunlamp or sunbed exposure																																								
Cohort																																										
Cho 2005 ⁹³ Nurses' Health Study I & II, Health Professionals Followup Study	NR	NR																																								
Green 1996 ⁶⁵ Nambour Skin Cancer Study	<p>Relative rates of BCC and SCC according to occupational exposure</p> <table border="1"> <thead> <tr> <th></th> <th>BCC (n=250) RR (95% CI)</th> <th>P</th> <th>SCC (n=94) RR (95% CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td>Mainly indoors</td> <td>1.00</td> <td></td> <td>1.00</td> <td></td> </tr> <tr> <td>Indoors and outdoors</td> <td>1.07 (0.79-1.46)</td> <td></td> <td>0.82 (0.47-1.43)</td> <td></td> </tr> <tr> <td>Mainly outdoors</td> <td>1.25 (0.88-1.78)</td> <td>0.221</td> <td>1.37 (0.80-2.34)</td> <td>0.224</td> </tr> </tbody> </table> <p>Relative rates of BCC and SCC according to leisure exposure</p> <table border="1"> <thead> <tr> <th></th> <th>BCC (n=250) RR (95% CI)</th> <th>P</th> <th>SCC (n=94) RR (95% CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td>Mainly indoors</td> <td>1.00</td> <td></td> <td>1.00</td> <td></td> </tr> <tr> <td>Indoors and outdoors</td> <td>0.93 (0.63-1.37)</td> <td></td> <td>0.81 (0.37-1.80)</td> <td></td> </tr> <tr> <td>Mainly outdoors</td> <td>0.85 (0.59-1.21)</td> <td>0.342</td> <td>1.29 (0.66-2.52)</td> <td>0.223</td> </tr> </tbody> </table> <p>Adjusted for age, sex, and skin color</p>		BCC (n=250) RR (95% CI)	P	SCC (n=94) RR (95% CI)	P	Mainly indoors	1.00		1.00		Indoors and outdoors	1.07 (0.79-1.46)		0.82 (0.47-1.43)		Mainly outdoors	1.25 (0.88-1.78)	0.221	1.37 (0.80-2.34)	0.224		BCC (n=250) RR (95% CI)	P	SCC (n=94) RR (95% CI)	P	Mainly indoors	1.00		1.00		Indoors and outdoors	0.93 (0.63-1.37)		0.81 (0.37-1.80)		Mainly outdoors	0.85 (0.59-1.21)	0.342	1.29 (0.66-2.52)	0.223	NR
	BCC (n=250) RR (95% CI)	P	SCC (n=94) RR (95% CI)	P																																						
Mainly indoors	1.00		1.00																																							
Indoors and outdoors	1.07 (0.79-1.46)		0.82 (0.47-1.43)																																							
Mainly outdoors	1.25 (0.88-1.78)	0.221	1.37 (0.80-2.34)	0.224																																						
	BCC (n=250) RR (95% CI)	P	SCC (n=94) RR (95% CI)	P																																						
Mainly indoors	1.00		1.00																																							
Indoors and outdoors	0.93 (0.63-1.37)		0.81 (0.37-1.80)																																							
Mainly outdoors	0.85 (0.59-1.21)	0.342	1.29 (0.66-2.52)	0.223																																						

Study reference USPSTF quality	Measurement of sunscreen use	Measurement of sunburn	Comments																																				
Cohort																																							
Cho 2005 ⁹³ Nurses' Health Study I & II, Health Professionals Followup Study	"Use of sunscreen was not related to a reduced risk of melanoma" (p. 2671) when this variable was added to the multivariate model to predict risk of melanoma	<p>Number of severe and painful sunburns and relative risk of melanoma (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>N (%)</th> <th>Regression Coefficient</th> <th>SE</th> <th>P</th> <th>RR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>None</td> <td>64 (12)</td> <td>--</td> <td>--</td> <td>--</td> <td>1.0</td> </tr> <tr> <td>1-2</td> <td>109 (20)</td> <td>0.3358</td> <td>0.1579</td> <td>0.0334</td> <td>1.40 (1.03-1.91)</td> </tr> <tr> <td>3-5</td> <td>107 (20)</td> <td>0.4833</td> <td>0.1599</td> <td>0.0025</td> <td>1.62 (1.19-2.22)</td> </tr> <tr> <td>6-9</td> <td>89 (17)</td> <td>0.6683</td> <td>0.1670</td> <td><0.0001</td> <td>1.95 (1.41-2.71)</td> </tr> <tr> <td>10+</td> <td>166 (31)</td> <td>0.8574</td> <td>0.1549</td> <td><0.0001</td> <td>2.36 (1.74-3.19)</td> </tr> </tbody> </table> <p>Adjusted for sex, age, family history of melanoma, moles larger than 3mm on arms or legs, hair color</p>		N (%)	Regression Coefficient	SE	P	RR (95% CI)	None	64 (12)	--	--	--	1.0	1-2	109 (20)	0.3358	0.1579	0.0334	1.40 (1.03-1.91)	3-5	107 (20)	0.4833	0.1599	0.0025	1.62 (1.19-2.22)	6-9	89 (17)	0.6683	0.1670	<0.0001	1.95 (1.41-2.71)	10+	166 (31)	0.8574	0.1549	<0.0001	2.36 (1.74-3.19)	
	N (%)	Regression Coefficient	SE	P	RR (95% CI)																																		
None	64 (12)	--	--	--	1.0																																		
1-2	109 (20)	0.3358	0.1579	0.0334	1.40 (1.03-1.91)																																		
3-5	107 (20)	0.4833	0.1599	0.0025	1.62 (1.19-2.22)																																		
6-9	89 (17)	0.6683	0.1670	<0.0001	1.95 (1.41-2.71)																																		
10+	166 (31)	0.8574	0.1549	<0.0001	2.36 (1.74-3.19)																																		
Green 1996 ⁶⁵ Nambour Skin Cancer Study	NR	<p>Relative rates of BCC and SCC according to number of painful sunburns</p> <table border="1"> <thead> <tr> <th></th> <th>BCC (n=250) RR (95% CI)</th> <th>P</th> <th>SCC (n=94) RR (95% CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td>None</td> <td>1.00</td> <td></td> <td>1.00</td> <td></td> </tr> <tr> <td>1</td> <td>0.91 (0.55-1.50)</td> <td></td> <td>1.71 (0.66-4.41)</td> <td></td> </tr> <tr> <td>2-5</td> <td>1.10 (0.73-1.67)</td> <td></td> <td>3.31 (1.48-7.43)</td> <td></td> </tr> <tr> <td>6+</td> <td>1.68 (1.10-2.57)</td> <td>0.003</td> <td>3.28 (1.41-7.59)</td> <td><0.001</td> </tr> </tbody> </table> <p>Adjusted for sex and age</p>		BCC (n=250) RR (95% CI)	P	SCC (n=94) RR (95% CI)	P	None	1.00		1.00		1	0.91 (0.55-1.50)		1.71 (0.66-4.41)		2-5	1.10 (0.73-1.67)		3.31 (1.48-7.43)		6+	1.68 (1.10-2.57)	0.003	3.28 (1.41-7.59)	<0.001												
	BCC (n=250) RR (95% CI)	P	SCC (n=94) RR (95% CI)	P																																			
None	1.00		1.00																																				
1	0.91 (0.55-1.50)		1.71 (0.66-4.41)																																				
2-5	1.10 (0.73-1.67)		3.31 (1.48-7.43)																																				
6+	1.68 (1.10-2.57)	0.003	3.28 (1.41-7.59)	<0.001																																			

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered	Followup
Cohort						
Neale 2007 ⁶¹ Supplement to Green 1999 ⁵⁷	Skin Cancer: BCC of head and trunk Study Design: Cohort from Nambour Skin Cancer Trial Location: Australia	Inclusion: Aged 20-69, resident of Nambour, Queensland from electoral roll 1986, who attended a second survey in 1992; subgroup of those with their first BCC on head and trunk only Exclusion: Taking vitamin supplements containing betacarotene, already applying sunscreen on a strict daily basis	N= 1517 N (no lesions)= 1248 N (BCC head or trunk)= 269 (head n=175, trunk n=94) Mean age (range): Head first: 61 Trunk first: 57 Sex: NR Skin phenotype: NR	Sun exposure	Age and sex	unclear (see Green 1999 ⁵⁷)

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sunlamp or sunbed exposure																								
Cohort																										
Neale 2007 ⁶¹ Supplement to Green 1999 ⁵⁷	<p>Association between truncal BCC and BCC of the head and occupational type, compared to participants without lesions</p> <table border="1"> <thead> <tr> <th></th> <th>Head OR (95% CI)</th> <th>Trunk OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Mainly indoors</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>Indoors & outdoors</td> <td>0.95 (0.60-1.49)</td> <td>1.07 (0.60-1.93)</td> </tr> <tr> <td>Mainly outdoors</td> <td>0.86 (0.53-1.40)</td> <td>1.12 (0.60-2.11)</td> </tr> </tbody> </table> <p>Association between truncal BCC and BCC of the head and leisure type, compared to participants without lesions</p> <table border="1"> <thead> <tr> <th></th> <th>Head OR (95% CI)</th> <th>Trunk OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Mainly indoors</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>Indoors & outdoors</td> <td>0.93 (0.64-1.35)</td> <td>1.15 (0.62-2.12)</td> </tr> <tr> <td>Mainly outdoors</td> <td>0.99 (0.60-1.63)</td> <td>0.84 (0.32-2.17)</td> </tr> </tbody> </table>		Head OR (95% CI)	Trunk OR (95% CI)	Mainly indoors	1.0	1.0	Indoors & outdoors	0.95 (0.60-1.49)	1.07 (0.60-1.93)	Mainly outdoors	0.86 (0.53-1.40)	1.12 (0.60-2.11)		Head OR (95% CI)	Trunk OR (95% CI)	Mainly indoors	1.0	1.0	Indoors & outdoors	0.93 (0.64-1.35)	1.15 (0.62-2.12)	Mainly outdoors	0.99 (0.60-1.63)	0.84 (0.32-2.17)	NR
	Head OR (95% CI)	Trunk OR (95% CI)																								
Mainly indoors	1.0	1.0																								
Indoors & outdoors	0.95 (0.60-1.49)	1.07 (0.60-1.93)																								
Mainly outdoors	0.86 (0.53-1.40)	1.12 (0.60-2.11)																								
	Head OR (95% CI)	Trunk OR (95% CI)																								
Mainly indoors	1.0	1.0																								
Indoors & outdoors	0.93 (0.64-1.35)	1.15 (0.62-2.12)																								
Mainly outdoors	0.99 (0.60-1.63)	0.84 (0.32-2.17)																								

Study reference USPSTF quality	Measurement of sunscreen use	Measurement of sunburn	Comments															
Case-control																		
Neale 2007 ⁶¹ Supplement to Green 1999 ⁵⁷	NR	<p>Association between truncal BCC and BCC of the head and lifetime sunburns, compared to participants without lesions</p> <table border="1"> <thead> <tr> <th></th> <th>Head OR (95% CI)</th> <th>Trunk OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>None</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>1-5</td> <td>0.96 (0.61-1.53)</td> <td>1.44 (0.73-2.84)</td> </tr> <tr> <td>6-10</td> <td>1.37 (0.74-2.56)</td> <td>1.75 (0.74-4.17)</td> </tr> <tr> <td>>10</td> <td>1.79 (0.93-3.45)</td> <td>2.49 (1.04-5.99)</td> </tr> </tbody> </table>		Head OR (95% CI)	Trunk OR (95% CI)	None	1.0	1.0	1-5	0.96 (0.61-1.53)	1.44 (0.73-2.84)	6-10	1.37 (0.74-2.56)	1.75 (0.74-4.17)	>10	1.79 (0.93-3.45)	2.49 (1.04-5.99)	
	Head OR (95% CI)	Trunk OR (95% CI)																
None	1.0	1.0																
1-5	0.96 (0.61-1.53)	1.44 (0.73-2.84)																
6-10	1.37 (0.74-2.56)	1.75 (0.74-4.17)																
>10	1.79 (0.93-3.45)	2.49 (1.04-5.99)																

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered																																				
Case-control																																									
White 1994 ⁷²	<p>Skin Cancer: Melanoma</p> <p>Study Design: Case control</p> <p>Location: Washington</p>	<p>Cases: Selection: SEER cancer registry that were diagnosed between 1984-1987 in 3 counties. Only cases read in hospital pathology labs were eligible to be disclosed</p> <p>Eligibility criteria: age 25-65 years, living, white, currently residing in the 3 counties, had a telephone, and had a melanoma histology defined as eligible; excluded nodular melanoma and malignant Hutchinson's melanotic freckle</p> <p>Controls: Selection: age, sex, and residence matched from random digit dialing</p> <p>Eligibility criteria: otherwise NR</p>	<p>Cases n= 256 Controls n= 273</p> <p>Age</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>29-36</td> <td>52 (20%)</td> <td>31 (12%)</td> </tr> <tr> <td>37-47</td> <td>78 (31%)</td> <td>52 (19%)</td> </tr> <tr> <td>48-58</td> <td>82 (32%)</td> <td>124 (45%)</td> </tr> <tr> <td>59-65</td> <td>44 (17%)</td> <td>66 (24%)</td> </tr> </tbody> </table> <p>Sex</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Male</td> <td>129 (50%)</td> <td>128 (47%)</td> </tr> </tbody> </table> <p>Skin phenotype <i>Skin reaction to chronic sun</i></p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Deep tan</td> <td>46 (18%)</td> <td>87 (32%)</td> </tr> <tr> <td>Moderate tan</td> <td>105 (41%)</td> <td>113 (41%)</td> </tr> <tr> <td>Mild tan</td> <td>66 (26%)</td> <td>64 (23%)</td> </tr> <tr> <td>None or freckles</td> <td>39 (15%)</td> <td>9 (4%)</td> </tr> </tbody> </table>		Cases	Controls	29-36	52 (20%)	31 (12%)	37-47	78 (31%)	52 (19%)	48-58	82 (32%)	124 (45%)	59-65	44 (17%)	66 (24%)		Cases	Controls	Male	129 (50%)	128 (47%)		Cases	Controls	Deep tan	46 (18%)	87 (32%)	Moderate tan	105 (41%)	113 (41%)	Mild tan	66 (26%)	64 (23%)	None or freckles	39 (15%)	9 (4%)	<p>Sun exposure</p> <p>Telephone interview</p>	<p>Age, sex and educational level</p>
	Cases	Controls																																							
29-36	52 (20%)	31 (12%)																																							
37-47	78 (31%)	52 (19%)																																							
48-58	82 (32%)	124 (45%)																																							
59-65	44 (17%)	66 (24%)																																							
	Cases	Controls																																							
Male	129 (50%)	128 (47%)																																							
	Cases	Controls																																							
Deep tan	46 (18%)	87 (32%)																																							
Moderate tan	105 (41%)	113 (41%)																																							
Mild tan	66 (26%)	64 (23%)																																							
None or freckles	39 (15%)	9 (4%)																																							

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sunlamp or sunbed exposure																																																																																																																								
Case-control																																																																																																																										
White 1994 ⁷²	<p>Average yearly sun exposure (hours) for previous 10 years</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR* (95%CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>97 (38%)</td> <td>126 (46%)</td> <td>1.0</td> <td></td> </tr> <tr> <td>1-201</td> <td>86 (34%)</td> <td>63 (23%)</td> <td>1.16 (0.72-1.87)</td> <td></td> </tr> <tr> <td>202-499</td> <td>47 (18%)</td> <td>48 (18%)</td> <td>0.80 (0.45-1.42)</td> <td></td> </tr> <tr> <td>500-2,880</td> <td>26 (10%)</td> <td>36 (13%)</td> <td>0.88 (0.47-1.64)</td> <td>0.53</td> </tr> </tbody> </table> <p>Lifetime occupational sun exposure</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR* (95% CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>168 (66%)</td> <td>165 (60%)</td> <td>1.00</td> <td></td> </tr> <tr> <td><50%</td> <td>72 (28%)</td> <td>78 (29%)</td> <td>0.89 (0.60-1.32)</td> <td></td> </tr> <tr> <td>≥50%</td> <td>16 (6%)</td> <td>30 (11%)</td> <td>0.64 (0.33-1.23)</td> <td>0.13</td> </tr> </tbody> </table> <p>Sun exposure index, by skin type</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR* (95% CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td colspan="5">Poor tanners (no tan, mild tan, or freckling in response to chronic sun)</td> </tr> <tr> <td colspan="5"><i>Sun exposure index, age 2-10</i></td> </tr> <tr> <td>low</td> <td>50 (52%)</td> <td>34 (49%)</td> <td>1.00</td> <td></td> </tr> <tr> <td>med</td> <td>23 (24%)</td> <td>17 (24%)</td> <td>0.96 (0.43-2.18)</td> <td></td> </tr> <tr> <td>high</td> <td>23 (24%)</td> <td>19 (27%)</td> <td>0.88 (0.39-1.96)</td> <td>0.78</td> </tr> <tr> <td colspan="5"><i>Sun exposure index, age 11-20</i></td> </tr> <tr> <td>low</td> <td>53 (54%)</td> <td>43 (60%)</td> <td>1.00</td> <td></td> </tr> <tr> <td>med</td> <td>24 (25%)</td> <td>18 (25%)</td> <td>0.94 (0.42-2.08)</td> <td></td> </tr> <tr> <td>high</td> <td>20 (21%)</td> <td>11 (15%)</td> <td>1.55 (0.61-3.99)</td> <td>0.45</td> </tr> <tr> <td colspan="5">Deep tanners (moderate or deep tan in response to chronic sun)</td> </tr> <tr> <td colspan="5"><i>Sun exposure index, age 2-10</i></td> </tr> <tr> <td>low</td> <td>78 (54%)</td> <td>71 (36%)</td> <td>1.00</td> <td></td> </tr> <tr> <td>med</td> <td>40 (28%)</td> <td>55 (28%)</td> <td>0.69 (0.40-1.21)</td> <td></td> </tr> <tr> <td>high</td> <td>26 (18%)</td> <td>71 (36%)</td> <td>0.30 (0.17-0.55)</td> <td>0.001</td> </tr> </tbody> </table>		Cases	Controls	OR* (95%CI)	P	0	97 (38%)	126 (46%)	1.0		1-201	86 (34%)	63 (23%)	1.16 (0.72-1.87)		202-499	47 (18%)	48 (18%)	0.80 (0.45-1.42)		500-2,880	26 (10%)	36 (13%)	0.88 (0.47-1.64)	0.53		Cases	Controls	OR* (95% CI)	P	0	168 (66%)	165 (60%)	1.00		<50%	72 (28%)	78 (29%)	0.89 (0.60-1.32)		≥50%	16 (6%)	30 (11%)	0.64 (0.33-1.23)	0.13		Cases	Controls	OR* (95% CI)	P	Poor tanners (no tan, mild tan, or freckling in response to chronic sun)					<i>Sun exposure index, age 2-10</i>					low	50 (52%)	34 (49%)	1.00		med	23 (24%)	17 (24%)	0.96 (0.43-2.18)		high	23 (24%)	19 (27%)	0.88 (0.39-1.96)	0.78	<i>Sun exposure index, age 11-20</i>					low	53 (54%)	43 (60%)	1.00		med	24 (25%)	18 (25%)	0.94 (0.42-2.08)		high	20 (21%)	11 (15%)	1.55 (0.61-3.99)	0.45	Deep tanners (moderate or deep tan in response to chronic sun)					<i>Sun exposure index, age 2-10</i>					low	78 (54%)	71 (36%)	1.00		med	40 (28%)	55 (28%)	0.69 (0.40-1.21)		high	26 (18%)	71 (36%)	0.30 (0.17-0.55)	0.001	<p>NR</p>
	Cases	Controls	OR* (95%CI)	P																																																																																																																						
0	97 (38%)	126 (46%)	1.0																																																																																																																							
1-201	86 (34%)	63 (23%)	1.16 (0.72-1.87)																																																																																																																							
202-499	47 (18%)	48 (18%)	0.80 (0.45-1.42)																																																																																																																							
500-2,880	26 (10%)	36 (13%)	0.88 (0.47-1.64)	0.53																																																																																																																						
	Cases	Controls	OR* (95% CI)	P																																																																																																																						
0	168 (66%)	165 (60%)	1.00																																																																																																																							
<50%	72 (28%)	78 (29%)	0.89 (0.60-1.32)																																																																																																																							
≥50%	16 (6%)	30 (11%)	0.64 (0.33-1.23)	0.13																																																																																																																						
	Cases	Controls	OR* (95% CI)	P																																																																																																																						
Poor tanners (no tan, mild tan, or freckling in response to chronic sun)																																																																																																																										
<i>Sun exposure index, age 2-10</i>																																																																																																																										
low	50 (52%)	34 (49%)	1.00																																																																																																																							
med	23 (24%)	17 (24%)	0.96 (0.43-2.18)																																																																																																																							
high	23 (24%)	19 (27%)	0.88 (0.39-1.96)	0.78																																																																																																																						
<i>Sun exposure index, age 11-20</i>																																																																																																																										
low	53 (54%)	43 (60%)	1.00																																																																																																																							
med	24 (25%)	18 (25%)	0.94 (0.42-2.08)																																																																																																																							
high	20 (21%)	11 (15%)	1.55 (0.61-3.99)	0.45																																																																																																																						
Deep tanners (moderate or deep tan in response to chronic sun)																																																																																																																										
<i>Sun exposure index, age 2-10</i>																																																																																																																										
low	78 (54%)	71 (36%)	1.00																																																																																																																							
med	40 (28%)	55 (28%)	0.69 (0.40-1.21)																																																																																																																							
high	26 (18%)	71 (36%)	0.30 (0.17-0.55)	0.001																																																																																																																						

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

<i>Sun exposure index, age 11-20</i> low 76 (52%) 64 (32%) 1.00 med 46 (31%) 81 (41%) 0.50 (0.30-0.85) high 25 (17%) 54 (27%) 0.31 (0.16-0.59) 0.001 *Adjusted for age, sex and education	
---	--

Study reference USPSTF quality	Measurement of sunscreen use	Measurement of sunburn	Comments
Case-control			
White 1994 ⁷²	NR	NR	

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered																					
Case-control																										
Osterlind 1988 ⁸³ Osterlind 1988 ¹²⁹	Skin Cancer: Melanoma Study Design: Case control Location: East Denmark	Cases: Selection: incident cases 1982-1985 from the Danish Cancer Registry Eligibility criteria: age 20-79 years, any cutaneous melanoma except lentigo maligna melanoma Controls: Selection: age, sex matched from national population register in 1984 Eligibility criteria: otherwise NR	Cases n= 474 Controls n= 926 Average age at diagnosis: 52 Sex (calc) <table border="1"> <tr> <td></td> <td>Cases</td> <td>Controls</td> </tr> <tr> <td>Male</td> <td>194 (41%)</td> <td>NR</td> </tr> </table> Chronic reaction to sunlight (calc) <table border="1"> <tr> <td></td> <td>Cases</td> <td>Controls</td> </tr> <tr> <td>Deep tan</td> <td>125 (26.4%)</td> <td>326 (35.2%)</td> </tr> <tr> <td>Moderate tan</td> <td>228 (48.1%)</td> <td>429 (46.3%)</td> </tr> <tr> <td>Mild tan</td> <td>101 (21.3%)</td> <td>143 (15.4%)</td> </tr> <tr> <td>No tan</td> <td>18 (3.8%)</td> <td>24 (2.6%)</td> </tr> </table>		Cases	Controls	Male	194 (41%)	NR		Cases	Controls	Deep tan	125 (26.4%)	326 (35.2%)	Moderate tan	228 (48.1%)	429 (46.3%)	Mild tan	101 (21.3%)	143 (15.4%)	No tan	18 (3.8%)	24 (2.6%)	Sun exposure, sunscreen use, sunburns mixed Telephone and in-person interviews	Constitutional factors, sex and age
	Cases	Controls																								
Male	194 (41%)	NR																								
	Cases	Controls																								
Deep tan	125 (26.4%)	326 (35.2%)																								
Moderate tan	228 (48.1%)	429 (46.3%)																								
Mild tan	101 (21.3%)	143 (15.4%)																								
No tan	18 (3.8%)	24 (2.6%)																								

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sunlamp or sunbed exposure																																																							
Case-control																																																									
Osterlind 1988 ⁸³ Osterlind 1988 ¹²⁹	Sunbathing habits (calc) <table border="1"> <tr> <td></td> <td>Cases</td> <td>Controls</td> <td>Crude RR (95% CI)</td> <td>Adjusted* RR (95% CI)</td> </tr> <tr> <td>Never</td> <td>42 (8.9%)</td> <td>135 (14.6%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>At some time</td> <td>432 (91.1%)</td> <td>791 (85.4%)</td> <td>1.8 (1.2-2.5)</td> <td>1.6 (1.1-2.4)</td> </tr> <tr> <td>1-9 years</td> <td>16 (3.4%)</td> <td>27 (2.9%)</td> <td>1.9 (0.9-3.9)</td> <td></td> </tr> <tr> <td>10-24 years</td> <td>99 (20.9%)</td> <td>197 (21.3%)</td> <td>1.6 (1.1-2.5)</td> <td></td> </tr> <tr> <td>25-39 years</td> <td>161 (34.0%)</td> <td>313 (33.8%)</td> <td>1.7 (1.1-2.5)</td> <td></td> </tr> <tr> <td>40+ years</td> <td>149 (31.4%)</td> <td>248 (26.8%)</td> <td>1.9 (1.3-2.9)</td> <td></td> </tr> </table> <p><i>p=0.004</i> *Adjusted for sex, naevi, freckles and hair color</p> Vacations spent in sun (calc) <table border="1"> <tr> <td></td> <td>Cases</td> <td>Controls</td> <td>Crude RR (95% CI)</td> <td>Adjusted* RR (95% CI)</td> </tr> <tr> <td>Never</td> <td>182 (38.4%)</td> <td>406 (43.8%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>Sunny</td> <td>229 (48.3%)</td> <td>433 (46.8%)</td> <td>1.2 (0.9-1.5)</td> <td>1.0 (0.8-1.3)</td> </tr> <tr> <td>Very sunny</td> <td>63 (13.3%)</td> <td>84 (9.1%)</td> <td>1.7 (1.2-2.4)</td> <td>1.4 (1.0-2.1)</td> </tr> </table> <p><i>p<0.01</i> <i>p=0.138</i> *Adjusted for history of sunbathing and sunburning</p>		Cases	Controls	Crude RR (95% CI)	Adjusted* RR (95% CI)	Never	42 (8.9%)	135 (14.6%)	1.0	1.0	At some time	432 (91.1%)	791 (85.4%)	1.8 (1.2-2.5)	1.6 (1.1-2.4)	1-9 years	16 (3.4%)	27 (2.9%)	1.9 (0.9-3.9)		10-24 years	99 (20.9%)	197 (21.3%)	1.6 (1.1-2.5)		25-39 years	161 (34.0%)	313 (33.8%)	1.7 (1.1-2.5)		40+ years	149 (31.4%)	248 (26.8%)	1.9 (1.3-2.9)			Cases	Controls	Crude RR (95% CI)	Adjusted* RR (95% CI)	Never	182 (38.4%)	406 (43.8%)	1.0	1.0	Sunny	229 (48.3%)	433 (46.8%)	1.2 (0.9-1.5)	1.0 (0.8-1.3)	Very sunny	63 (13.3%)	84 (9.1%)	1.7 (1.2-2.4)	1.4 (1.0-2.1)	Ever used sunbed Cases (calc): 66 (14%) Controls (calc): 167 (18%) RR (95% CI): 0.7 (0.5-1.0)
	Cases	Controls	Crude RR (95% CI)	Adjusted* RR (95% CI)																																																					
Never	42 (8.9%)	135 (14.6%)	1.0	1.0																																																					
At some time	432 (91.1%)	791 (85.4%)	1.8 (1.2-2.5)	1.6 (1.1-2.4)																																																					
1-9 years	16 (3.4%)	27 (2.9%)	1.9 (0.9-3.9)																																																						
10-24 years	99 (20.9%)	197 (21.3%)	1.6 (1.1-2.5)																																																						
25-39 years	161 (34.0%)	313 (33.8%)	1.7 (1.1-2.5)																																																						
40+ years	149 (31.4%)	248 (26.8%)	1.9 (1.3-2.9)																																																						
	Cases	Controls	Crude RR (95% CI)	Adjusted* RR (95% CI)																																																					
Never	182 (38.4%)	406 (43.8%)	1.0	1.0																																																					
Sunny	229 (48.3%)	433 (46.8%)	1.2 (0.9-1.5)	1.0 (0.8-1.3)																																																					
Very sunny	63 (13.3%)	84 (9.1%)	1.7 (1.2-2.4)	1.4 (1.0-2.1)																																																					

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sunscreen use	Measurement of sunburn	Comments																									
Case-control																												
Osterlind 1988 ⁸³ Osterlind 1988 ¹²⁹	NR	<p>Number of painful sunburns before age 15 (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Crude RR (95%CI)</th> <th>Adjusted RR* (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Never</td> <td>93 (19.6%)</td> <td>277 (29.9%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>1</td> <td>35 (7.4%)</td> <td>80 (8.6%)</td> <td>1.3 (0.8-2.1)</td> <td>1.2 (0.7-1.9)</td> </tr> <tr> <td>2-4</td> <td>85 (17.9%)</td> <td>121 (13.1%)</td> <td>2.1 (1.5-3.0)</td> <td>1.9 (1.3-2.9)</td> </tr> <tr> <td>5+</td> <td>44 (9.3%)</td> <td>35 (3.8%)</td> <td>3.7 (2.3-6.1)</td> <td>2.7 (1.6-4.8)</td> </tr> </tbody> </table> <p><i>p</i><0.001 <i>p</i><0.001</p> <p>*Adjusted for sex, number of raised naevi, freckles and hair color</p>		Cases	Controls	Crude RR (95%CI)	Adjusted RR* (95% CI)	Never	93 (19.6%)	277 (29.9%)	1.0	1.0	1	35 (7.4%)	80 (8.6%)	1.3 (0.8-2.1)	1.2 (0.7-1.9)	2-4	85 (17.9%)	121 (13.1%)	2.1 (1.5-3.0)	1.9 (1.3-2.9)	5+	44 (9.3%)	35 (3.8%)	3.7 (2.3-6.1)	2.7 (1.6-4.8)	
	Cases	Controls	Crude RR (95%CI)	Adjusted RR* (95% CI)																								
Never	93 (19.6%)	277 (29.9%)	1.0	1.0																								
1	35 (7.4%)	80 (8.6%)	1.3 (0.8-2.1)	1.2 (0.7-1.9)																								
2-4	85 (17.9%)	121 (13.1%)	2.1 (1.5-3.0)	1.9 (1.3-2.9)																								
5+	44 (9.3%)	35 (3.8%)	3.7 (2.3-6.1)	2.7 (1.6-4.8)																								

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered																																							
Case-control																																												
Berwick 1996 ⁷³ Lea 2007 ¹³⁰ Chen 1996 ¹³¹	<p>Skin Cancer: Melanoma</p> <p>Study Design: Case control</p> <p>Location: Connecticut</p>	<p>Cases: Selection: all first incident cases from SEER cancer registry that were diagnosed between 1987-1989</p> <p>Eligibility criteria: ≥18 years, Caucasian, invasive melanoma, excluded melanoma in situ</p> <p>Controls: Selection: age and sex matched, random digit dialing</p> <p>Eligibility criteria: otherwise NR</p>	<p>Cases n= 650 Controls n= 549</p> <p>Age:</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td><40</td> <td>123 (19%)</td> <td>110 (20%)</td> </tr> <tr> <td>40-70</td> <td>380 (58.5%)</td> <td>320 (58.3%)</td> </tr> <tr> <td>≥70</td> <td>147 (22.6%)</td> <td>119 (21.7%)</td> </tr> </tbody> </table> <p>Sex:</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Male</td> <td>343 (52.8%)</td> <td>316 (57.6%)</td> </tr> </tbody> </table> <p>Skin phenotype*</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td colspan="3"><i>Acute Skin Response</i></td> </tr> <tr> <td>Tan</td> <td>201 (53%)</td> <td>220 (60%)</td> </tr> <tr> <td>Burn</td> <td>179 (47%)</td> <td>144 (40%)</td> </tr> <tr> <td colspan="3"><i>Prolonged Skin Response</i></td> </tr> <tr> <td>Tan</td> <td>233 (61%)</td> <td>283 (77%)</td> </tr> <tr> <td>No tan</td> <td>147 (39%)</td> <td>81 (23%)</td> </tr> </tbody> </table> <p>*Missing information, lived abroad, lentigo maligna, and acral lentiginous melanoma excluded from analysis</p>		Cases	Controls	<40	123 (19%)	110 (20%)	40-70	380 (58.5%)	320 (58.3%)	≥70	147 (22.6%)	119 (21.7%)		Cases	Controls	Male	343 (52.8%)	316 (57.6%)		Cases	Controls	<i>Acute Skin Response</i>			Tan	201 (53%)	220 (60%)	Burn	179 (47%)	144 (40%)	<i>Prolonged Skin Response</i>			Tan	233 (61%)	283 (77%)	No tan	147 (39%)	81 (23%)	<p>Sun exposure</p> <p>Nurse-administered questionnaire and examination of arms and back for nevi</p>	<p>Berwick 1996: Age, sex, sun exposure, nevi, family history, skin type, eye color, hair color, tendency to freckle, ever severely sunburned,</p> <p>Lea 2007: Age, sex, sun sensitivity, number of vacations and mean number of days per year in recreational activity, cumulative UVB</p>
	Cases	Controls																																										
<40	123 (19%)	110 (20%)																																										
40-70	380 (58.5%)	320 (58.3%)																																										
≥70	147 (22.6%)	119 (21.7%)																																										
	Cases	Controls																																										
Male	343 (52.8%)	316 (57.6%)																																										
	Cases	Controls																																										
<i>Acute Skin Response</i>																																												
Tan	201 (53%)	220 (60%)																																										
Burn	179 (47%)	144 (40%)																																										
<i>Prolonged Skin Response</i>																																												
Tan	233 (61%)	283 (77%)																																										
No tan	147 (39%)	81 (23%)																																										

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sunlamp or sunbed exposure																																																																																																														
Case-control																																																																																																																
Berwick 1996 ⁷³ Lea 2007 ¹³⁰ Chen 1996 ¹³¹	<p>Total Sun Exposure</p> <table border="1"> <thead> <tr> <th></th> <th>OR* (95% CI)</th> <th>Adjusted OR** (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Light</td> <td>1.00</td> <td>1.00</td> </tr> <tr> <td>Moderate</td> <td>1.04 (0.65-1.66)</td> <td>1.26 (0.69-2.29)</td> </tr> <tr> <td>Heavy</td> <td>1.80 (1.14-2.86)</td> <td>2.20 (1.21-4.01)</td> </tr> <tr> <td>Very heavy</td> <td>2.11 (1.18-3.15)</td> <td>2.63 (1.25-5.54)</td> </tr> </tbody> </table> <p>*Adjusted for age and sex **Adjusted for skin self-examination, total nevi, family hx skin cancer, skin type, eye color, hair color, freckle, and ever severely sunburned</p> <p>Total recreational sun exposure index*</p> <table border="1"> <thead> <tr> <th></th> <th>Head/neck OR (95% CI)</th> <th>Upper limb OR (95% CI)</th> <th>Lower limb OR (95% CI)</th> <th>Trunk OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Level 1</td> <td>--</td> <td>--</td> <td>--</td> <td>--</td> </tr> <tr> <td>Level 2</td> <td>1.5 (0.7-3.3)</td> <td>0.9 (0.4-1.8)</td> <td>1.0 (0.5-2.2)</td> <td>1.7 (1.0-2.9)</td> </tr> <tr> <td>Level 3</td> <td>1.0 (0.7-2.1)</td> <td>1.0 (0.5-2.0)</td> <td>1.2 (0.6-2.7)</td> <td>1.4 (0.7-2.2)</td> </tr> <tr> <td>Level 4</td> <td>2.6 (1.2-5.6)</td> <td>2.4 (1.2-4.8)</td> <td>2.7 (1.2-5.8)</td> <td>2.7 (1.6-4.5)</td> </tr> </tbody> </table> <p>Total years in outdoor jobs**</p> <table border="1"> <thead> <tr> <th></th> <th>Head/neck OR (95% CI)</th> <th>Upper limb OR (95% CI)</th> <th>Lower limb OR (95% CI)</th> <th>Trunk OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>--</td> <td>--</td> <td>--</td> <td>--</td> </tr> <tr> <td><5</td> <td>0.8 (0.4-1.5)</td> <td>0.7 (0.4-1.4)</td> <td>0.7 (0.3-1.3)</td> <td>0.7 (0.5-1.1)</td> </tr> <tr> <td>5+</td> <td>0.5 (0.2-1.1)</td> <td>0.6 (0.2-1.1)</td> <td>0.3 (0.1-0.9)</td> <td>0.9 (0.6-1.3)</td> </tr> </tbody> </table> <p>*Adjusted for sex, age, skin color, number of nevi on arms, and skin type **Due to missing values, 525 cases and 468 controls</p> <p>Number of vacations</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td colspan="5"><i>Birth to age 15</i></td> </tr> <tr> <td>0</td> <td>235 (61.8%)</td> <td>238 (65.4%)</td> <td>1.0 (R)</td> <td></td> </tr> <tr> <td>1-14</td> <td>100 (26.3%)</td> <td>83 (22.8%)</td> <td>1.1 (0.8-1.7)</td> <td>0.5</td> </tr> <tr> <td>15-90</td> <td>45 (11.8%)</td> <td>43 (11.8%)</td> <td>0.9 (0.5-1.4)</td> <td>0.7</td> </tr> <tr> <td colspan="5"><i>10 years before interview</i></td> </tr> <tr> <td>0</td> <td>88 (23.2%)</td> <td>93 (25.6%)</td> <td>1.0 (R)</td> <td></td> </tr> <tr> <td>1-3</td> <td>88 (23.2%)</td> <td>93 (25.6%)</td> <td>1.1 (0.7-1.7)</td> <td>0.8</td> </tr> <tr> <td>4-8</td> <td>81 (21.3%)</td> <td>91 (25.0%)</td> <td>1.0 (0.6-1.6)</td> <td>0.9</td> </tr> <tr> <td>9-40</td> <td>123 (32.4%)</td> <td>87 (23.9%)</td> <td>1.5 (0.9-2.4)</td> <td>0.05</td> </tr> </tbody> </table>		OR* (95% CI)	Adjusted OR** (95% CI)	Light	1.00	1.00	Moderate	1.04 (0.65-1.66)	1.26 (0.69-2.29)	Heavy	1.80 (1.14-2.86)	2.20 (1.21-4.01)	Very heavy	2.11 (1.18-3.15)	2.63 (1.25-5.54)		Head/neck OR (95% CI)	Upper limb OR (95% CI)	Lower limb OR (95% CI)	Trunk OR (95% CI)	Level 1	--	--	--	--	Level 2	1.5 (0.7-3.3)	0.9 (0.4-1.8)	1.0 (0.5-2.2)	1.7 (1.0-2.9)	Level 3	1.0 (0.7-2.1)	1.0 (0.5-2.0)	1.2 (0.6-2.7)	1.4 (0.7-2.2)	Level 4	2.6 (1.2-5.6)	2.4 (1.2-4.8)	2.7 (1.2-5.8)	2.7 (1.6-4.5)		Head/neck OR (95% CI)	Upper limb OR (95% CI)	Lower limb OR (95% CI)	Trunk OR (95% CI)	0	--	--	--	--	<5	0.8 (0.4-1.5)	0.7 (0.4-1.4)	0.7 (0.3-1.3)	0.7 (0.5-1.1)	5+	0.5 (0.2-1.1)	0.6 (0.2-1.1)	0.3 (0.1-0.9)	0.9 (0.6-1.3)		Cases	Controls	OR (95% CI)	P	<i>Birth to age 15</i>					0	235 (61.8%)	238 (65.4%)	1.0 (R)		1-14	100 (26.3%)	83 (22.8%)	1.1 (0.8-1.7)	0.5	15-90	45 (11.8%)	43 (11.8%)	0.9 (0.5-1.4)	0.7	<i>10 years before interview</i>					0	88 (23.2%)	93 (25.6%)	1.0 (R)		1-3	88 (23.2%)	93 (25.6%)	1.1 (0.7-1.7)	0.8	4-8	81 (21.3%)	91 (25.0%)	1.0 (0.6-1.6)	0.9	9-40	123 (32.4%)	87 (23.9%)	1.5 (0.9-2.4)	0.05	NR
	OR* (95% CI)	Adjusted OR** (95% CI)																																																																																																														
Light	1.00	1.00																																																																																																														
Moderate	1.04 (0.65-1.66)	1.26 (0.69-2.29)																																																																																																														
Heavy	1.80 (1.14-2.86)	2.20 (1.21-4.01)																																																																																																														
Very heavy	2.11 (1.18-3.15)	2.63 (1.25-5.54)																																																																																																														
	Head/neck OR (95% CI)	Upper limb OR (95% CI)	Lower limb OR (95% CI)	Trunk OR (95% CI)																																																																																																												
Level 1	--	--	--	--																																																																																																												
Level 2	1.5 (0.7-3.3)	0.9 (0.4-1.8)	1.0 (0.5-2.2)	1.7 (1.0-2.9)																																																																																																												
Level 3	1.0 (0.7-2.1)	1.0 (0.5-2.0)	1.2 (0.6-2.7)	1.4 (0.7-2.2)																																																																																																												
Level 4	2.6 (1.2-5.6)	2.4 (1.2-4.8)	2.7 (1.2-5.8)	2.7 (1.6-4.5)																																																																																																												
	Head/neck OR (95% CI)	Upper limb OR (95% CI)	Lower limb OR (95% CI)	Trunk OR (95% CI)																																																																																																												
0	--	--	--	--																																																																																																												
<5	0.8 (0.4-1.5)	0.7 (0.4-1.4)	0.7 (0.3-1.3)	0.7 (0.5-1.1)																																																																																																												
5+	0.5 (0.2-1.1)	0.6 (0.2-1.1)	0.3 (0.1-0.9)	0.9 (0.6-1.3)																																																																																																												
	Cases	Controls	OR (95% CI)	P																																																																																																												
<i>Birth to age 15</i>																																																																																																																
0	235 (61.8%)	238 (65.4%)	1.0 (R)																																																																																																													
1-14	100 (26.3%)	83 (22.8%)	1.1 (0.8-1.7)	0.5																																																																																																												
15-90	45 (11.8%)	43 (11.8%)	0.9 (0.5-1.4)	0.7																																																																																																												
<i>10 years before interview</i>																																																																																																																
0	88 (23.2%)	93 (25.6%)	1.0 (R)																																																																																																													
1-3	88 (23.2%)	93 (25.6%)	1.1 (0.7-1.7)	0.8																																																																																																												
4-8	81 (21.3%)	91 (25.0%)	1.0 (0.6-1.6)	0.9																																																																																																												
9-40	123 (32.4%)	87 (23.9%)	1.5 (0.9-2.4)	0.05																																																																																																												

Study reference USPSTF quality	Measurement of sunscreen use	Measurement of sunburn	Comments
Case-control			
Berwick 1996 ⁷³ Lea 2007 ¹³⁰ Chen 1996 ¹³¹	NR	<p>Ever severely sunburned</p> <p>OR (95% CI): 1.26 (0.99-1.61) Adjusted* OR (95% CI): 0.97 (0.71-1.32)</p> <p>*Adjusted for skin self-examination, skin color, sun exposure, number of nevi, family history of skin cancer, skin type, eye color, hair color, and tendency to freckle before age 25</p>	

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered																					
Case-control																										
Chen 1998 ⁸⁹	See Berwick et al 1996	See Berwick et al 1996	Cases n= 624 Controls n= 512 Sample drawn from larger case control study Berwick 1996, RM 215	Sunlamp exposure Nurse-administered questionnaires in home, at place of employment, or public place	Hair color, eye color, skin color, skin type (ability to tan), total number of nevi on arms and back, history of recreational sun exposure and history of occupational sun exposure																					
Weinstock 1991 ⁸⁷ Nurses Health Study	Skin Cancer: Melanoma Study Design: nested- Case control Location: US (multi- state)	Cases: Selection: members of Nurses' Health Study with dx of melanoma 1976-1984 confirmed by examination of medical records Eligibility criteria: born between 1921-1946; excluded ppts who were black, Asian or Hispanic, ppts with family hx of melanoma; excluded acral lentiginous melanoma or lentigo maligna Controls: Selection: 2 age-matched controls per case from same cohort Eligibility criteria: excluded ppts who were black, Asian, Hispanic and fam hx of melanoma	Cases n= 130 Controls n= 300 Age: 52.1 (mean) Sex <table border="1"> <tr> <td></td> <td><u>Cases</u></td> <td><u>Controls</u></td> </tr> <tr> <td>Male</td> <td>0</td> <td>0</td> </tr> </table> Skin phenotype <i>Depth of tan after repeated exposure (calc)</i> <table border="1"> <tr> <td></td> <td><u>Cases</u></td> <td><u>Controls</u></td> </tr> <tr> <td>Deep</td> <td>17 (13.1%)</td> <td>75 (25.0%)</td> </tr> <tr> <td>Medium</td> <td>52 (40.0%)</td> <td>118 (39.3%)</td> </tr> <tr> <td>Light</td> <td>51 (39.2%)</td> <td>79 (26.3%)</td> </tr> <tr> <td>None</td> <td>6 (4.6%)</td> <td>17 (5.7%)</td> </tr> </table>		<u>Cases</u>	<u>Controls</u>	Male	0	0		<u>Cases</u>	<u>Controls</u>	Deep	17 (13.1%)	75 (25.0%)	Medium	52 (40.0%)	118 (39.3%)	Light	51 (39.2%)	79 (26.3%)	None	6 (4.6%)	17 (5.7%)	Sun exposure Mixed mailed questionnaires and telephone interviews	Birth year, cycle of questionnaire, method of data collection, sun sensitivity, and latitude of residence at ages 15-20 years
	<u>Cases</u>	<u>Controls</u>																								
Male	0	0																								
	<u>Cases</u>	<u>Controls</u>																								
Deep	17 (13.1%)	75 (25.0%)																								
Medium	52 (40.0%)	118 (39.3%)																								
Light	51 (39.2%)	79 (26.3%)																								
None	6 (4.6%)	17 (5.7%)																								

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sunlamp or sunbed exposure																																																												
Case-control																																																														
Chen 1998 ⁸⁹	NR	<p>Ever used sunlamp (calc)</p> <table border="1"> <tr> <td></td> <td><u>Cases</u></td> <td><u>Controls</u></td> <td><u>Crude*</u> <u>OR (95% CI)</u></td> <td><u>Adjusted**</u> <u>OR (95% CI)</u></td> </tr> <tr> <td>No</td> <td>483 (77.4%)</td> <td>417 (81.4%)</td> <td>--</td> <td>--</td> </tr> <tr> <td>Yes</td> <td>141 (22.6%)</td> <td>95 (18.6%)</td> <td>1.30 (0.97-1.74)</td> <td>1.13 (0.82-1.54)</td> </tr> </table> <p>Total # sunlamp uses</p> <table border="1"> <tr> <td></td> <td><u>Cases</u></td> <td><u>Controls</u></td> <td><u>Crude*</u> <u>OR (95% CI)</u></td> <td><u>Adjusted**</u> <u>OR (95% CI)</u></td> </tr> <tr> <td>Never</td> <td>483 (77.4%)</td> <td>417 (81.4%)</td> <td>--</td> <td>--</td> </tr> <tr> <td><10</td> <td>76 (12.2%)</td> <td>50 (9.8%)</td> <td>1.32 (0.91-1.92)</td> <td>1.25 (0.84-1.84)</td> </tr> <tr> <td>≥10</td> <td>63 (10.1%)</td> <td>40 (7.8%)</td> <td>1.40 (0.93-2.12)</td> <td>1.15 (0.60-2.20)</td> </tr> </table> <p><i>p=0.97</i> <i>p=0.86</i></p> <p>Age at first use of sunlamp</p> <table border="1"> <tr> <td></td> <td><u>Cases</u></td> <td><u>Controls</u></td> <td><u>Crude*</u> <u>OR (95% CI)</u></td> <td><u>Adjusted**</u> <u>OR (95% CI)</u></td> </tr> <tr> <td>Never</td> <td>483 (77.4%)</td> <td>417 (81.4%)</td> <td>--</td> <td>--</td> </tr> <tr> <td><25</td> <td>74 (11.9%)</td> <td>42 (8.2%)</td> <td>1.58 (1.05-2.39)</td> <td>1.35 (0.88-2.08)</td> </tr> <tr> <td>25-45</td> <td>39 (6.3%)</td> <td>31 (6.1%)</td> <td>1.11 (0.68-1.80)</td> <td>1.02 (0.61-1.70)</td> </tr> <tr> <td>>45</td> <td>23 (3.7%)</td> <td>15 (2.9%)</td> <td>1.27 (0.65-2.47)</td> <td>1.13 (0.56-2.28)</td> </tr> </table> <p>*Adjusted for sex and age **Adjusted for sex, age, cutaneous phenotype index, and total recreational sun exposure index</p>		<u>Cases</u>	<u>Controls</u>	<u>Crude*</u> <u>OR (95% CI)</u>	<u>Adjusted**</u> <u>OR (95% CI)</u>	No	483 (77.4%)	417 (81.4%)	--	--	Yes	141 (22.6%)	95 (18.6%)	1.30 (0.97-1.74)	1.13 (0.82-1.54)		<u>Cases</u>	<u>Controls</u>	<u>Crude*</u> <u>OR (95% CI)</u>	<u>Adjusted**</u> <u>OR (95% CI)</u>	Never	483 (77.4%)	417 (81.4%)	--	--	<10	76 (12.2%)	50 (9.8%)	1.32 (0.91-1.92)	1.25 (0.84-1.84)	≥10	63 (10.1%)	40 (7.8%)	1.40 (0.93-2.12)	1.15 (0.60-2.20)		<u>Cases</u>	<u>Controls</u>	<u>Crude*</u> <u>OR (95% CI)</u>	<u>Adjusted**</u> <u>OR (95% CI)</u>	Never	483 (77.4%)	417 (81.4%)	--	--	<25	74 (11.9%)	42 (8.2%)	1.58 (1.05-2.39)	1.35 (0.88-2.08)	25-45	39 (6.3%)	31 (6.1%)	1.11 (0.68-1.80)	1.02 (0.61-1.70)	>45	23 (3.7%)	15 (2.9%)	1.27 (0.65-2.47)	1.13 (0.56-2.28)
	<u>Cases</u>	<u>Controls</u>	<u>Crude*</u> <u>OR (95% CI)</u>	<u>Adjusted**</u> <u>OR (95% CI)</u>																																																										
No	483 (77.4%)	417 (81.4%)	--	--																																																										
Yes	141 (22.6%)	95 (18.6%)	1.30 (0.97-1.74)	1.13 (0.82-1.54)																																																										
	<u>Cases</u>	<u>Controls</u>	<u>Crude*</u> <u>OR (95% CI)</u>	<u>Adjusted**</u> <u>OR (95% CI)</u>																																																										
Never	483 (77.4%)	417 (81.4%)	--	--																																																										
<10	76 (12.2%)	50 (9.8%)	1.32 (0.91-1.92)	1.25 (0.84-1.84)																																																										
≥10	63 (10.1%)	40 (7.8%)	1.40 (0.93-2.12)	1.15 (0.60-2.20)																																																										
	<u>Cases</u>	<u>Controls</u>	<u>Crude*</u> <u>OR (95% CI)</u>	<u>Adjusted**</u> <u>OR (95% CI)</u>																																																										
Never	483 (77.4%)	417 (81.4%)	--	--																																																										
<25	74 (11.9%)	42 (8.2%)	1.58 (1.05-2.39)	1.35 (0.88-2.08)																																																										
25-45	39 (6.3%)	31 (6.1%)	1.11 (0.68-1.80)	1.02 (0.61-1.70)																																																										
>45	23 (3.7%)	15 (2.9%)	1.27 (0.65-2.47)	1.13 (0.56-2.28)																																																										

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Weinstock 1991 ⁸⁷	Annual frequency of any swimsuit use outdoors at ages 15-20 years				NR
Nurses Health Study		<u>Cases</u>	<u>Controls</u>	<u>RR (95% CI)</u>	<u>P</u>
	<i>Sun resistant*</i>				
	0-10	21 (44%)	37 (24%)	1.0 (R)	
	11-30	17 (35%)	60 (39%)	0.6 (0.2-1.4)	
	≥31	10 (21%)	57 (37%)	0.3 (0.1-0.8)	0.02
	<i>Sun sensitive**</i>				
	0-10	23 (32%)	47 (44%)	1.0 (R)	
	11-30	23 (32%)	39 (36%)	1.2 (0.6-2.6)	
	≥31	26 (36%)	21 (20%)	3.5 (1.3-9.3)	0.01
	*A priori sun sensitivity score <0.5				
	**A priori sun sensitivity score ≥0.5				

Study reference USPSTF quality	Measurement of sunscreen use	Measurement of sunburn	Comments
Case-control			
Chen 1998 ⁸⁹	NR	NR	
Weinstock 1991 ⁸⁷	NR	NR	
Nurses Health Study			

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered				
Case-control									
Walter 1999 ⁹⁰	Skin Cancer: Melanoma	Cases: Selection: incident cases between 1984-1986 from local lab pathology reports Eligibility criteria: aged 20-69; recurrent lesions excluded (lesion considered recurrent if dx within previous yr and located in same lymphatic drainage area). Blacks and non-English speaking subjects excluded Controls: Selection: age, sex, and municipality matched from property tax assessment rolls Eligibility criteria: Blacks and non-English speaking subjects excluded	Cases n= 583 Controls n= 608 Age: NR Sex (calc) Male <table border="0" style="display: inline-table; vertical-align: middle;"><tr><td style="border: none;"><u>Cases</u></td><td style="border: none;"><u>Controls</u></td></tr><tr><td style="border: none;">277 (47.5%)</td><td style="border: none;">283 (46.5%)</td></tr></table> Skin phenotype: NR	<u>Cases</u>	<u>Controls</u>	277 (47.5%)	283 (46.5%)	Sun exposure, Sunbed exposure In-person interview	Sex, age, and skin reaction to initial summer sun exposure
<u>Cases</u>	<u>Controls</u>								
277 (47.5%)	283 (46.5%)								
Walter 1990 ¹³²	Study Design: case control Location: Ontario, Canada								

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sunlamp or sunbed exposure																																																																																																																											
Case-control																																																																																																																													
Walter 1999 ⁹⁰ Walter 1990 ¹³²	<p>Beach vacation past 5 years (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Yes</td> <td>295 (50.6%)</td> <td>302 (49.7%)</td> </tr> <tr> <td>No</td> <td>284 (47.7%)</td> <td>303 (49.8%)</td> </tr> </tbody> </table> <p>Crude* OR (95%CI): 1.04 (0.82-1.32) Adjusted** OR (95% CI): 1.04 (0.82-1.32)</p> <p>*Adjusted for sex, age, and reaction to initial summer sun exposure **Adjusted for sex, age, reaction to initial summer sun exposure, and potential confounders</p>		Cases	Controls	Yes	295 (50.6%)	302 (49.7%)	No	284 (47.7%)	303 (49.8%)	<p>Ever use (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Yes</td> <td>153 (26.2%)</td> <td>109 (49.7%)</td> </tr> <tr> <td>No</td> <td>431 (73.9%)</td> <td>498 (81.9%)</td> </tr> </tbody> </table> <p>Crude* OR (95%CI): 1.61 (1.21-2.15) Adjusted** OR (95% CI): 1.54 (1.16-2.05) *Adjusted for sex, age, and reaction to initial summer sun exposure **Adjusted for sex, age, reaction to initial summer sun exposure, and potential confounders</p> <p>Ever use (by sex)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td>Males</td> <td>277 (24.2%)</td> <td>283 (14.5%)</td> <td>1.88 (1.20-2.98)</td> <td><0.01</td> </tr> <tr> <td>Females</td> <td>306 (27.8%)</td> <td>324 (21.0%)</td> <td>1.45 (0.99-2.13)</td> <td>0.06</td> </tr> </tbody> </table> <p>Age-adjusted cumulative minutes use (by sex)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td colspan="5"><i>Males</i></td> </tr> <tr> <td>0</td> <td>210 (77%)</td> <td>242 (86%)</td> <td>1.00</td> <td></td> </tr> <tr> <td><180</td> <td>25 (9%)</td> <td>20 (7%)</td> <td>1.44 (0.75-2.82)</td> <td>0.31</td> </tr> <tr> <td>≥180</td> <td>39 (14%)</td> <td>18 (6%)</td> <td>2.50 (1.34-4.80)</td> <td><0.01</td> </tr> <tr> <td colspan="5"><i>Females</i></td> </tr> <tr> <td>0</td> <td>222 (74%)</td> <td>256 (80%)</td> <td>1.00</td> <td></td> </tr> <tr> <td><180</td> <td>39 (13%)</td> <td>39 (12%)</td> <td>1.17 (0.70-1.95)</td> <td>0.61</td> </tr> <tr> <td>≥180</td> <td>38 (13%)</td> <td>27 (8%)</td> <td>1.62 (0.91-2.89)</td> <td>0.10</td> </tr> </tbody> </table> <p>Age-adjusted age at first use (by sex)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td colspan="5"><i>Males</i></td> </tr> <tr> <td>Never</td> <td>210 (76%)</td> <td>242 (87%)</td> <td>1.00</td> <td></td> </tr> <tr> <td><30</td> <td>33 (12%)</td> <td>19 (7%)</td> <td>2.13 (1.13-4.13)</td> <td>0.02</td> </tr> <tr> <td>≥30</td> <td>33 (12%)</td> <td>18 (6%)</td> <td>2.04 (1.07-3.99)</td> <td>0.03</td> </tr> <tr> <td colspan="5"><i>Females</i></td> </tr> <tr> <td>Never</td> <td>221 (73%)</td> <td>256 (79%)</td> <td>1.00</td> <td></td> </tr> <tr> <td><30</td> <td>51 (17%)</td> <td>39 (12%)</td> <td>1.55 (0.94-2.59)</td> <td>0.09</td> </tr> <tr> <td>≥30</td> <td>30 (10%)</td> <td>29 (9%)</td> <td>1.19 (0.66-2.13)</td> <td>0.63</td> </tr> </tbody> </table>		Cases	Controls	Yes	153 (26.2%)	109 (49.7%)	No	431 (73.9%)	498 (81.9%)		Cases	Controls	OR (95% CI)	P	Males	277 (24.2%)	283 (14.5%)	1.88 (1.20-2.98)	<0.01	Females	306 (27.8%)	324 (21.0%)	1.45 (0.99-2.13)	0.06		Cases	Controls	OR (95% CI)	P	<i>Males</i>					0	210 (77%)	242 (86%)	1.00		<180	25 (9%)	20 (7%)	1.44 (0.75-2.82)	0.31	≥180	39 (14%)	18 (6%)	2.50 (1.34-4.80)	<0.01	<i>Females</i>					0	222 (74%)	256 (80%)	1.00		<180	39 (13%)	39 (12%)	1.17 (0.70-1.95)	0.61	≥180	38 (13%)	27 (8%)	1.62 (0.91-2.89)	0.10		Cases	Controls	OR (95% CI)	P	<i>Males</i>					Never	210 (76%)	242 (87%)	1.00		<30	33 (12%)	19 (7%)	2.13 (1.13-4.13)	0.02	≥30	33 (12%)	18 (6%)	2.04 (1.07-3.99)	0.03	<i>Females</i>					Never	221 (73%)	256 (79%)	1.00		<30	51 (17%)	39 (12%)	1.55 (0.94-2.59)	0.09	≥30	30 (10%)	29 (9%)	1.19 (0.66-2.13)	0.63
	Cases	Controls																																																																																																																											
Yes	295 (50.6%)	302 (49.7%)																																																																																																																											
No	284 (47.7%)	303 (49.8%)																																																																																																																											
	Cases	Controls																																																																																																																											
Yes	153 (26.2%)	109 (49.7%)																																																																																																																											
No	431 (73.9%)	498 (81.9%)																																																																																																																											
	Cases	Controls	OR (95% CI)	P																																																																																																																									
Males	277 (24.2%)	283 (14.5%)	1.88 (1.20-2.98)	<0.01																																																																																																																									
Females	306 (27.8%)	324 (21.0%)	1.45 (0.99-2.13)	0.06																																																																																																																									
	Cases	Controls	OR (95% CI)	P																																																																																																																									
<i>Males</i>																																																																																																																													
0	210 (77%)	242 (86%)	1.00																																																																																																																										
<180	25 (9%)	20 (7%)	1.44 (0.75-2.82)	0.31																																																																																																																									
≥180	39 (14%)	18 (6%)	2.50 (1.34-4.80)	<0.01																																																																																																																									
<i>Females</i>																																																																																																																													
0	222 (74%)	256 (80%)	1.00																																																																																																																										
<180	39 (13%)	39 (12%)	1.17 (0.70-1.95)	0.61																																																																																																																									
≥180	38 (13%)	27 (8%)	1.62 (0.91-2.89)	0.10																																																																																																																									
	Cases	Controls	OR (95% CI)	P																																																																																																																									
<i>Males</i>																																																																																																																													
Never	210 (76%)	242 (87%)	1.00																																																																																																																										
<30	33 (12%)	19 (7%)	2.13 (1.13-4.13)	0.02																																																																																																																									
≥30	33 (12%)	18 (6%)	2.04 (1.07-3.99)	0.03																																																																																																																									
<i>Females</i>																																																																																																																													
Never	221 (73%)	256 (79%)	1.00																																																																																																																										
<30	51 (17%)	39 (12%)	1.55 (0.94-2.59)	0.09																																																																																																																									
≥30	30 (10%)	29 (9%)	1.19 (0.66-2.13)	0.63																																																																																																																									
Study reference USPSTF quality																																																																																																																													
Walter 1999 ⁹⁰ Walter 1990 ¹³²	Measurement of sunscreen use	Measurement of sunburn	Comments																																																																																																																										
	NR	NR																																																																																																																											

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered																																														
Case-control																																																			
Shors 2001 ⁷⁴ Soloman 2004 ¹³⁴	Skin Cancer: Melanoma Study Design: case control Location: Washington	Cases: Selection: incident cases of primary invasive melanoma diagnosed in 1997 through the Seattle-Puget Sound SEER registry Eligibility criteria: aged 35-74, living, English-speaking; excluded for previous dx melanoma, diagnosis of melanoma in situ, Hutchinson's melanotic freckle, or lentigo maligna melanoma, non-white race or Hispanic origin Controls: Selection: random digit dialing Eligibility criteria: excluded those of non-white race or Hispanic origin, and those with history of melanoma	Cases n= 386 Controls n= 727 Age: <table border="1"> <thead> <tr> <th></th> <th>Cases M (n=201)</th> <th>Controls M (n=261)</th> <th>Cases F (n=185)</th> <th>Control F (n=466)</th> </tr> </thead> <tbody> <tr> <td>35-44</td> <td>40</td> <td>96</td> <td>58</td> <td>185</td> </tr> <tr> <td>45-54</td> <td>79</td> <td>89</td> <td>55</td> <td>134</td> </tr> <tr> <td>55-64</td> <td>44</td> <td>46</td> <td>40</td> <td>90</td> </tr> <tr> <td>65-74</td> <td>38</td> <td>30</td> <td>32</td> <td>57</td> </tr> </tbody> </table> Sex (calc) <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Male</td> <td>201 (52.1%)</td> <td>261 (35.9%)</td> </tr> </tbody> </table> Skin phenotype <i>Ability to tan (calc)</i> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Deep tan</td> <td>77 (19.9%)</td> <td>164 (22.6%)</td> </tr> <tr> <td>Moderate tan</td> <td>145 (37.6%)</td> <td>306 (42.1%)</td> </tr> <tr> <td>Mild tan</td> <td>121 (31.3%)</td> <td>192 (26.4%)</td> </tr> <tr> <td>Freckle/no tan</td> <td>42 (10.9%)</td> <td>55 (7.6%)</td> </tr> </tbody> </table>		Cases M (n=201)	Controls M (n=261)	Cases F (n=185)	Control F (n=466)	35-44	40	96	58	185	45-54	79	89	55	134	55-64	44	46	40	90	65-74	38	30	32	57		Cases	Controls	Male	201 (52.1%)	261 (35.9%)		Cases	Controls	Deep tan	77 (19.9%)	164 (22.6%)	Moderate tan	145 (37.6%)	306 (42.1%)	Mild tan	121 (31.3%)	192 (26.4%)	Freckle/no tan	42 (10.9%)	55 (7.6%)	Sun exposure Telephone interviews	Adjusted for age, income, tendency to burn, number of sunburns age 2-10, and sex
	Cases M (n=201)	Controls M (n=261)	Cases F (n=185)	Control F (n=466)																																															
35-44	40	96	58	185																																															
45-54	79	89	55	134																																															
55-64	44	46	40	90																																															
65-74	38	30	32	57																																															
	Cases	Controls																																																	
Male	201 (52.1%)	261 (35.9%)																																																	
	Cases	Controls																																																	
Deep tan	77 (19.9%)	164 (22.6%)																																																	
Moderate tan	145 (37.6%)	306 (42.1%)																																																	
Mild tan	121 (31.3%)	192 (26.4%)																																																	
Freckle/no tan	42 (10.9%)	55 (7.6%)																																																	

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sun exposure (cont.)																																																																																																																																																
Case-control																																																																																																																																																		
Shors 2001 ⁷⁴ Soloman 2004 ¹³⁴	Lifetime average days spent >4 hours in the sun (by quartile) (calc) <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>First quartile</td> <td>70 (19.6%)</td> <td>168 (24.7%)</td> <td>1.0</td> </tr> <tr> <td>Second quartile</td> <td>89 (24.9%)</td> <td>171 (25.2%)</td> <td>1.3 (0.86-1.9)</td> </tr> <tr> <td>Third quartile</td> <td>95 (26.5%)</td> <td>169 (24.9%)</td> <td>1.4 (0.92-2.0)</td> </tr> <tr> <td>Fourth quartile</td> <td>104 (29.1%)</td> <td>171 (25.2%)</td> <td>1.4 (0.95-2.0)</td> </tr> <tr> <td>p for trend</td> <td></td> <td></td> <td>p=0.10</td> </tr> </tbody> </table> Age 2-10 days/month in sun (calc) <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td><i>Men</i></td> <td></td> <td></td> <td></td> </tr> <tr> <td>First quartile</td> <td>24 (15.6%)</td> <td>41 (20.3%)</td> <td>1.00</td> </tr> <tr> <td>Second quartile</td> <td>34 (22.1%)</td> <td>38 (18.8%)</td> <td>1.53 (0.76-3.07)</td> </tr> <tr> <td>Third quartile</td> <td>38 (24.7%)</td> <td>47 (23.3%)</td> <td>1.30 (0.66-2.55)</td> </tr> <tr> <td>Fourth quartile</td> <td>58 (37.7%)</td> <td>76 (37.6%)</td> <td>1.14 (0.61-2.13)</td> </tr> <tr> <td>p for trend</td> <td>p=0.99</td> <td></td> <td></td> </tr> <tr> <td><i>Women</i></td> <td></td> <td></td> <td></td> </tr> <tr> <td>First quartile</td> <td>23 (15.9%)</td> <td>79 (22.7%)</td> <td>1.00</td> </tr> <tr> <td>Second quartile</td> <td>24 (16.6%)</td> <td>80 (23.0%)</td> <td>1.06 (0.55-2.05)</td> </tr> <tr> <td>Third quartile</td> <td>39 (26.9%)</td> <td>73 (21.0%)</td> <td>1.81 (0.99-3.34)</td> </tr> <tr> <td>Fourth quartile</td> <td>59 (40.7%)</td> <td>116 (33.3%)</td> <td>1.72 (0.98-3.02)</td> </tr> <tr> <td>p for trend</td> <td>p=0.02</td> <td></td> <td></td> </tr> </tbody> </table>		Cases	Controls	OR (95% CI)	First quartile	70 (19.6%)	168 (24.7%)	1.0	Second quartile	89 (24.9%)	171 (25.2%)	1.3 (0.86-1.9)	Third quartile	95 (26.5%)	169 (24.9%)	1.4 (0.92-2.0)	Fourth quartile	104 (29.1%)	171 (25.2%)	1.4 (0.95-2.0)	p for trend			p=0.10		Cases	Controls	Adjusted* OR (95% CI)	<i>Men</i>				First quartile	24 (15.6%)	41 (20.3%)	1.00	Second quartile	34 (22.1%)	38 (18.8%)	1.53 (0.76-3.07)	Third quartile	38 (24.7%)	47 (23.3%)	1.30 (0.66-2.55)	Fourth quartile	58 (37.7%)	76 (37.6%)	1.14 (0.61-2.13)	p for trend	p=0.99			<i>Women</i>				First quartile	23 (15.9%)	79 (22.7%)	1.00	Second quartile	24 (16.6%)	80 (23.0%)	1.06 (0.55-2.05)	Third quartile	39 (26.9%)	73 (21.0%)	1.81 (0.99-3.34)	Fourth quartile	59 (40.7%)	116 (33.3%)	1.72 (0.98-3.02)	p for trend	p=0.02			Lifetime overall UV exposure (time in sun, erythemat exposure) <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td><i>Men</i></td> <td></td> <td></td> <td></td> </tr> <tr> <td>First quartile</td> <td>50 (27.2%)</td> <td>62 (25.1%)</td> <td>1.00</td> </tr> <tr> <td>Second quartile</td> <td>31 (16.8%)</td> <td>62 (25.1%)</td> <td>0.51 (0.23-0.80)</td> </tr> <tr> <td>Third quartile</td> <td>38 (20.7%)</td> <td>62 (25.1%)</td> <td>0.67 (0.31-1.03)</td> </tr> <tr> <td>Fourth quartile</td> <td>65 (35.3%)</td> <td>61 (24.7%)</td> <td>1.24 (0.62-1.86)</td> </tr> <tr> <td>p for trend</td> <td></td> <td></td> <td>p=0.28</td> </tr> <tr> <td><i>Women</i></td> <td></td> <td></td> <td></td> </tr> <tr> <td>First quartile</td> <td>35 (20.2%)</td> <td>110 (25.6%)</td> <td>1.00</td> </tr> <tr> <td>Second quartile</td> <td>36 (20.8%)</td> <td>105 (24.4%)</td> <td>1.35 (0.64-2.05)</td> </tr> <tr> <td>Third quartile</td> <td>56 (32.4%)</td> <td>107 (24.9%)</td> <td>2.45 (1.23-3.68)</td> </tr> <tr> <td>Fourth quartile</td> <td>46 (26.6%)</td> <td>108 (25.1%)</td> <td>1.99 (0.95-3.03)</td> </tr> <tr> <td>p for trend</td> <td></td> <td></td> <td>p=0.008</td> </tr> </tbody> </table> *Adjusted for age, income, tendency to burn and number of sunburns age 2-10 yrs Age 1-10 yrs overall UV exposure (time in sun, erythemat exposure) <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td><i>Men</i></td> <td></td> <td></td> <td></td> </tr> <tr> <td>First quartile</td> <td>39 (20.7%)</td> <td>64 (33.7%)</td> <td>1.00</td> </tr> <tr> <td>Second quartile</td> <td>42 (22.3%)</td> <td>61 (32.1%)</td> <td>0.84 (0.38-1.29)</td> </tr> </tbody> </table>		Cases	Controls	Adjusted* OR (95% CI)	<i>Men</i>				First quartile	50 (27.2%)	62 (25.1%)	1.00	Second quartile	31 (16.8%)	62 (25.1%)	0.51 (0.23-0.80)	Third quartile	38 (20.7%)	62 (25.1%)	0.67 (0.31-1.03)	Fourth quartile	65 (35.3%)	61 (24.7%)	1.24 (0.62-1.86)	p for trend			p=0.28	<i>Women</i>				First quartile	35 (20.2%)	110 (25.6%)	1.00	Second quartile	36 (20.8%)	105 (24.4%)	1.35 (0.64-2.05)	Third quartile	56 (32.4%)	107 (24.9%)	2.45 (1.23-3.68)	Fourth quartile	46 (26.6%)	108 (25.1%)	1.99 (0.95-3.03)	p for trend			p=0.008		Cases	Controls	Adjusted* OR (95% CI)	<i>Men</i>				First quartile	39 (20.7%)	64 (33.7%)	1.00	Second quartile	42 (22.3%)	61 (32.1%)	0.84 (0.38-1.29)
	Cases	Controls	OR (95% CI)																																																																																																																																															
First quartile	70 (19.6%)	168 (24.7%)	1.0																																																																																																																																															
Second quartile	89 (24.9%)	171 (25.2%)	1.3 (0.86-1.9)																																																																																																																																															
Third quartile	95 (26.5%)	169 (24.9%)	1.4 (0.92-2.0)																																																																																																																																															
Fourth quartile	104 (29.1%)	171 (25.2%)	1.4 (0.95-2.0)																																																																																																																																															
p for trend			p=0.10																																																																																																																																															
	Cases	Controls	Adjusted* OR (95% CI)																																																																																																																																															
<i>Men</i>																																																																																																																																																		
First quartile	24 (15.6%)	41 (20.3%)	1.00																																																																																																																																															
Second quartile	34 (22.1%)	38 (18.8%)	1.53 (0.76-3.07)																																																																																																																																															
Third quartile	38 (24.7%)	47 (23.3%)	1.30 (0.66-2.55)																																																																																																																																															
Fourth quartile	58 (37.7%)	76 (37.6%)	1.14 (0.61-2.13)																																																																																																																																															
p for trend	p=0.99																																																																																																																																																	
<i>Women</i>																																																																																																																																																		
First quartile	23 (15.9%)	79 (22.7%)	1.00																																																																																																																																															
Second quartile	24 (16.6%)	80 (23.0%)	1.06 (0.55-2.05)																																																																																																																																															
Third quartile	39 (26.9%)	73 (21.0%)	1.81 (0.99-3.34)																																																																																																																																															
Fourth quartile	59 (40.7%)	116 (33.3%)	1.72 (0.98-3.02)																																																																																																																																															
p for trend	p=0.02																																																																																																																																																	
	Cases	Controls	Adjusted* OR (95% CI)																																																																																																																																															
<i>Men</i>																																																																																																																																																		
First quartile	50 (27.2%)	62 (25.1%)	1.00																																																																																																																																															
Second quartile	31 (16.8%)	62 (25.1%)	0.51 (0.23-0.80)																																																																																																																																															
Third quartile	38 (20.7%)	62 (25.1%)	0.67 (0.31-1.03)																																																																																																																																															
Fourth quartile	65 (35.3%)	61 (24.7%)	1.24 (0.62-1.86)																																																																																																																																															
p for trend			p=0.28																																																																																																																																															
<i>Women</i>																																																																																																																																																		
First quartile	35 (20.2%)	110 (25.6%)	1.00																																																																																																																																															
Second quartile	36 (20.8%)	105 (24.4%)	1.35 (0.64-2.05)																																																																																																																																															
Third quartile	56 (32.4%)	107 (24.9%)	2.45 (1.23-3.68)																																																																																																																																															
Fourth quartile	46 (26.6%)	108 (25.1%)	1.99 (0.95-3.03)																																																																																																																																															
p for trend			p=0.008																																																																																																																																															
	Cases	Controls	Adjusted* OR (95% CI)																																																																																																																																															
<i>Men</i>																																																																																																																																																		
First quartile	39 (20.7%)	64 (33.7%)	1.00																																																																																																																																															
Second quartile	42 (22.3%)	61 (32.1%)	0.84 (0.38-1.29)																																																																																																																																															

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

	Previous 20 years days/month in sun (calc)			Adjusted* OR (95% CI)	Third quartile Fourth quartile p for trend	38 (20.7%) 65 (35.3%) p=0.28	63 (25.1%) 62 (24.7%) p=0.28	0.87 (0.40-1.35) 1.34 (0.65-2.03) p=0.28
	Cases	Controls						
<i>Men</i>								
First quartile	47 (23.7%)	66 (25.4%)	1.00		First quartile	32 (18.1%)	109 (25.2%)	1.00
Second quartile	43 (21.7%)	59 (22.7%)	1.07 (0.62-1.87)		Second quartile	44 (24.9%)	107 (24.8%)	1.69 (0.85-2.53)
Third quartile	62 (31.3%)	47 (23.3%)	1.31 (0.78-2.20)		Third quartile	51 (28.8%)	108 (25.0%)	1.69 (0.83-2.55)
Fourth quartile	46 (23.2%)	67 (25.8%)	1.04 (0.60-1.79)		Fourth quartile	50 (28.2%)	108 (25.0%)	2.14 (1.08-3.20)
p for trend	p=0.69				p for trend	p=0.002		
<i>Women</i>								
First quartile	39 (21.5%)	110 (23.7%)	1.00		*Adjusted for age in the combined analysis of men and women			
Second quartile	35 (19.3%)	112 (24.1%)	0.97 (0.57-1.66)					
Third quartile	62 (34.3%)	129 (27.8%)	1.52 (0.94-2.47)					
Fourth quartile	45 (24.9%)	113 (24.4%)	1.23 (0.74-2.06)					
p for trend	p=0.18							
*Adjusted for age in the combined analysis of men and women								

Study reference USPSTF quality	Measurement of sun exposure (cont.)	Measurement of sunlamp or sun bed exposure	Measurement of sunscreen use	Measurement of sunburn	Comments
Case-control					
Shors 2001 ¹⁴	Age 11-20 overall UV exposure (time in sun, erythemat exposure)	NR	NR	# sunburns, age 2-10	Controls were younger that cases for both sexes. Missing sun exposure estimates were assumed to be the same at the earliest age for which there were data. If any other data was missing, that participant was excluded from the analysis for that age period.
Soloman 2004 ¹³⁴	Adjusted* OR (95% CI)			<u>Cases</u> <u>Controls</u> <u>OR (95% CI)</u>	
<i>Men</i>				0 173 (47.0%) 436 (62.0%) 1.0	
First quartile	45 (23.1%)	62 (24.2%)	1.00	1 37 (10.1%) 72 (10.2%) 1.4 (0.88-2.1)	
Second quartile	44 (22.6%)	66 (25.8%)	0.95 (0.46-1.44)	2 33 (9.0%) 64 (9.1%) 1.3 (0.81-2.1)	
Third quartile	43 (22.1%)	63 (24.6%)	0.96 (0.46-1.45)	3+ 125 (34.0%) 131*(18.6%) 2.4 (1.8-3.4)	
Fourth quartile	63 (32.3%)	65 (25.4%)	1.19 (0.60-1.78)	p for trend p=0.001	
p for trend	p=0.56			*n reported as 1331, believe it is a typo	
<i>Women</i>				# sunburns, age 11-20	
First quartile	35 (18.9%)	118 (25.6%)	1.00	<u>Cases</u> <u>Controls</u> <u>OR (95% CI)</u>	
Second quartile	37 (20.0%)	112 (24.3%)	1.39 (0.68-2.09)	0 93 (24.5%) 261 (36.3%) 1.0	
Third quartile	59 (31.9%)	116 (25.2%)	2.37 (1.25-3.48)	1 63 (16.6%) 151 (21.0%) 1.3 (0.91-2.0)	
Fourth quartile	54 (29.2%)	115 (24.9%)	2.33 (1.19-3.46)	2 37 (9.7%) 89 (12.4%) 1.3 (0.80-2.0)	
p for trend	p=0.001			3+ 187 (49.2%) 219 (30.4%) 2.7 (2.0-3.7)	
*Adjusted for age in the combined analysis of men and women				p for trend p=0.001	
Previous 20 years overall UV exposure (time in sun, erythemat exposure)					
Adjusted* OR (95% CI)					
<i>Men</i>					
First quartile	44 (22.3%)	65 (25.0%)	1.00		
Second quartile	40 (20.3%)	65 (25.0%)	1.00 (0.47-1.53)		
Third quartile	59 (29.9%)	65 (25.0%)	1.72 (0.85-2.59)		
Fourth quartile	54 (27.4%)	65 (25.0%)	1.53 (0.74-2.33)		
p for trend	p=0.07				
<i>Women</i>					
First quartile	43 (23.8%)	117 (25.2%)	1.00		
Second quartile	39 (21.5%)	115 (24.8%)	1.01 (0.52-1.49)		
Third quartile	54 (29.8%)	116 (25.0%)	1.82 (0.96-2.68)		
Fourth quartile	45 (24.9%)	116 (25.0%)	1.30 (0.67-1.94)		
p for trend	p=0.14				
*Adjusted for age in the combined analysis of men and women					

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered																														
Case-control																																			
Bataille 2005 ⁹¹	<p>Skin Cancer: Melanoma</p> <p>Study Design: Case control</p> <p>Location: Sweden, The Netherlands, UK, Belgium, France</p>	<p>Cases: Selection: (varied by country) all first incident cases from dermatologists, pathologists, plastic surgeons, oncologists and melanoma databases between 1998-2001</p> <p>Eligibility criteria: aged 18-49, Caucasian, excluded lentigo malignant melanoma or in situ melanoma</p> <p>Controls: Selection: (varied by country) age, sex matched, random selection from population registries, from general practices matched by geographical area, and from door-to-door search</p> <p>Eligibility criteria: otherwise NR</p>	<p>Cases n= 597 Controls n= 622</p> <p>Mean age (SD) Cases: 38 (7.8) Controls: 37 (7.8)</p> <p>Sex:</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Male</td> <td>219 (37%)</td> <td>214 (34%)</td> </tr> </tbody> </table> <p>Skin phenotype (Fitzpatrick classification)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>IV (good tanner)</td> <td>61 (10%)</td> <td>118 (19%)</td> </tr> <tr> <td>III</td> <td>194 (32%)</td> <td>273 (44%)</td> </tr> <tr> <td>II</td> <td>245 (41%)</td> <td>171 (27%)</td> </tr> <tr> <td>I (never tan)</td> <td>97 (16%)</td> <td>60 (10%)</td> </tr> </tbody> </table>		Cases	Controls	Male	219 (37%)	214 (34%)		Cases	Controls	IV (good tanner)	61 (10%)	118 (19%)	III	194 (32%)	273 (44%)	II	245 (41%)	171 (27%)	I (never tan)	97 (16%)	60 (10%)	<p>Sunbed exposure</p> <p>In-person interviews</p>	<p>Age, sex, skin type</p>									
	Cases	Controls																																	
Male	219 (37%)	214 (34%)																																	
	Cases	Controls																																	
IV (good tanner)	61 (10%)	118 (19%)																																	
III	194 (32%)	273 (44%)																																	
II	245 (41%)	171 (27%)																																	
I (never tan)	97 (16%)	60 (10%)																																	
Garbe 1989 ⁷⁸	<p>Skin Cancer: Melanoma</p> <p>Study Design: case control</p> <p>Location: Germany</p>	<p>Cases: Selection: 200 consecutive patients presenting at dermato-oncologic followup clinic in 1987</p> <p>Eligibility criteria: German origin</p> <p>Controls: Selection: age and sex matched nonmelanoma patients at the clinic with any skin disease other than melanoma</p> <p>Eligibility criteria: German origin; excluded if had consultation due to pigmented nevi, or previously treated by UV radiation</p>	<p>Cases n= 200 Controls n= 200</p> <p>Mean age:</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Male</td> <td>50.7</td> <td>51.0</td> </tr> <tr> <td>Female</td> <td>56.6</td> <td>57.0</td> </tr> </tbody> </table> <p>Sex (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Male</td> <td>79 (39.5%)</td> <td>NR</td> </tr> </tbody> </table> <p>Skin phenotype:</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>IV</td> <td>18 (9.0%)</td> <td>21 (10.5%)</td> </tr> <tr> <td>III</td> <td>76 (38.0%)</td> <td>94 (47.0%)</td> </tr> <tr> <td>II</td> <td>71 (35.5%)</td> <td>65 (32.5%)</td> </tr> <tr> <td>I</td> <td>35 (17.5%)</td> <td>20 (10.0%)</td> </tr> </tbody> </table>		Cases	Controls	Male	50.7	51.0	Female	56.6	57.0		Cases	Controls	Male	79 (39.5%)	NR		Cases	Controls	IV	18 (9.0%)	21 (10.5%)	III	76 (38.0%)	94 (47.0%)	II	71 (35.5%)	65 (32.5%)	I	35 (17.5%)	20 (10.0%)	<p>Sun exposure</p> <p>20 minute interview and physical exam</p>	<p>NR</p>
	Cases	Controls																																	
Male	50.7	51.0																																	
Female	56.6	57.0																																	
	Cases	Controls																																	
Male	79 (39.5%)	NR																																	
	Cases	Controls																																	
IV	18 (9.0%)	21 (10.5%)																																	
III	76 (38.0%)	94 (47.0%)																																	
II	71 (35.5%)	65 (32.5%)																																	
I	35 (17.5%)	20 (10.0%)																																	

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sunlamp or sunbed exposure																																																			
Case-control																																																					
Bataille 2005 ⁹¹	NR	<p>Ever used sunbed</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Crude OR (95% CI)</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td><age 15</td> <td>23 (4%)</td> <td>14 (2%)</td> <td>1.74 (0.89-3.42)</td> <td>1.82 (0.92-3.62)</td> </tr> <tr> <td>Ever</td> <td>315 (53%)</td> <td>354 (57%)</td> <td>0.84 (0.67-1.06)</td> <td>0.90 (0.71-1.14)</td> </tr> </tbody> </table> <p>Cumulative lifetime sunbed use (in hours)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Crude OR (95% CI)</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>282 (47%)</td> <td>268 (43%)</td> <td>1.00</td> <td>1.00</td> </tr> <tr> <td><10</td> <td>163 (28%)</td> <td>168 (28%)</td> <td>0.92 (0.70-1.21)</td> <td>0.95 (0.71-1.25)</td> </tr> <tr> <td>10-30</td> <td>56 (10%)</td> <td>76 (13%)</td> <td>0.70 (0.48-1.03)</td> <td>0.75 (0.50-1.11)</td> </tr> <tr> <td>31-60</td> <td>25 (4%)</td> <td>37 (6%)</td> <td>0.64 (0.38-1.09)</td> <td>0.75 (0.43-1.30)</td> </tr> <tr> <td>61-100</td> <td>17 (3%)</td> <td>17 (3%)</td> <td>0.95 (0.47-1.89)</td> <td>1.10 (0.55-2.24)</td> </tr> <tr> <td>>100</td> <td>40 (7%)</td> <td>38 (6%)</td> <td>1.00 (0.62-1.60)</td> <td>1.19 (0.73-1.93)</td> </tr> </tbody> </table> <p>*Adjusted for age, sex, skin phototype</p>			Cases	Controls	Crude OR (95% CI)	Adjusted* OR (95% CI)	<age 15	23 (4%)	14 (2%)	1.74 (0.89-3.42)	1.82 (0.92-3.62)	Ever	315 (53%)	354 (57%)	0.84 (0.67-1.06)	0.90 (0.71-1.14)		Cases	Controls	Crude OR (95% CI)	Adjusted* OR (95% CI)	0	282 (47%)	268 (43%)	1.00	1.00	<10	163 (28%)	168 (28%)	0.92 (0.70-1.21)	0.95 (0.71-1.25)	10-30	56 (10%)	76 (13%)	0.70 (0.48-1.03)	0.75 (0.50-1.11)	31-60	25 (4%)	37 (6%)	0.64 (0.38-1.09)	0.75 (0.43-1.30)	61-100	17 (3%)	17 (3%)	0.95 (0.47-1.89)	1.10 (0.55-2.24)	>100	40 (7%)	38 (6%)	1.00 (0.62-1.60)	1.19 (0.73-1.93)
	Cases	Controls	Crude OR (95% CI)	Adjusted* OR (95% CI)																																																	
<age 15	23 (4%)	14 (2%)	1.74 (0.89-3.42)	1.82 (0.92-3.62)																																																	
Ever	315 (53%)	354 (57%)	0.84 (0.67-1.06)	0.90 (0.71-1.14)																																																	
	Cases	Controls	Crude OR (95% CI)	Adjusted* OR (95% CI)																																																	
0	282 (47%)	268 (43%)	1.00	1.00																																																	
<10	163 (28%)	168 (28%)	0.92 (0.70-1.21)	0.95 (0.71-1.25)																																																	
10-30	56 (10%)	76 (13%)	0.70 (0.48-1.03)	0.75 (0.50-1.11)																																																	
31-60	25 (4%)	37 (6%)	0.64 (0.38-1.09)	0.75 (0.43-1.30)																																																	
61-100	17 (3%)	17 (3%)	0.95 (0.47-1.89)	1.10 (0.55-2.24)																																																	
>100	40 (7%)	38 (6%)	1.00 (0.62-1.60)	1.19 (0.73-1.93)																																																	
Garbe 1989 ⁷⁸	<p>The skin type as well as the occupational sun exposure appeared to represent a significant increase of RR, but, the duration of the occupational sun exposure in years had no significant influence</p> <p>Relative risk for occupational sun exposure to upper part of the body and/or the extremities on the occasion of sunshine</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Nonadjusted RR (95% CI)</th> <th>Adjusted RR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>None</td> <td>159 (79.5%)</td> <td>174 (87.0%)</td> <td>1.00</td> <td>1.00</td> </tr> <tr> <td>Sometimes</td> <td>31 (15.5%)</td> <td>24 (12.0%)</td> <td>1.41 (0.80-2.51)</td> <td>1.18 (0.56-2.48)</td> </tr> <tr> <td>Nearly every time</td> <td>10 (5.0%)</td> <td>2 (1.0%)</td> <td>5.47 (1.18-25.30)</td> <td>11.62 (2.13-63.33)</td> </tr> </tbody> </table>		Cases	Controls	Nonadjusted RR (95% CI)	Adjusted RR (95% CI)	None	159 (79.5%)	174 (87.0%)	1.00	1.00	Sometimes	31 (15.5%)	24 (12.0%)	1.41 (0.80-2.51)	1.18 (0.56-2.48)	Nearly every time	10 (5.0%)	2 (1.0%)	5.47 (1.18-25.30)	11.62 (2.13-63.33)	NR																															
	Cases	Controls	Nonadjusted RR (95% CI)	Adjusted RR (95% CI)																																																	
None	159 (79.5%)	174 (87.0%)	1.00	1.00																																																	
Sometimes	31 (15.5%)	24 (12.0%)	1.41 (0.80-2.51)	1.18 (0.56-2.48)																																																	
Nearly every time	10 (5.0%)	2 (1.0%)	5.47 (1.18-25.30)	11.62 (2.13-63.33)																																																	
Case-control																																																					
Bataille 2005 ⁹¹	NR	<p>Sunburn before age 15</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Crude OR (95%CI)</th> <th>Adjusted* OR (CI 95% CI)</th> </tr> </thead> <tbody> <tr> <td>No</td> <td>308 (52%)</td> <td>375 (61%)</td> <td></td> <td></td> </tr> <tr> <td>Yes</td> <td>289 (48%)</td> <td>247 (39%)</td> <td>1.42 (1.13-1.79)</td> <td>1.20 (0.95-1.54)</td> </tr> </tbody> </table> <p>*Adjusted for age, sex, and skin type</p>			Cases	Controls	Crude OR (95%CI)	Adjusted* OR (CI 95% CI)	No	308 (52%)	375 (61%)			Yes	289 (48%)	247 (39%)	1.42 (1.13-1.79)	1.20 (0.95-1.54)																																			
	Cases	Controls	Crude OR (95%CI)	Adjusted* OR (CI 95% CI)																																																	
No	308 (52%)	375 (61%)																																																			
Yes	289 (48%)	247 (39%)	1.42 (1.13-1.79)	1.20 (0.95-1.54)																																																	
Garbe 1989 ⁷⁸	NR	NR																																																			

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered																					
Case-control																										
Gallagher 1986 ⁷⁵ Elwood 1985 ¹³⁵ Elwood 1984 ¹³⁶ Western Canada Melanoma Study	Skin Cancer: Melanoma Study Design: Case control Location: Western Canada	Cases: Selection: newly diagnosed from province cancer registries between 1979-1981 Eligibility criteria: aged 20-79 years. Excluded lentigo maligna and acral lentiginous melanoma Controls: Selection: from medical insurance plan list of subscribers, age and sex matched Eligibility criteria: NR	Cases n= 595 Controls n= 595 Age (mean): NR Sex (calc) <table border="1"> <tr> <td></td> <td><u>Cases</u></td> <td><u>Controls</u></td> </tr> <tr> <td>Male</td> <td>234 (39%)</td> <td>234 (39%)</td> </tr> </table> Skin phenotype (calc): <i>Skin reaction to sun</i> <table border="1"> <tr> <td></td> <td><u>Cases</u></td> <td><u>Controls</u></td> </tr> <tr> <td>Tan, no burn</td> <td>184 (31%)</td> <td>280 (47%)</td> </tr> <tr> <td>Tan with protection</td> <td>77 (13%)</td> <td>60 (10%)</td> </tr> <tr> <td>Burn then tan</td> <td>250 (42%)</td> <td>202 (34%)</td> </tr> <tr> <td>Burn only</td> <td>83 (14%)</td> <td>60 (10%)</td> </tr> </table>		<u>Cases</u>	<u>Controls</u>	Male	234 (39%)	234 (39%)		<u>Cases</u>	<u>Controls</u>	Tan, no burn	184 (31%)	280 (47%)	Tan with protection	77 (13%)	60 (10%)	Burn then tan	250 (42%)	202 (34%)	Burn only	83 (14%)	60 (10%)	Sun exposure In-person interviews	Hair color, skin color, history of freckles and ethnic origin
	<u>Cases</u>	<u>Controls</u>																								
Male	234 (39%)	234 (39%)																								
	<u>Cases</u>	<u>Controls</u>																								
Tan, no burn	184 (31%)	280 (47%)																								
Tan with protection	77 (13%)	60 (10%)																								
Burn then tan	250 (42%)	202 (34%)																								
Burn only	83 (14%)	60 (10%)																								

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sun exposure (cont.)																																																																																																																																																
Case-control																																																																																																																																																		
Gallagher 1986 ⁷⁵ Elwood 1985 ¹³⁵ Elwood 1984 ¹³⁶ Western Canada Melanoma Study	Occupational sun exposure (calc) <table border="1"> <tr> <th>Equivalent hours*</th> <th>Cases</th> <th>Adjusted RR**</th> </tr> <tr> <td><1</td> <td>143 (24%)</td> <td>1.0</td> </tr> <tr> <td>1-99</td> <td>196 (33%)</td> <td>1.8</td> </tr> <tr> <td>100-199</td> <td>101 (17%)</td> <td>1.0</td> </tr> <tr> <td>200-399</td> <td>89 (15%)</td> <td>0.9</td> </tr> <tr> <td>400+</td> <td>71 (12%)</td> <td>0.9</td> </tr> </table> <i>p<0.01</i> Recreational sun exposure in summer season (calc) <table border="1"> <tr> <th>Equivalent hours*</th> <th>Cases</th> <th>Adjusted RR**</th> </tr> <tr> <td><1</td> <td>173 (29%)</td> <td>1.0</td> </tr> <tr> <td>1-19</td> <td>89 (15%)</td> <td>1.1</td> </tr> <tr> <td>20-79</td> <td>167 (28%)</td> <td>1.7</td> </tr> <tr> <td>80-159</td> <td>89 (15%)</td> <td>1.8</td> </tr> <tr> <td>160+</td> <td>77 (13%)</td> <td>1.7</td> </tr> </table> <i>p<0.01</i> Vacation sun exposure in summer season (calc) <table border="1"> <tr> <th>Equivalent hours*</th> <th>Cases</th> <th>Adjusted RR**</th> </tr> <tr> <td><1</td> <td>196 (33%)</td> <td>1.0</td> </tr> <tr> <td>1-6</td> <td>149 (25%)</td> <td>0.9</td> </tr> <tr> <td>7-19</td> <td>77 (13%)</td> <td>0.9</td> </tr> <tr> <td>20-39</td> <td>89 (15%)</td> <td>1.9</td> </tr> <tr> <td>40+</td> <td>83 (14%)</td> <td>1.5</td> </tr> </table> <i>p<0.01</i> *1 hour of sun exposure to the whole body. Converted using estimates of proportion of body area exposed. **Adjusted for hair color, skin color, freckling, and ethnic origin	Equivalent hours*	Cases	Adjusted RR**	<1	143 (24%)	1.0	1-99	196 (33%)	1.8	100-199	101 (17%)	1.0	200-399	89 (15%)	0.9	400+	71 (12%)	0.9	Equivalent hours*	Cases	Adjusted RR**	<1	173 (29%)	1.0	1-19	89 (15%)	1.1	20-79	167 (28%)	1.7	80-159	89 (15%)	1.8	160+	77 (13%)	1.7	Equivalent hours*	Cases	Adjusted RR**	<1	196 (33%)	1.0	1-6	149 (25%)	0.9	7-19	77 (13%)	0.9	20-39	89 (15%)	1.9	40+	83 (14%)	1.5	Occupational, summer, hr/season (calc) <table border="1"> <tr> <th></th> <th><u>Cases</u></th> <th><u>Controls</u></th> <th><u>Crude RR</u></th> <th><u>Adjusted RR* (95%CI)</u></th> </tr> <tr> <td><1</td> <td>141 (23.7%)</td> <td>156 (26.2%)</td> <td>1.0 (R)</td> <td>1.0</td> </tr> <tr> <td>1-99</td> <td>195 (32.8%)</td> <td>136 (22.9%)</td> <td>1.6</td> <td>1.8 (1.2-2.5)</td> </tr> <tr> <td>100-199</td> <td>100 (16.8%)</td> <td>103 (17.3%)</td> <td>1.1</td> <td>1.0 (0.7-1.5)</td> </tr> <tr> <td>200-399</td> <td>87 (14.6%)</td> <td>110 (18.5%)</td> <td>0.9</td> <td>0.9 (0.6-1.4)</td> </tr> <tr> <td>400+</td> <td>72 (12.1%)</td> <td>90 (15.1%)</td> <td>0.9</td> <td>0.9 (0.6-1.5)</td> </tr> </table> <i>p<0.01</i> Recreational, summer, hr/season (calc) <table border="1"> <tr> <th></th> <th><u>Cases</u></th> <th><u>Controls</u></th> <th><u>Crude RR</u></th> <th><u>Adjusted RR* (95%CI)</u></th> </tr> <tr> <td><1</td> <td>172 (28.9%)</td> <td>230 (38.7%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>1-19</td> <td>92 (15.5%)</td> <td>105 (17.6%)</td> <td>1.3</td> <td>1.1 (0.7-1.6)</td> </tr> <tr> <td>20-79</td> <td>165 (27.7%)</td> <td>122 (20.5%)</td> <td>2.0</td> <td>1.7 (1.2-2.5)</td> </tr> <tr> <td>80-159</td> <td>89 (15.0%)</td> <td>79 (13.3%)</td> <td>1.7</td> <td>1.8 (1.2-2.7)</td> </tr> <tr> <td>160+</td> <td>77 (12.9%)</td> <td>59 (10.0%)</td> <td>2.0</td> <td>1.7 (1.1-2.7)</td> </tr> </table> <i>p<0.001</i> Vacation, summer, hr/season (calc) <table border="1"> <tr> <th></th> <th><u>Cases</u></th> <th><u>Controls</u></th> <th><u>Crude RR</u></th> <th><u>Adjusted RR* (95%CI)</u></th> </tr> <tr> <td><1</td> <td>194 (32.6%)</td> <td>216 (36.3%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>1-6</td> <td>151 (25.4%)</td> <td>175 (29.4%)</td> <td>1.0</td> <td>0.9 (0.7-1.3)</td> </tr> <tr> <td>7-19</td> <td>79 (13.3%)</td> <td>91 (15.3%)</td> <td>1.0</td> <td>0.9 (0.6-1.4)</td> </tr> <tr> <td>20-39</td> <td>90 (15.1%)</td> <td>50 (8.4%)</td> <td>2.1</td> <td>1.9 (1.3-3.0)</td> </tr> <tr> <td>40+</td> <td>81 (13.6%)</td> <td>63 (10.6%)</td> <td>1.5</td> <td>1.5 (1.0-2.3)</td> </tr> </table> <i>p<0.001</i>		<u>Cases</u>	<u>Controls</u>	<u>Crude RR</u>	<u>Adjusted RR* (95%CI)</u>	<1	141 (23.7%)	156 (26.2%)	1.0 (R)	1.0	1-99	195 (32.8%)	136 (22.9%)	1.6	1.8 (1.2-2.5)	100-199	100 (16.8%)	103 (17.3%)	1.1	1.0 (0.7-1.5)	200-399	87 (14.6%)	110 (18.5%)	0.9	0.9 (0.6-1.4)	400+	72 (12.1%)	90 (15.1%)	0.9	0.9 (0.6-1.5)		<u>Cases</u>	<u>Controls</u>	<u>Crude RR</u>	<u>Adjusted RR* (95%CI)</u>	<1	172 (28.9%)	230 (38.7%)	1.0	1.0	1-19	92 (15.5%)	105 (17.6%)	1.3	1.1 (0.7-1.6)	20-79	165 (27.7%)	122 (20.5%)	2.0	1.7 (1.2-2.5)	80-159	89 (15.0%)	79 (13.3%)	1.7	1.8 (1.2-2.7)	160+	77 (12.9%)	59 (10.0%)	2.0	1.7 (1.1-2.7)		<u>Cases</u>	<u>Controls</u>	<u>Crude RR</u>	<u>Adjusted RR* (95%CI)</u>	<1	194 (32.6%)	216 (36.3%)	1.0	1.0	1-6	151 (25.4%)	175 (29.4%)	1.0	0.9 (0.7-1.3)	7-19	79 (13.3%)	91 (15.3%)	1.0	0.9 (0.6-1.4)	20-39	90 (15.1%)	50 (8.4%)	2.1	1.9 (1.3-3.0)	40+	81 (13.6%)	63 (10.6%)	1.5	1.5 (1.0-2.3)
Equivalent hours*	Cases	Adjusted RR**																																																																																																																																																
<1	143 (24%)	1.0																																																																																																																																																
1-99	196 (33%)	1.8																																																																																																																																																
100-199	101 (17%)	1.0																																																																																																																																																
200-399	89 (15%)	0.9																																																																																																																																																
400+	71 (12%)	0.9																																																																																																																																																
Equivalent hours*	Cases	Adjusted RR**																																																																																																																																																
<1	173 (29%)	1.0																																																																																																																																																
1-19	89 (15%)	1.1																																																																																																																																																
20-79	167 (28%)	1.7																																																																																																																																																
80-159	89 (15%)	1.8																																																																																																																																																
160+	77 (13%)	1.7																																																																																																																																																
Equivalent hours*	Cases	Adjusted RR**																																																																																																																																																
<1	196 (33%)	1.0																																																																																																																																																
1-6	149 (25%)	0.9																																																																																																																																																
7-19	77 (13%)	0.9																																																																																																																																																
20-39	89 (15%)	1.9																																																																																																																																																
40+	83 (14%)	1.5																																																																																																																																																
	<u>Cases</u>	<u>Controls</u>	<u>Crude RR</u>	<u>Adjusted RR* (95%CI)</u>																																																																																																																																														
<1	141 (23.7%)	156 (26.2%)	1.0 (R)	1.0																																																																																																																																														
1-99	195 (32.8%)	136 (22.9%)	1.6	1.8 (1.2-2.5)																																																																																																																																														
100-199	100 (16.8%)	103 (17.3%)	1.1	1.0 (0.7-1.5)																																																																																																																																														
200-399	87 (14.6%)	110 (18.5%)	0.9	0.9 (0.6-1.4)																																																																																																																																														
400+	72 (12.1%)	90 (15.1%)	0.9	0.9 (0.6-1.5)																																																																																																																																														
	<u>Cases</u>	<u>Controls</u>	<u>Crude RR</u>	<u>Adjusted RR* (95%CI)</u>																																																																																																																																														
<1	172 (28.9%)	230 (38.7%)	1.0	1.0																																																																																																																																														
1-19	92 (15.5%)	105 (17.6%)	1.3	1.1 (0.7-1.6)																																																																																																																																														
20-79	165 (27.7%)	122 (20.5%)	2.0	1.7 (1.2-2.5)																																																																																																																																														
80-159	89 (15.0%)	79 (13.3%)	1.7	1.8 (1.2-2.7)																																																																																																																																														
160+	77 (12.9%)	59 (10.0%)	2.0	1.7 (1.1-2.7)																																																																																																																																														
	<u>Cases</u>	<u>Controls</u>	<u>Crude RR</u>	<u>Adjusted RR* (95%CI)</u>																																																																																																																																														
<1	194 (32.6%)	216 (36.3%)	1.0	1.0																																																																																																																																														
1-6	151 (25.4%)	175 (29.4%)	1.0	0.9 (0.7-1.3)																																																																																																																																														
7-19	79 (13.3%)	91 (15.3%)	1.0	0.9 (0.6-1.4)																																																																																																																																														
20-39	90 (15.1%)	50 (8.4%)	2.1	1.9 (1.3-3.0)																																																																																																																																														
40+	81 (13.6%)	63 (10.6%)	1.5	1.5 (1.0-2.3)																																																																																																																																														

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sun exposure (cont.)	Measurement of sunlamp or sun bed exposure	Measurement of sunscreen use	Measurement of sunburn	Comments
Case-control					
Gallagher 1986 ⁷⁵	Sunny vacations per decade (calc)	NR	NR	Childhood sunburn (calc)	
	Adjusted RR* (95%CI)			Cases RR Crude RR Adjusted*	
Elwood 1985 ¹³⁵	0			Rare or mild	143 (24%) 1.0 1.0
	<1			Moderate or infrequent	161 (27%) 1.4 1.1
Elwood 1984 ¹³⁶	1-3			Severe or frequent	292 (49%) 1.9 1.3
	4+			<i>p=NS</i>	
Western Canada Melanoma Study	* Adjusted for hair color, skin color, history of freckles, and ethnic origin			*Adjusted for other pigmentation factors and for freckling, childhood sunburn and ethnic origin	
	Annual sun exposure, hours (calc)				
	<49				
	50-99				
	100-149				
	150-199				
	200-299				
	300-399				
	400-499				
	500+				

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered																													
Case-control																																		
Kricker 1991 ⁶²	Skin Cancer: BCC & SCC	Cases: Selection: BCC or SCC diagnosed at the Geraldton prevalence survey in 1987 or within the preceding 12 months	Cases n= 248 (23 persons with both BCC and SCC) BCC cases n=226 SCC cases n=45 Controls n= 1,015 BCC controls n= 1,021 (6 cases of SCC) SCC controls n= 1,064 (49 cases of BCC)	Sun exposure, sunscreen exposure	Ethnicity, pigmentary traits and sensitivity of the skin to sunlight, sun exposure, sun damage, skin conditions																													
Kricker 1995 ¹¹⁶	Study Design: Case-control	Eligibility criteria: 40-64 years of age, resident in Geraldton	Age (mean): NR	Interviews (location NR)																														
Kricker 1995 ³⁶	Location: Western Australia	Controls: Selection: from same survey, subjects who had no diagnosis of BCC, SCC, keratocanthoma, or intraepithelial carcinoma. Stratified by sex and age	Sex: NR																															
English 1998 ⁶³		Eligibility criteria: NR	Skin phenotype: <i>Ability to tan (calc)</i>																															
English 1998 ³³			<table border="1"> <thead> <tr> <th></th> <th colspan="2">BCC</th> <th colspan="2">SCC</th> </tr> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Very brown</td> <td>43 (19.0%)</td> <td>369 (36.2%)</td> <td>7 (15.6%)</td> <td>320 (34.2%)</td> </tr> <tr> <td>Moderate tan</td> <td>100 (44.2%)</td> <td>436 (43.1%)</td> <td>19 (42.2%)</td> <td>409 (43.7%)</td> </tr> <tr> <td>Mild tan</td> <td>66 (29.2%)</td> <td>176 (17.3%)</td> <td>12 (26.7%)</td> <td>171 (18.3%)</td> </tr> <tr> <td>Freckle/no tan</td> <td>17 (7.5%)</td> <td>37 (3.6%)</td> <td>7 (15.6%)</td> <td>35 (3.7%)</td> </tr> </tbody> </table>		BCC		SCC			Cases	Controls	Cases	Controls	Very brown	43 (19.0%)	369 (36.2%)	7 (15.6%)	320 (34.2%)	Moderate tan	100 (44.2%)	436 (43.1%)	19 (42.2%)	409 (43.7%)	Mild tan	66 (29.2%)	176 (17.3%)	12 (26.7%)	171 (18.3%)	Freckle/no tan	17 (7.5%)	37 (3.6%)	7 (15.6%)	35 (3.7%)	
	BCC		SCC																															
	Cases	Controls	Cases	Controls																														
Very brown	43 (19.0%)	369 (36.2%)	7 (15.6%)	320 (34.2%)																														
Moderate tan	100 (44.2%)	436 (43.1%)	19 (42.2%)	409 (43.7%)																														
Mild tan	66 (29.2%)	176 (17.3%)	12 (26.7%)	171 (18.3%)																														
Freckle/no tan	17 (7.5%)	37 (3.6%)	7 (15.6%)	35 (3.7%)																														

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sun exposure (cont.)																																																																																																																																																																																																	
<p>Case-control</p> <p>Kricker 1991⁶²</p> <p>Kricker 1995¹¹⁶</p> <p>Kricker 1995³⁶</p> <p>English 1998⁶³</p> <p>English 1998³³</p>	<p>Risk of BCC in relation to intermittency of sun exposure in 15-19-year-olds before diagnosis estimated from a typical week in each of the warmer and cooler months at each place of residence and adjusted for age, sex, ability to tan and total sun exposure (calc)</p> <table border="1"> <thead> <tr> <th>Cases</th> <th>Controls</th> <th>OR (95%CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td>0-40%</td> <td>36 (17.9%)</td> <td>177 (25.3%)</td> <td>1.00</td> </tr> <tr> <td>41-58%</td> <td>50 (24.9%)</td> <td>183 (26.1%)</td> <td>1.49 (0.88-2.52)</td> </tr> <tr> <td>59-99%</td> <td>49 (24.4%)</td> <td>156 (22.3%)</td> <td>1.82 (1.01-3.28)</td> </tr> <tr> <td>100%</td> <td>66 (32.8%)</td> <td>184 (26.3%)</td> <td>3.86 (1.93-7.75)</td> </tr> </tbody> </table> <p><0.001 for trend</p> <p>Risk of BCC in relation to the interaction between ability to tan and intermittency of sun exposure adjusted for age, sex and total outdoor exposure for 15-19-year-olds (calc)</p> <table border="1"> <thead> <tr> <th>Cases</th> <th>Controls</th> <th>OR (95%CI)</th> </tr> </thead> <tbody> <tr> <td colspan="3"><i>Very Brown</i></td> </tr> <tr> <td>0-40%</td> <td>3 (8.3%)</td> <td>65 (27.0%)</td> </tr> <tr> <td>41-58%</td> <td>8 (22.2%)</td> <td>64 (26.6%)</td> </tr> <tr> <td>59-99%</td> <td>8 (22.2%)</td> <td>48 (20.0%)</td> </tr> <tr> <td>100%</td> <td>17 (47.2%)</td> <td>64 (26.6%)</td> </tr> <tr> <td colspan="3"><i>Moderately brown, peel, freckle</i></td> </tr> <tr> <td>0-40%</td> <td>44 (26.7%)</td> <td>120 (26.1%)</td> </tr> <tr> <td>41-58%</td> <td>45 (27.3%)</td> <td>111 (24.2%)</td> </tr> <tr> <td>59-99%</td> <td>49 (29.7%)</td> <td>112 (24.4%)</td> </tr> <tr> <td>100%</td> <td>27 (16.4%)</td> <td>116 (25.3%)</td> </tr> </tbody> </table> <p>Risk of BCC in relation to lifetime hours of sun exposure on holidays between 9am and 5pm when the site was exposed (calc)*</p> <table border="1"> <thead> <tr> <th>Cases</th> <th>Controls</th> <th>OR (95%CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td>0-602</td> <td>40 (20.8%)</td> <td>174 (24.9%)</td> <td>1.00</td> </tr> <tr> <td>602-2268</td> <td>54 (28.1%)</td> <td>176 (25.1%)</td> <td>1.65 (1.01-2.70)</td> </tr> <tr> <td>2268-3794</td> <td>49 (25.5%)</td> <td>174 (24.9%)</td> <td>1.68 (1.00-2.80)</td> </tr> <tr> <td>3794+</td> <td>49 (25.5%)</td> <td>176 (25.1%)</td> <td>1.85 (1.09-3.13)</td> </tr> </tbody> </table> <p>0.09</p> <p>Risk of BCC in relation to lifetime frequency of sunbathing when the site was exposed (calc)*</p> <table border="1"> <thead> <tr> <th>Cases</th> <th>Controls</th> <th>OR (95%CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td>None</td> <td>95 (49.0%)</td> <td>342 (48.9%)</td> <td>1.00</td> </tr> <tr> <td>1-200</td> <td>35 (18.0%)</td> <td>91 (13.0%)</td> <td>1.57 (0.98-2.51)</td> </tr> <tr> <td>201-700</td> <td>34 (17.5%)</td> <td>136 (19.4%)</td> <td>1.08 (0.68-1.72)</td> </tr> <tr> <td>701-9000</td> <td>30 (15.5%)</td> <td>131 (18.7%)</td> <td>1.02 (0.63-1.64)</td> </tr> </tbody> </table> <p>0.31</p> <p>*Adjusted for age, sex, ability to tan, and site</p>	Cases	Controls	OR (95%CI)	P	0-40%	36 (17.9%)	177 (25.3%)	1.00	41-58%	50 (24.9%)	183 (26.1%)	1.49 (0.88-2.52)	59-99%	49 (24.4%)	156 (22.3%)	1.82 (1.01-3.28)	100%	66 (32.8%)	184 (26.3%)	3.86 (1.93-7.75)	Cases	Controls	OR (95%CI)	<i>Very Brown</i>			0-40%	3 (8.3%)	65 (27.0%)	41-58%	8 (22.2%)	64 (26.6%)	59-99%	8 (22.2%)	48 (20.0%)	100%	17 (47.2%)	64 (26.6%)	<i>Moderately brown, peel, freckle</i>			0-40%	44 (26.7%)	120 (26.1%)	41-58%	45 (27.3%)	111 (24.2%)	59-99%	49 (29.7%)	112 (24.4%)	100%	27 (16.4%)	116 (25.3%)	Cases	Controls	OR (95%CI)	P	0-602	40 (20.8%)	174 (24.9%)	1.00	602-2268	54 (28.1%)	176 (25.1%)	1.65 (1.01-2.70)	2268-3794	49 (25.5%)	174 (24.9%)	1.68 (1.00-2.80)	3794+	49 (25.5%)	176 (25.1%)	1.85 (1.09-3.13)	Cases	Controls	OR (95%CI)	P	None	95 (49.0%)	342 (48.9%)	1.00	1-200	35 (18.0%)	91 (13.0%)	1.57 (0.98-2.51)	201-700	34 (17.5%)	136 (19.4%)	1.08 (0.68-1.72)	701-9000	30 (15.5%)	131 (18.7%)	1.02 (0.63-1.64)	<p>Risk of BCC in relation to accumulated hours sun exposure between 9am and 5pm estimated from a typical week in each of the warmer and cooler months at each place of residence, controlling for age, sex, and ability to tan (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95%CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td>0-40.5</td> <td>50 (24.9%)</td> <td>176 (25.1%)</td> <td>1.00</td> <td></td> </tr> <tr> <td>40.5-56.4</td> <td>48 (23.9%)</td> <td>177 (25.3%)</td> <td>0.99 (0.61-1.58)</td> <td></td> </tr> <tr> <td>46.4-81.6</td> <td>59 (29.4%)</td> <td>166 (23.7%)</td> <td>1.42 (0.86-2.35)</td> <td></td> </tr> <tr> <td>81.6+</td> <td>44 (21.9%)</td> <td>181 (25.9%)</td> <td>0.77 (0.43-1.40)</td> <td>0.10</td> </tr> </tbody> </table> <p>Risk of BCC in relation to measures of ambient solar radiation at places of residence for the whole year, controlling for age, sex and ability to tan (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95%CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td>0-8.8</td> <td>39 (19.4%)</td> <td>186 (26.6%)</td> <td>1.00</td> <td></td> </tr> <tr> <td>8.8-10.1</td> <td>52 (25.9%)</td> <td>174 (24.9%)</td> <td>1.32 (0.69-2.55)</td> <td></td> </tr> <tr> <td>10.1-11.4</td> <td>54 (26.9%)</td> <td>174 (24.9%)</td> <td>1.72 (0.72-4.09)</td> <td>0.47</td> </tr> <tr> <td>11.4+</td> <td>56 (27.9%)</td> <td>166 (23.7%)</td> <td>2.18 (0.82-5.82)</td> <td>0.11 for trend</td> </tr> </tbody> </table> <p>Risk of BCC in relation to accumulated sun exposure between 9am and 5pm on working days and on non-working days from 15 years of age estimated from a typical week in each of the warmer and cooler months at each place of residence, controlling for age, sex, and ability to tan (calc)</p> <table border="1"> <thead> <tr> <th>Thousands of Hours</th> <th>Cases</th> <th>Controls</th> <th>OR (95%CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td>0-14.7</td> <td>47 (23.4%)</td> <td>179 (25.6%)</td> <td>1.00</td> <td></td> </tr> <tr> <td>14.8-27.7</td> <td>58 (28.9%)</td> <td>168 (24.0%)</td> <td>1.25 (0.79-1.97)</td> <td></td> </tr> <tr> <td>27.8-49.3</td> <td>52 (25.9%)</td> <td>174 (24.9%)</td> <td>1.17 (0.72-1.90)</td> <td></td> </tr> <tr> <td>49.4+</td> <td>44 (21.9%)</td> <td>179 (25.6%)</td> <td>0.86 (0.50-1.51)</td> <td>0.46</td> </tr> </tbody> </table> <p>Relationship of SCC to ambient sunlight in accumulated global radiance (mWh cm-2 X 105) at places of residence from birth until 1987, adjusted for age, sex, year of interview, ability to tan and propensity to burn (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95%CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td><8.8410</td> <td>17 (20.7%)</td> <td>249 (24.2%)</td> <td>1.0</td> <td></td> </tr> <tr> <td>8.8410-10.1399</td> <td>25 (30.5%)</td> <td>236 (22.9%)</td> <td>1.4 (0.51-3.6)</td> <td></td> </tr> <tr> <td>10.1400-11.4509</td> <td>54 (65.9%)</td> <td>291 (28.2%)</td> <td>2.7 (0.84-8.6)</td> <td></td> </tr> <tr> <td>11.4510+</td> <td>36 (43.9%)</td> <td>255 (24.7%)</td> <td>2.3 (0.62-8.3)</td> <td>0.17</td> </tr> </tbody> </table>		Cases	Controls	OR (95%CI)	P	0-40.5	50 (24.9%)	176 (25.1%)	1.00		40.5-56.4	48 (23.9%)	177 (25.3%)	0.99 (0.61-1.58)		46.4-81.6	59 (29.4%)	166 (23.7%)	1.42 (0.86-2.35)		81.6+	44 (21.9%)	181 (25.9%)	0.77 (0.43-1.40)	0.10		Cases	Controls	OR (95%CI)	P	0-8.8	39 (19.4%)	186 (26.6%)	1.00		8.8-10.1	52 (25.9%)	174 (24.9%)	1.32 (0.69-2.55)		10.1-11.4	54 (26.9%)	174 (24.9%)	1.72 (0.72-4.09)	0.47	11.4+	56 (27.9%)	166 (23.7%)	2.18 (0.82-5.82)	0.11 for trend	Thousands of Hours	Cases	Controls	OR (95%CI)	P	0-14.7	47 (23.4%)	179 (25.6%)	1.00		14.8-27.7	58 (28.9%)	168 (24.0%)	1.25 (0.79-1.97)		27.8-49.3	52 (25.9%)	174 (24.9%)	1.17 (0.72-1.90)		49.4+	44 (21.9%)	179 (25.6%)	0.86 (0.50-1.51)	0.46		Cases	Controls	OR (95%CI)	P	<8.8410	17 (20.7%)	249 (24.2%)	1.0		8.8410-10.1399	25 (30.5%)	236 (22.9%)	1.4 (0.51-3.6)		10.1400-11.4509	54 (65.9%)	291 (28.2%)	2.7 (0.84-8.6)		11.4510+	36 (43.9%)	255 (24.7%)	2.3 (0.62-8.3)	0.17
	Cases	Controls	OR (95%CI)	P																																																																																																																																																																																															
	0-40%	36 (17.9%)	177 (25.3%)	1.00																																																																																																																																																																																															
	41-58%	50 (24.9%)	183 (26.1%)	1.49 (0.88-2.52)																																																																																																																																																																																															
	59-99%	49 (24.4%)	156 (22.3%)	1.82 (1.01-3.28)																																																																																																																																																																																															
	100%	66 (32.8%)	184 (26.3%)	3.86 (1.93-7.75)																																																																																																																																																																																															
	Cases	Controls	OR (95%CI)																																																																																																																																																																																																
	<i>Very Brown</i>																																																																																																																																																																																																		
	0-40%	3 (8.3%)	65 (27.0%)																																																																																																																																																																																																
	41-58%	8 (22.2%)	64 (26.6%)																																																																																																																																																																																																
59-99%	8 (22.2%)	48 (20.0%)																																																																																																																																																																																																	
100%	17 (47.2%)	64 (26.6%)																																																																																																																																																																																																	
<i>Moderately brown, peel, freckle</i>																																																																																																																																																																																																			
0-40%	44 (26.7%)	120 (26.1%)																																																																																																																																																																																																	
41-58%	45 (27.3%)	111 (24.2%)																																																																																																																																																																																																	
59-99%	49 (29.7%)	112 (24.4%)																																																																																																																																																																																																	
100%	27 (16.4%)	116 (25.3%)																																																																																																																																																																																																	
Cases	Controls	OR (95%CI)	P																																																																																																																																																																																																
0-602	40 (20.8%)	174 (24.9%)	1.00																																																																																																																																																																																																
602-2268	54 (28.1%)	176 (25.1%)	1.65 (1.01-2.70)																																																																																																																																																																																																
2268-3794	49 (25.5%)	174 (24.9%)	1.68 (1.00-2.80)																																																																																																																																																																																																
3794+	49 (25.5%)	176 (25.1%)	1.85 (1.09-3.13)																																																																																																																																																																																																
Cases	Controls	OR (95%CI)	P																																																																																																																																																																																																
None	95 (49.0%)	342 (48.9%)	1.00																																																																																																																																																																																																
1-200	35 (18.0%)	91 (13.0%)	1.57 (0.98-2.51)																																																																																																																																																																																																
201-700	34 (17.5%)	136 (19.4%)	1.08 (0.68-1.72)																																																																																																																																																																																																
701-9000	30 (15.5%)	131 (18.7%)	1.02 (0.63-1.64)																																																																																																																																																																																																
	Cases	Controls	OR (95%CI)	P																																																																																																																																																																																															
0-40.5	50 (24.9%)	176 (25.1%)	1.00																																																																																																																																																																																																
40.5-56.4	48 (23.9%)	177 (25.3%)	0.99 (0.61-1.58)																																																																																																																																																																																																
46.4-81.6	59 (29.4%)	166 (23.7%)	1.42 (0.86-2.35)																																																																																																																																																																																																
81.6+	44 (21.9%)	181 (25.9%)	0.77 (0.43-1.40)	0.10																																																																																																																																																																																															
	Cases	Controls	OR (95%CI)	P																																																																																																																																																																																															
0-8.8	39 (19.4%)	186 (26.6%)	1.00																																																																																																																																																																																																
8.8-10.1	52 (25.9%)	174 (24.9%)	1.32 (0.69-2.55)																																																																																																																																																																																																
10.1-11.4	54 (26.9%)	174 (24.9%)	1.72 (0.72-4.09)	0.47																																																																																																																																																																																															
11.4+	56 (27.9%)	166 (23.7%)	2.18 (0.82-5.82)	0.11 for trend																																																																																																																																																																																															
Thousands of Hours	Cases	Controls	OR (95%CI)	P																																																																																																																																																																																															
0-14.7	47 (23.4%)	179 (25.6%)	1.00																																																																																																																																																																																																
14.8-27.7	58 (28.9%)	168 (24.0%)	1.25 (0.79-1.97)																																																																																																																																																																																																
27.8-49.3	52 (25.9%)	174 (24.9%)	1.17 (0.72-1.90)																																																																																																																																																																																																
49.4+	44 (21.9%)	179 (25.6%)	0.86 (0.50-1.51)	0.46																																																																																																																																																																																															
	Cases	Controls	OR (95%CI)	P																																																																																																																																																																																															
<8.8410	17 (20.7%)	249 (24.2%)	1.0																																																																																																																																																																																																
8.8410-10.1399	25 (30.5%)	236 (22.9%)	1.4 (0.51-3.6)																																																																																																																																																																																																
10.1400-11.4509	54 (65.9%)	291 (28.2%)	2.7 (0.84-8.6)																																																																																																																																																																																																
11.4510+	36 (43.9%)	255 (24.7%)	2.3 (0.62-8.3)	0.17																																																																																																																																																																																															

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sun exposure (cont.)	Measurement of sunlamp or sun bed exposure																																																							
Case-control																																																									
Kricker 1991 ⁶²	Relationship of SCC to hours of sun exposure to the anatomic site according to whether the site was usually exposed to sunlight (calc)	NR																																																							
Kricker 1995 ¹¹⁶	<table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95%CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td colspan="5">Working days</td> </tr> <tr> <td>0-11,499</td> <td>15 (18.1%)</td> <td>137 (25.3%)</td> <td>1.0</td> <td></td> </tr> <tr> <td>11,500-19,999</td> <td>16 (19.3%)</td> <td>144 (26.6%)</td> <td>0.93 (0.42-2.1)</td> <td></td> </tr> <tr> <td>20,000-32,999</td> <td>25 (30.1%)</td> <td>123 (22.7%)</td> <td>1.7 (0.81-3.8)</td> <td></td> </tr> <tr> <td>33,000+</td> <td>27 (32.5%)</td> <td>138 (25.5%)</td> <td>1.3 (0.58-2.8)</td> <td>0.32</td> </tr> <tr> <td colspan="5">Non-working days</td> </tr> <tr> <td>0-4,999</td> <td>14 (16.9%)</td> <td>146 (26.9%)</td> <td>1.0</td> <td></td> </tr> <tr> <td>5,000-8,499</td> <td>20 (24.1%)</td> <td>124 (22.9%)</td> <td>2.0 (0.89-4.4)</td> <td></td> </tr> <tr> <td>8,500-13,999</td> <td>24 (28.9%)</td> <td>128 (23.6%)</td> <td>1.9 (0.86-4.2)</td> <td></td> </tr> <tr> <td>14,000+</td> <td>25 (30.1%)</td> <td>144 (26.6%)</td> <td>1.3 (0.57-2.9)</td> <td>0.68</td> </tr> </tbody> </table>		Cases	Controls	OR (95%CI)	P	Working days					0-11,499	15 (18.1%)	137 (25.3%)	1.0		11,500-19,999	16 (19.3%)	144 (26.6%)	0.93 (0.42-2.1)		20,000-32,999	25 (30.1%)	123 (22.7%)	1.7 (0.81-3.8)		33,000+	27 (32.5%)	138 (25.5%)	1.3 (0.58-2.8)	0.32	Non-working days					0-4,999	14 (16.9%)	146 (26.9%)	1.0		5,000-8,499	20 (24.1%)	124 (22.9%)	2.0 (0.89-4.4)		8,500-13,999	24 (28.9%)	128 (23.6%)	1.9 (0.86-4.2)		14,000+	25 (30.1%)	144 (26.6%)	1.3 (0.57-2.9)	0.68	
	Cases	Controls	OR (95%CI)	P																																																					
Working days																																																									
0-11,499	15 (18.1%)	137 (25.3%)	1.0																																																						
11,500-19,999	16 (19.3%)	144 (26.6%)	0.93 (0.42-2.1)																																																						
20,000-32,999	25 (30.1%)	123 (22.7%)	1.7 (0.81-3.8)																																																						
33,000+	27 (32.5%)	138 (25.5%)	1.3 (0.58-2.8)	0.32																																																					
Non-working days																																																									
0-4,999	14 (16.9%)	146 (26.9%)	1.0																																																						
5,000-8,499	20 (24.1%)	124 (22.9%)	2.0 (0.89-4.4)																																																						
8,500-13,999	24 (28.9%)	128 (23.6%)	1.9 (0.86-4.2)																																																						
14,000+	25 (30.1%)	144 (26.6%)	1.3 (0.57-2.9)	0.68																																																					
English 1998 ⁶³																																																									
English 1998 ³³	<p>Risk of SCC in relation to lifetime hours of sun exposure to the site on holidays (calc)*</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95%CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td><600</td> <td>19 (18.6%)</td> <td>252 (24.4%)</td> <td>1.0</td> <td></td> </tr> <tr> <td>600-2,268</td> <td>28 (27.5%)</td> <td>288 (27.9%)</td> <td>0.89 (0.44-1.8)</td> <td></td> </tr> <tr> <td>2,269-3,793</td> <td>28 (27.5%)</td> <td>241 (23.4%)</td> <td>1.0 (0.51-2.1)</td> <td></td> </tr> <tr> <td>3,794+</td> <td>27 (26.5%)</td> <td>250 (24.2%)</td> <td>0.93 (0.44-1.9)</td> <td>0.97</td> </tr> </tbody> </table>		Cases	Controls	OR (95%CI)	P	<600	19 (18.6%)	252 (24.4%)	1.0		600-2,268	28 (27.5%)	288 (27.9%)	0.89 (0.44-1.8)		2,269-3,793	28 (27.5%)	241 (23.4%)	1.0 (0.51-2.1)		3,794+	27 (26.5%)	250 (24.2%)	0.93 (0.44-1.9)	0.97																															
	Cases	Controls	OR (95%CI)	P																																																					
<600	19 (18.6%)	252 (24.4%)	1.0																																																						
600-2,268	28 (27.5%)	288 (27.9%)	0.89 (0.44-1.8)																																																						
2,269-3,793	28 (27.5%)	241 (23.4%)	1.0 (0.51-2.1)																																																						
3,794+	27 (26.5%)	250 (24.2%)	0.93 (0.44-1.9)	0.97																																																					

Study reference USPSTF quality	Measurement of sunscreen use	Measurement of sunburn	Comments																																																		
Case-control																																																					
Kricker 1991 ⁶²	Risk of BCC in relation to use of SPF10+ sunscreen on the site: frequency and duration of use (calc)*	Risk of BCC in relation to frequency of painful sunburn to the site (calc)*																																																			
Kricker 1995 ¹¹⁶	<table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95%CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td><half the time</td> <td>117 (60.9%)</td> <td>476 (68.0%)</td> <td>1.00</td> <td></td> </tr> <tr> <td colspan="5">≥half the time</td> </tr> <tr> <td>1-9 years</td> <td>31 (16.1%)</td> <td>75 (10.7%)</td> <td>1.92 (1.17-3.13)</td> <td></td> </tr> <tr> <td>10+ years</td> <td>44 (22.9%)</td> <td>149 (21.3%)</td> <td>1.25 (0.82-1.90)</td> <td>0.04</td> </tr> </tbody> </table>		Cases	Controls	OR (95%CI)	P	<half the time	117 (60.9%)	476 (68.0%)	1.00		≥half the time					1-9 years	31 (16.1%)	75 (10.7%)	1.92 (1.17-3.13)		10+ years	44 (22.9%)	149 (21.3%)	1.25 (0.82-1.90)	0.04	<table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95%CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td>None</td> <td>87 (45.3%)</td> <td>378 (54.0%)</td> <td>1.00</td> <td></td> </tr> <tr> <td>1-2 times</td> <td>27 (14.1%)</td> <td>105 (15.0%)</td> <td>1.09 (0.67-1.79)</td> <td></td> </tr> <tr> <td>3-10 times</td> <td>31 (16.1%)</td> <td>77 (11.0%)</td> <td>1.75 (1.08-2.85)</td> <td></td> </tr> <tr> <td>11+ times</td> <td>47 (24.5%)</td> <td>140 (20.0%)</td> <td>1.50 (0.99-2.26)</td> <td>0.07</td> </tr> </tbody> </table>		Cases	Controls	OR (95%CI)	P	None	87 (45.3%)	378 (54.0%)	1.00		1-2 times	27 (14.1%)	105 (15.0%)	1.09 (0.67-1.79)		3-10 times	31 (16.1%)	77 (11.0%)	1.75 (1.08-2.85)		11+ times	47 (24.5%)	140 (20.0%)	1.50 (0.99-2.26)	0.07	
	Cases	Controls	OR (95%CI)	P																																																	
<half the time	117 (60.9%)	476 (68.0%)	1.00																																																		
≥half the time																																																					
1-9 years	31 (16.1%)	75 (10.7%)	1.92 (1.17-3.13)																																																		
10+ years	44 (22.9%)	149 (21.3%)	1.25 (0.82-1.90)	0.04																																																	
	Cases	Controls	OR (95%CI)	P																																																	
None	87 (45.3%)	378 (54.0%)	1.00																																																		
1-2 times	27 (14.1%)	105 (15.0%)	1.09 (0.67-1.79)																																																		
3-10 times	31 (16.1%)	77 (11.0%)	1.75 (1.08-2.85)																																																		
11+ times	47 (24.5%)	140 (20.0%)	1.50 (0.99-2.26)	0.07																																																	
Kricker 1995 ³⁶																																																					
English 1998 ⁶³																																																					
English 1998 ³³	*Adjusted for age, sex, ability to tan, and site	*Adjusted for age, sex, ability to tan, and site																																																			
		<p>Risk of SCC in relation to frequency of painful sunburn to the site (calc)*</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95%CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td>None</td> <td>53 (52.0%)</td> <td>584 (56.6%)</td> <td>1.0</td> <td></td> </tr> <tr> <td>1-2 times</td> <td>9 (8.8%)</td> <td>141 (13.7%)</td> <td>0.84 (0.39-1.8)</td> <td></td> </tr> <tr> <td>3-10 times</td> <td>17 (16.7%)</td> <td>109 (10.6%)</td> <td>1.8 (0.99-3.4)</td> <td></td> </tr> <tr> <td>11+ times</td> <td>23 (22.5%)</td> <td>197 (19.1%)</td> <td>1.4 (0.82-2.5)</td> <td>0.08</td> </tr> </tbody> </table>		Cases	Controls	OR (95%CI)	P	None	53 (52.0%)	584 (56.6%)	1.0		1-2 times	9 (8.8%)	141 (13.7%)	0.84 (0.39-1.8)		3-10 times	17 (16.7%)	109 (10.6%)	1.8 (0.99-3.4)		11+ times	23 (22.5%)	197 (19.1%)	1.4 (0.82-2.5)	0.08																										
	Cases	Controls	OR (95%CI)	P																																																	
None	53 (52.0%)	584 (56.6%)	1.0																																																		
1-2 times	9 (8.8%)	141 (13.7%)	0.84 (0.39-1.8)																																																		
3-10 times	17 (16.7%)	109 (10.6%)	1.8 (0.99-3.4)																																																		
11+ times	23 (22.5%)	197 (19.1%)	1.4 (0.82-2.5)	0.08																																																	
		*Adjusted for age, sex, year of interview, and anatomic site																																																			

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered																								
Case-control																													
Vlajinac 2000 ¹²⁷	<p>Skin Cancer: BCC</p> <p>Study Design: Case-control</p> <p>Location: Yugoslavia</p>	<p>Cases: Selection: consecutive cases at City Departments for Skin and Venereal Diseases</p> <p>Eligibility criteria: diagnosis of BCC</p> <p>Controls: Selection: consecutive patients presenting at the same institutions for dermatologic diseases other than cancer</p> <p>Eligibility criteria: aged >30 years</p>	<p>Cases n= 200 Controls n= 399</p> <p>Age (calc):</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>≤59 years</td> <td>60 (30.0%)</td> <td>114 (28.6%)</td> </tr> <tr> <td>≥60 years</td> <td>140 (70.0%)</td> <td>285 (71.4%)</td> </tr> </tbody> </table> <p>Sex</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Male</td> <td>124 (62.0%)</td> <td>239 (59.9%)</td> </tr> </tbody> </table> <p>Skin phenotype: <i>Skin reaction to sun exposure</i></p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Usually burns with no or little tan</td> <td>78 (39.0%)</td> <td>91 (22.8%)</td> </tr> <tr> <td>Never or rarely burns and always tans</td> <td>122 (61.0%)</td> <td>308 (77.2%)</td> </tr> </tbody> </table>		Cases	Controls	≤59 years	60 (30.0%)	114 (28.6%)	≥60 years	140 (70.0%)	285 (71.4%)		Cases	Controls	Male	124 (62.0%)	239 (59.9%)		Cases	Controls	Usually burns with no or little tan	78 (39.0%)	91 (22.8%)	Never or rarely burns and always tans	122 (61.0%)	308 (77.2%)	<p>Sun exposure</p> <p>Physician interviews</p>	
	Cases	Controls																											
≤59 years	60 (30.0%)	114 (28.6%)																											
≥60 years	140 (70.0%)	285 (71.4%)																											
	Cases	Controls																											
Male	124 (62.0%)	239 (59.9%)																											
	Cases	Controls																											
Usually burns with no or little tan	78 (39.0%)	91 (22.8%)																											
Never or rarely burns and always tans	122 (61.0%)	308 (77.2%)																											
Fagnoli 2004 ⁷⁹	<p>Skin Cancer: Melanoma</p> <p>Study Design: Case-control</p> <p>Location: Central Italy</p>	<p>Cases: Selection: consecutive cases presenting at the Department of Dermatology of the University of L'Aquila between 2000-2001</p> <p>Eligibility criteria: sporadic primary cutaneous melanoma of any stage either as a first diagnosis or during periodic followup. Excluded those with family history of melanoma or with visceral malignant tumors</p> <p>Controls: Selection: age, sex, ethnicity and residential area matched recruited consecutively from same department with allergic disorders, skin infections, psoriasis, ulcers or autoimmune diseases</p> <p>Eligibility criteria: excluded those with family history of melanoma, visceral malignant tumors, melanocytic naevi or skin cancer with a history of phototherapy</p>	<p>Cases n= 100 Controls n= 200</p> <p>Mean age (SD): Cases: 48.16 (14.8) Controls: NR</p> <p>Sex (calc):</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Male</td> <td>47 (47.0%)</td> <td>NR</td> </tr> </tbody> </table> <p>Skin phenotype: <i>Fitzpatrick scale</i></p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>IV</td> <td>8 (8%)</td> <td>39 (19.5%)</td> </tr> <tr> <td>III</td> <td>39 (39%)</td> <td>101 (50.5%)</td> </tr> <tr> <td>II</td> <td>49 (49%)</td> <td>57 (28.5%)</td> </tr> <tr> <td>I</td> <td>4 (4%)</td> <td>3 (1.5%)</td> </tr> </tbody> </table>		Cases	Controls	Male	47 (47.0%)	NR		Cases	Controls	IV	8 (8%)	39 (19.5%)	III	39 (39%)	101 (50.5%)	II	49 (49%)	57 (28.5%)	I	4 (4%)	3 (1.5%)	<p>Sun exposure, use of sunscreen, sunlamp exposure</p> <p>Physician interviews</p>	<p>Hair color, eye color, skin type for pigmentation factors</p>			
	Cases	Controls																											
Male	47 (47.0%)	NR																											
	Cases	Controls																											
IV	8 (8%)	39 (19.5%)																											
III	39 (39%)	101 (50.5%)																											
II	49 (49%)	57 (28.5%)																											
I	4 (4%)	3 (1.5%)																											

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sunlamp or sunbed exposure																																													
Case-control																																															
Vlajinac 2000 ¹²⁷	<p>Risk of BCC in relation to number of vacations at seaside before age 10</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95%CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>162 (81.0%)</td> <td>307 (76.9%)</td> <td>NR</td> <td>NS</td> </tr> <tr> <td>1-4</td> <td>21 (10.5%)</td> <td>41 (10.3%)</td> <td>NR</td> <td>NS</td> </tr> <tr> <td>5-9</td> <td>17 (8.5%)</td> <td>51 (12.8%)</td> <td>NR</td> <td>NS</td> </tr> </tbody> </table> <p>not significant in adjusted analyses therefore NR</p> <p>Risk of BCC in relation to average number of weeks per year spent at seaside during vacation</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95%CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>47 (23.5%)</td> <td>125 (31.3%)</td> <td>NR</td> <td>NS</td> </tr> <tr> <td>1-6</td> <td>34 (17.0%)</td> <td>267 (66.9%)</td> <td>NR</td> <td>NS</td> </tr> <tr> <td>7+</td> <td>19 (9.5%)</td> <td>7 (1.8%)</td> <td>1.81 (1.24-2.64)</td> <td>0.0022</td> </tr> </tbody> </table>		Cases	Controls	OR (95%CI)	P	0	162 (81.0%)	307 (76.9%)	NR	NS	1-4	21 (10.5%)	41 (10.3%)	NR	NS	5-9	17 (8.5%)	51 (12.8%)	NR	NS		Cases	Controls	OR (95%CI)	P	0	47 (23.5%)	125 (31.3%)	NR	NS	1-6	34 (17.0%)	267 (66.9%)	NR	NS	7+	19 (9.5%)	7 (1.8%)	1.81 (1.24-2.64)	0.0022	NR					
	Cases	Controls	OR (95%CI)	P																																											
0	162 (81.0%)	307 (76.9%)	NR	NS																																											
1-4	21 (10.5%)	41 (10.3%)	NR	NS																																											
5-9	17 (8.5%)	51 (12.8%)	NR	NS																																											
	Cases	Controls	OR (95%CI)	P																																											
0	47 (23.5%)	125 (31.3%)	NR	NS																																											
1-6	34 (17.0%)	267 (66.9%)	NR	NS																																											
7+	19 (9.5%)	7 (1.8%)	1.81 (1.24-2.64)	0.0022																																											
Fargnoli 2004 ⁷⁹	<p>Melanoma risk associated with recreational sun exposure (h/year)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> <th>Adjusted OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td><60</td> <td>38 (38%)</td> <td>97 (48.5%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>60-120</td> <td>26 (26%)</td> <td>63 (31.5%)</td> <td>1.053 (0.580-1.897)</td> <td>0.761 (0.420-1.378)</td> </tr> <tr> <td>120-240</td> <td>18 (18%)</td> <td>29 (14.5%)</td> <td>1.584 (0.781-3.171)</td> <td>1.641 (0.799-3.370)</td> </tr> <tr> <td>>240</td> <td>18 (18%)</td> <td>11 (5.5%)</td> <td>4.177 (1.831-9.928)</td> <td>5.010 (2.110-11.891)</td> </tr> </tbody> </table> <p>Melanoma risk associated with occupational sun exposure</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> <th>Adjusted OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Yes</td> <td>33 (33%)</td> <td>34 (17.0%)</td> <td>2.405 (1.377-4.207)</td> <td>2.573 (1.399-4.732)</td> </tr> </tbody> </table> <p>Adjusted for hair color, eye color, and skin type</p>		Cases	Controls	OR (95% CI)	Adjusted OR (95% CI)	<60	38 (38%)	97 (48.5%)	1.0	1.0	60-120	26 (26%)	63 (31.5%)	1.053 (0.580-1.897)	0.761 (0.420-1.378)	120-240	18 (18%)	29 (14.5%)	1.584 (0.781-3.171)	1.641 (0.799-3.370)	>240	18 (18%)	11 (5.5%)	4.177 (1.831-9.928)	5.010 (2.110-11.891)		Cases	Controls	OR (95% CI)	Adjusted OR (95% CI)	Yes	33 (33%)	34 (17.0%)	2.405 (1.377-4.207)	2.573 (1.399-4.732)	<p>Melanoma risk associated with use of sunlamps</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> <th>Adjusted OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Yes</td> <td>7 (7%)</td> <td>25 (12.5%)</td> <td>0.527 (0.204-1.204)</td> <td>0.634 (0.247-1.625)</td> </tr> </tbody> </table>		Cases	Controls	OR (95% CI)	Adjusted OR (95% CI)	Yes	7 (7%)	25 (12.5%)	0.527 (0.204-1.204)	0.634 (0.247-1.625)
	Cases	Controls	OR (95% CI)	Adjusted OR (95% CI)																																											
<60	38 (38%)	97 (48.5%)	1.0	1.0																																											
60-120	26 (26%)	63 (31.5%)	1.053 (0.580-1.897)	0.761 (0.420-1.378)																																											
120-240	18 (18%)	29 (14.5%)	1.584 (0.781-3.171)	1.641 (0.799-3.370)																																											
>240	18 (18%)	11 (5.5%)	4.177 (1.831-9.928)	5.010 (2.110-11.891)																																											
	Cases	Controls	OR (95% CI)	Adjusted OR (95% CI)																																											
Yes	33 (33%)	34 (17.0%)	2.405 (1.377-4.207)	2.573 (1.399-4.732)																																											
	Cases	Controls	OR (95% CI)	Adjusted OR (95% CI)																																											
Yes	7 (7%)	25 (12.5%)	0.527 (0.204-1.204)	0.634 (0.247-1.625)																																											

Study reference USPSTF quality	Measurement of sunscreen use	Measurement of sunburn	Comments																				
Case-control																							
Vlajinac 2000 ¹²⁷	NR	<p>Risk of BCC in relation to sunburn pain</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95%CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td>Lifetime</td> <td>67 (33.5%)</td> <td>67 (16.8%)</td> <td>NR</td> <td>NS</td> </tr> <tr> <td>Before age 15</td> <td>24 (12.0%)</td> <td>21 (5.3%)</td> <td>NR</td> <td>NS</td> </tr> </tbody> </table> <p>not significant in adjusted analyses therefore NR</p>		Cases	Controls	OR (95%CI)	P	Lifetime	67 (33.5%)	67 (16.8%)	NR	NS	Before age 15	24 (12.0%)	21 (5.3%)	NR	NS						
	Cases	Controls	OR (95%CI)	P																			
Lifetime	67 (33.5%)	67 (16.8%)	NR	NS																			
Before age 15	24 (12.0%)	21 (5.3%)	NR	NS																			
Fargnoli 2004 ⁷⁹	<p>Melanoma risk associated with use of sunscreens</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> <th>Adjusted OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Yes</td> <td>51 (51%)</td> <td>106 (53.0%)</td> <td>0.923 (0.570-1.494)</td> <td>0.634 (0.247-1.625)</td> </tr> </tbody> </table>		Cases	Controls	OR (95% CI)	Adjusted OR (95% CI)	Yes	51 (51%)	106 (53.0%)	0.923 (0.570-1.494)	0.634 (0.247-1.625)	<p>Melanoma risk associated with childhood sunburns</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> <th>Adjusted OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Yes</td> <td>62 (62%)</td> <td>113 (56.0%)</td> <td>1.256 (0.771-2.063)</td> <td>0.958 (0.554-1.655)</td> </tr> </tbody> </table>		Cases	Controls	OR (95% CI)	Adjusted OR (95% CI)	Yes	62 (62%)	113 (56.0%)	1.256 (0.771-2.063)	0.958 (0.554-1.655)	
	Cases	Controls	OR (95% CI)	Adjusted OR (95% CI)																			
Yes	51 (51%)	106 (53.0%)	0.923 (0.570-1.494)	0.634 (0.247-1.625)																			
	Cases	Controls	OR (95% CI)	Adjusted OR (95% CI)																			
Yes	62 (62%)	113 (56.0%)	1.256 (0.771-2.063)	0.958 (0.554-1.655)																			

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered						
Case-control											
Holly 1995 ⁸⁰	<p>Skin Cancer: Melanoma</p> <p>Study Design: Case-control</p> <p>Location: San Francisco, CA</p>	<p>Cases: Selection: diagnosed with melanoma between 1981-1986 from the San Francisco Bay Area SEER database</p> <p>Eligibility criteria: women aged 25-59 years, Caucasian, able to complete interview in English</p> <p>Controls: Selection: Age, sex, and county matched, random digit dialing</p> <p>Eligibility criteria: women aged 25-59 years, Caucasian, lived in the same counties as the cases</p>	<p>Cases (calc) n= 452 Controls n= 930</p> <p>Mean age: 42</p> <p>Sex:</p> <table border="1"> <tr> <td></td> <td><u>Cases</u></td> <td><u>Controls</u></td> </tr> <tr> <td>Male</td> <td>0 (0%)</td> <td>0 (0%)</td> </tr> </table> <p>Skin phenotype: NR</p>		<u>Cases</u>	<u>Controls</u>	Male	0 (0%)	0 (0%)	<p>Sun exposure, use of sunscreen, sunlamp exposure</p> <p>In-person interviews</p>	<p>Skin phenotype</p>
	<u>Cases</u>	<u>Controls</u>									
Male	0 (0%)	0 (0%)									

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sunlamp or sunbed exposure																																								
Case-control																																										
Holly 1995 ⁸⁰	<p>Risk for cutaneous malignant melanoma by time spent outdoors on weekdays with arms and legs exposed to the sun (past 10 years)</p> <table border="1"> <tr> <td></td> <td><u>OR (95% CI)</u></td> </tr> <tr> <td>None</td> <td>1.0</td> </tr> <tr> <td><1/4 of time</td> <td>0.71 (0.49-1.0)</td> </tr> <tr> <td>1/4 - 1/2 of time</td> <td>0.83 (0.53-1.3)</td> </tr> <tr> <td>≥1/2 of time</td> <td>0.83 (0.46-1.5)</td> </tr> </table> <p>Risk for cutaneous malignant melanoma by time spent outdoors on weekends with arms and legs exposed to the sun (past 10 years)</p> <table border="1"> <tr> <td></td> <td><u>OR (95% CI)</u></td> </tr> <tr> <td>None</td> <td>1.0</td> </tr> <tr> <td><1/4 of time</td> <td>0.72 (0.35-1.4)</td> </tr> <tr> <td>1/4 - 1/2 of time</td> <td>0.71 (0.37-1.4)</td> </tr> <tr> <td>1/2 - 3/4 of time</td> <td>0.86 (0.42-1.8)</td> </tr> <tr> <td>≥3/4 of time</td> <td>0.84 (0.37-1.9)</td> </tr> </table> <p>Risk for cutaneous malignant melanoma by how often subject sunbathed in a typical year (past 10 years)</p> <table border="1"> <tr> <td></td> <td><u>OR (95% CI)</u></td> </tr> <tr> <td>Never</td> <td>1.0</td> </tr> <tr> <td><Once/month</td> <td>0.75 (0.52-1.1)</td> </tr> <tr> <td>Once/month</td> <td>0.57 (0.36-0.89)</td> </tr> <tr> <td>2-3 times/month</td> <td>0.67 (0.46-0.98)</td> </tr> <tr> <td>≥Once/week</td> <td>0.79 (0.56-1.1)</td> </tr> </table> <p>crude odds ratios only</p>		<u>OR (95% CI)</u>	None	1.0	<1/4 of time	0.71 (0.49-1.0)	1/4 - 1/2 of time	0.83 (0.53-1.3)	≥1/2 of time	0.83 (0.46-1.5)		<u>OR (95% CI)</u>	None	1.0	<1/4 of time	0.72 (0.35-1.4)	1/4 - 1/2 of time	0.71 (0.37-1.4)	1/2 - 3/4 of time	0.86 (0.42-1.8)	≥3/4 of time	0.84 (0.37-1.9)		<u>OR (95% CI)</u>	Never	1.0	<Once/month	0.75 (0.52-1.1)	Once/month	0.57 (0.36-0.89)	2-3 times/month	0.67 (0.46-0.98)	≥Once/week	0.79 (0.56-1.1)	<p>Risk for cutaneous malignant melanoma by use of sunlamp</p> <table border="1"> <tr> <td></td> <td><u>OR (95% CI)</u></td> </tr> <tr> <td>Never used</td> <td>1.0</td> </tr> <tr> <td>Ever used</td> <td>0.94 (0.74-1.2)</td> </tr> </table> <p>crude odds ratios only</p>		<u>OR (95% CI)</u>	Never used	1.0	Ever used	0.94 (0.74-1.2)
	<u>OR (95% CI)</u>																																									
None	1.0																																									
<1/4 of time	0.71 (0.49-1.0)																																									
1/4 - 1/2 of time	0.83 (0.53-1.3)																																									
≥1/2 of time	0.83 (0.46-1.5)																																									
	<u>OR (95% CI)</u>																																									
None	1.0																																									
<1/4 of time	0.72 (0.35-1.4)																																									
1/4 - 1/2 of time	0.71 (0.37-1.4)																																									
1/2 - 3/4 of time	0.86 (0.42-1.8)																																									
≥3/4 of time	0.84 (0.37-1.9)																																									
	<u>OR (95% CI)</u>																																									
Never	1.0																																									
<Once/month	0.75 (0.52-1.1)																																									
Once/month	0.57 (0.36-0.89)																																									
2-3 times/month	0.67 (0.46-0.98)																																									
≥Once/week	0.79 (0.56-1.1)																																									
	<u>OR (95% CI)</u>																																									
Never used	1.0																																									
Ever used	0.94 (0.74-1.2)																																									

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sunscreen use	Measurement of sunburn	Comments																																																						
Case-control																																																									
Holly 1995 ⁸⁰	<p>Risk of cutaneous malignant melanoma by use of sunscreen (before diagnosis)</p> <table border="1"> <thead> <tr> <th></th> <th>OR (95% CI)</th> <th>P</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Almost always</td> <td>1.0</td> <td></td> <td>1.0</td> </tr> <tr> <td>Sometimes</td> <td>1.3 (0.93-1.8)</td> <td></td> <td>1.5 (1.1-2.2)</td> </tr> <tr> <td>Never</td> <td>1.6 (1.2-2.1)</td> <td>0.002</td> <td>2.1 (1.5-3.0)</td> </tr> </tbody> </table> <p>*Adjusted for history of sunburn up to age 12 years, skin's reaction after a few days of exposure to the sun, hair color, number of large nevi, complexion, maternal ethnicity, history of skin cancer, and age</p>		OR (95% CI)	P	Adjusted* OR (95% CI)	Almost always	1.0		1.0	Sometimes	1.3 (0.93-1.8)		1.5 (1.1-2.2)	Never	1.6 (1.2-2.1)	0.002	2.1 (1.5-3.0)	<p>Risk for cutaneous malignant melanoma by number of painful sunburns during elementary school</p> <table border="1"> <thead> <tr> <th></th> <th>OR (95% CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td>None</td> <td>1.0</td> <td></td> </tr> <tr> <td>1-3</td> <td>1.3 (0.96-1.7)</td> <td></td> </tr> <tr> <td>4-6</td> <td>2.2 (1.5-3.1)</td> <td></td> </tr> <tr> <td>≥7</td> <td>2.0 (1.4-2.9)</td> <td><0.001</td> </tr> </tbody> </table> <p>Risk for cutaneous malignant melanoma by number of painful sunburns during high school</p> <table border="1"> <thead> <tr> <th></th> <th>OR (95% CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td>None</td> <td>1.0</td> <td></td> </tr> <tr> <td>1-3</td> <td>1.2 (0.87-1.5)</td> <td></td> </tr> <tr> <td>4-6</td> <td>1.6 (1.2-2.3)</td> <td></td> </tr> <tr> <td>≥7</td> <td>2.4 (1.6-3.5)</td> <td><0.001</td> </tr> </tbody> </table> <p>Risk for cutaneous malignant melanoma by history of sunburn up to age 12 years</p> <table border="1"> <thead> <tr> <th></th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Rare, mild, and/or no burns</td> <td>1.0</td> </tr> <tr> <td>Moderate and/or infrequent burns</td> <td>1.7 (1.2-2.3)</td> </tr> <tr> <td>Severe and/or frequent burns</td> <td>1.9 (1.2-3.0)</td> </tr> </tbody> </table> <p>*Adjusted for use of sunscreen, skin's reaction after a few days of exposure to the sun, hair color, number of large nevi, complexion, maternal ethnicity, history of skin cancer, and age</p>		OR (95% CI)	P	None	1.0		1-3	1.3 (0.96-1.7)		4-6	2.2 (1.5-3.1)		≥7	2.0 (1.4-2.9)	<0.001		OR (95% CI)	P	None	1.0		1-3	1.2 (0.87-1.5)		4-6	1.6 (1.2-2.3)		≥7	2.4 (1.6-3.5)	<0.001		Adjusted* OR (95% CI)	Rare, mild, and/or no burns	1.0	Moderate and/or infrequent burns	1.7 (1.2-2.3)	Severe and/or frequent burns	1.9 (1.2-3.0)	When sun exposure on weekends and weekdays was adjusted for skin phenotype, all risk estimates were at 1.0 or slightly above (specific data NR)
	OR (95% CI)	P	Adjusted* OR (95% CI)																																																						
Almost always	1.0		1.0																																																						
Sometimes	1.3 (0.93-1.8)		1.5 (1.1-2.2)																																																						
Never	1.6 (1.2-2.1)	0.002	2.1 (1.5-3.0)																																																						
	OR (95% CI)	P																																																							
None	1.0																																																								
1-3	1.3 (0.96-1.7)																																																								
4-6	2.2 (1.5-3.1)																																																								
≥7	2.0 (1.4-2.9)	<0.001																																																							
	OR (95% CI)	P																																																							
None	1.0																																																								
1-3	1.2 (0.87-1.5)																																																								
4-6	1.6 (1.2-2.3)																																																								
≥7	2.4 (1.6-3.5)	<0.001																																																							
	Adjusted* OR (95% CI)																																																								
Rare, mild, and/or no burns	1.0																																																								
Moderate and/or infrequent burns	1.7 (1.2-2.3)																																																								
Severe and/or frequent burns	1.9 (1.2-3.0)																																																								

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered																					
Case-control																										
Gallagher 1995 ⁸⁶ Bajdik 1996 ¹²⁸	<p>Skin Cancer: SCC</p> <p>Study Design: Case-control</p> <p>Location: Alberta, Canada</p>	<p>Cases: Selection: newly diagnosed SCC in males between 1983-1984 from the Alberta Cancer Registry</p> <p>Eligibility criteria: men aged 25-79 years</p> <p>Controls: Selection: age and sex matched, from the Alberta Health Care Insurance Plan</p> <p>Eligibility criteria: no previous diagnosis of nonmelanocytic skin cancer</p>	<p>Cases n= 180 Controls n= 406 Mean age: NR Sex:</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Male</td> <td>100%</td> <td>100%</td> </tr> </tbody> </table> <p>Skin phenotype: <i>Skin reaction to 1-week sun exposure (calc)</i></p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Tan without burning</td> <td>58 (32%)</td> <td>155 (37%)</td> </tr> <tr> <td>Tan with protection</td> <td>6 (3%)</td> <td>14 (3%)</td> </tr> <tr> <td>Burn then tan</td> <td>77 (43%)</td> <td>193 (48%)</td> </tr> <tr> <td>Burn, never tan</td> <td>39 (22%)</td> <td>43 (11%)</td> </tr> </tbody> </table>		Cases	Controls	Male	100%	100%		Cases	Controls	Tan without burning	58 (32%)	155 (37%)	Tan with protection	6 (3%)	14 (3%)	Burn then tan	77 (43%)	193 (48%)	Burn, never tan	39 (22%)	43 (11%)	<p>Sun exposure, sunlamp use</p> <p>In-home interviews</p>	Age, pigment, and phenotype
	Cases	Controls																								
Male	100%	100%																								
	Cases	Controls																								
Tan without burning	58 (32%)	155 (37%)																								
Tan with protection	6 (3%)	14 (3%)																								
Burn then tan	77 (43%)	193 (48%)																								
Burn, never tan	39 (22%)	43 (11%)																								

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sun exposure (cont.)																																																																																																																																												
Case-control Gallagher 1995 ⁶⁶ Bajdik 1996 ¹²⁸	<p>Mean recreational sun exposure per year, ages 0-19 years, and risk of SCC (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td><100/y WBE, <3.8 h/wk summer</td> <td>52 (29%)</td> <td>97 (24%)</td> <td>1.0</td> </tr> <tr> <td>100-199/y WBE, 3.8-7.4 h/wk summer</td> <td>49 (27%)</td> <td>113 (28%)</td> <td>1.2 (0.6-2.5)</td> </tr> <tr> <td>200-332/y WBE, 7.5-12.4 h/wk summer</td> <td>36 (20%)</td> <td>101 (25%)</td> <td>1.1 (0.5-2.6)</td> </tr> <tr> <td>333+/y WBE, 12.5+ h/wk summer</td> <td>25 (14%)</td> <td>76 (19%)</td> <td>1.6 (0.6-4.5)</td> </tr> </tbody> </table> <p><i>p (trend) = NS</i></p> <p>Mean recreational sun exposure per year, lifetime, and risk of SCC (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td><75/y WBE, <2.8 h/wk summer</td> <td>38 (21%)</td> <td>75 (18%)</td> <td>1.0</td> </tr> <tr> <td>75-149/y WBE, 2.8-5.5 h/wk summer</td> <td>43 (24%)</td> <td>106 (26%)</td> <td>0.6 (0.3-1.1)</td> </tr> <tr> <td>150-224/y WBE, 5.6-8.4 h/wk summer</td> <td>32 (18%)</td> <td>72 (18%)</td> <td>0.8 (0.3-1.8)</td> </tr> <tr> <td>225+/y WBE, 8.5+ h/wk summer</td> <td>23 (13%)</td> <td>73 (18%)</td> <td>0.3 (0.1-0.9)</td> </tr> </tbody> </table> <p><i>p (trend) = 0.09</i></p> <p>Mean recreational sun exposure per year, last 10 years, and risk of SCC (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td><65/y WBE, <2.4 h/wk summer</td> <td>53 (29%)</td> <td>75 (18%)</td> <td>1.0</td> </tr> <tr> <td>65-119/y WBE, 2.4-4.4 h/wk summer</td> <td>29 (16%)</td> <td>99 (24%)</td> <td>0.4 (0.2-0.7)</td> </tr> <tr> <td>120-199/y WBE, 4.5-7.4 h/wk summer</td> <td>60 (33%)</td> <td>115 (28%)</td> <td>0.7 (0.4-1.2)</td> </tr> <tr> <td>200+/y WBE, 7.5+ h/wk summer</td> <td>25 (14%)</td> <td>83 (20%)</td> <td>0.4 (0.2-0.7)</td> </tr> </tbody> </table> <p><i>p (trend)=0.06</i></p> <p>WBE-whole body equivalent is 1 h of sun exposure to the whole surface of the body *Adjusted for effects of mother's ethnic origin, hair color, and skin color</p> <p>Mean occupational sun exposure per year, lifetime, and risk of SCC (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td><15/y WBE, 3.5 h/wk summer</td> <td>26 (14%)</td> <td>87 (21%)</td> <td>1.0</td> </tr> <tr> <td>15-59/y WBE, 3.5-13.9 h/wk summer</td> <td>36 (20%)</td> <td>105 (26%)</td> <td>0.8 (0.3-2.0)</td> </tr> <tr> <td>60-104/y WBE, 14.0-24.9 h/wk summer</td> <td>42 (23%)</td> <td>86 (21%)</td> <td>1.5 (0.6-4.2)</td> </tr> <tr> <td>105+/y WBE, 25.0 h/wk summer</td> <td>76 (42%)</td> <td>128 (32%)</td> <td>1.4 (0.4-4.3)</td> </tr> </tbody> </table> <p><i>p (trend)=NS</i></p>		Cases	Controls	Adjusted* OR (95% CI)	<100/y WBE, <3.8 h/wk summer	52 (29%)	97 (24%)	1.0	100-199/y WBE, 3.8-7.4 h/wk summer	49 (27%)	113 (28%)	1.2 (0.6-2.5)	200-332/y WBE, 7.5-12.4 h/wk summer	36 (20%)	101 (25%)	1.1 (0.5-2.6)	333+/y WBE, 12.5+ h/wk summer	25 (14%)	76 (19%)	1.6 (0.6-4.5)		Cases	Controls	Adjusted* OR (95% CI)	<75/y WBE, <2.8 h/wk summer	38 (21%)	75 (18%)	1.0	75-149/y WBE, 2.8-5.5 h/wk summer	43 (24%)	106 (26%)	0.6 (0.3-1.1)	150-224/y WBE, 5.6-8.4 h/wk summer	32 (18%)	72 (18%)	0.8 (0.3-1.8)	225+/y WBE, 8.5+ h/wk summer	23 (13%)	73 (18%)	0.3 (0.1-0.9)		Cases	Controls	Adjusted* OR (95% CI)	<65/y WBE, <2.4 h/wk summer	53 (29%)	75 (18%)	1.0	65-119/y WBE, 2.4-4.4 h/wk summer	29 (16%)	99 (24%)	0.4 (0.2-0.7)	120-199/y WBE, 4.5-7.4 h/wk summer	60 (33%)	115 (28%)	0.7 (0.4-1.2)	200+/y WBE, 7.5+ h/wk summer	25 (14%)	83 (20%)	0.4 (0.2-0.7)		Cases	Controls	Adjusted* OR (95% CI)	<15/y WBE, 3.5 h/wk summer	26 (14%)	87 (21%)	1.0	15-59/y WBE, 3.5-13.9 h/wk summer	36 (20%)	105 (26%)	0.8 (0.3-2.0)	60-104/y WBE, 14.0-24.9 h/wk summer	42 (23%)	86 (21%)	1.5 (0.6-4.2)	105+/y WBE, 25.0 h/wk summer	76 (42%)	128 (32%)	1.4 (0.4-4.3)	<p>Mean occupational sun exposure per year, last 10 years, and risk of SCC (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>0/y WBE, 0 h/wk summer</td> <td>61 (34%)</td> <td>161 (40%)</td> <td>1.0</td> </tr> <tr> <td>1-29/y WBE, <7.0 h/wk summer</td> <td>18 (10%)</td> <td>45 (11%)</td> <td>1.9 (0.6-5.6)</td> </tr> <tr> <td>30-99/y WBE, 7.0-22.9 h/wk summer</td> <td>46 (26%)</td> <td>113 (28%)</td> <td>2.2 (0.8-6.4)</td> </tr> <tr> <td>100+/y WBE, 23+ h/wk summer</td> <td>55 (31%)</td> <td>87 (21%)</td> <td>4.0 (1.2-13.1)</td> </tr> </tbody> </table> <p><i>p (trend)<0.05</i></p> <p>Mean cumulative sun exposure per year, lifetime, and risk of SCC (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td><120/y WBE, <11.5 h/wk summer</td> <td>32 (18%)</td> <td>85 (21%)</td> <td>1.0</td> </tr> <tr> <td>120-189/y WBE, 11.5-18.9 h/wk summer</td> <td>47 (26%)</td> <td>84 (21%)</td> <td>1.8 (0.9-3.3)</td> </tr> <tr> <td>190-279/y WBE, 19.0-27.9 h/wk summer</td> <td>35 (19%)</td> <td>90 (22%)</td> <td>1.2 (0.6-2.3)</td> </tr> <tr> <td>280+/y WBE, 28+ h/wk summer</td> <td>22 (12%)</td> <td>67 (17%)</td> <td>1.0 (0.4-2.1)</td> </tr> </tbody> </table> <p><i>p (trend)=NS</i></p> <p>Mean cumulative sun exposure per year, last 10 years, and risk of SCC (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td><100/y WBE, 9.5 h/wk summer</td> <td>41 (23%)</td> <td>107 (26%)</td> <td>1.0</td> </tr> <tr> <td>100-159/y WBE, 9.5-15.9 h/wk summer</td> <td>45 (25%)</td> <td>88 (22%)</td> <td>1.5 (0.9-2.7)</td> </tr> <tr> <td>160-239/y WBE, 16.0-23.9 h/wk summer</td> <td>43 (24%)</td> <td>78 (19%)</td> <td>1.7 (0.9-3.1)</td> </tr> <tr> <td>240+/y WBE, 24+ h/wk summer</td> <td>38 (21%)</td> <td>99 (24%)</td> <td>1.1 (0.6-2.1)</td> </tr> </tbody> </table> <p><i>p (trend)=NS</i></p> <p>WBE-whole body equivalent is 1 h of sun exposure to the whole surface of the body *Adjusted for effects of mother's ethnic origin, hair color, and skin color</p>		Cases	Controls	Adjusted* OR (95% CI)	0/y WBE, 0 h/wk summer	61 (34%)	161 (40%)	1.0	1-29/y WBE, <7.0 h/wk summer	18 (10%)	45 (11%)	1.9 (0.6-5.6)	30-99/y WBE, 7.0-22.9 h/wk summer	46 (26%)	113 (28%)	2.2 (0.8-6.4)	100+/y WBE, 23+ h/wk summer	55 (31%)	87 (21%)	4.0 (1.2-13.1)		Cases	Controls	Adjusted* OR (95% CI)	<120/y WBE, <11.5 h/wk summer	32 (18%)	85 (21%)	1.0	120-189/y WBE, 11.5-18.9 h/wk summer	47 (26%)	84 (21%)	1.8 (0.9-3.3)	190-279/y WBE, 19.0-27.9 h/wk summer	35 (19%)	90 (22%)	1.2 (0.6-2.3)	280+/y WBE, 28+ h/wk summer	22 (12%)	67 (17%)	1.0 (0.4-2.1)		Cases	Controls	Adjusted* OR (95% CI)	<100/y WBE, 9.5 h/wk summer	41 (23%)	107 (26%)	1.0	100-159/y WBE, 9.5-15.9 h/wk summer	45 (25%)	88 (22%)	1.5 (0.9-2.7)	160-239/y WBE, 16.0-23.9 h/wk summer	43 (24%)	78 (19%)	1.7 (0.9-3.1)	240+/y WBE, 24+ h/wk summer	38 (21%)	99 (24%)	1.1 (0.6-2.1)
		Cases	Controls	Adjusted* OR (95% CI)																																																																																																																																										
<100/y WBE, <3.8 h/wk summer	52 (29%)	97 (24%)	1.0																																																																																																																																											
100-199/y WBE, 3.8-7.4 h/wk summer	49 (27%)	113 (28%)	1.2 (0.6-2.5)																																																																																																																																											
200-332/y WBE, 7.5-12.4 h/wk summer	36 (20%)	101 (25%)	1.1 (0.5-2.6)																																																																																																																																											
333+/y WBE, 12.5+ h/wk summer	25 (14%)	76 (19%)	1.6 (0.6-4.5)																																																																																																																																											
	Cases	Controls	Adjusted* OR (95% CI)																																																																																																																																											
<75/y WBE, <2.8 h/wk summer	38 (21%)	75 (18%)	1.0																																																																																																																																											
75-149/y WBE, 2.8-5.5 h/wk summer	43 (24%)	106 (26%)	0.6 (0.3-1.1)																																																																																																																																											
150-224/y WBE, 5.6-8.4 h/wk summer	32 (18%)	72 (18%)	0.8 (0.3-1.8)																																																																																																																																											
225+/y WBE, 8.5+ h/wk summer	23 (13%)	73 (18%)	0.3 (0.1-0.9)																																																																																																																																											
	Cases	Controls	Adjusted* OR (95% CI)																																																																																																																																											
<65/y WBE, <2.4 h/wk summer	53 (29%)	75 (18%)	1.0																																																																																																																																											
65-119/y WBE, 2.4-4.4 h/wk summer	29 (16%)	99 (24%)	0.4 (0.2-0.7)																																																																																																																																											
120-199/y WBE, 4.5-7.4 h/wk summer	60 (33%)	115 (28%)	0.7 (0.4-1.2)																																																																																																																																											
200+/y WBE, 7.5+ h/wk summer	25 (14%)	83 (20%)	0.4 (0.2-0.7)																																																																																																																																											
	Cases	Controls	Adjusted* OR (95% CI)																																																																																																																																											
<15/y WBE, 3.5 h/wk summer	26 (14%)	87 (21%)	1.0																																																																																																																																											
15-59/y WBE, 3.5-13.9 h/wk summer	36 (20%)	105 (26%)	0.8 (0.3-2.0)																																																																																																																																											
60-104/y WBE, 14.0-24.9 h/wk summer	42 (23%)	86 (21%)	1.5 (0.6-4.2)																																																																																																																																											
105+/y WBE, 25.0 h/wk summer	76 (42%)	128 (32%)	1.4 (0.4-4.3)																																																																																																																																											
	Cases	Controls	Adjusted* OR (95% CI)																																																																																																																																											
0/y WBE, 0 h/wk summer	61 (34%)	161 (40%)	1.0																																																																																																																																											
1-29/y WBE, <7.0 h/wk summer	18 (10%)	45 (11%)	1.9 (0.6-5.6)																																																																																																																																											
30-99/y WBE, 7.0-22.9 h/wk summer	46 (26%)	113 (28%)	2.2 (0.8-6.4)																																																																																																																																											
100+/y WBE, 23+ h/wk summer	55 (31%)	87 (21%)	4.0 (1.2-13.1)																																																																																																																																											
	Cases	Controls	Adjusted* OR (95% CI)																																																																																																																																											
<120/y WBE, <11.5 h/wk summer	32 (18%)	85 (21%)	1.0																																																																																																																																											
120-189/y WBE, 11.5-18.9 h/wk summer	47 (26%)	84 (21%)	1.8 (0.9-3.3)																																																																																																																																											
190-279/y WBE, 19.0-27.9 h/wk summer	35 (19%)	90 (22%)	1.2 (0.6-2.3)																																																																																																																																											
280+/y WBE, 28+ h/wk summer	22 (12%)	67 (17%)	1.0 (0.4-2.1)																																																																																																																																											
	Cases	Controls	Adjusted* OR (95% CI)																																																																																																																																											
<100/y WBE, 9.5 h/wk summer	41 (23%)	107 (26%)	1.0																																																																																																																																											
100-159/y WBE, 9.5-15.9 h/wk summer	45 (25%)	88 (22%)	1.5 (0.9-2.7)																																																																																																																																											
160-239/y WBE, 16.0-23.9 h/wk summer	43 (24%)	78 (19%)	1.7 (0.9-3.1)																																																																																																																																											
240+/y WBE, 24+ h/wk summer	38 (21%)	99 (24%)	1.1 (0.6-2.1)																																																																																																																																											

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sunlamp or sunbed exposure	Measurement of sunscreen use	Measurement of sunburn	Comments																																																												
Gallagher 1995 ⁶⁶ Bajdik 1996 ¹²⁸	<p>Use of sunlamps and risk of SCC (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Never</td> <td>162 (90%)</td> <td>371 (91%)</td> <td>1.0</td> </tr> <tr> <td>Ever</td> <td>18 (10%)</td> <td>33 (8%)</td> <td>1.4 (0.7-2.7)</td> </tr> </tbody> </table> <p>*Adjusted for age, ethnic origin, skin and hair color, and lifetime occupational sun exposure</p>		Cases	Controls	Adjusted* OR (95% CI)	Never	162 (90%)	371 (91%)	1.0	Ever	18 (10%)	33 (8%)	1.4 (0.7-2.7)	NR	<p>Sunburn history, age 5-15 years, and risk of SCC (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Never burned</td> <td>66 (37%)</td> <td>175 (43%)</td> <td>1.0</td> </tr> <tr> <td>Rare or mild burns</td> <td>27 (15%)</td> <td>86 (21%)</td> <td>0.8 (0.5-1.6)</td> </tr> <tr> <td>Moderate burns</td> <td>52 (29%)</td> <td>92 (23%)</td> <td>1.3 (0.7-2.2)</td> </tr> <tr> <td>Frequent or severe burns</td> <td>35 (19%)</td> <td>53 (13%)</td> <td>0.6 (0.6-1.4)</td> </tr> </tbody> </table> <p><i>p (trend)=NS</i></p> <p>Sunburn pain ≥2 days, age 5-15 years, and risk of SCC (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Never</td> <td>150 (83%)</td> <td>375 (92%)</td> <td>1.0</td> </tr> <tr> <td>Once per year</td> <td>14 (8%)</td> <td>24 (6%)</td> <td>1.9 (0.8-4.4)</td> </tr> <tr> <td>Twice or more per year</td> <td>16 (9%)</td> <td>7 (2%)</td> <td>10.5 (2.9-38.0)</td> </tr> </tbody> </table> <p><i>p (trend)=0.001</i></p> <p>Sunburn pain ≥2 days, lifetime, and risk of SCC (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Never</td> <td>121 (67%)</td> <td>291 (72%)</td> <td>1.0</td> </tr> <tr> <td>Ever</td> <td>59 (33%)</td> <td>115 (28%)</td> <td>1.2 (0.8-1.8)</td> </tr> </tbody> </table> <p><i>p (trend)=NS</i></p> <p>*Adjusted for age, mother's ethnic origin, hair color, and skin color</p>		Cases	Controls	Adjusted* OR (95% CI)	Never burned	66 (37%)	175 (43%)	1.0	Rare or mild burns	27 (15%)	86 (21%)	0.8 (0.5-1.6)	Moderate burns	52 (29%)	92 (23%)	1.3 (0.7-2.2)	Frequent or severe burns	35 (19%)	53 (13%)	0.6 (0.6-1.4)		Cases	Controls	Adjusted* OR (95% CI)	Never	150 (83%)	375 (92%)	1.0	Once per year	14 (8%)	24 (6%)	1.9 (0.8-4.4)	Twice or more per year	16 (9%)	7 (2%)	10.5 (2.9-38.0)		Cases	Controls	Adjusted* OR (95% CI)	Never	121 (67%)	291 (72%)	1.0	Ever	59 (33%)	115 (28%)	1.2 (0.8-1.8)	
	Cases	Controls	Adjusted* OR (95% CI)																																																													
Never	162 (90%)	371 (91%)	1.0																																																													
Ever	18 (10%)	33 (8%)	1.4 (0.7-2.7)																																																													
	Cases	Controls	Adjusted* OR (95% CI)																																																													
Never burned	66 (37%)	175 (43%)	1.0																																																													
Rare or mild burns	27 (15%)	86 (21%)	0.8 (0.5-1.6)																																																													
Moderate burns	52 (29%)	92 (23%)	1.3 (0.7-2.2)																																																													
Frequent or severe burns	35 (19%)	53 (13%)	0.6 (0.6-1.4)																																																													
	Cases	Controls	Adjusted* OR (95% CI)																																																													
Never	150 (83%)	375 (92%)	1.0																																																													
Once per year	14 (8%)	24 (6%)	1.9 (0.8-4.4)																																																													
Twice or more per year	16 (9%)	7 (2%)	10.5 (2.9-38.0)																																																													
	Cases	Controls	Adjusted* OR (95% CI)																																																													
Never	121 (67%)	291 (72%)	1.0																																																													
Ever	59 (33%)	115 (28%)	1.2 (0.8-1.8)																																																													

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered																					
Case-control																										
Gallagher 1995 ⁷⁰ Bajdik 1996 ¹²⁸	<p>Skin Cancer: BCC</p> <p>Study Design: Case-control</p> <p>Location: Alberta, Canada</p>	<p>Cases: Selection: newly diagnosed BCC in males between 1983-1984 from the Alberta Cancer Registry</p> <p>Eligibility criteria: men aged 25-79 years</p> <p>Controls: Selection: age and sex matched, from the Alberta Health Care Insurance Plan</p> <p>Eligibility criteria: no previous diagnosis of skin cancer</p>	<p>Cases n=226 Controls n=406 Mean age: NR Sex:</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Male</td> <td>100%</td> <td>100%</td> </tr> </tbody> </table> <p>Skin phenotype: <i>Skin reaction to 1 week of exposure (calc)</i></p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Tan without burning</td> <td>72 (32%)</td> <td>155 (38%)</td> </tr> <tr> <td>Tan with protection</td> <td>9 (4%)</td> <td>14 (3%)</td> </tr> <tr> <td>Burn, then tan</td> <td>100 (56%)</td> <td>193 (48%)</td> </tr> <tr> <td>Burn, never tan</td> <td>45 (25%)</td> <td>43 (11%)</td> </tr> </tbody> </table>		Cases	Controls	Male	100%	100%		Cases	Controls	Tan without burning	72 (32%)	155 (38%)	Tan with protection	9 (4%)	14 (3%)	Burn, then tan	100 (56%)	193 (48%)	Burn, never tan	45 (25%)	43 (11%)	<p>Sun exposure, sunlamp exposure</p> <p>In-home interviews</p>	<p>Age, mother's ethnic origin, skin color, and hair color</p>
	Cases	Controls																								
Male	100%	100%																								
	Cases	Controls																								
Tan without burning	72 (32%)	155 (38%)																								
Tan with protection	9 (4%)	14 (3%)																								
Burn, then tan	100 (56%)	193 (48%)																								
Burn, never tan	45 (25%)	43 (11%)																								

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sunlamp or sunbed exposure																																																																								
Case-control																																																																										
Gallagher 1995 ⁷⁰ Bajdik 1996 ¹²⁸	<p>Mean recreational sun exposure per year, ages 0-19 years, and risk of BCC (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td><100/y WBE, <3.8 h/wk summer</td> <td>49 (22%)</td> <td>97 (24%)</td> <td>1.0</td> </tr> <tr> <td>100-199/y WBE, 3.8-7.4 h/wk summer</td> <td>56 (25%)</td> <td>113 (28%)</td> <td>1.1 (0.6-2.0)</td> </tr> <tr> <td>200-332/y WBE, 7.5-12.4 h/wk summer</td> <td>54 (24%)</td> <td>101 (25%)</td> <td>1.4 (0.7-3.0)</td> </tr> <tr> <td>333+/y WBE, 12.5+ h/wk summer</td> <td>57 (25%)</td> <td>76 (19%)</td> <td>2.6 (1.1-6.5)</td> </tr> </tbody> </table> <p><i>p (trend)=0.03</i></p> <p>Mean recreational sun exposure per year, lifetime, and risk of BCC (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td><75/y WBE, <2.8 h/wk summer</td> <td>47 (21%)</td> <td>75 (18%)</td> <td>1.0</td> </tr> <tr> <td>75-149/y WBE, 2.8-5.5 h/wk summer</td> <td>65 (29%)</td> <td>106 (26%)</td> <td>0.9 (0.5-1.7)</td> </tr> <tr> <td>150-224/y WBE, 5.6-8.4 h/wk summer</td> <td>42 (19%)</td> <td>72 (18%)</td> <td>0.6 (0.3-1.3)</td> </tr> <tr> <td>225+/y WBE, 8.5+ h/wk summer</td> <td>32 (14%)</td> <td>73 (18%)</td> <td>0.4 (0.2-1.0)</td> </tr> </tbody> </table> <p><i>p (trend)=0.03</i></p> <p>Mean occupational sun exposure per year, lifetime, and risk of BCC (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td><15/y WBE, <3.5 h/wk summer</td> <td>56 (25%)</td> <td>87 (21%)</td> <td>1.0</td> </tr> <tr> <td>15-59/y WBE, 3.5-13.9 h/wk summer</td> <td>56 (25%)</td> <td>105 (26%)</td> <td>1.0 (0.6-1.8)</td> </tr> <tr> <td>60-104/y WBE, 14.0-24.9 h/wk summer</td> <td>46 (20%)</td> <td>86 (21%)</td> <td>1.3 (0.8-2.3)</td> </tr> <tr> <td>105+/y WBE, 25+ h/wk summer</td> <td>68 (30%)</td> <td>128 (32%)</td> <td>1.4 (0.8-2.4)</td> </tr> </tbody> </table> <p><i>p (trend)=NS</i></p>		Cases	Controls	Adjusted* OR (95% CI)	<100/y WBE, <3.8 h/wk summer	49 (22%)	97 (24%)	1.0	100-199/y WBE, 3.8-7.4 h/wk summer	56 (25%)	113 (28%)	1.1 (0.6-2.0)	200-332/y WBE, 7.5-12.4 h/wk summer	54 (24%)	101 (25%)	1.4 (0.7-3.0)	333+/y WBE, 12.5+ h/wk summer	57 (25%)	76 (19%)	2.6 (1.1-6.5)		Cases	Controls	Adjusted* OR (95% CI)	<75/y WBE, <2.8 h/wk summer	47 (21%)	75 (18%)	1.0	75-149/y WBE, 2.8-5.5 h/wk summer	65 (29%)	106 (26%)	0.9 (0.5-1.7)	150-224/y WBE, 5.6-8.4 h/wk summer	42 (19%)	72 (18%)	0.6 (0.3-1.3)	225+/y WBE, 8.5+ h/wk summer	32 (14%)	73 (18%)	0.4 (0.2-1.0)		Cases	Controls	Adjusted* OR (95% CI)	<15/y WBE, <3.5 h/wk summer	56 (25%)	87 (21%)	1.0	15-59/y WBE, 3.5-13.9 h/wk summer	56 (25%)	105 (26%)	1.0 (0.6-1.8)	60-104/y WBE, 14.0-24.9 h/wk summer	46 (20%)	86 (21%)	1.3 (0.8-2.3)	105+/y WBE, 25+ h/wk summer	68 (30%)	128 (32%)	1.4 (0.8-2.4)	<p>Sunlamp use and risk of BCC (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Never</td> <td>203 (90%)</td> <td>371 (91%)</td> <td>1.0</td> </tr> <tr> <td>Ever</td> <td>23 (10%)</td> <td>33 (8%)</td> <td>1.2 (0.7-2.2)</td> </tr> </tbody> </table> <p>*Adjusted for age, ethnic origin, skin and hair color, and lifetime occupational sun exposure</p>		Cases	Controls	Adjusted* OR (95% CI)	Never	203 (90%)	371 (91%)	1.0	Ever	23 (10%)	33 (8%)	1.2 (0.7-2.2)
	Cases	Controls	Adjusted* OR (95% CI)																																																																							
<100/y WBE, <3.8 h/wk summer	49 (22%)	97 (24%)	1.0																																																																							
100-199/y WBE, 3.8-7.4 h/wk summer	56 (25%)	113 (28%)	1.1 (0.6-2.0)																																																																							
200-332/y WBE, 7.5-12.4 h/wk summer	54 (24%)	101 (25%)	1.4 (0.7-3.0)																																																																							
333+/y WBE, 12.5+ h/wk summer	57 (25%)	76 (19%)	2.6 (1.1-6.5)																																																																							
	Cases	Controls	Adjusted* OR (95% CI)																																																																							
<75/y WBE, <2.8 h/wk summer	47 (21%)	75 (18%)	1.0																																																																							
75-149/y WBE, 2.8-5.5 h/wk summer	65 (29%)	106 (26%)	0.9 (0.5-1.7)																																																																							
150-224/y WBE, 5.6-8.4 h/wk summer	42 (19%)	72 (18%)	0.6 (0.3-1.3)																																																																							
225+/y WBE, 8.5+ h/wk summer	32 (14%)	73 (18%)	0.4 (0.2-1.0)																																																																							
	Cases	Controls	Adjusted* OR (95% CI)																																																																							
<15/y WBE, <3.5 h/wk summer	56 (25%)	87 (21%)	1.0																																																																							
15-59/y WBE, 3.5-13.9 h/wk summer	56 (25%)	105 (26%)	1.0 (0.6-1.8)																																																																							
60-104/y WBE, 14.0-24.9 h/wk summer	46 (20%)	86 (21%)	1.3 (0.8-2.3)																																																																							
105+/y WBE, 25+ h/wk summer	68 (30%)	128 (32%)	1.4 (0.8-2.4)																																																																							
	Cases	Controls	Adjusted* OR (95% CI)																																																																							
Never	203 (90%)	371 (91%)	1.0																																																																							
Ever	23 (10%)	33 (8%)	1.2 (0.7-2.2)																																																																							

Study reference USPSTF quality	Measurement of sunscreen use	Measurement of sunburn	Comments																																																
Case-control																																																			
Gallagher 1995 ⁷⁰ Bajdik 1996 ¹²⁸	NR	<p>Sunburn, age 5-15 years, and risk of BCC (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Never burned</td> <td>77 (34%)</td> <td>175 (43%)</td> <td>1.0</td> </tr> <tr> <td>Rare or mild burns</td> <td>29 (13%)</td> <td>86 (21%)</td> <td>0.8 (0.5-1.4)</td> </tr> <tr> <td>Moderate burns</td> <td>68 (30%)</td> <td>92 (23%)</td> <td>1.3 (0.8-2.1)</td> </tr> <tr> <td>Frequent or severe burns</td> <td>25 (11%)</td> <td>53 (13%)</td> <td>1.6 (1.0-2.7)</td> </tr> </tbody> </table> <p><i>p=0.05</i></p> <p>Sunburn pain ≥2 days, age 5-15 years, and risk of BCC (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Never</td> <td>188 (83%)</td> <td>375 (92%)</td> <td>1.0</td> </tr> <tr> <td>Once per year</td> <td>22 (10%)</td> <td>24 (6%)</td> <td>1.7 (0.9-3.4)</td> </tr> <tr> <td>2+ per year</td> <td>16 (7%)</td> <td>7 (2%)</td> <td>4.5 (1.7-12.3)</td> </tr> </tbody> </table> <p><i>p<0.001</i></p> <p>Sunburn pain ≥2 days, lifetime, and risk of BCC (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Never</td> <td>160 (71%)</td> <td>291 (72%)</td> <td>1.0</td> </tr> <tr> <td>Ever</td> <td>66 (29%)</td> <td>115 (28%)</td> <td>0.9 (0.6-1.3)</td> </tr> </tbody> </table> <p><i>p=NS; *Adjusted for age, mother's ethnic origin, skin color, and hair color</i></p>		Cases	Controls	Adjusted* OR (95% CI)	Never burned	77 (34%)	175 (43%)	1.0	Rare or mild burns	29 (13%)	86 (21%)	0.8 (0.5-1.4)	Moderate burns	68 (30%)	92 (23%)	1.3 (0.8-2.1)	Frequent or severe burns	25 (11%)	53 (13%)	1.6 (1.0-2.7)		Cases	Controls	Adjusted* OR (95% CI)	Never	188 (83%)	375 (92%)	1.0	Once per year	22 (10%)	24 (6%)	1.7 (0.9-3.4)	2+ per year	16 (7%)	7 (2%)	4.5 (1.7-12.3)		Cases	Controls	Adjusted* OR (95% CI)	Never	160 (71%)	291 (72%)	1.0	Ever	66 (29%)	115 (28%)	0.9 (0.6-1.3)	
	Cases	Controls	Adjusted* OR (95% CI)																																																
Never burned	77 (34%)	175 (43%)	1.0																																																
Rare or mild burns	29 (13%)	86 (21%)	0.8 (0.5-1.4)																																																
Moderate burns	68 (30%)	92 (23%)	1.3 (0.8-2.1)																																																
Frequent or severe burns	25 (11%)	53 (13%)	1.6 (1.0-2.7)																																																
	Cases	Controls	Adjusted* OR (95% CI)																																																
Never	188 (83%)	375 (92%)	1.0																																																
Once per year	22 (10%)	24 (6%)	1.7 (0.9-3.4)																																																
2+ per year	16 (7%)	7 (2%)	4.5 (1.7-12.3)																																																
	Cases	Controls	Adjusted* OR (95% CI)																																																
Never	160 (71%)	291 (72%)	1.0																																																
Ever	66 (29%)	115 (28%)	0.9 (0.6-1.3)																																																

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/ exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered																															
Case-control																																				
Han 2006 ¹¹ Nurses' Health Study	Skin Cancer: SCC, BCC & melanoma Study Design: Nested case-control Location: US (11 states)	Cases: Selection: newly diagnosed SCC, BCC or melanoma in females between 1989-1998/2000 from the Nurses' Health Study, who gave blood specimen Eligibility criteria: Caucasian women Controls: selection: women from the NHS who gave a blood sample in 1989-90, matched by birth year (±1 year) Eligibility criteria: free of diagnosed skin cancer up to and including the questionnaire cycle in which the case was diagnosed	Cases n=758 (melanoma n=200, SCC n=275, BCC n=283) Controls n=804 Mean age: 58.7 (range: 43-68) Sex: Male <table border="1"> <tr> <td></td> <td><u>Cases</u></td> <td><u>Controls</u></td> </tr> <tr> <td>Male</td> <td>0%</td> <td>0%</td> </tr> </table> Skin phenotype: <i>Skin reaction</i> <table border="1"> <tr> <td></td> <td><u>Melanoma</u></td> <td><u>SCC</u></td> <td><u>BCC</u></td> <td><u>Control</u></td> </tr> <tr> <td>Practically none</td> <td>12 (6.6%)</td> <td>12 (4.8%)</td> <td>17 (6.7%)</td> <td>92 (13.0%)</td> </tr> <tr> <td>Some redness</td> <td>62 (33.9%)</td> <td>94 (37.3%)</td> <td>82 (32.2%)</td> <td>327 (46.3%)</td> </tr> <tr> <td>Burn</td> <td>72 (39.3%)</td> <td>81 (32.1%)</td> <td>91 (35.7%)</td> <td>201 (28.4%)</td> </tr> <tr> <td>Painful burn</td> <td>37 (20.2%)</td> <td>65 (25.8%)</td> <td>65 (25.5%)</td> <td>87 (12.3%)</td> </tr> </table>		<u>Cases</u>	<u>Controls</u>	Male	0%	0%		<u>Melanoma</u>	<u>SCC</u>	<u>BCC</u>	<u>Control</u>	Practically none	12 (6.6%)	12 (4.8%)	17 (6.7%)	92 (13.0%)	Some redness	62 (33.9%)	94 (37.3%)	82 (32.2%)	327 (46.3%)	Burn	72 (39.3%)	81 (32.1%)	91 (35.7%)	201 (28.4%)	Painful burn	37 (20.2%)	65 (25.8%)	65 (25.5%)	87 (12.3%)	Sun exposure, sun lamp/bed exposure Mailed questionnaire	Age, family history of skin cancer, number of lifetime severe sunburns which blistered, sunlamp use or tanning salon attendance, geographic region, sun exposure while wearing a bathing suit
	<u>Cases</u>	<u>Controls</u>																																		
Male	0%	0%																																		
	<u>Melanoma</u>	<u>SCC</u>	<u>BCC</u>	<u>Control</u>																																
Practically none	12 (6.6%)	12 (4.8%)	17 (6.7%)	92 (13.0%)																																
Some redness	62 (33.9%)	94 (37.3%)	82 (32.2%)	327 (46.3%)																																
Burn	72 (39.3%)	81 (32.1%)	91 (35.7%)	201 (28.4%)																																
Painful burn	37 (20.2%)	65 (25.8%)	65 (25.5%)	87 (12.3%)																																

Study reference USPSTF quality	Measurement of sun exposure										
Case-control											
Han 2006 ¹¹ Nurses' Health Study	Risk for skin cancer according to cumulative sun exposure while wearing a bathing suit (tertile)										
	<u>Melanoma</u>			<u>SCC</u>			<u>BCC</u>			<u>Control</u>	
	<u>N(%)</u>	<u>Age-adjusted OR (95% CI)</u>	<u>Multivariate OR (95% CI)</u>	<u>N(%)</u>	<u>Age-adjusted OR (95% CI)</u>	<u>Multivariate OR (95% CI)</u>	<u>N(%)</u>	<u>Age-adjusted OR (95% CI)</u>	<u>Multivariate OR (95% CI)</u>	<u>N(%)</u>	
	Low	37(20.6)	1.00	1.00	58(23.7)	1.00	1.00	55(21.5)	1.00	1.00	227(33.2)
	Intermediate	47(26.1)	1.25 (0.78-2.00)	1.20 (0.73-1.97)	74(30.2)	1.28 (0.87-1.90)	1.28 (0.85-1.93)	92(35.9)	1.66 (1.13-2.43)	1.71 (1.14-2.56)	228(33.4)
	High	96(53.3)	2.58 (1.69-3.94)	2.37 (1.51-3.73)	113(46.1)	1.97 (1.37-2.85)	2.15 (1.45-3.19)	109(42.6)	1.95 (1.34-2.83)	2.05 (1.38-3.06)	228(33.4)
	Trend		<0.001	<0.001		<0.001	<0.001		<0.001	<0.001	
	LRT		<0.001	<0.001		<0.001	<0.001		<0.001	<0.001	
	<i>P=0.15; adjusted for: age, constitutional susceptibility, family history of skin cancer, number of lifetime severe sunburns which blistered, sunlamp use or tanning salon attendance, geographic region</i>										
	Interaction between constitutional susceptibility score and sun exposure with a bathing suit on melanoma risk										
	<u>Susceptibility score (tertile)</u>	<u>Sun exposure with a bathing suit (tertile)</u>									
		<u>Low</u>	<u>Intermediate</u>	<u>High</u>							
	<i>Low</i>										
	Cases (%)	5 (20.0)	12 (48.0)	8 (32.0)							
	Controls (%)	62 (27.9)	70 (31.5)	90 (40.5)							
	OR (95% CI)	1.00	1.92 (0.63-5.90)	0.97 (0.30-3.16)							
	<i>Intermediate</i>										
	Cases (%)	11 (21.2)	12 (23.1)	29 (55.8)							
	Controls (%)	78 (33.3)	86 (36.8)	70 (29.9)							
	OR (95% CI)	1.73 (0.56-5.32)	1.39 (0.46-4.23)	4.13 (1.47-11.61)							
	<i>High</i>										
	Cases (%)	21 (20.4)	23 (22.3)	59 (57.3)							
	Controls (%)	87 (38.3)	72 (31.7)	68 (30.0)							
	OR (95% CI)	2.65 (0.93-7.60)	3.02 (1.06-8.62)	8.37 (3.07-22.84)							
	<i>adjusted for: age, family history of skin cancer, number of lifetime severe sunburns which blistered, sunlamp use or tanning salon attendance, geographic region</i>										

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sunlamp or sunbed exposure										
Case-control											
Han 2006 ⁷¹	Risk for skin cancer according to sunlamp use or tanning salon attendance										
Nurses' Health Study	Melanoma			SCC			BCC			Control	
		Age-adjusted	Multivariate		Age-adjusted	Multivariate		Age-adjusted	Multivariate		
	N(%)	OR (95% CI)	OR (95% CI)	N(%)	OR (95% CI)	OR (95% CI)	N(%)	OR (95% CI)	OR (95% CI)	N(%)	
	No	140(76.9)	1.00	1.00	212(83.8)	1.00	1.00	215(83.0)	1.00	1.00	625(87.8)
	Yes	42(23.1)	1.98 (1.30-3.02)	2.06 (1.30-3.26)	41(16.2)	1.47 (0.98-2.22)	1.44 (0.93-2.24)	44(17.0)	1.45 (0.97-2.16)	1.32 (0.87-2.03)	87(12.2)
	LRT		0.01			0.24			0.35		
	P=0.15										
	LRT- likelihood ratio test. Adjusted for: age, constitutional susceptibility, family history of skin cancer, number of lifetime severe sunburns which blistered, cumulative sun exposure while wearing a bathing suit, geographic region										

Study reference USPSTF quality	Measurement of sun-screen use	Measurement of sunburn										Comments
Case-control												
Han 2006 ⁷¹	NR	Risk for skin cancer according to lifetime severe sunburns which blistered										
Nurses' Health Study	Melanoma			SCC			BCC			Control		
		Age-adjusted	Multivariate		Age-adjusted	Multivariate		Age-adjusted	Multivariate			
	N(%)	OR (95% CI)	OR (95% CI)	N(%)	OR (95% CI)	OR (95% CI)	N(%)	OR (95% CI)	OR (95% CI)	N(%)		
	None	29(17.1)	1.00	1.00	46(20.0)	1.00	1.00	49(20.1)	1.00	1.00	231(34.5)	
	1-4	48(28.2)	1.63(0.99-2.68)	1.43(0.85-2.42)	80(34.8)	1.85(1.23-2.79)	1.65(1.08-2.53)	82(33.6)	1.70(1.14-2.54)	1.38(0.90-2.11)	226(33.7)	
	5-9	33(19.4)	2.57(1.48-4.48)	1.75(0.97-3.16)	46(20.0)	2.47(1.53-3.98)	1.88(1.14-3.11)	49(20.1)	2.33(1.47-3.71)	1.55(0.95-2.55)	98(14.6)	
	≥10	60(35.3)	3.90(2.36-6.47)	2.24(1.30-3.84)	58(25.2)	2.72(1.73-4.29)	1.67(1.02-2.72)	64(26.2)	2.62(1.69-4.06)	1.37(0.84-2.21)	115(17.2)	
	Trend	<0.001	0.003		<0.001	0.04		<0.001	0.15			
	LRT		0.04			0.01			0.37			
	P=0.43											
	LRT- likelihood ratio test. Adjusted for: age, constitutional susceptibility, family history of skin cancer, cumulative sun exposure while wearing a bathing suit, sunlamp use or tanning salon attendance, geographic region											

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered															
Case-control																				
Tabenkin 1999 ⁷⁶	Skin Cancer: Melanoma Study Design: Case-control Location: Israel	Cases: Selection: People with malignant melanoma living in kibbutzim who participated in a health survey conducted in 1992 were recruited by the kibbutz nurses Eligibility criteria: Level 1 non-invasive melanomas and all other histological forms of melanoma Controls: Selection: People living in kibbutzim who participated in a health survey conducted in 1992 were recruited by the kibbutz nurses Eligibility criteria: Sex and age matched (±3 years)	Cases n= 168 Controls n= 325 Mean age (SD): Cases: 53.5 (13.9) Controls: 53.1 (13.6) Sex: <table border="0"> <tr> <td></td> <td><u>Cases</u></td> <td><u>Controls</u></td> </tr> <tr> <td>Male</td> <td>75 (44.6%)</td> <td>144 (44.3%)</td> </tr> </table> Skin phenotype: <i>Skin sensitivity*</i> <table border="0"> <tr> <td></td> <td><u>Cases</u></td> <td><u>Controls</u></td> </tr> <tr> <td>Sensitive</td> <td>151 (91.5%)</td> <td>242 (76.3%)</td> </tr> <tr> <td>Not sensitive</td> <td>14 (8.5%) (c)</td> <td>75 (23.7%)</td> </tr> </table> *These numbers don't add up to 168 and 325		<u>Cases</u>	<u>Controls</u>	Male	75 (44.6%)	144 (44.3%)		<u>Cases</u>	<u>Controls</u>	Sensitive	151 (91.5%)	242 (76.3%)	Not sensitive	14 (8.5%) (c)	75 (23.7%)	Sun exposure Structured questionnaire	NR
	<u>Cases</u>	<u>Controls</u>																		
Male	75 (44.6%)	144 (44.3%)																		
	<u>Cases</u>	<u>Controls</u>																		
Sensitive	151 (91.5%)	242 (76.3%)																		
Not sensitive	14 (8.5%) (c)	75 (23.7%)																		

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sunlamp or sunbed exposure																							
Case-control																									
Tabenkin 1999 ⁶	<p>Number of hours of sun exposure, age 6-13 (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>3+ hours/day</td> <td>34 (20.0%)</td> <td>40 (12.3%)</td> </tr> </tbody> </table> <p><i>p</i><0.05</p> <p>Number of hours of sun exposure, age 14-18, 18-21, and above 21 <i>p</i>=NS</p> <p><i>in conditional logistic regression, exposure to sun at various ages was not significantly associated with malignant melanoma (results not shown), only hair color, skin sensitivity and other skin lesions were independently associated with malignant melanoma</i></p> <p>Odds ratios and exposure to sun at work from age 21 (number of years at work x number of hours per day exposed) (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> <th>P</th> </tr> </thead> <tbody> <tr> <td>None</td> <td>8 (5%)</td> <td>33 (10%)</td> <td>2.44 (1.01-5.91)</td> <td><0.05</td> </tr> <tr> <td>1+</td> <td>NR</td> <td>NR</td> <td>NR</td> <td>NS</td> </tr> </tbody> </table>		Cases	Controls	3+ hours/day	34 (20.0%)	40 (12.3%)		Cases	Controls	OR (95% CI)	P	None	8 (5%)	33 (10%)	2.44 (1.01-5.91)	<0.05	1+	NR	NR	NR	NS	NR		
	Cases	Controls																							
3+ hours/day	34 (20.0%)	40 (12.3%)																							
	Cases	Controls	OR (95% CI)	P																					
None	8 (5%)	33 (10%)	2.44 (1.01-5.91)	<0.05																					
1+	NR	NR	NR	NS																					
Study reference USPSTF quality	Measurement of sunscreen use	Measurement of sunburn	Comments																						
Case-control																									
Tabenkin 1999 ⁶	NR	NR																							
Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered																				
Case-control																									
Green 1985 ⁷⁷ Green 1986 ¹³³ Green 1985 ¹⁴⁰ Green 1984 ¹⁴¹	<p>Skin Cancer: Melanoma</p> <p>Study Design: Case-control</p> <p>Location: Queensland, Australia</p>	<p>Cases: Selection: First primary cutaneous melanoma diagnosed between 1979-80 in residents of Queensland from pathology laboratories throughout the state</p> <p>Eligibility criteria: excluded those with acral lentiginous melanoma and lentigo maligna melanoma analyzed separately (not included in the 183 cases)</p> <p>Controls: Selection: Sex, age (±5 years), and area of residence matched from Electoral Roll</p> <p>Eligibility criteria: NR</p>	<p>Cases n= 183 (excludes lentigo maligna) Controls n= 183</p> <p>Mean age: NR</p> <table border="1"> <thead> <tr> <th>Age range</th> <th>Controls only (183 controls)</th> </tr> </thead> <tbody> <tr> <td><35</td> <td>46 (25%)</td> </tr> <tr> <td>35-49</td> <td>58 (32%)</td> </tr> <tr> <td>50+</td> <td>79 (43%)</td> </tr> </tbody> </table> <p>Sex: NR</p> <p>Skin phenotype: <i>Propensity to sunburn</i></p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Tan only</td> <td>12 (7%)</td> <td>31 (17%)</td> </tr> <tr> <td>Burn, then tan</td> <td>41 (22%)</td> <td>58 (32%)</td> </tr> <tr> <td>Burn, then peel</td> <td>130 (71%)</td> <td>94 (71%)</td> </tr> </tbody> </table>	Age range	Controls only (183 controls)	<35	46 (25%)	35-49	58 (32%)	50+	79 (43%)		Cases	Controls	Tan only	12 (7%)	31 (17%)	Burn, then tan	41 (22%)	58 (32%)	Burn, then peel	130 (71%)	94 (71%)	Sun exposure Interviewed at home, work, or hospital out-patient departments using a standard questionnaire	Age, presence of nevi on the arms, hair color, sunburn propensity
Age range	Controls only (183 controls)																								
<35	46 (25%)																								
35-49	58 (32%)																								
50+	79 (43%)																								
	Cases	Controls																							
Tan only	12 (7%)	31 (17%)																							
Burn, then tan	41 (22%)	58 (32%)																							
Burn, then peel	130 (71%)	94 (71%)																							

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sunlamp or sunbed exposure																																																																								
Case-control																																																																										
Green 1985 ⁷⁷	Relative risk of melanoma and number of cumulative hours of sun exposure - excluding cases of lentigo malignant melanoma (calc)	NR																																																																								
Green 1986 ¹³³	<table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Crude RR</th> <th>Adjusted* RR (95% CI)</th> </tr> </thead> <tbody> <tr> <td><2,000</td> <td>12 (6.6%)</td> <td>21 (11.5%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>2,000-</td> <td>78 (42.6%)</td> <td>78 (42.6%)</td> <td>1.8</td> <td></td> </tr> <tr> <td>20,000-</td> <td>53 (29.0%)</td> <td>53 (29.0%)</td> <td>1.8</td> <td>3.2 (0.9-12.4)</td> </tr> <tr> <td>50,000-100,000</td> <td>31 (16.9%)</td> <td>24 (13.1%)</td> <td>2.3</td> <td></td> </tr> <tr> <td>>100,000</td> <td>9 (4.9%)</td> <td>7 (3.8%)</td> <td>2.3</td> <td>5.3 (0.9-30.8)</td> </tr> </tbody> </table> <p>*Adjusted for exact age, presence of nevi on the arms, hair color, and sunburn propensity</p>		Cases	Controls	Crude RR	Adjusted* RR (95% CI)	<2,000	12 (6.6%)	21 (11.5%)	1.0	1.0	2,000-	78 (42.6%)	78 (42.6%)	1.8		20,000-	53 (29.0%)	53 (29.0%)	1.8	3.2 (0.9-12.4)	50,000-100,000	31 (16.9%)	24 (13.1%)	2.3		>100,000	9 (4.9%)	7 (3.8%)	2.3	5.3 (0.9-30.8)																																											
	Cases	Controls	Crude RR	Adjusted* RR (95% CI)																																																																						
<2,000	12 (6.6%)	21 (11.5%)	1.0	1.0																																																																						
2,000-	78 (42.6%)	78 (42.6%)	1.8																																																																							
20,000-	53 (29.0%)	53 (29.0%)	1.8	3.2 (0.9-12.4)																																																																						
50,000-100,000	31 (16.9%)	24 (13.1%)	2.3																																																																							
>100,000	9 (4.9%)	7 (3.8%)	2.3	5.3 (0.9-30.8)																																																																						
Green 1985 ¹⁴⁰	<table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Crude RR</th> <th>Adjusted* RR (95% CI)</th> </tr> </thead> <tbody> <tr> <td colspan="5">Relative risk of melanoma and cumulative hours sun exposure (calc)</td> </tr> <tr> <td colspan="5"><i>Whole of life</i></td> </tr> <tr> <td><2000</td> <td>12 (9.9%)</td> <td>21 (17.1%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>2000-</td> <td>78 (64.5%)</td> <td>78 (63.4%)</td> <td>1.7</td> <td>2.3 (1.0-5.1)</td> </tr> <tr> <td>50,000-</td> <td>31 (25.6%)</td> <td>24 (19.5%)</td> <td>2.3</td> <td>1.7 (0.4-7.8)</td> </tr> <tr> <td colspan="5"><i>Ages 10-19 years</i></td> </tr> <tr> <td><500</td> <td>42 (27.5%)</td> <td>52 (34.2%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>500-</td> <td>70 (45.8%)</td> <td>81 (52.6%)</td> <td>1.1</td> <td>1.0 (0.5-2.0)</td> </tr> <tr> <td>5000-</td> <td>41 (26.8%)</td> <td>21 (13.6%)</td> <td>1.8</td> <td>4.4 (1.8-184.5)</td> </tr> <tr> <td colspan="5"><i>The 5 years prior to diagnosis</i></td> </tr> <tr> <td><500</td> <td>87 (49.2%)</td> <td>74 (42.0%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>500-</td> <td>78 (44.1%)</td> <td>92 (52.3%)</td> <td>0.7</td> <td>0.9 (0.5-1.6)</td> </tr> <tr> <td>5000-</td> <td>12 (6.8%)</td> <td>10 (5.7%)</td> <td>0.9</td> <td>1.2 (0.5-2.9)</td> </tr> </tbody> </table> <p>*Adjusted for age and presence of naevi on arms</p>		Cases	Controls	Crude RR	Adjusted* RR (95% CI)	Relative risk of melanoma and cumulative hours sun exposure (calc)					<i>Whole of life</i>					<2000	12 (9.9%)	21 (17.1%)	1.0	1.0	2000-	78 (64.5%)	78 (63.4%)	1.7	2.3 (1.0-5.1)	50,000-	31 (25.6%)	24 (19.5%)	2.3	1.7 (0.4-7.8)	<i>Ages 10-19 years</i>					<500	42 (27.5%)	52 (34.2%)	1.0	1.0	500-	70 (45.8%)	81 (52.6%)	1.1	1.0 (0.5-2.0)	5000-	41 (26.8%)	21 (13.6%)	1.8	4.4 (1.8-184.5)	<i>The 5 years prior to diagnosis</i>					<500	87 (49.2%)	74 (42.0%)	1.0	1.0	500-	78 (44.1%)	92 (52.3%)	0.7	0.9 (0.5-1.6)	5000-	12 (6.8%)	10 (5.7%)	0.9	1.2 (0.5-2.9)			
	Cases	Controls	Crude RR	Adjusted* RR (95% CI)																																																																						
Relative risk of melanoma and cumulative hours sun exposure (calc)																																																																										
<i>Whole of life</i>																																																																										
<2000	12 (9.9%)	21 (17.1%)	1.0	1.0																																																																						
2000-	78 (64.5%)	78 (63.4%)	1.7	2.3 (1.0-5.1)																																																																						
50,000-	31 (25.6%)	24 (19.5%)	2.3	1.7 (0.4-7.8)																																																																						
<i>Ages 10-19 years</i>																																																																										
<500	42 (27.5%)	52 (34.2%)	1.0	1.0																																																																						
500-	70 (45.8%)	81 (52.6%)	1.1	1.0 (0.5-2.0)																																																																						
5000-	41 (26.8%)	21 (13.6%)	1.8	4.4 (1.8-184.5)																																																																						
<i>The 5 years prior to diagnosis</i>																																																																										
<500	87 (49.2%)	74 (42.0%)	1.0	1.0																																																																						
500-	78 (44.1%)	92 (52.3%)	0.7	0.9 (0.5-1.6)																																																																						
5000-	12 (6.8%)	10 (5.7%)	0.9	1.2 (0.5-2.9)																																																																						
Green 1984 ¹⁴¹	<table border="1"> <thead> <tr> <th>Life period</th> <th>Hours</th> <th>Cases</th> <th>Controls</th> <th>Crude RR</th> <th>Adjusted RR (95% CI)</th> </tr> </thead> <tbody> <tr> <td colspan="6">Recreational hours spent on the beach in the sun during different life periods and associated risk of melanoma, crude and adjusted for presence of naevi on the arms and age</td> </tr> <tr> <td>Whole life</td> <td>0</td> <td>18 (9.8%)</td> <td>13 (7.1%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td></td> <td>1-</td> <td>79 (43.2%)</td> <td>72 (39.3%)</td> <td>0.8</td> <td>0.6 (0.2-1.4)</td> </tr> <tr> <td></td> <td>500-</td> <td>70 (38.3%)</td> <td>92 (50.3%)</td> <td>0.5</td> <td>0.3 (0.1-0.8)</td> </tr> <tr> <td></td> <td>5000-</td> <td>16 (8.7%)</td> <td>6 (3.3%)</td> <td>1.9</td> <td>1.3 (0.4-4.3)</td> </tr> <tr> <td>Ages 10-19</td> <td>0</td> <td>54 (29.5%)</td> <td>64 (35.0%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td></td> <td>1-</td> <td>99 (54.1%)</td> <td>85 (46.4%)</td> <td>1.4</td> <td>1.1 (0.6-2.0)</td> </tr> <tr> <td></td> <td>500-</td> <td>30 (16.4%)</td> <td>34 (18.6%)</td> <td>1.0</td> <td>0.8 (0.4-1.9)</td> </tr> <tr> <td>The 5 years prior to dx</td> <td>0</td> <td>61 (33.3%)</td> <td>49 (26.8%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td></td> <td>1-</td> <td>104 (56.8%)</td> <td>122 (66.7%)</td> <td>0.7</td> <td>0.6 (0.0-1.0)</td> </tr> <tr> <td></td> <td>500-</td> <td>18 (9.8%)</td> <td>12 (6.6%)</td> <td>1.2</td> <td>0.9 (0.3-3.1)</td> </tr> </tbody> </table>	Life period	Hours	Cases	Controls	Crude RR	Adjusted RR (95% CI)	Recreational hours spent on the beach in the sun during different life periods and associated risk of melanoma, crude and adjusted for presence of naevi on the arms and age						Whole life	0	18 (9.8%)	13 (7.1%)	1.0	1.0		1-	79 (43.2%)	72 (39.3%)	0.8	0.6 (0.2-1.4)		500-	70 (38.3%)	92 (50.3%)	0.5	0.3 (0.1-0.8)		5000-	16 (8.7%)	6 (3.3%)	1.9	1.3 (0.4-4.3)	Ages 10-19	0	54 (29.5%)	64 (35.0%)	1.0	1.0		1-	99 (54.1%)	85 (46.4%)	1.4	1.1 (0.6-2.0)		500-	30 (16.4%)	34 (18.6%)	1.0	0.8 (0.4-1.9)	The 5 years prior to dx	0	61 (33.3%)	49 (26.8%)	1.0	1.0		1-	104 (56.8%)	122 (66.7%)	0.7	0.6 (0.0-1.0)		500-	18 (9.8%)	12 (6.6%)	1.2	0.9 (0.3-3.1)	
Life period	Hours	Cases	Controls	Crude RR	Adjusted RR (95% CI)																																																																					
Recreational hours spent on the beach in the sun during different life periods and associated risk of melanoma, crude and adjusted for presence of naevi on the arms and age																																																																										
Whole life	0	18 (9.8%)	13 (7.1%)	1.0	1.0																																																																					
	1-	79 (43.2%)	72 (39.3%)	0.8	0.6 (0.2-1.4)																																																																					
	500-	70 (38.3%)	92 (50.3%)	0.5	0.3 (0.1-0.8)																																																																					
	5000-	16 (8.7%)	6 (3.3%)	1.9	1.3 (0.4-4.3)																																																																					
Ages 10-19	0	54 (29.5%)	64 (35.0%)	1.0	1.0																																																																					
	1-	99 (54.1%)	85 (46.4%)	1.4	1.1 (0.6-2.0)																																																																					
	500-	30 (16.4%)	34 (18.6%)	1.0	0.8 (0.4-1.9)																																																																					
The 5 years prior to dx	0	61 (33.3%)	49 (26.8%)	1.0	1.0																																																																					
	1-	104 (56.8%)	122 (66.7%)	0.7	0.6 (0.0-1.0)																																																																					
	500-	18 (9.8%)	12 (6.6%)	1.2	0.9 (0.3-3.1)																																																																					

Study reference USPSTF quality	Measurement of sunscreen use	Measurement of sunburn	Comments																		
Case-control																					
Green 1985 ⁷⁷	NR	Risk of melanoma in relation to experience of severe sunburns in life																			
Green 1986 ¹³³		<table border="1"> <thead> <tr> <th rowspan="2"># sunburns</th> <th colspan="2">Unadjusted RR</th> <th rowspan="2">Adjusted RR* (95% CI)</th> </tr> <tr> <th>Unmatched</th> <th>Matched</th> </tr> </thead> <tbody> <tr> <td>0-1</td> <td>1.0</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>2-5</td> <td>2.4</td> <td>1.9</td> <td>1.5 (0.7-3.2)</td> </tr> <tr> <td>≥6</td> <td>3.3</td> <td>5.0</td> <td>2.4 (1.0-6.1)</td> </tr> </tbody> </table> <p>*Adjusted for presence of naevi on the arms and exact age</p>	# sunburns	Unadjusted RR		Adjusted RR* (95% CI)	Unmatched	Matched	0-1	1.0	1.0	1.0	2-5	2.4	1.9	1.5 (0.7-3.2)	≥6	3.3	5.0	2.4 (1.0-6.1)	
# sunburns	Unadjusted RR			Adjusted RR* (95% CI)																	
	Unmatched	Matched																			
0-1	1.0	1.0	1.0																		
2-5	2.4	1.9	1.5 (0.7-3.2)																		
≥6	3.3	5.0	2.4 (1.0-6.1)																		
Green 1985 ¹⁴⁰																					
Green 1984 ¹⁴¹																					

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered						
Case-control											
Zanetti 1992 ⁸⁴ Rosso 2008 ¹⁴²	Skin Cancer: Melanoma Study Design: Case-control Location: Turin, Italy	Cases: Selection: All new cases of cutaneous malignant melanoma diagnosed between 1984-86 in residents of Turin, Italy from the local Cancer Registry Eligibility criteria: NR Controls: Selection: From the roster of the National Health Service of Turin Eligibility criteria: NR	Cases n= 260 Controls n= 416 Mean age: Cases: 56, range 19-92 Controls: 55, range 17-92 Sex: Male <table border="1" style="display: inline-table; vertical-align: middle;"><tr><td></td><td><u>Cases</u></td><td><u>Controls</u></td></tr><tr><td></td><td>74 (28.5%)</td><td>211 (50.7%)</td></tr></table> Skin phenotype: NR		<u>Cases</u>	<u>Controls</u>		74 (28.5%)	211 (50.7%)	Sun exposure Interviewed by trained interviewers using a standard questionnaire	Sex and age in decades
	<u>Cases</u>	<u>Controls</u>									
	74 (28.5%)	211 (50.7%)									

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sunlamp or sunbed exposure																																																															
Case-control																																																																	
Zanetti 1992 ⁸⁴ Rosso 2008 ¹⁴²	<p>Odds ratios of melanoma and number of weeks of sunny vacation (beach holiday), childhood and teenage (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR* (95% CI)</th> </tr> </thead> <tbody> <tr><td>0</td><td>182 (79.5%)</td><td>326 (78.7%)</td><td>1.0</td></tr> <tr><td>1-59</td><td>42 (18.3%)</td><td>37 (8.9%)</td><td>2.8 (1.6-4.6)</td></tr> <tr><td>≥60</td><td>35 (18.3%)</td><td>51 (12.3%)</td><td>1.7 (1.0-2.9)</td></tr> </tbody> </table> <p><i>p=0.003</i></p> <p>Odds ratios of melanoma and number of sunny vacations (beach holidays) in lifetime (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR* (95% CI)</th> </tr> </thead> <tbody> <tr><td>0</td><td>74 (28.9%)</td><td>148 (36.3%)</td><td>1.0</td></tr> <tr><td>1-29</td><td>25 (9.8%)</td><td>62 (15.2%)</td><td>0.9 (0.5-1.6)</td></tr> <tr><td>30-59</td><td>34 (13.3%)</td><td>50 (12.3%)</td><td>1.6 (0.9-2.8)</td></tr> <tr><td>60-89</td><td>36 (14.1%)</td><td>51 (12.5%)</td><td>1.6 (0.9-2.9)</td></tr> <tr><td>90-119</td><td>28 (10.9%)</td><td>42 (10.3%)</td><td>1.5 (0.8-2.7)</td></tr> <tr><td>≥120</td><td>59 (23.0%)</td><td>55 (13.5%)</td><td>2.3 (1.4-3.8)</td></tr> </tbody> </table> <p><i>p=0.001</i></p> <p>*Adjusted for sex and age in decades</p> <p>Hazard ratios for risk of DEATH FOR MELANOMA and number of weeks of on the beach during childhood and adulthood, HR (95% CI)</p> <table border="1"> <thead> <tr> <th rowspan="2"># weeks on beach adulthood</th> <th colspan="3"># weeks on beach childhood</th> </tr> <tr> <th>0</th> <th>1-59</th> <th>>60</th> </tr> </thead> <tbody> <tr><td>0</td><td>ref</td><td>1.87 (0.49, 7.2)</td><td>0.75 (0.10, 5.7)</td></tr> <tr><td>1-59</td><td>0.40 (0.17, 0.94)</td><td>0.14 (0.02, 0.96)</td><td>0.13 (0.01, 5.1)</td></tr> <tr><td>>60</td><td>0.42 (0.18, 0.98)</td><td>0.36 (0.10, 1.3)</td><td>0.68 (0.25, 1.9)</td></tr> </tbody> </table> <p>*Adjusted for age, sex, education and follow-up period</p>		Cases	Controls	OR* (95% CI)	0	182 (79.5%)	326 (78.7%)	1.0	1-59	42 (18.3%)	37 (8.9%)	2.8 (1.6-4.6)	≥60	35 (18.3%)	51 (12.3%)	1.7 (1.0-2.9)		Cases	Controls	OR* (95% CI)	0	74 (28.9%)	148 (36.3%)	1.0	1-29	25 (9.8%)	62 (15.2%)	0.9 (0.5-1.6)	30-59	34 (13.3%)	50 (12.3%)	1.6 (0.9-2.8)	60-89	36 (14.1%)	51 (12.5%)	1.6 (0.9-2.9)	90-119	28 (10.9%)	42 (10.3%)	1.5 (0.8-2.7)	≥120	59 (23.0%)	55 (13.5%)	2.3 (1.4-3.8)	# weeks on beach adulthood	# weeks on beach childhood			0	1-59	>60	0	ref	1.87 (0.49, 7.2)	0.75 (0.10, 5.7)	1-59	0.40 (0.17, 0.94)	0.14 (0.02, 0.96)	0.13 (0.01, 5.1)	>60	0.42 (0.18, 0.98)	0.36 (0.10, 1.3)	0.68 (0.25, 1.9)	NR
	Cases	Controls	OR* (95% CI)																																																														
0	182 (79.5%)	326 (78.7%)	1.0																																																														
1-59	42 (18.3%)	37 (8.9%)	2.8 (1.6-4.6)																																																														
≥60	35 (18.3%)	51 (12.3%)	1.7 (1.0-2.9)																																																														
	Cases	Controls	OR* (95% CI)																																																														
0	74 (28.9%)	148 (36.3%)	1.0																																																														
1-29	25 (9.8%)	62 (15.2%)	0.9 (0.5-1.6)																																																														
30-59	34 (13.3%)	50 (12.3%)	1.6 (0.9-2.8)																																																														
60-89	36 (14.1%)	51 (12.5%)	1.6 (0.9-2.9)																																																														
90-119	28 (10.9%)	42 (10.3%)	1.5 (0.8-2.7)																																																														
≥120	59 (23.0%)	55 (13.5%)	2.3 (1.4-3.8)																																																														
# weeks on beach adulthood	# weeks on beach childhood																																																																
	0	1-59	>60																																																														
0	ref	1.87 (0.49, 7.2)	0.75 (0.10, 5.7)																																																														
1-59	0.40 (0.17, 0.94)	0.14 (0.02, 0.96)	0.13 (0.01, 5.1)																																																														
>60	0.42 (0.18, 0.98)	0.36 (0.10, 1.3)	0.68 (0.25, 1.9)																																																														

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sunscreen use	Measurement of sunburn	Comments																																
Case-control																																			
Zanetti 1992 ⁸⁴ Rosso 2008 ¹⁴²	NR	<p>Odds ratios of melanoma by sunburns in childhood (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR* (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Never</td> <td>186 (71.5%)</td> <td>382 (92.3%)</td> <td>1.0</td> </tr> <tr> <td>Sometimes</td> <td>48 (18.5%)</td> <td>26 (6.3%)</td> <td>4.4 (2.5-7.5)</td> </tr> <tr> <td>Often</td> <td>26 (10.0%)</td> <td>6 (1.4%)</td> <td>12.0 (4.6-31.0)</td> </tr> </tbody> </table> <p><i>p</i><0.001</p> <p>Odds ratios of melanoma by severe sunburns lifelong (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR* (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Never</td> <td>180 (70.9%)</td> <td>328 (80.0%)</td> <td>1.0</td> </tr> <tr> <td>1</td> <td>50 (19.7%)</td> <td>53 (12.9%)</td> <td>1.7 (1.1-2.6)</td> </tr> <tr> <td>≥2</td> <td>24 (9.4%)</td> <td>29 (7.1%)</td> <td>1.5 (0.8-2.7)</td> </tr> </tbody> </table> <p><i>p</i>=0.04 *Adjusted for sex and age in decades</p>		Cases	Controls	OR* (95% CI)	Never	186 (71.5%)	382 (92.3%)	1.0	Sometimes	48 (18.5%)	26 (6.3%)	4.4 (2.5-7.5)	Often	26 (10.0%)	6 (1.4%)	12.0 (4.6-31.0)		Cases	Controls	OR* (95% CI)	Never	180 (70.9%)	328 (80.0%)	1.0	1	50 (19.7%)	53 (12.9%)	1.7 (1.1-2.6)	≥2	24 (9.4%)	29 (7.1%)	1.5 (0.8-2.7)	Long-term follow-up mortality data from Rosso 2008, it was not possible to identify the cause of death in 17% of deaths (22/128)
	Cases	Controls	OR* (95% CI)																																
Never	186 (71.5%)	382 (92.3%)	1.0																																
Sometimes	48 (18.5%)	26 (6.3%)	4.4 (2.5-7.5)																																
Often	26 (10.0%)	6 (1.4%)	12.0 (4.6-31.0)																																
	Cases	Controls	OR* (95% CI)																																
Never	180 (70.9%)	328 (80.0%)	1.0																																
1	50 (19.7%)	53 (12.9%)	1.7 (1.1-2.6)																																
≥2	24 (9.4%)	29 (7.1%)	1.5 (0.8-2.7)																																

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered																														
Case-control																																			
Rosso 1999 ⁸⁴	<p>Skin Cancer: SCC and BCC</p> <p>Study Design: Case-control</p> <p>Location: Valais, Switzerland</p>	<p>Cases: Selection: All new cases of SCC and BCC diagnosed between 1994-96 from the Sion Cancer Registry</p> <p>Eligibility criteria: Aged 20-75 years</p> <p>Controls: Selection: Recruited from lists of contributors and supporters of the Swiss League for the Fight Against Cancer and volunteer associations of blood donors (approx. 65% of population)</p> <p>Eligibility criteria: Age and sex matched</p>	<p>Cases n= 146 Controls n= 144</p> <p>Mean age: NR</p> <p>Sex (calc):</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Male</td> <td>76 (52.4%)</td> <td>NR</td> </tr> </tbody> </table> <p>Skin phenotype: <i>Skin reaction to sun exposure</i></p> <table border="1"> <thead> <tr> <th></th> <th>BCCs</th> <th>SCCs</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Tan no burn</td> <td>16(13.3%)</td> <td>7(28.0%)</td> <td>41(28.5%)</td> </tr> <tr> <td>Rare burn then tan</td> <td>48(40.0%)</td> <td>8(32.0%)</td> <td>62(43.1%)</td> </tr> <tr> <td>Often burn then tan</td> <td>35(29.2%)</td> <td>6(24.0%)</td> <td>31(21.5%)</td> </tr> <tr> <td>Burn never tan</td> <td>16(13.3%)</td> <td>2(8.0%)</td> <td>10(6.9%)</td> </tr> <tr> <td>Missing data</td> <td>5(4.2%)</td> <td>2(8.0%)</td> <td>0(0%)</td> </tr> </tbody> </table>		Cases	Controls	Male	76 (52.4%)	NR		BCCs	SCCs	Controls	Tan no burn	16(13.3%)	7(28.0%)	41(28.5%)	Rare burn then tan	48(40.0%)	8(32.0%)	62(43.1%)	Often burn then tan	35(29.2%)	6(24.0%)	31(21.5%)	Burn never tan	16(13.3%)	2(8.0%)	10(6.9%)	Missing data	5(4.2%)	2(8.0%)	0(0%)	<p>Sun exposure, sunlamp exposure, sunscreen exposure</p> <p>Interviewed by trained interviewers using the standard questionnaire from the HELIOS study</p>	Age and sex
	Cases	Controls																																	
Male	76 (52.4%)	NR																																	
	BCCs	SCCs	Controls																																
Tan no burn	16(13.3%)	7(28.0%)	41(28.5%)																																
Rare burn then tan	48(40.0%)	8(32.0%)	62(43.1%)																																
Often burn then tan	35(29.2%)	6(24.0%)	31(21.5%)																																
Burn never tan	16(13.3%)	2(8.0%)	10(6.9%)																																
Missing data	5(4.2%)	2(8.0%)	0(0%)																																

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sunlamp or sunbed exposure																																																																																																																								
Case-control																																																																																																																										
Rosso 1999 ⁶⁴	<p>Odds ratio of BCC and SCC by lifetime hours of outdoor work (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>BCC</th> <th>SCC</th> <th>Controls</th> <th>BCC OR* (95% CI)</th> <th>SCC OR* (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Never</td> <td>61 (51.3%)</td> <td>7 (28.0%)</td> <td>69 (47.9%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>-12,000</td> <td>19 (16.0%)</td> <td>3 (12.0%)</td> <td>19 (13.2%)</td> <td>0.98 (0.58-1.66)</td> <td>1.84 (0.30-11.09)</td> </tr> <tr> <td>-47,900</td> <td>19 (16.0%)</td> <td>2 (8.0%)</td> <td>19 (13.2%)</td> <td>1.30 (0.69-2.46)</td> <td></td> </tr> <tr> <td>-77,200</td> <td>12 (10.1%)</td> <td>9 (7.6%)</td> <td>19 (13.2%)</td> <td>0.78 (0.52-1.19)</td> <td>2.02 (0.60-6.78)</td> </tr> <tr> <td>77,200+</td> <td>8 (6.7%)</td> <td>4 (16.0%)</td> <td>18 (12.5%)</td> <td>0.90 (0.51-1.59)</td> <td>1.88 (0.30-11.70)</td> </tr> </tbody> </table> <p>Odds ratio of BCC and SCC by lifetime hours at the beach on vacation (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>BCC</th> <th>SCC</th> <th>Controls</th> <th>BCC OR* (95% CI)</th> <th>SCC OR* (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Never</td> <td>50 (41.7%)</td> <td>15 (60.0%)</td> <td>75 (52.1%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td><300</td> <td>24 (20.0%)</td> <td>2 (8.8%)</td> <td>19 (13.2%)</td> <td>1.46 (0.52-4.07)</td> <td></td> </tr> <tr> <td>-1,140</td> <td>15 (12.5%)</td> <td>3 (12.0%)</td> <td>16 (11.1%)</td> <td>1.39 (0.72-2.66)</td> <td></td> </tr> <tr> <td>-2,260</td> <td>7 (5.8%)</td> <td>2 (8.8%)</td> <td>16 (11.1%)</td> <td>0.92 (0.44-1.91)</td> <td></td> </tr> <tr> <td>2,260+</td> <td>24 (20.0%)</td> <td>3 (12.0%)</td> <td>18 (12.5%)</td> <td>1.20 (0.61-2.34)</td> <td>0.78 (0.26-2.40)</td> </tr> </tbody> </table> <p>Odds ratio of BCC and SCC by lifetime hours of sun exposure (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>BCC</th> <th>SCC</th> <th>Controls</th> <th>BCC OR* (95% CI)</th> <th>SCC OR* (95% CI)</th> </tr> </thead> <tbody> <tr> <td><5,000</td> <td>33 (27.5%)</td> <td>5 (20.0%)</td> <td>37 (25.7%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>-15,800</td> <td>37 (30.8%)</td> <td>2 (8.0%)</td> <td>36 (25.0%)</td> <td>1.09 (0.62-1.92)</td> <td></td> </tr> <tr> <td>-64,200</td> <td>33 (27.5%)</td> <td>9 (36.0%)</td> <td>36 (25.0%)</td> <td>0.99 (0.35-2.79)</td> <td>1.78 (0.18-17.67)</td> </tr> <tr> <td>64,200+</td> <td>17 (14.2%)</td> <td>9 (36.0%)</td> <td>35 (24.3%)</td> <td>0.70 (0.20-2.39)</td> <td>1.42 (0.53-3.85)</td> </tr> </tbody> </table> <p>*Adjusted for sex and age</p>		BCC	SCC	Controls	BCC OR* (95% CI)	SCC OR* (95% CI)	Never	61 (51.3%)	7 (28.0%)	69 (47.9%)	1.0	1.0	-12,000	19 (16.0%)	3 (12.0%)	19 (13.2%)	0.98 (0.58-1.66)	1.84 (0.30-11.09)	-47,900	19 (16.0%)	2 (8.0%)	19 (13.2%)	1.30 (0.69-2.46)		-77,200	12 (10.1%)	9 (7.6%)	19 (13.2%)	0.78 (0.52-1.19)	2.02 (0.60-6.78)	77,200+	8 (6.7%)	4 (16.0%)	18 (12.5%)	0.90 (0.51-1.59)	1.88 (0.30-11.70)		BCC	SCC	Controls	BCC OR* (95% CI)	SCC OR* (95% CI)	Never	50 (41.7%)	15 (60.0%)	75 (52.1%)	1.0	1.0	<300	24 (20.0%)	2 (8.8%)	19 (13.2%)	1.46 (0.52-4.07)		-1,140	15 (12.5%)	3 (12.0%)	16 (11.1%)	1.39 (0.72-2.66)		-2,260	7 (5.8%)	2 (8.8%)	16 (11.1%)	0.92 (0.44-1.91)		2,260+	24 (20.0%)	3 (12.0%)	18 (12.5%)	1.20 (0.61-2.34)	0.78 (0.26-2.40)		BCC	SCC	Controls	BCC OR* (95% CI)	SCC OR* (95% CI)	<5,000	33 (27.5%)	5 (20.0%)	37 (25.7%)	1.0	1.0	-15,800	37 (30.8%)	2 (8.0%)	36 (25.0%)	1.09 (0.62-1.92)		-64,200	33 (27.5%)	9 (36.0%)	36 (25.0%)	0.99 (0.35-2.79)	1.78 (0.18-17.67)	64,200+	17 (14.2%)	9 (36.0%)	35 (24.3%)	0.70 (0.20-2.39)	1.42 (0.53-3.85)	<p>Odds ratio of BCC and SCC by use of a sunlamp (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Never</th> <th>Yes</th> </tr> </thead> <tbody> <tr> <td>BCC</td> <td>110 (91.7%)</td> <td>10 (8.3%)</td> </tr> <tr> <td>SCC</td> <td>25 (100%)</td> <td>0 (0%)</td> </tr> <tr> <td>Controls</td> <td>135 (93.8%)</td> <td>9 (6.2%)</td> </tr> <tr> <td>BCC OR* (95% CI)</td> <td>1.0</td> <td>1.24 (0.53-2.88)</td> </tr> <tr> <td>SCC OR* (95% CI)</td> <td>1.0</td> <td>--</td> </tr> </tbody> </table> <p>*Adjusted for sex and age</p>		Never	Yes	BCC	110 (91.7%)	10 (8.3%)	SCC	25 (100%)	0 (0%)	Controls	135 (93.8%)	9 (6.2%)	BCC OR* (95% CI)	1.0	1.24 (0.53-2.88)	SCC OR* (95% CI)	1.0	--
	BCC	SCC	Controls	BCC OR* (95% CI)	SCC OR* (95% CI)																																																																																																																					
Never	61 (51.3%)	7 (28.0%)	69 (47.9%)	1.0	1.0																																																																																																																					
-12,000	19 (16.0%)	3 (12.0%)	19 (13.2%)	0.98 (0.58-1.66)	1.84 (0.30-11.09)																																																																																																																					
-47,900	19 (16.0%)	2 (8.0%)	19 (13.2%)	1.30 (0.69-2.46)																																																																																																																						
-77,200	12 (10.1%)	9 (7.6%)	19 (13.2%)	0.78 (0.52-1.19)	2.02 (0.60-6.78)																																																																																																																					
77,200+	8 (6.7%)	4 (16.0%)	18 (12.5%)	0.90 (0.51-1.59)	1.88 (0.30-11.70)																																																																																																																					
	BCC	SCC	Controls	BCC OR* (95% CI)	SCC OR* (95% CI)																																																																																																																					
Never	50 (41.7%)	15 (60.0%)	75 (52.1%)	1.0	1.0																																																																																																																					
<300	24 (20.0%)	2 (8.8%)	19 (13.2%)	1.46 (0.52-4.07)																																																																																																																						
-1,140	15 (12.5%)	3 (12.0%)	16 (11.1%)	1.39 (0.72-2.66)																																																																																																																						
-2,260	7 (5.8%)	2 (8.8%)	16 (11.1%)	0.92 (0.44-1.91)																																																																																																																						
2,260+	24 (20.0%)	3 (12.0%)	18 (12.5%)	1.20 (0.61-2.34)	0.78 (0.26-2.40)																																																																																																																					
	BCC	SCC	Controls	BCC OR* (95% CI)	SCC OR* (95% CI)																																																																																																																					
<5,000	33 (27.5%)	5 (20.0%)	37 (25.7%)	1.0	1.0																																																																																																																					
-15,800	37 (30.8%)	2 (8.0%)	36 (25.0%)	1.09 (0.62-1.92)																																																																																																																						
-64,200	33 (27.5%)	9 (36.0%)	36 (25.0%)	0.99 (0.35-2.79)	1.78 (0.18-17.67)																																																																																																																					
64,200+	17 (14.2%)	9 (36.0%)	35 (24.3%)	0.70 (0.20-2.39)	1.42 (0.53-3.85)																																																																																																																					
	Never	Yes																																																																																																																								
BCC	110 (91.7%)	10 (8.3%)																																																																																																																								
SCC	25 (100%)	0 (0%)																																																																																																																								
Controls	135 (93.8%)	9 (6.2%)																																																																																																																								
BCC OR* (95% CI)	1.0	1.24 (0.53-2.88)																																																																																																																								
SCC OR* (95% CI)	1.0	--																																																																																																																								

Study reference USPSTF quality	Measurement of sunscreen use																		
Case-control																			
Rosso 1999 ⁶⁴	<p>Odds ratio for BCC and SCC by use of sunscreens (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>BCC</th> <th>SCC</th> <th>Controls</th> <th>BCC OR* (95% CI)</th> <th>SCC OR* (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Never</td> <td>56 (46.7%)</td> <td>16 (64.0%)</td> <td>93 (64.6%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>Yes</td> <td>64 (53.3%)</td> <td>9 (36.0%)</td> <td>51 (35.4%)</td> <td>1.69 (1.14-2.05)</td> <td>1.63 (0.41-6.53)</td> </tr> </tbody> </table> <p>*Adjusted for sex and age</p>		BCC	SCC	Controls	BCC OR* (95% CI)	SCC OR* (95% CI)	Never	56 (46.7%)	16 (64.0%)	93 (64.6%)	1.0	1.0	Yes	64 (53.3%)	9 (36.0%)	51 (35.4%)	1.69 (1.14-2.05)	1.63 (0.41-6.53)
	BCC	SCC	Controls	BCC OR* (95% CI)	SCC OR* (95% CI)														
Never	56 (46.7%)	16 (64.0%)	93 (64.6%)	1.0	1.0														
Yes	64 (53.3%)	9 (36.0%)	51 (35.4%)	1.69 (1.14-2.05)	1.63 (0.41-6.53)														

Study reference USPSTF quality	Measurement of sunburn	Comments																														
Case-control																																
Rosso 1999 ⁶⁴	<p>Odds ratio of BCC and SCC by number of painful sunburns in a lifetime (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>BCC</th> <th>SCC</th> <th>Controls</th> <th>BCC OR* (95% CI)</th> <th>SCC OR* (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Never</td> <td>82 (68.3%)</td> <td>23 (92.0%)</td> <td>119 (82.6%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>1</td> <td>14 (11.7%)</td> <td>2 (8.0%)</td> <td>19 (13.2%)</td> <td>0.97 (0.59-1.59)</td> <td>not estimable (sparse data)</td> </tr> <tr> <td>2</td> <td>5 (4.2%)</td> <td>0 (0%)</td> <td>3 (2.1%)</td> <td>1.26 (0.41-3.86)</td> <td>--</td> </tr> <tr> <td>3+</td> <td>14 (11.7%)</td> <td>0 (0%)</td> <td>3 (2.1%)</td> <td>2.42 (1.74-3.36)</td> <td>--</td> </tr> </tbody> </table> <p>*Adjusted for sex and age</p>		BCC	SCC	Controls	BCC OR* (95% CI)	SCC OR* (95% CI)	Never	82 (68.3%)	23 (92.0%)	119 (82.6%)	1.0	1.0	1	14 (11.7%)	2 (8.0%)	19 (13.2%)	0.97 (0.59-1.59)	not estimable (sparse data)	2	5 (4.2%)	0 (0%)	3 (2.1%)	1.26 (0.41-3.86)	--	3+	14 (11.7%)	0 (0%)	3 (2.1%)	2.42 (1.74-3.36)	--	
	BCC	SCC	Controls	BCC OR* (95% CI)	SCC OR* (95% CI)																											
Never	82 (68.3%)	23 (92.0%)	119 (82.6%)	1.0	1.0																											
1	14 (11.7%)	2 (8.0%)	19 (13.2%)	0.97 (0.59-1.59)	not estimable (sparse data)																											
2	5 (4.2%)	0 (0%)	3 (2.1%)	1.26 (0.41-3.86)	--																											
3+	14 (11.7%)	0 (0%)	3 (2.1%)	2.42 (1.74-3.36)	--																											

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered																					
Case-control																										
Karagas 2002 ⁸⁸	<p>Skin Cancer: BCC and SCC</p> <p>Study Design: Case-control</p> <p>Location: New Hampshire and bordering regions</p>	<p>Cases: Selection: Newly diagnosed BCC and SCC between 1993-95 from a collaborative network of dermatologists and pathology laboratories throughout New Hampshire and its bordering regions</p> <p>Eligibility criteria: Aged 25-74 years</p> <p>Controls: Selection: New Hampshire residents from the New Hampshire Department of Transportation listing and the Medicare Program of the Centers for Medicare and Medicaid Services</p> <p>Eligibility criteria: Age and sex matched</p>	<p>Cases n= 896 (BCC n=603, SCC n=293) Controls n= 540</p> <p>Mean age: NR</p> <p>Sex (calc):</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Male</td> <td>527 (59%)</td> <td>325 (60.3%)</td> </tr> </tbody> </table> <p>Skin phenotype: NR</p>		Cases	Controls	Male	527 (59%)	325 (60.3%)	<p>Sunlamp exposure</p> <p>Structured personal interviews</p>	<p>Age, sex, skin sensitivity</p>															
	Cases	Controls																								
Male	527 (59%)	325 (60.3%)																								
LeMarchand 2006 ⁸¹	<p>Skin Cancer: Melanoma</p> <p>Study Design: Case-control</p> <p>Location: Hawaii</p>	<p>Cases: Selection: Oahu residents diagnosed with melanoma 1986-87 (prevalent cases) or newly diagnosed 1988-92 (incident cases) from the Hawaii SEER database</p> <p>Eligibility criteria: Four grandparents of pure Caucasian origin, aged 18-79 years, invasive or in situ malignant melanoma. Excluded those with previous history of melanoma</p> <p>Controls: Selection: From a list of Caucasian Oahu residents interviewed by the Hawaii State Department of Health as part of a health survey of a 2% random sample of state households</p> <p>Eligibility criteria: Age and sex matched, four grandparents of pure Caucasian origin</p>	<p>Cases n= 278 Controls n= 278</p> <p>Mean age (SD): Cases: 53.7 (15.0) Controls: 52.1 (15.0)</p> <p>Sex (calc):</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Male</td> <td>167 (60.1%)</td> <td>167 (60.1%)</td> </tr> </tbody> </table> <p>Skin phenotype: <i>Propensity to sunburn (calc)</i></p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Tan only</td> <td>19 (6.9%)</td> <td>34 (12.4%)</td> </tr> <tr> <td>Mild burn and tanning</td> <td>135 (49.1%)</td> <td>139 (50.5%)</td> </tr> <tr> <td>Severe burn and peeling</td> <td>102 (37.1%)</td> <td>84 (30.5%)</td> </tr> <tr> <td>Severe burn and blistering</td> <td>19 (6.9%)</td> <td>18 (6.5%)</td> </tr> </tbody> </table>		Cases	Controls	Male	167 (60.1%)	167 (60.1%)		Cases	Controls	Tan only	19 (6.9%)	34 (12.4%)	Mild burn and tanning	135 (49.1%)	139 (50.5%)	Severe burn and peeling	102 (37.1%)	84 (30.5%)	Severe burn and blistering	19 (6.9%)	18 (6.5%)	<p>Sun exposure</p> <p>In-home interviews by trained interviewers</p>	<p>Height, education, hair color, ability to tan, and drinking status</p>
	Cases	Controls																								
Male	167 (60.1%)	167 (60.1%)																								
	Cases	Controls																								
Tan only	19 (6.9%)	34 (12.4%)																								
Mild burn and tanning	135 (49.1%)	139 (50.5%)																								
Severe burn and peeling	102 (37.1%)	84 (30.5%)																								
Severe burn and blistering	19 (6.9%)	18 (6.5%)																								

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sun exposure																																																																																																																																																																								
Case-control																																																																																																																																																																									
Karagas 2002 ⁸⁸	NR																																																																																																																																																																								
LeMarchand 2006 ⁸¹	<p>Risk of melanoma and number of hours during summer in bathing suit, age 8-10 years</p> <table border="1"> <thead> <tr> <th colspan="4">Males</th> <th colspan="4">Females</th> </tr> <tr> <th>No.</th> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> <th>No.</th> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>74 (44.3%)</td> <td>88 (52.7%)</td> <td>1.0</td> <td>0</td> <td>35 (31.8%)</td> <td>52 (47.3%)</td> <td>1.0</td> </tr> <tr> <td>1-32</td> <td>32 (19.2%)</td> <td>30 (18.0%)</td> <td>1.2 (0.6-2.3)</td> <td>1-20</td> <td>28 (25.5%)</td> <td>17 (15.5%)</td> <td>2.1 (0.8-5.4)</td> </tr> <tr> <td>33-80</td> <td>27 (16.2%)</td> <td>31 (18.6%)</td> <td>0.9 (0.4-1.8)</td> <td>21-64</td> <td>21 (19.1%)</td> <td>23 (20.9%)</td> <td>1.4 (0.5-3.7)</td> </tr> <tr> <td>≥80</td> <td>34 (20.4%)</td> <td>18 (10.8%)</td> <td>2.0 (0.9-4.4)</td> <td>≥65</td> <td>26 (23.6%)</td> <td>18 (16.4%)</td> <td>3.4 (1.2-9.1)</td> </tr> <tr> <td colspan="4" style="text-align: center;"><i>p=0.14</i></td> <td colspan="4" style="text-align: center;"><i>p=0.03</i></td> </tr> </tbody> </table> <p>Risk of melanoma and number of hours during summer in bathing suit, past 5 years</p> <table border="1"> <thead> <tr> <th colspan="4">Males</th> <th colspan="4">Females</th> </tr> <tr> <th>No.</th> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> <th>No.</th> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>86 (51.5%)</td> <td>108 (64.7%)</td> <td>1.0</td> <td>0</td> <td>31 (28.2%)</td> <td>56 (50.9%)</td> <td>1.0</td> </tr> <tr> <td>1-12</td> <td>29 (17.4%)</td> <td>26 (15.6%)</td> <td>1.4 (0.6-3.0)</td> <td>1-8</td> <td>31 (28.2%)</td> <td>26 (15.6%)</td> <td>2.1 (0.8-5.6)</td> </tr> <tr> <td>13-24</td> <td>23 (13.8%)</td> <td>16 (9.6%)</td> <td>1.9 (0.8-4.4)</td> <td>9-20</td> <td>25 (22.7%)</td> <td>13 (11.8%)</td> <td>4.8 (1.7-13.4)</td> </tr> <tr> <td>≥25</td> <td>29 (17.4%)</td> <td>17 (10.2%)</td> <td>2.5 (1.2-5.4)</td> <td>≥21</td> <td>23 (20.9%)</td> <td>15 (13.6%)</td> <td>3.3 (1.1-10.10)</td> </tr> <tr> <td colspan="4" style="text-align: center;"><i>p=0.01</i></td> <td colspan="4" style="text-align: center;"><i>p=0.01</i></td> </tr> </tbody> </table> <p>Risk of melanoma and number of hours worked outdoors over lifetime</p> <table border="1"> <thead> <tr> <th colspan="4">Males</th> <th colspan="4">Females</th> </tr> <tr> <th>No.</th> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> <th>No.</th> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>≤438</td> <td>42 (25.1%)</td> <td>42 (25.1%)</td> <td>1.0</td> <td>0</td> <td>45 (40.9%)</td> <td>58 (52.7%)</td> <td>1.0</td> </tr> <tr> <td>439-1,644</td> <td>41 (24.6%)</td> <td>43 (25.7%)</td> <td>1.0 (0.5-2.0)</td> <td>1-330</td> <td>17 (15.5%)</td> <td>16 (14.5%)</td> <td>1.3 (0.6-3.8)</td> </tr> <tr> <td>1,645-3,360</td> <td>38 (22.8%)</td> <td>46 (27.5%)</td> <td>0.7 (0.4-1.5)</td> <td>331-864</td> <td>22 (20.0%)</td> <td>13 (11.8%)</td> <td>1.8 (0.8-4.2)</td> </tr> <tr> <td>≥3,361</td> <td>46 (27.5%)</td> <td>36 (21.6%)</td> <td>1.3 (0.7-2.7)</td> <td>≥865</td> <td>18 (16.4%)</td> <td>15 (13.6%)</td> <td>1.2 (0.5-3.0)</td> </tr> <tr> <td colspan="4" style="text-align: center;"><i>p=0.36</i></td> <td colspan="4" style="text-align: center;"><i>p=0.59</i></td> </tr> </tbody> </table>	Males				Females				No.	Cases	Controls	OR (95% CI)	No.	Cases	Controls	OR (95% CI)	0	74 (44.3%)	88 (52.7%)	1.0	0	35 (31.8%)	52 (47.3%)	1.0	1-32	32 (19.2%)	30 (18.0%)	1.2 (0.6-2.3)	1-20	28 (25.5%)	17 (15.5%)	2.1 (0.8-5.4)	33-80	27 (16.2%)	31 (18.6%)	0.9 (0.4-1.8)	21-64	21 (19.1%)	23 (20.9%)	1.4 (0.5-3.7)	≥80	34 (20.4%)	18 (10.8%)	2.0 (0.9-4.4)	≥65	26 (23.6%)	18 (16.4%)	3.4 (1.2-9.1)	<i>p=0.14</i>				<i>p=0.03</i>				Males				Females				No.	Cases	Controls	OR (95% CI)	No.	Cases	Controls	OR (95% CI)	0	86 (51.5%)	108 (64.7%)	1.0	0	31 (28.2%)	56 (50.9%)	1.0	1-12	29 (17.4%)	26 (15.6%)	1.4 (0.6-3.0)	1-8	31 (28.2%)	26 (15.6%)	2.1 (0.8-5.6)	13-24	23 (13.8%)	16 (9.6%)	1.9 (0.8-4.4)	9-20	25 (22.7%)	13 (11.8%)	4.8 (1.7-13.4)	≥25	29 (17.4%)	17 (10.2%)	2.5 (1.2-5.4)	≥21	23 (20.9%)	15 (13.6%)	3.3 (1.1-10.10)	<i>p=0.01</i>				<i>p=0.01</i>				Males				Females				No.	Cases	Controls	OR (95% CI)	No.	Cases	Controls	OR (95% CI)	≤438	42 (25.1%)	42 (25.1%)	1.0	0	45 (40.9%)	58 (52.7%)	1.0	439-1,644	41 (24.6%)	43 (25.7%)	1.0 (0.5-2.0)	1-330	17 (15.5%)	16 (14.5%)	1.3 (0.6-3.8)	1,645-3,360	38 (22.8%)	46 (27.5%)	0.7 (0.4-1.5)	331-864	22 (20.0%)	13 (11.8%)	1.8 (0.8-4.2)	≥3,361	46 (27.5%)	36 (21.6%)	1.3 (0.7-2.7)	≥865	18 (16.4%)	15 (13.6%)	1.2 (0.5-3.0)	<i>p=0.36</i>				<i>p=0.59</i>			
Males				Females																																																																																																																																																																					
No.	Cases	Controls	OR (95% CI)	No.	Cases	Controls	OR (95% CI)																																																																																																																																																																		
0	74 (44.3%)	88 (52.7%)	1.0	0	35 (31.8%)	52 (47.3%)	1.0																																																																																																																																																																		
1-32	32 (19.2%)	30 (18.0%)	1.2 (0.6-2.3)	1-20	28 (25.5%)	17 (15.5%)	2.1 (0.8-5.4)																																																																																																																																																																		
33-80	27 (16.2%)	31 (18.6%)	0.9 (0.4-1.8)	21-64	21 (19.1%)	23 (20.9%)	1.4 (0.5-3.7)																																																																																																																																																																		
≥80	34 (20.4%)	18 (10.8%)	2.0 (0.9-4.4)	≥65	26 (23.6%)	18 (16.4%)	3.4 (1.2-9.1)																																																																																																																																																																		
<i>p=0.14</i>				<i>p=0.03</i>																																																																																																																																																																					
Males				Females																																																																																																																																																																					
No.	Cases	Controls	OR (95% CI)	No.	Cases	Controls	OR (95% CI)																																																																																																																																																																		
0	86 (51.5%)	108 (64.7%)	1.0	0	31 (28.2%)	56 (50.9%)	1.0																																																																																																																																																																		
1-12	29 (17.4%)	26 (15.6%)	1.4 (0.6-3.0)	1-8	31 (28.2%)	26 (15.6%)	2.1 (0.8-5.6)																																																																																																																																																																		
13-24	23 (13.8%)	16 (9.6%)	1.9 (0.8-4.4)	9-20	25 (22.7%)	13 (11.8%)	4.8 (1.7-13.4)																																																																																																																																																																		
≥25	29 (17.4%)	17 (10.2%)	2.5 (1.2-5.4)	≥21	23 (20.9%)	15 (13.6%)	3.3 (1.1-10.10)																																																																																																																																																																		
<i>p=0.01</i>				<i>p=0.01</i>																																																																																																																																																																					
Males				Females																																																																																																																																																																					
No.	Cases	Controls	OR (95% CI)	No.	Cases	Controls	OR (95% CI)																																																																																																																																																																		
≤438	42 (25.1%)	42 (25.1%)	1.0	0	45 (40.9%)	58 (52.7%)	1.0																																																																																																																																																																		
439-1,644	41 (24.6%)	43 (25.7%)	1.0 (0.5-2.0)	1-330	17 (15.5%)	16 (14.5%)	1.3 (0.6-3.8)																																																																																																																																																																		
1,645-3,360	38 (22.8%)	46 (27.5%)	0.7 (0.4-1.5)	331-864	22 (20.0%)	13 (11.8%)	1.8 (0.8-4.2)																																																																																																																																																																		
≥3,361	46 (27.5%)	36 (21.6%)	1.3 (0.7-2.7)	≥865	18 (16.4%)	15 (13.6%)	1.2 (0.5-3.0)																																																																																																																																																																		
<i>p=0.36</i>				<i>p=0.59</i>																																																																																																																																																																					
Study reference USPSTF quality																																																																																																																																																																									
Measurement of sunlamp or sunbed exposure																																																																																																																																																																									
Case-control																																																																																																																																																																									
Karagas 2002 ⁸⁸	<p>Odds ratios for BCC and SCC associated with tanning device use</p> <table border="1"> <thead> <tr> <th></th> <th>BCC</th> <th>SCC</th> <th>Controls</th> <th>BCC OR (95% CI)</th> <th>SCC OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>No</td> <td>474 (78.9%)</td> <td>229 (78.4%)</td> <td>464 (86.1%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>Yes</td> <td>127 (21.1%)</td> <td>63 (21.6%)</td> <td>75 (13.9%)</td> <td>1.5 (1.1-2.1)</td> <td>2.5 (1.7-3.8)</td> </tr> </tbody> </table> <p>effects similar in men and women (data not shown)</p> <p>Odds ratios for BCC and SCC associated with age at first tanning device use</p> <table border="1"> <thead> <tr> <th></th> <th>BCC</th> <th>SCC</th> <th>Controls</th> <th>BCC OR (95% CI)</th> <th>SCC OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>No use</td> <td>474 (78.9%)</td> <td>229 (78.4%)</td> <td>464 (86.1%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td><20</td> <td>46 (7.7%)</td> <td>24 (8.2%)</td> <td>23 (4.3%)</td> <td>1.8 (1.0-3.0)</td> <td>3.6 (1.9-6.9)</td> </tr> <tr> <td>20-35</td> <td>42 (7.0%)</td> <td>20 (6.9%)</td> <td>26 (4.8%)</td> <td>1.4 (0.8-2.3)</td> <td>2.8 (1.4-5.5)</td> </tr> <tr> <td>>35</td> <td>39 (6.5%)</td> <td>19 (6.5%)</td> <td>26 (4.8%)</td> <td>1.4 (0.8-2.3)</td> <td>1.7 (0.9-3.2)</td> </tr> <tr> <td>Test for trend</td> <td colspan="3"></td> <td><i>p=0.46</i></td> <td><i>p=0.15</i></td> </tr> </tbody> </table>		BCC	SCC	Controls	BCC OR (95% CI)	SCC OR (95% CI)	No	474 (78.9%)	229 (78.4%)	464 (86.1%)	1.0	1.0	Yes	127 (21.1%)	63 (21.6%)	75 (13.9%)	1.5 (1.1-2.1)	2.5 (1.7-3.8)		BCC	SCC	Controls	BCC OR (95% CI)	SCC OR (95% CI)	No use	474 (78.9%)	229 (78.4%)	464 (86.1%)	1.0	1.0	<20	46 (7.7%)	24 (8.2%)	23 (4.3%)	1.8 (1.0-3.0)	3.6 (1.9-6.9)	20-35	42 (7.0%)	20 (6.9%)	26 (4.8%)	1.4 (0.8-2.3)	2.8 (1.4-5.5)	>35	39 (6.5%)	19 (6.5%)	26 (4.8%)	1.4 (0.8-2.3)	1.7 (0.9-3.2)	Test for trend				<i>p=0.46</i>	<i>p=0.15</i>																																																																																																																		
	BCC	SCC	Controls	BCC OR (95% CI)	SCC OR (95% CI)																																																																																																																																																																				
No	474 (78.9%)	229 (78.4%)	464 (86.1%)	1.0	1.0																																																																																																																																																																				
Yes	127 (21.1%)	63 (21.6%)	75 (13.9%)	1.5 (1.1-2.1)	2.5 (1.7-3.8)																																																																																																																																																																				
	BCC	SCC	Controls	BCC OR (95% CI)	SCC OR (95% CI)																																																																																																																																																																				
No use	474 (78.9%)	229 (78.4%)	464 (86.1%)	1.0	1.0																																																																																																																																																																				
<20	46 (7.7%)	24 (8.2%)	23 (4.3%)	1.8 (1.0-3.0)	3.6 (1.9-6.9)																																																																																																																																																																				
20-35	42 (7.0%)	20 (6.9%)	26 (4.8%)	1.4 (0.8-2.3)	2.8 (1.4-5.5)																																																																																																																																																																				
>35	39 (6.5%)	19 (6.5%)	26 (4.8%)	1.4 (0.8-2.3)	1.7 (0.9-3.2)																																																																																																																																																																				
Test for trend				<i>p=0.46</i>	<i>p=0.15</i>																																																																																																																																																																				
LeMarchand 2006 ⁸¹	NR																																																																																																																																																																								

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sunscreen use	Measurement of sunburn	Comments																																																																																																								
Case-control																																																																																																											
Karagas 2002 ⁸⁸	NR	NR																																																																																																									
LeMarchand 2006 ⁸¹	NR	<p>Risk of melanoma and number of blistering sunburns age 0-9</p> <table border="1"> <thead> <tr> <th colspan="4">Males</th> <th colspan="4">Females</th> </tr> <tr> <th>No.</th> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> <th>No.</th> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>130 (77.8%)</td> <td>131 (78.4%)</td> <td>1.0</td> <td>0</td> <td>83 (75.5%)</td> <td>91 (82.7%)</td> <td>1.0</td> </tr> <tr> <td>1-4</td> <td>19 (11.4%)</td> <td>16 (9.6%)</td> <td>0.9 (0.4-2.2)</td> <td>1-3</td> <td>10 (9.1%)</td> <td>8 (7.3%)</td> <td>1.2 (0.3-4.4)</td> </tr> <tr> <td>≥5</td> <td>18 (10.8%)</td> <td>20 (18.2%)</td> <td>0.7 (0.4-1.5)</td> <td>≥4</td> <td>17 (15.5%)</td> <td>11 (10.0%)</td> <td>1.2 (0.4-3.8)</td> </tr> <tr> <td colspan="4" style="text-align: center;"><i>p=0.34</i></td> <td colspan="4" style="text-align: center;"><i>p=0.58</i></td> </tr> </tbody> </table> <p>Risk of melanoma and number of blistering sunburns age 10-17</p> <table border="1"> <thead> <tr> <th colspan="4">Males</th> <th colspan="4">Females</th> </tr> <tr> <th>No.</th> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> <th>No.</th> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>94 (56.3%)</td> <td>111 (66.5%)</td> <td>1.0</td> <td>0</td> <td>50 (45.5%)</td> <td>73 (66.4%)</td> <td>1.0</td> </tr> <tr> <td>1-4</td> <td>27 (16.2%)</td> <td>23 (13.8%)</td> <td>1.2 (0.6-2.2)</td> <td>1-3</td> <td>25 (22.7%)</td> <td>13 (11.8%)</td> <td>2.4 (0.9-6.2)</td> </tr> <tr> <td>5-12</td> <td>22 (13.2%)</td> <td>18 (10.8%)</td> <td>1.2 (0.6-2.6)</td> <td>4-10</td> <td>15 (13.6%)</td> <td>12 (10.9%)</td> <td>3.3 (1.0-10.0)</td> </tr> <tr> <td>≥13</td> <td>24 (14.4%)</td> <td>15 (9.0%)</td> <td>2.0 (0.9-4.6)</td> <td>≥11</td> <td>20 (18.2%)</td> <td>12 (10.9%)</td> <td>1.9 (0.7-6.7)</td> </tr> <tr> <td colspan="4" style="text-align: center;"><i>p=0.09</i></td> <td colspan="4" style="text-align: center;"><i>p=0.13</i></td> </tr> </tbody> </table>	Males				Females				No.	Cases	Controls	OR (95% CI)	No.	Cases	Controls	OR (95% CI)	0	130 (77.8%)	131 (78.4%)	1.0	0	83 (75.5%)	91 (82.7%)	1.0	1-4	19 (11.4%)	16 (9.6%)	0.9 (0.4-2.2)	1-3	10 (9.1%)	8 (7.3%)	1.2 (0.3-4.4)	≥5	18 (10.8%)	20 (18.2%)	0.7 (0.4-1.5)	≥4	17 (15.5%)	11 (10.0%)	1.2 (0.4-3.8)	<i>p=0.34</i>				<i>p=0.58</i>				Males				Females				No.	Cases	Controls	OR (95% CI)	No.	Cases	Controls	OR (95% CI)	0	94 (56.3%)	111 (66.5%)	1.0	0	50 (45.5%)	73 (66.4%)	1.0	1-4	27 (16.2%)	23 (13.8%)	1.2 (0.6-2.2)	1-3	25 (22.7%)	13 (11.8%)	2.4 (0.9-6.2)	5-12	22 (13.2%)	18 (10.8%)	1.2 (0.6-2.6)	4-10	15 (13.6%)	12 (10.9%)	3.3 (1.0-10.0)	≥13	24 (14.4%)	15 (9.0%)	2.0 (0.9-4.6)	≥11	20 (18.2%)	12 (10.9%)	1.9 (0.7-6.7)	<i>p=0.09</i>				<i>p=0.13</i>				
Males				Females																																																																																																							
No.	Cases	Controls	OR (95% CI)	No.	Cases	Controls	OR (95% CI)																																																																																																				
0	130 (77.8%)	131 (78.4%)	1.0	0	83 (75.5%)	91 (82.7%)	1.0																																																																																																				
1-4	19 (11.4%)	16 (9.6%)	0.9 (0.4-2.2)	1-3	10 (9.1%)	8 (7.3%)	1.2 (0.3-4.4)																																																																																																				
≥5	18 (10.8%)	20 (18.2%)	0.7 (0.4-1.5)	≥4	17 (15.5%)	11 (10.0%)	1.2 (0.4-3.8)																																																																																																				
<i>p=0.34</i>				<i>p=0.58</i>																																																																																																							
Males				Females																																																																																																							
No.	Cases	Controls	OR (95% CI)	No.	Cases	Controls	OR (95% CI)																																																																																																				
0	94 (56.3%)	111 (66.5%)	1.0	0	50 (45.5%)	73 (66.4%)	1.0																																																																																																				
1-4	27 (16.2%)	23 (13.8%)	1.2 (0.6-2.2)	1-3	25 (22.7%)	13 (11.8%)	2.4 (0.9-6.2)																																																																																																				
5-12	22 (13.2%)	18 (10.8%)	1.2 (0.6-2.6)	4-10	15 (13.6%)	12 (10.9%)	3.3 (1.0-10.0)																																																																																																				
≥13	24 (14.4%)	15 (9.0%)	2.0 (0.9-4.6)	≥11	20 (18.2%)	12 (10.9%)	1.9 (0.7-6.7)																																																																																																				
<i>p=0.09</i>				<i>p=0.13</i>																																																																																																							

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered																								
Case-control																													
Westerdahl 1994 ⁸⁶ Westerdahl 1994 ⁴⁰ Westerdahl 1995 ⁴¹	Skin Cancer: Melanoma Study Design: Case-control Location: Sweden	Cases: Selection: First diagnosis of malignant melanoma between 1988-1990 from the South Swedish Health Care Region Tumour Registry Eligibility criteria: Aged 15-75 years, physician consented Controls: Selection: Randomly selected from the National Population Registry of residents of the South Swedish Health Care Region Eligibility criteria: Parish-, sex-, and age- (within a year) matched	Cases n= 400 Controls n= 640 Mean age (SD): NR Sex (calc): <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Male</td> <td>48.8%</td> <td>48.9%</td> </tr> </tbody> </table> Skin phenotype: NR		Cases	Controls	Male	48.8%	48.9%	Sun exposure, sunlamp exposure, sunscreen exposure Mailed questionnaires	History of sunburns, blond hair color, red hair color, raised nevi, outdoor employment during the summer, eye color, freckling, and history of frequent sunbathing during the summer																		
	Cases	Controls																											
Male	48.8%	48.9%																											
Westerdahl 2000 ⁸⁵	Skin Cancer: Melanoma Study Design: Case-control Location: Sweden	Cases: Selection: First diagnosis of cutaneous invasive malignant melanoma between 1995-1997 from the South Swedish Health Care Region Tumour Registry Eligibility criteria: Aged 16-80, physician consented Controls: Selection: Random sample from the National Population Registry of residents of the South Swedish Health Care Region Eligibility criteria: Sex-, age- (within a year), and parish-matched	Cases n= 558 Controls n= 891 Mean age (calc): <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>18-50</td> <td>NR</td> <td>292 (32.8%)</td> </tr> <tr> <td>51-80</td> <td>NR</td> <td>599 (67.2%)</td> </tr> </tbody> </table> Sex (calc): <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Male</td> <td>NR</td> <td>443 (49.7%)</td> </tr> </tbody> </table> Skin phenotype: <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>III-IV</td> <td>NR</td> <td>588 (68.1%)</td> </tr> <tr> <td>I-II</td> <td>NR</td> <td>276 (31.9%)</td> </tr> </tbody> </table>		Cases	Controls	18-50	NR	292 (32.8%)	51-80	NR	599 (67.2%)		Cases	Controls	Male	NR	443 (49.7%)		Cases	Controls	III-IV	NR	588 (68.1%)	I-II	NR	276 (31.9%)	Sun exposure, sunbed exposure, sunscreen exposure Mailed questionnaires	Hair color, history of sunburns, skin phototype, history of sunbathing, and number of raised naevi
	Cases	Controls																											
18-50	NR	292 (32.8%)																											
51-80	NR	599 (67.2%)																											
	Cases	Controls																											
Male	NR	443 (49.7%)																											
	Cases	Controls																											
III-IV	NR	588 (68.1%)																											
I-II	NR	276 (31.9%)																											

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sunlamp or sunbed exposure																																																																																			
Case-control																																																																																					
Westerdahl 1994 ⁸⁶ Westerdahl 1994 ⁴⁰ Westerdahl 1995 ⁴¹	<p>The frequency of sunbathing or the duration of the practice of sunbathing was not related to melanoma risk (data not shown)</p> <p>Odds ratios for developing malignant melanoma in relation to sunbathing frequently during the summer (April-September) (calc)</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>No</td> <td>301 (75.3%)</td> <td>501 (78.3%)</td> <td>1.0</td> </tr> <tr> <td>Yes</td> <td>99 (24.7%)</td> <td>139 (21.7%)</td> <td>1.2 (0.9-1.7)</td> </tr> </tbody> </table> <p><i>p</i>=0.25</p> <p>*Adjusted for exposure to sunbeds or sunlamps, history of sunburns, hair color, number of raised nevi, and history of malignant melanoma in immediate family</p>		Cases	Controls	Adjusted* OR (95% CI)	No	301 (75.3%)	501 (78.3%)	1.0	Yes	99 (24.7%)	139 (21.7%)	1.2 (0.9-1.7)	<p>Odds ratio of malignant melanoma in individuals younger than age 30 by sunbed or sunlamp exposure</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td>Never</td> <td>8 (32%)</td> <td>19 (54%)</td> <td>1.0</td> </tr> <tr> <td>Ever</td> <td>17 (68%)</td> <td>16 (46%)</td> <td>2.7 (0.7-9.8)</td> </tr> </tbody> </table> <p>*Adjusted for history of sunburns, blond hair color, red hair color, raised nevi, and history of frequent sunbathing during the summer</p> <p>Odds ratios for developing malignant melanoma in relation to use of sunbeds or sunlamps (times/year) in different age groups (calc)</p> <table border="1"> <thead> <tr> <th rowspan="2">trend</th> <th colspan="3">Adjusted*</th> <th colspan="2">Test for</th> </tr> <tr> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> <th>p value</th> <th>p value</th> </tr> </thead> <tbody> <tr> <td colspan="6"><30 years</td> </tr> <tr> <td>Never</td> <td>8 (32.0%)</td> <td>19 (54.3%)</td> <td>1.0</td> <td></td> <td></td> </tr> <tr> <td>1-10</td> <td>9 (36.0%)</td> <td>13 (37.1%)</td> <td>2.0 (0.5-8.0)</td> <td></td> <td></td> </tr> <tr> <td>>10</td> <td>8 (32.0%)</td> <td>3 (8.6%)</td> <td>7.7 (1.0-63.6)</td> <td>0.09</td> <td>0.02</td> </tr> <tr> <td colspan="6">30-60 years</td> </tr> <tr> <td>Never</td> <td>142 (65.4%)</td> <td>230 (65.5%)</td> <td>1.0</td> <td></td> <td></td> </tr> <tr> <td>1-10</td> <td>51 (23.5%)</td> <td>90 (25.6%)</td> <td>1.0 (0.7-1.6)</td> <td></td> <td></td> </tr> <tr> <td>10</td> <td>24 (11.1%)</td> <td>31 (8.8%)</td> <td>1.4 (0.7-2.7)</td> <td>0.21</td> <td>0.69</td> </tr> </tbody> </table> <p>*Adjusted for history of sunburns, blond/fair and red hair color, raised nevi, and history of frequent sunbathing during the summer</p>		Cases	Controls	Adjusted* OR (95% CI)	Never	8 (32%)	19 (54%)	1.0	Ever	17 (68%)	16 (46%)	2.7 (0.7-9.8)	trend	Adjusted*			Test for		Cases	Controls	OR (95% CI)	p value	p value	<30 years						Never	8 (32.0%)	19 (54.3%)	1.0			1-10	9 (36.0%)	13 (37.1%)	2.0 (0.5-8.0)			>10	8 (32.0%)	3 (8.6%)	7.7 (1.0-63.6)	0.09	0.02	30-60 years						Never	142 (65.4%)	230 (65.5%)	1.0			1-10	51 (23.5%)	90 (25.6%)	1.0 (0.7-1.6)			10	24 (11.1%)	31 (8.8%)	1.4 (0.7-2.7)	0.21	0.69
	Cases	Controls	Adjusted* OR (95% CI)																																																																																		
No	301 (75.3%)	501 (78.3%)	1.0																																																																																		
Yes	99 (24.7%)	139 (21.7%)	1.2 (0.9-1.7)																																																																																		
	Cases	Controls	Adjusted* OR (95% CI)																																																																																		
Never	8 (32%)	19 (54%)	1.0																																																																																		
Ever	17 (68%)	16 (46%)	2.7 (0.7-9.8)																																																																																		
trend	Adjusted*			Test for																																																																																	
	Cases	Controls	OR (95% CI)	p value	p value																																																																																
<30 years																																																																																					
Never	8 (32.0%)	19 (54.3%)	1.0																																																																																		
1-10	9 (36.0%)	13 (37.1%)	2.0 (0.5-8.0)																																																																																		
>10	8 (32.0%)	3 (8.6%)	7.7 (1.0-63.6)	0.09	0.02																																																																																
30-60 years																																																																																					
Never	142 (65.4%)	230 (65.5%)	1.0																																																																																		
1-10	51 (23.5%)	90 (25.6%)	1.0 (0.7-1.6)																																																																																		
10	24 (11.1%)	31 (8.8%)	1.4 (0.7-2.7)	0.21	0.69																																																																																
Westerdahl 2000 ⁸⁵	<p>Odds ratios for developing malignant melanoma in relation to frequency of sunbathing April-September by use of sunscreen</p> <table border="1"> <thead> <tr> <th rowspan="2"></th> <th colspan="2">OR (95% CI) Use of sunscreen</th> <th colspan="2">OR* (95% CI) Use of sunscreen</th> </tr> <tr> <th>Never</th> <th>Ever</th> <th>Never</th> <th>Ever</th> </tr> </thead> <tbody> <tr> <td><15 times</td> <td>1.0</td> <td>1.3 (1.0-1.9)</td> <td>1.0</td> <td>1.3 (0.8-2.2)</td> </tr> <tr> <td>≥15 times</td> <td>0.8 (0.5-1.3)</td> <td>1.1 (0.8-1.6)</td> <td>0.9 (0.5-1.8)</td> <td>1.2 (0.7-2.0)</td> </tr> </tbody> </table> <p>*Adjusted for sunburns after age 19 years, skin phototype, and hair color</p>		OR (95% CI) Use of sunscreen		OR* (95% CI) Use of sunscreen		Never	Ever	Never	Ever	<15 times	1.0	1.3 (1.0-1.9)	1.0	1.3 (0.8-2.2)	≥15 times	0.8 (0.5-1.3)	1.1 (0.8-1.6)	0.9 (0.5-1.8)	1.2 (0.7-2.0)	NR																																																																
	OR (95% CI) Use of sunscreen		OR* (95% CI) Use of sunscreen																																																																																		
	Never	Ever	Never	Ever																																																																																	
<15 times	1.0	1.3 (1.0-1.9)	1.0	1.3 (0.8-2.2)																																																																																	
≥15 times	0.8 (0.5-1.3)	1.1 (0.8-1.6)	0.9 (0.5-1.8)	1.2 (0.7-2.0)																																																																																	

Study reference USPSTF quality	Measurement of sunscreen use	Measurement of sunburn	Comments																																																																																		
Case-control																																																																																					
Westerdahl 1994 ⁸⁶ Westerdahl 1994 ⁴⁰ Westerdahl 1995 ⁴¹	<p>Odds ratios for developing malignant melanoma in relation to use of sunscreen (calc)</p> <table border="1"> <thead> <tr> <th rowspan="2"></th> <th rowspan="2">Cases</th> <th rowspan="2">Controls</th> <th>Crude</th> <th>Adjusted*</th> <th rowspan="2">P</th> </tr> <tr> <th>OR(95% CI)</th> <th>OR(95% CI)</th> </tr> </thead> <tbody> <tr> <td>Never</td> <td>84(21.5%)</td> <td>182(28.8%)</td> <td>1.0</td> <td>1.0</td> <td></td> </tr> <tr> <td>Sometimes</td> <td>208(53.2%)</td> <td>334(52.8%)</td> <td>1.4(1.0-2.0)</td> <td>1.3(0.9-1.9)</td> <td></td> </tr> <tr> <td>Almost always</td> <td>99(25.3%)</td> <td>116(18.4%)</td> <td>2.1(1.4-3.2)</td> <td>1.8(1.1-2.8)</td> <td>0.01</td> </tr> </tbody> </table> <p>*Adjusted for history of sunburns, history of frequent sunbathing during the summer, outdoor employment during the summer, and host factors (i.e. raised naevi, hair colour, eye colour, and freckling)</p>		Cases	Controls	Crude	Adjusted*	P	OR(95% CI)	OR(95% CI)	Never	84(21.5%)	182(28.8%)	1.0	1.0		Sometimes	208(53.2%)	334(52.8%)	1.4(1.0-2.0)	1.3(0.9-1.9)		Almost always	99(25.3%)	116(18.4%)	2.1(1.4-3.2)	1.8(1.1-2.8)	0.01	<p>Relative risk of malignant melanoma according to number of painful sunburns in different age groups (calc)</p> <table border="1"> <thead> <tr> <th rowspan="2"></th> <th rowspan="2">Cases</th> <th rowspan="2">Controls</th> <th>Adjusted</th> <th>Crude</th> <th rowspan="2">Test for trend p value</th> </tr> <tr> <th>RR (95% CI)</th> <th>RR (95% CI)</th> </tr> </thead> <tbody> <tr> <td colspan="6">Before age 15</td> </tr> <tr> <td>Never</td> <td>143(42.2%)</td> <td>259(47.3%)</td> <td>1.0</td> <td>1.0</td> <td></td> </tr> <tr> <td>1-5</td> <td>149(44.0%)</td> <td>224(40.9%)</td> <td>1.4(1.0-1.9)</td> <td>1.0(0.6-1.5)</td> <td></td> </tr> <tr> <td>>5</td> <td>47(13.9%)</td> <td>65(11.9%)</td> <td>1.6(1.0-2.6)</td> <td>1.0(0.5-2.1)</td> <td>>0.05</td> </tr> <tr> <td colspan="6">Ages 15-19</td> </tr> <tr> <td>Never</td> <td>108(29.4%)</td> <td>209(39.7%)</td> <td>1.0</td> <td>1.0</td> <td></td> </tr> <tr> <td>1-5</td> <td>213(58.0%)</td> <td>312(59.3%)</td> <td>1.4(1.0-1.9)</td> <td>1.3(0.8-2.0)</td> <td></td> </tr> <tr> <td>>5</td> <td>46(12.5%)</td> <td>65(12.4%)</td> <td>1.6(1.0-2.5)</td> <td>0.9(0.4-2.1)</td> <td>>0.05</td> </tr> </tbody> </table> <p>adjusted for raised nevi, red hair color, and blond/fair hair color</p>		Cases	Controls	Adjusted	Crude	Test for trend p value	RR (95% CI)	RR (95% CI)	Before age 15						Never	143(42.2%)	259(47.3%)	1.0	1.0		1-5	149(44.0%)	224(40.9%)	1.4(1.0-1.9)	1.0(0.6-1.5)		>5	47(13.9%)	65(11.9%)	1.6(1.0-2.6)	1.0(0.5-2.1)	>0.05	Ages 15-19						Never	108(29.4%)	209(39.7%)	1.0	1.0		1-5	213(58.0%)	312(59.3%)	1.4(1.0-1.9)	1.3(0.8-2.0)		>5	46(12.5%)	65(12.4%)	1.6(1.0-2.5)	0.9(0.4-2.1)	>0.05	
	Cases				Controls	Crude		Adjusted*	P																																																																												
		OR(95% CI)	OR(95% CI)																																																																																		
Never	84(21.5%)	182(28.8%)	1.0	1.0																																																																																	
Sometimes	208(53.2%)	334(52.8%)	1.4(1.0-2.0)	1.3(0.9-1.9)																																																																																	
Almost always	99(25.3%)	116(18.4%)	2.1(1.4-3.2)	1.8(1.1-2.8)	0.01																																																																																
	Cases	Controls	Adjusted	Crude	Test for trend p value																																																																																
			RR (95% CI)	RR (95% CI)																																																																																	
Before age 15																																																																																					
Never	143(42.2%)	259(47.3%)	1.0	1.0																																																																																	
1-5	149(44.0%)	224(40.9%)	1.4(1.0-1.9)	1.0(0.6-1.5)																																																																																	
>5	47(13.9%)	65(11.9%)	1.6(1.0-2.6)	1.0(0.5-2.1)	>0.05																																																																																
Ages 15-19																																																																																					
Never	108(29.4%)	209(39.7%)	1.0	1.0																																																																																	
1-5	213(58.0%)	312(59.3%)	1.4(1.0-1.9)	1.3(0.8-2.0)																																																																																	
>5	46(12.5%)	65(12.4%)	1.6(1.0-2.5)	0.9(0.4-2.1)	>0.05																																																																																

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sunscreen use	Measurement of sunburn	Comments																																																		
Case-control																																																					
Westerdahl 2000 ⁸⁵	<p>Odds ratios for developing malignant melanoma in relation to sunscreen use (calc)</p> <p style="text-align: center;">Adjusted*</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> <th>OR (95% CI)</th> </tr> </thead> <tbody> <tr> <td colspan="5"><i>Use of sunscreens</i></td> </tr> <tr> <td>Never</td> <td>145(26.0%)</td> <td>275(30.9%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>Sometimes</td> <td>269(48.2%)</td> <td>409(45.9%)</td> <td>1.3(1.0-1.7)</td> <td>1.3(0.9-1.9)</td> </tr> <tr> <td>Always initially sometimes</td> <td>+52 (9.3%)</td> <td>104 (11.7%)</td> <td>1.0 (0.7-1.5)</td> <td>0.9 (0.6-1.5)</td> </tr> <tr> <td>Always</td> <td>92(16.5%)</td> <td>103(11.6%)</td> <td>1.9(1.3-2.7)</td> <td>1.8(1.1-2.9)</td> </tr> <tr> <td colspan="5"><i>Number of years of regular use</i></td> </tr> <tr> <td>None</td> <td>145(61.2%)</td> <td>275(72.8%)</td> <td>1.0</td> <td>1.0</td> </tr> <tr> <td>1-20</td> <td>48(20.3%)</td> <td>40(10.6%)</td> <td>3.8(1.5-9.6)</td> <td>4.3(0.8-21.9)</td> </tr> <tr> <td>>20</td> <td>44(18.6%)</td> <td>63(16.7%)</td> <td>1.3(0.6-2.7)</td> <td>1.7(0.5-5.6)</td> </tr> </tbody> </table> <p>*Adjusted for hair color, history of sunburns, frequency of sunbathing during the summer, and the duration of each sunbathing occasion</p>		Cases	Controls	OR (95% CI)	OR (95% CI)	<i>Use of sunscreens</i>					Never	145(26.0%)	275(30.9%)	1.0	1.0	Sometimes	269(48.2%)	409(45.9%)	1.3(1.0-1.7)	1.3(0.9-1.9)	Always initially sometimes	+52 (9.3%)	104 (11.7%)	1.0 (0.7-1.5)	0.9 (0.6-1.5)	Always	92(16.5%)	103(11.6%)	1.9(1.3-2.7)	1.8(1.1-2.9)	<i>Number of years of regular use</i>					None	145(61.2%)	275(72.8%)	1.0	1.0	1-20	48(20.3%)	40(10.6%)	3.8(1.5-9.6)	4.3(0.8-21.9)	>20	44(18.6%)	63(16.7%)	1.3(0.6-2.7)	1.7(0.5-5.6)	NR	
	Cases	Controls	OR (95% CI)	OR (95% CI)																																																	
<i>Use of sunscreens</i>																																																					
Never	145(26.0%)	275(30.9%)	1.0	1.0																																																	
Sometimes	269(48.2%)	409(45.9%)	1.3(1.0-1.7)	1.3(0.9-1.9)																																																	
Always initially sometimes	+52 (9.3%)	104 (11.7%)	1.0 (0.7-1.5)	0.9 (0.6-1.5)																																																	
Always	92(16.5%)	103(11.6%)	1.9(1.3-2.7)	1.8(1.1-2.9)																																																	
<i>Number of years of regular use</i>																																																					
None	145(61.2%)	275(72.8%)	1.0	1.0																																																	
1-20	48(20.3%)	40(10.6%)	3.8(1.5-9.6)	4.3(0.8-21.9)																																																	
>20	44(18.6%)	63(16.7%)	1.3(0.6-2.7)	1.7(0.5-5.6)																																																	

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered																																	
Case-control																																						
Westerdahl 2000 ⁴²	See Westerdahl et al 2000 ⁸⁵	See Westerdahl et al 2000 ⁸⁵	<p>Cases n= 571 Controls n= 913 Mean age (calc):</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>18-35</td> <td>NR</td> <td>87 (9.6%)</td> </tr> <tr> <td>36-60</td> <td>NR</td> <td>381(41.9%)</td> </tr> <tr> <td>61-80</td> <td>NR</td> <td>442 (48.6%)</td> </tr> </tbody> </table> <p>Sex:</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Male</td> <td>49.7%</td> <td>49.2%</td> </tr> </tbody> </table> <p>Skin phenotype (calc): skin reaction to sun exposure</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Tan/noburn</td> <td>NR</td> <td>118 (13.0%)</td> </tr> <tr> <td>Moderate tan</td> <td>NR</td> <td>479 (52.6%)</td> </tr> <tr> <td>Light tan</td> <td>NR</td> <td>272(29.9%)</td> </tr> <tr> <td>No tan</td> <td>NR</td> <td>10 (1.1%)</td> </tr> </tbody> </table>		Cases	Controls	18-35	NR	87 (9.6%)	36-60	NR	381(41.9%)	61-80	NR	442 (48.6%)		Cases	Controls	Male	49.7%	49.2%		Cases	Controls	Tan/noburn	NR	118 (13.0%)	Moderate tan	NR	479 (52.6%)	Light tan	NR	272(29.9%)	No tan	NR	10 (1.1%)	See Westerdahl et al 2000 ⁸⁵	See Westerdahl et al 2000 ⁸⁵
	Cases	Controls																																				
18-35	NR	87 (9.6%)																																				
36-60	NR	381(41.9%)																																				
61-80	NR	442 (48.6%)																																				
	Cases	Controls																																				
Male	49.7%	49.2%																																				
	Cases	Controls																																				
Tan/noburn	NR	118 (13.0%)																																				
Moderate tan	NR	479 (52.6%)																																				
Light tan	NR	272(29.9%)																																				
No tan	NR	10 (1.1%)																																				

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sunlamp or sunbed exposure																																																																																								
Case-control																																																																																										
Westerdahl 2000 ⁴²	NR	Odds ratios for developing cutaneous malignant melanoma in relation to sunbed use (calc) <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>OR (95% CI)</th> <th>Adjusted* OR (95% CI)</th> <th>Test for trend P-value</th> </tr> </thead> <tbody> <tr> <td colspan="6"><i>Exposure to sunbed</i></td> </tr> <tr> <td>Never</td> <td>319 (56.1%)</td> <td>538 (59.1%)</td> <td>1.0</td> <td>1.0</td> <td></td> </tr> <tr> <td>Sometimes</td> <td>162 (28.5%)</td> <td>270 (29.7%)</td> <td>1.1 (0.8-1.4)</td> <td>1.1 (0.8-1.4)</td> <td></td> </tr> <tr> <td>Regular</td> <td>88 (15.5%)</td> <td>102 (11.2%)</td> <td>1.6 (1.1-2.4)</td> <td>1.8 (1.2-2.7)</td> <td>0.05</td> </tr> <tr> <td colspan="6"><i>Total number of sunbed uses</i></td> </tr> <tr> <td>None</td> <td>319 (78.6%)</td> <td>538 (84.3%)</td> <td>1.0</td> <td>1.0</td> <td></td> </tr> <tr> <td>1-125</td> <td>22 (4.1%)</td> <td>32 (5.0%)</td> <td>1.7 (0.8-3.7)</td> <td>2.8 (1.0-7.8)</td> <td></td> </tr> <tr> <td>126-250</td> <td>34 (8.4%)</td> <td>31 (4.9%)</td> <td>2.2 (1.1-4.4)</td> <td>3.1 (1.3-7.1)</td> <td></td> </tr> <tr> <td>>250</td> <td>31 (7.6%)</td> <td>37 (5.8%)</td> <td>1.3 (0.7-2.5)</td> <td>1.5 (0.7-3.2)</td> <td>0.26</td> </tr> <tr> <td colspan="6"><i>Age at first exposure</i></td> </tr> <tr> <td>Never</td> <td>319 (78.4%)</td> <td>538 (84.3%)</td> <td>1.0</td> <td>1.0</td> <td></td> </tr> <tr> <td>≤35</td> <td>50 (12.3%)</td> <td>56 (8.8%)</td> <td>2.0 (1.2-3.5)</td> <td>2.3 (1.2-4.2)</td> <td></td> </tr> <tr> <td>>35</td> <td>38 (9.3%)</td> <td>44 (6.9%)</td> <td>1.6 (0.9-2.5)</td> <td>1.6 (0.9-2.9)</td> <td>NR</td> </tr> </tbody> </table>						Cases	Controls	OR (95% CI)	Adjusted* OR (95% CI)	Test for trend P-value	<i>Exposure to sunbed</i>						Never	319 (56.1%)	538 (59.1%)	1.0	1.0		Sometimes	162 (28.5%)	270 (29.7%)	1.1 (0.8-1.4)	1.1 (0.8-1.4)		Regular	88 (15.5%)	102 (11.2%)	1.6 (1.1-2.4)	1.8 (1.2-2.7)	0.05	<i>Total number of sunbed uses</i>						None	319 (78.6%)	538 (84.3%)	1.0	1.0		1-125	22 (4.1%)	32 (5.0%)	1.7 (0.8-3.7)	2.8 (1.0-7.8)		126-250	34 (8.4%)	31 (4.9%)	2.2 (1.1-4.4)	3.1 (1.3-7.1)		>250	31 (7.6%)	37 (5.8%)	1.3 (0.7-2.5)	1.5 (0.7-3.2)	0.26	<i>Age at first exposure</i>						Never	319 (78.4%)	538 (84.3%)	1.0	1.0		≤35	50 (12.3%)	56 (8.8%)	2.0 (1.2-3.5)	2.3 (1.2-4.2)		>35	38 (9.3%)	44 (6.9%)	1.6 (0.9-2.5)	1.6 (0.9-2.9)	NR
	Cases	Controls	OR (95% CI)	Adjusted* OR (95% CI)	Test for trend P-value																																																																																					
<i>Exposure to sunbed</i>																																																																																										
Never	319 (56.1%)	538 (59.1%)	1.0	1.0																																																																																						
Sometimes	162 (28.5%)	270 (29.7%)	1.1 (0.8-1.4)	1.1 (0.8-1.4)																																																																																						
Regular	88 (15.5%)	102 (11.2%)	1.6 (1.1-2.4)	1.8 (1.2-2.7)	0.05																																																																																					
<i>Total number of sunbed uses</i>																																																																																										
None	319 (78.6%)	538 (84.3%)	1.0	1.0																																																																																						
1-125	22 (4.1%)	32 (5.0%)	1.7 (0.8-3.7)	2.8 (1.0-7.8)																																																																																						
126-250	34 (8.4%)	31 (4.9%)	2.2 (1.1-4.4)	3.1 (1.3-7.1)																																																																																						
>250	31 (7.6%)	37 (5.8%)	1.3 (0.7-2.5)	1.5 (0.7-3.2)	0.26																																																																																					
<i>Age at first exposure</i>																																																																																										
Never	319 (78.4%)	538 (84.3%)	1.0	1.0																																																																																						
≤35	50 (12.3%)	56 (8.8%)	2.0 (1.2-3.5)	2.3 (1.2-4.2)																																																																																						
>35	38 (9.3%)	44 (6.9%)	1.6 (0.9-2.5)	1.6 (0.9-2.9)	NR																																																																																					
*Adjusted for hair color, number of raised naevi, skin type, and number of sunburns																																																																																										

Study reference USPSTF quality	Measurement of sunscreen use	Measurement of sunburn	Comments
Case-control			
Westerdahl 2000 ⁴²	NR	NR	

Study reference USPSTF quality	Skin cancer Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Measurement of exposure	Confounders considered																					
Case-control																										
Clough-Gorr 2008 ⁹²	Skin Cancer: Melanoma Study Design: Case-control Location: New Hampshire, US	Cases: Selection: First diagnosis of cutaneous malignant melanoma between 1995-1998 from the New Hampshire State Cancer Registry Eligibility criteria: Aged 20-69 years, working telephone number, English speaking, physician of record consent Controls: Selection: Randomly selected from the New Hampshire Department of Motor Vehicles Eligibility criteria: sex-, and age- (within 5 year age groups) matched	Cases n= 423 Controls n= 678 Mean age (SD): Cases: 50.1 (12.2) Controls: 50.3 (11.6) Sex: <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Male</td> <td>223 (52.7%)</td> <td>348 (51.3%)</td> </tr> </tbody> </table> Skin phenotype: <i>Sun sensitivity from acute exposure</i> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>Tan only</td> <td>14 (3.3%)</td> <td>68 (10.0%)</td> </tr> <tr> <td>Sunburn, then tan</td> <td>185 (43.8%)</td> <td>286 (41.6%)</td> </tr> <tr> <td>Sunburn, peeling/freckling</td> <td>20 (4.7%)</td> <td>42 (6.2%)</td> </tr> <tr> <td>Sunburn, then no tan</td> <td>204 (48.2%)</td> <td>282 (42.2%)</td> </tr> </tbody> </table>		Cases	Controls	Male	223 (52.7%)	348 (51.3%)		Cases	Controls	Tan only	14 (3.3%)	68 (10.0%)	Sunburn, then tan	185 (43.8%)	286 (41.6%)	Sunburn, peeling/freckling	20 (4.7%)	42 (6.2%)	Sunburn, then no tan	204 (48.2%)	282 (42.2%)	Sun sunbed exposure Telephone interview	Age, sex, education level, family history of melanoma, pigmentary characteristics, sunburn history, solar exposure history
	Cases	Controls																								
Male	223 (52.7%)	348 (51.3%)																								
	Cases	Controls																								
Tan only	14 (3.3%)	68 (10.0%)																								
Sunburn, then tan	185 (43.8%)	286 (41.6%)																								
Sunburn, peeling/freckling	20 (4.7%)	42 (6.2%)																								
Sunburn, then no tan	204 (48.2%)	282 (42.2%)																								

Appendix C Table 1. Evidence Table for the Association Between Sun Exposure, Indoor Tanning, or Sunscreen Use and Skin Cancer

Study reference USPSTF quality	Measurement of sun exposure	Measurement of sunlamp or sunbed exposure																																																																																																																																																			
Case-control																																																																																																																																																					
Clough-Gorr 2008 ⁹²	NR	<p>Odds ratios for developing cutaneous malignant melanoma in relation to sunlamp use</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> <th>Adjusted** OR (95% CI)</th> <th>Test for trend P-value</th> </tr> </thead> <tbody> <tr> <td colspan="6"><i>Exposure to sunlamp</i></td> </tr> <tr> <td>Never</td> <td>337 (79.7%)</td> <td>576 (85.1%)</td> <td>1.0</td> <td>1.0</td> <td></td> </tr> <tr> <td>Ever</td> <td>86 (20.3%)</td> <td>102 (15.0%)</td> <td>1.46 (1.06-2.01)</td> <td>1.39 (1.00-1.96)</td> <td></td> </tr> <tr> <td colspan="6"><i>Frequency of sunlamp use</i></td> </tr> <tr> <td>Never</td> <td>337 (79.9%)</td> <td>576 (85.1%)</td> <td>1.0</td> <td>1.0</td> <td>p=0.02</td> </tr> <tr> <td><6 times</td> <td>52 (11.6%)</td> <td>67 (9.4%)</td> <td>1.33 (0.89-1.98)</td> <td>1.29 (0.84-1.99)</td> <td></td> </tr> <tr> <td>6+ times</td> <td>33 (8.5%)</td> <td>34 (5.5%)</td> <td>1.69 (1.05-2.73)</td> <td>1.54 (0.93-2.57)</td> <td></td> </tr> <tr> <td colspan="6"><i>Age at first use</i></td> </tr> <tr> <td>Never</td> <td>337 (79.9%)</td> <td>576 (85.1%)</td> <td>1.0</td> <td>1.0</td> <td>p=0.05</td> </tr> <tr> <td>≤20</td> <td>52 (12.3%)</td> <td>67 (9.9%)</td> <td>1.34 (0.91-1.98)</td> <td>1.23 (0.81-1.88)</td> <td></td> </tr> <tr> <td>>20</td> <td>33 (7.8%)</td> <td>34 (5.0%)</td> <td>1.70 (1.03-2.80)</td> <td>1.71 (1.00-2.92)</td> <td></td> </tr> </tbody> </table> <p>Odds ratios for developing cutaneous malignant melanoma in relation to tanning bed use</p> <table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> <th>Adjusted* OR (95% CI)</th> <th>Adjusted** OR (95% CI)</th> <th>Test for trend P-value</th> </tr> </thead> <tbody> <tr> <td colspan="6"><i>Exposure to tanning bed</i></td> </tr> <tr> <td>Never</td> <td>326 (77.1%)</td> <td>536 (79.1%)</td> <td>1.0</td> <td>1.0</td> <td></td> </tr> <tr> <td>Ever</td> <td>97 (22.9%)</td> <td>142 (20.9%)</td> <td>1.15 (0.83-1.58)</td> <td>1.14 (0.80-1.61)</td> <td></td> </tr> <tr> <td colspan="6"><i>Frequency of tanning bed use</i></td> </tr> <tr> <td>Never</td> <td>326 (77.1%)</td> <td>536 (79.1%)</td> <td>1.0</td> <td>1.0</td> <td>p=0.42</td> </tr> <tr> <td><10 times</td> <td>43 (10.2%)</td> <td>78 (12%)</td> <td>0.93 (0.62-1.41)</td> <td>1.05 (0.67-1.64)</td> <td></td> </tr> <tr> <td>10+ times</td> <td>54 (12.7%)</td> <td>63 (9%)</td> <td>1.46 (0.96-2.21)</td> <td>1.25 (0.79-1.98)</td> <td></td> </tr> <tr> <td colspan="6"><i>Age at first use</i></td> </tr> <tr> <td>Never</td> <td>326 (77.1%)</td> <td>536 (79.2%)</td> <td>1.0</td> <td>1.0</td> <td>p=0.65</td> </tr> <tr> <td>≤20</td> <td>18 (4.3%)</td> <td>17 (2.5%)</td> <td>1.89 (0.90-3.97)</td> <td>1.78 (0.76-4.15)</td> <td></td> </tr> <tr> <td>>20</td> <td>79 (18.6%)</td> <td>124 (18.3%)</td> <td>1.07 (0.78-1.51)</td> <td>1.08 (0.75-1.55)</td> <td></td> </tr> </tbody> </table> <p>*Adjusted for age and gender **Adjusted for age, gender, family history of melanoma, hair color, freckles, sun sensitivity, and total sun exposure hours</p>					Cases	Controls	Adjusted* OR (95% CI)	Adjusted** OR (95% CI)	Test for trend P-value	<i>Exposure to sunlamp</i>						Never	337 (79.7%)	576 (85.1%)	1.0	1.0		Ever	86 (20.3%)	102 (15.0%)	1.46 (1.06-2.01)	1.39 (1.00-1.96)		<i>Frequency of sunlamp use</i>						Never	337 (79.9%)	576 (85.1%)	1.0	1.0	p=0.02	<6 times	52 (11.6%)	67 (9.4%)	1.33 (0.89-1.98)	1.29 (0.84-1.99)		6+ times	33 (8.5%)	34 (5.5%)	1.69 (1.05-2.73)	1.54 (0.93-2.57)		<i>Age at first use</i>						Never	337 (79.9%)	576 (85.1%)	1.0	1.0	p=0.05	≤20	52 (12.3%)	67 (9.9%)	1.34 (0.91-1.98)	1.23 (0.81-1.88)		>20	33 (7.8%)	34 (5.0%)	1.70 (1.03-2.80)	1.71 (1.00-2.92)			Cases	Controls	Adjusted* OR (95% CI)	Adjusted** OR (95% CI)	Test for trend P-value	<i>Exposure to tanning bed</i>						Never	326 (77.1%)	536 (79.1%)	1.0	1.0		Ever	97 (22.9%)	142 (20.9%)	1.15 (0.83-1.58)	1.14 (0.80-1.61)		<i>Frequency of tanning bed use</i>						Never	326 (77.1%)	536 (79.1%)	1.0	1.0	p=0.42	<10 times	43 (10.2%)	78 (12%)	0.93 (0.62-1.41)	1.05 (0.67-1.64)		10+ times	54 (12.7%)	63 (9%)	1.46 (0.96-2.21)	1.25 (0.79-1.98)		<i>Age at first use</i>						Never	326 (77.1%)	536 (79.2%)	1.0	1.0	p=0.65	≤20	18 (4.3%)	17 (2.5%)	1.89 (0.90-3.97)	1.78 (0.76-4.15)		>20	79 (18.6%)	124 (18.3%)	1.07 (0.78-1.51)	1.08 (0.75-1.55)	
	Cases	Controls	Adjusted* OR (95% CI)	Adjusted** OR (95% CI)	Test for trend P-value																																																																																																																																																
<i>Exposure to sunlamp</i>																																																																																																																																																					
Never	337 (79.7%)	576 (85.1%)	1.0	1.0																																																																																																																																																	
Ever	86 (20.3%)	102 (15.0%)	1.46 (1.06-2.01)	1.39 (1.00-1.96)																																																																																																																																																	
<i>Frequency of sunlamp use</i>																																																																																																																																																					
Never	337 (79.9%)	576 (85.1%)	1.0	1.0	p=0.02																																																																																																																																																
<6 times	52 (11.6%)	67 (9.4%)	1.33 (0.89-1.98)	1.29 (0.84-1.99)																																																																																																																																																	
6+ times	33 (8.5%)	34 (5.5%)	1.69 (1.05-2.73)	1.54 (0.93-2.57)																																																																																																																																																	
<i>Age at first use</i>																																																																																																																																																					
Never	337 (79.9%)	576 (85.1%)	1.0	1.0	p=0.05																																																																																																																																																
≤20	52 (12.3%)	67 (9.9%)	1.34 (0.91-1.98)	1.23 (0.81-1.88)																																																																																																																																																	
>20	33 (7.8%)	34 (5.0%)	1.70 (1.03-2.80)	1.71 (1.00-2.92)																																																																																																																																																	
	Cases	Controls	Adjusted* OR (95% CI)	Adjusted** OR (95% CI)	Test for trend P-value																																																																																																																																																
<i>Exposure to tanning bed</i>																																																																																																																																																					
Never	326 (77.1%)	536 (79.1%)	1.0	1.0																																																																																																																																																	
Ever	97 (22.9%)	142 (20.9%)	1.15 (0.83-1.58)	1.14 (0.80-1.61)																																																																																																																																																	
<i>Frequency of tanning bed use</i>																																																																																																																																																					
Never	326 (77.1%)	536 (79.1%)	1.0	1.0	p=0.42																																																																																																																																																
<10 times	43 (10.2%)	78 (12%)	0.93 (0.62-1.41)	1.05 (0.67-1.64)																																																																																																																																																	
10+ times	54 (12.7%)	63 (9%)	1.46 (0.96-2.21)	1.25 (0.79-1.98)																																																																																																																																																	
<i>Age at first use</i>																																																																																																																																																					
Never	326 (77.1%)	536 (79.2%)	1.0	1.0	p=0.65																																																																																																																																																
≤20	18 (4.3%)	17 (2.5%)	1.89 (0.90-3.97)	1.78 (0.76-4.15)																																																																																																																																																	
>20	79 (18.6%)	124 (18.3%)	1.07 (0.78-1.51)	1.08 (0.75-1.55)																																																																																																																																																	
Case-control																																																																																																																																																					
Clough-Gorr 2008 ⁹²	NR	NR																																																																																																																																																			

Abbreviations: BCC=basal cell carcinoma; SCC=squamous cell carcinoma; RCT=randomized controlled trial; IG=intervention group; CG=control group; S=sunscreen; B=beta-carotene; (S+B)=sunscreen and beta-carotene; ppt=participant; CI=confidence interval; NR=not reported; RR=relative risk; BMI=body mass index; NHS=Nurses' Health Study; OR=odds ratio; dx=diagnosis; fam hx=family history; SPF=sun protection factor; NS=not significant; LRT=likelihood ratio test; (c)=calculated.

Appendix C Table 2. Studies Excluded From the Review for Key Question 4

Reference	Reason for exclusion
Abdulla FR, Feldman SR, Williford PM, Krowchuk D, Kaur M. Tanning and skin cancer. <i>Pediatr Dermatol.</i> 2005;22:501-512.	Study design
Adam SA, Sheaves JK, Wright NH, Mosser G, Harris RW, Vessey MP. A case-control study of the possible association between oral contraceptives and malignant melanoma. <i>Br J Cancer</i> 1981;44(1):45-50.	Quality
Almahroos M, Kurban AK. Ultraviolet carcinogenesis in nonmelanoma skin cancer part II: review and update on epidemiologic correlations. <i>Skinmed.</i> 2004;3:132-139.	Study design
Araki K, Nagano T, Ueda M, et al. Incidence of skin cancers and precancerous lesions in Japanese—risk factors and prevention. <i>J Epidemiol.</i> 1999;9(6 Suppl):S14-21.	No relevant outcomes
Aubry F, MacGibbon B. Risk factors of squamous cell carcinoma of the skin. A case-control study in the Montreal region. <i>Cancer.</i> 1985;55:907-911.	Study design
Autier P, Dore JF, Cattaruzza MS, et al. Sunscreen use, wearing clothes, and number of nevi in 6- to 7-year-old European children. European Organization for Research and Treatment of Cancer Melanoma Cooperative Group. <i>J Natl Cancer Inst.</i> 1998;90:1873-1880.	Study design
Autier P, Dore JF, Gefeller O, et al. Melanoma risk and residence in sunny areas. EORTC Melanoma Cooperative Group. European Organization for Research and Treatment of Cancer. <i>Br J Cancer.</i> 1997;76:1521-1524.	Study design
Autier P, Dore JF, Lejeune F, et al. Cutaneous malignant melanoma and exposure to sunlamps or sunbeds: an EORTC multicenter case-control study in Belgium, France and Germany. EORTC Melanoma Cooperative Group. <i>Int J Cancer.</i> 1994;58:809-813.	Study design
Autier P, Dore JF, Schiffllers E, et al. Melanoma and use of sunscreens: an EORTC case-control study in Germany, Belgium and France. EORTC Melanoma Cooperative Group. <i>Int J Cancer.</i> 1995;61:749-755.	Study design
Autier P. Cutaneous malignant melanoma: facts about sunbeds and sunscreen. <i>Expert Rev Anticancer Ther.</i> 2005;5:821-833.	Study design
Autier P. Perspectives in melanoma prevention: the case of sunbeds. <i>Eur J Cancer.</i> 2004;40:2367-2376.	Study design
Bajdik CD, Gallagher RP, Hill GB, Fincham S. Sunlight exposure, hat use, and squamous cell skin cancer on the head and neck. <i>J Cutan Med Surg.</i> 1998;3:68-73.	Outcome/exposure of interest not reported
Bakos L, Wagner M, Bakos RM, et al. Sunburn, sunscreens, and phenotypes: some risk factors for cutaneous melanoma in southern Brazil. <i>Int J Dermatol.</i> 2002;41:557-562.	Study design
Bastuji-Garin S, Diepgen TL. Cutaneous malignant melanoma, sun exposure, and sunscreen use: epidemiological evidence. <i>Br J Dermatol.</i> 2002;146(Suppl 61):24-30.	Study design
Bataille V, Winnett A, Sasieni P, Newton Bishop JA, Cuzick J. Exposure to the sun and sunbeds and the risk of cutaneous melanoma in the UK: a case-control study. <i>Eur J Cancer.</i> 2004;40:429-435.	Study design
Beitner H, Norell SE, Ringborg U, Wennersten G, Mattson B. Malignant melanoma: aetiological importance of individual pigmentation and sun exposure. <i>Br J Dermatol.</i> 1990;122:43-51.	Study design
Beral V, Evans S, Shaw H, Milton G. Malignant melanoma and exposure to fluorescent lighting at work. <i>Lancet.</i> 1982;2:290-293.	Study design
Beral V, Robinson N. The relationship of malignant melanoma, basal and squamous skin cancers to indoor and outdoor work. <i>Br J Cancer.</i> 1981;44:886-891.	No relevant outcomes
Berwick M, Armstrong BK, Ben-Porat L, et al. Sun exposure and mortality from melanoma. <i>J Natl Cancer Inst.</i> 2005;97:195-199.	Study design
Berwick M, Wiggins C. The current epidemiology of cutaneous malignant melanoma. <i>Front Biosci.</i> 2006;11:1244-1254.	Study design
Boniol M, Autier P, Dore JF. Photoprotection. <i>Lancet.</i> 2007;370:1481-1482.	Study design
Boscoe FP, Schymura MJ. Solar ultraviolet-B exposure and cancer incidence and mortality in the United States, 1993-2002. <i>BMC Cancer.</i> 2006;6:264.	Study design
Boyd AS, Shyr Y, King LE Jr. Basal cell carcinoma in young women: an evaluation of the association of tanning bed use and smoking. <i>J Am Acad Dermatol.</i> 2002;46:706-709.	Quality

Appendix C Table 2. Studies Excluded From the Review for Key Question 4

Reference	Reason for exclusion
Carey FA, Hogan JM. The relationship of sun exposure and solar elastosis to skin cancer in a high risk population. <i>Ir J Med Sci.</i> 1990;159:44-47.	Study design
Cho E, Rosner BA, Colditz GA. Risk factors for melanoma by body site. <i>Cancer Epidemiol Biomarkers Prev.</i> 2005;14:1241-1244.	No relevant outcomes
Cockburn M, Black W, McKelvey W, Mack T. Determinants of melanoma in a case-control study of twins (United States). <i>Cancer Causes Control.</i> 2001;12:615-625.	No relevant outcomes. Measures of sun exposure are very different from other studies
Cooke KR, Skegg DC, Fraser J. Socio-economic status, indoor and outdoor work, and malignant melanoma. <i>Int J Cancer.</i> 1984;34:57-62.	No relevant outcomes
Corona R, Dogliotti E, D'Errico M, et al. Risk factors for basal cell carcinoma in a Mediterranean population: role of recreational sun exposure early in life. <i>Arch Dermatol.</i> 2001;137:1162-1168.	Study design
Cress RD, Holly EA, Ahn DK. Cutaneous melanoma in women, V: characteristics of those who tan and those who burn when exposed to summer sun. <i>Epidemiology.</i> 1995;6:538-543.	Outcome/exposure of interest not reported
Dal H, Boldemann C, Lindelof B. Does relative melanoma distribution by body site 1960-2004 reflect changes in intermittent exposure and intentional tanning in the Swedish population? <i>Eur J Dermatol.</i> 2007;17:428-434.	Study relevance
Dennis LK, Beane Freeman LE, VanBeek MJ. Sunscreen use and the risk for melanoma: a quantitative review. <i>Ann Intern Med.</i> 2003;139:966-978.	Used as source document
Dixon A. Arc welding and the risk of cancer. <i>Aust Fam Physician.</i> 2007;36:255-256.	Study design
Dubin N, Moseson M, Pasternack BS. Epidemiology of malignant melanoma: pigmentary traits, ultraviolet radiation, and the identification of high-risk populations. <i>Recent Results Cancer Res.</i> 1986;102:56-75.	Study design
Dubin N, Moseson M, Pasternack BS. Sun exposure and malignant melanoma among susceptible individuals. <i>Environ Health Perspect.</i> 1989;81:139-151.	Study design
Dubin N, Pasternack BS, Moseson M. Simultaneous assessment of risk factors for malignant melanoma and non-melanoma skin lesions, with emphasis on sun exposure and related variables. <i>Int J Epidemiol.</i> 1990;19:811-819.	Study design
Dunn-Lane J, Herity B, Moriarty MJ, Conroy R. A case control study of malignant melanoma. <i>Ir Med J.</i> 1993;86:57-59.	Study design
el Khwsky F, Bedwani R, D'Avanzo B, et al. Risk factors for non-melanomatous skin cancer in Alexandria, Egypt. <i>Int J Cancer.</i> 1994;56:375-378.	Study design
Elwood JM, Jopson J. Melanoma and sun exposure: an overview of published studies. <i>Int J Cancer.</i> 1997;73:198-203.	Used as source document
Elwood JM, Williamson C, Stapleton PJ. Malignant melanoma in relation to moles, pigmentation, and exposure to fluorescent and other lighting sources. <i>Br J Cancer.</i> 1986;53:65-74.	Study design
Engel A, Johnson ML, Haynes SG. Health effects of sunlight exposure in the United States. Results from the first National Health and Nutrition Examination Survey, 1971-1974. <i>Arch Dermatol.</i> 1988;124:72-79.	Study design
English DR, Armstrong BK, Krickler A, Fleming C. Sunlight and cancer. <i>Cancer Causes Control.</i> 1997;8:271-283.	Study design
English DR, Milne E, Simpson JA. Sun protection and the development of melanocytic nevi in children. <i>Cancer Epidemiol Biomarkers Prev.</i> 2005;14:2873-2876.	No relevant outcomes
Espinosa AJ, Sanchez Hernandez JJ, Bravo FP, et al. Cutaneous malignant melanoma and sun exposure in Spain. <i>Melanoma Res.</i> 1999;9:199-205.	Study design
Evans RD, Kopf AW, Lew RA, et al. Risk factors for the development of malignant melanoma, I: review of case-control studies. <i>J Dermatol Surg Oncol.</i> 1988;14:393-408.	Study design
Farmer KC, Naylor MF. Sun exposure, sunscreens, and skin cancer prevention: a year-round concern. <i>Ann Pharmacother.</i> 1996;30:662-673.	Study design
Faurschou A, Wulf HC. Ecological analysis of the relation between sunbeds and skin cancer. <i>Photodermatol Photoimmunol Photomed.</i> 2007;23:120-125.	Study design
Fears TR, Gail MH. Analysis of a two-stage case-control study with cluster sampling of controls: application to nonmelanoma skin cancer. <i>Biometrics.</i> 2000;56:190-198.	Study relevance

Appendix C Table 2. Studies Excluded From the Review for Key Question 4

Reference	Reason for exclusion
Fears TR, Scotto J, Schneiderman MA. Mathematical models of age and ultraviolet effects on the incidence of skin cancer among whites in the United States. <i>Am J Epidemiol.</i> 1977;105:420-427.	Study design
Freedman DM, Zahm SH, Dosemeci M. Residential and occupational exposure to sunlight and mortality from non-Hodgkin's lymphoma: composite (threefold) case-control study. <i>BMJ.</i> 1997;314:1451-1455.	No relevant outcomes
Fritschi L, Siemiatycki J. Melanoma and occupation: results of a case-control study. <i>Occup Environ Med.</i> 1996;53:168-173.	No relevant outcomes
Gafa L, Filippazzo MG, Tumino R, Dardanoni G, Lanzarone F, Dardanoni L. Risk factors of nonmelanoma skin cancer in Ragusa, Sicily: a case-control study. <i>Cancer Causes Control.</i> 1991;2:395-399.	Quality
Gallagher RP, Rivers JK, Lee TK, Bajdik CD, McLean DI, Coldman AJ. Broad-spectrum sunscreen use and the development of new nevi in white children: a randomized controlled trial. <i>JAMA.</i> 2000;283:2955-2960.	No relevant outcomes
Gallagher RP, Spinelli JJ, Lee TK. Tanning beds, sunlamps, and risk of cutaneous malignant melanoma. <i>Cancer Epidemiol Biomarkers Prev.</i> 2005;14:562-566.	Used as source document
Gamble JF, Lerman SE, Holder WR, Nicolich MJ, Yarborough CM. Physician-based case-control study of non-melanoma skin cancer in Baytown, Texas. <i>Occup Med (Lond).</i> 1996;46:186-196.	Quality
Gandini S, Sera F, Cattaruzza MS, et al. Meta-analysis of risk factors for cutaneous melanoma, III: family history, actinic damage and phenotypic factors. <i>Eur J Cancer.</i> 2005;41:2040-2059.	Study relevance
Gandini S, Sera F, Cattaruzza MS, et al. Meta-analysis of risk factors for cutaneous melanoma, I: common and atypical naevi. <i>Eur J Cancer.</i> 2005;41:28-44.	Study relevance
Gandini S, Sera F, Cattaruzza MS, et al. Meta-analysis of risk factors for cutaneous melanoma, II: sun exposure. <i>Eur J Cancer.</i> 2005;41:45-60.	Used as source document
Garbe C, Weiss J, Kruger S, et al. The German melanoma registry and environmental risk factors implied. <i>Recent Results Cancer Res.</i> 1993;128:69-89.	Quality
Gefeller O, Pfahlerberg A. Sunscreen use and melanoma: a case of evidence-based prevention? <i>Photodermatol Photoimmunol Photomed.</i> 2002;18:153-156.	Study design
Geller AC, Colditz G, Oliveria S, et al. Use of sunscreen, sunburning rates, and tanning bed use among more than 10,000 US children and adolescents. <i>Pediatrics.</i> 2002;109:1009-1014.	No relevant outcomes
Giles GG, Marks R, Foley P. Incidence of non-melanocytic skin cancer treated in Australia. <i>BMJ.</i> 1988;296:13-17.	Study design
Goodman KJ, Bible ML, London S, Mack TM. Proportional melanoma incidence and occupation among white males in Los Angeles County (California, United States). <i>Cancer Causes Control.</i> 1995;6:451-459.	No relevant outcomes
Gorham ED, Mohr SB, Garland CF, Chaplin G, Garland FC. Do sunscreens increase risk of melanoma in populations residing at higher latitudes? <i>Ann Epidemiol.</i> 2007;17:956-963.	Used as source document
Graham S, Marshall J, Haughey B, et al. An inquiry into the epidemiology of melanoma. <i>Am J Epidemiol.</i> 1985;122:606-619.	Study design
Green A, Battistutta D. Incidence and determinants of skin cancer in a high-risk Australian population. <i>Int J Cancer.</i> 1990;46:356-361.	Study design
Green A, Beardmore G, Hart V, Leslie D, Marks R, Staines D. Skin cancer in a Queensland population. <i>J Am Acad Dermatol.</i> 1988;19:1045-1052.	Study design
Green A, McCredie M, MacKie R, et al. A case-control study of melanomas of the soles and palms (Australia and Scotland). <i>Cancer Causes Control.</i> 1999;10:21-25.	Study relevance
Green AE, Findley GB Jr, Klenk KF, Wilson WM, Mo T. The ultraviolet dose dependence of non-melanoma skin cancer incidence. <i>Photochem Photobiol.</i> 1976;24:353-362.	Study design
Hakansson N, Floderus B, Gustavsson P, Feychting M, Hallin N. Occupational sunlight exposure and cancer incidence among Swedish construction workers. <i>Epidemiology.</i> 2001;12:552-557.	No relevant outcomes
Harvey I, Frankel S, Marks R, Shalom D, Nolan-Farrell M. Non-melanoma skin cancer and solar keratoses, II: analytical results of the South Wales Skin Cancer Study. <i>Br J Cancer.</i> 1996;74:1308-1312.	No relevant outcomes

Appendix C Table 2. Studies Excluded From the Review for Key Question 4

Reference	Reason for exclusion
Harvey I, Frankel S, Marks R, Shalom D, Nolan-Farrell M. Non-melanoma skin cancer and solar keratoses, I: methods and descriptive results of the South Wales Skin Cancer Study. <i>Br J Cancer</i> . 1996;74:1302-1307.	No relevant outcomes
Heckmann M, Zogelmeier F, Konz B. Frequency of facial basal cell carcinoma does not correlate with site-specific UV exposure. <i>Arch Dermatol</i> . 2002;138:1494-1497.	Study design
Herity B, O'Loughlin G, Moriarty MJ, Conroy R. Risk factors for non-melanoma skin cancer. <i>Ir Med J</i> . 1989;82:151-152.	Study design
Herzfeld PM, Fitzgerald EF, Hwang SA, Stark A. A case-control study of malignant melanoma of the trunk among white males in upstate New York. <i>Cancer Detect Prev</i> . 1993;17(6):601-608.	Quality
Hogan DJ, Lane PR, Gran L, Wong D. Risk factors for squamous cell carcinoma of the skin in Saskatchewan, Canada. <i>J Dermatol Sci</i> . 1990;1:97-101.	No relevant outcomes
Hogan DJ, To T, Gran L, Wong D, Lane PR. Risk factors for basal cell carcinoma. <i>Int J Dermatol</i> . 1989;28:591-594.	Quality
Holly EA, Kelly JW, Shpall SN, Chiu SH. Number of melanocytic nevi as a major risk factor for malignant melanoma. <i>J Am Acad Dermatol</i> . 1987;17:459-468.	No relevant outcomes
Holman CD, Armstrong BK, Heenan PJ, et al. The causes of malignant melanoma: results from the West Australian Lions Melanoma Research Project. <i>Recent Results Cancer Res</i> . 1986;102:18-37.	Population
Holman CD, Armstrong BK, Heenan PJ. Relationship of cutaneous malignant melanoma to individual sunlight-exposure habits. <i>J Natl Cancer Inst</i> . 1986;76:403-414.	Population
Holman CD, Armstrong BK. Pigmentary traits, ethnic origin, benign nevi, and family history as risk factors for cutaneous malignant melanoma. <i>J Natl Cancer Inst</i> . 1984;72:257-266.	Population
Huncharek M, Kupelnick B. Use of topical sunscreens and the risk of malignant melanoma: a meta-analysis of 9067 patients from 11 case-control studies. <i>Am J Public Health</i> . 2002;92:1173-1177.	Used as source document
Ibrahim SF, Brown MD. Tanning and cutaneous malignancy. <i>Dermatol Surg</i> . 2008;34:460-474.	Study design
Ivry GB, Ogle CA, Shim EK. Role of sun exposure in melanoma. <i>Dermatol Surg</i> . 2006;32:481-492.	Study design
John EM, Dreon DM, Koo J, Schwartz GG. Residential sunlight exposure is associated with a decreased risk of prostate cancer. <i>J Steroid Biochem Mol Biol</i> . 2004;89-90:549-552.	Study design
Karagas MR, Greenberg ER, Spencer SK, Stukel TA, Mott LA. Increase in incidence rates of basal cell and squamous cell skin cancer in New Hampshire, USA. New Hampshire Skin Cancer Study Group. <i>Int J Cancer</i> . 1999;81:555-559.	Study relevance
Kaskel P, Sander S, Kron M, Kind P, Peter RU, Krahn G. Outdoor activities in childhood: a protective factor for cutaneous melanoma? Results of a case-control study in 271 matched pairs. <i>Br J Dermatol</i> . 2001;145:602-609.	Quality
Klepp O, Magnus K. Some environmental and bodily characteristics of melanoma patients. A case-control study. <i>Int J Cancer</i> . 1979;23:482-486.	Study design
Kricker A, Armstrong BK, English DR. Sun exposure and non-melanocytic skin cancer. <i>Cancer Causes Control</i> . 1994;5:367-392.	Study design
Kricker A, Armstrong BK, Goumas C, et al. Ambient UV, personal sun exposure and risk of multiple primary melanomas. <i>Cancer Causes Control</i> . 2007;18:295-304.	Study design
Landi MT, Baccarelli A, Calista D, et al. Combined risk factors for melanoma in a Mediterranean population. <i>Br J Cancer</i> . 2001;85:1304-1310.	Quality
Lazovich D, Sweeney C, Weinstock MA, Berwick M. A prospective study of pigmentation, sun exposure, and risk of cutaneous malignant melanoma in women. <i>J Natl Cancer Inst</i> . 2004;96:335-338.	Study design
Lear JT, Harvey I, de Berker D, Strange RC, Fryer AA. Basal cell carcinoma. <i>J R Soc Med</i> . 1998;91:585-588.	Study design
Lee JA, Strickland D. Malignant melanoma: social status and outdoor work. <i>Br J Cancer</i> . 1980;41:757-763.	No relevant outcomes
Leiter U, Garbe C. Epidemiology of melanoma and nonmelanoma skin cancer—the role of sunlight. <i>Adv Exp Med Biol</i> . 2008;624:89-103.	Study design

Appendix C Table 2. Studies Excluded From the Review for Key Question 4

Reference	Reason for exclusion
Lim JL, Stern RS. High levels of ultraviolet B exposure increase the risk of non-melanoma skin cancer in psoralen and ultraviolet A-treated patients. <i>J Invest Dermatol.</i> 2005;124:505-513.	Population
Lock-Andersen J, Drzewiecki KT, Wulf HC. Eye and hair colour, skin type and constitutive skin pigmentation as risk factors for basal cell carcinoma and cutaneous malignant melanoma. A Danish case-control study. <i>Acta Derm Venereol.</i> 1999;79:74-80.	No relevant outcomes
Lock-Andersen J, Drzewiecki KT, Wulf HC. Naevi as a risk factor for basal cell carcinoma in Caucasians: a Danish case-control study. <i>Acta Derm Venereol.</i> 1999;79:314-319.	No relevant outcomes
Loria D, Matos E. Risk factors for cutaneous melanoma: a case-control study in Argentina. <i>Int J Dermatol.</i> 2001;40:108-114.	Study design
Lovatt TJ, Lear JT, Bastrilles J, et al. Associations between UVR exposure and basal cell carcinoma site and histology. <i>Cancer Lett.</i> 2004;216:191-197.	Study design
MacKie RM, Freudenberger T, Aitchison TC. Personal risk-factor chart for cutaneous melanoma. <i>Lancet.</i> 1989;2:487-490.	Study design
Maia M, Proenca NG, de Moraes JC. Risk factors for basal cell carcinoma: a case-control study. <i>Rev Saude Publica.</i> 1995;29:27-37.	Quality
Marks R, Jolley D, Dorevitch AP, Selwood TS. The incidence of non-melanocytic skin cancers in an Australian population: results of a five-year prospective study. <i>Med J Aust.</i> 1989;150:475-478.	No relevant outcomes
Marks R, Ponsford MW, Selwood TS, Goodman G, Mason G. Non-melanotic skin cancer and solar keratoses in Victoria. <i>Med J Aust.</i> 1983;2:619-622.	Study design
Marks R, Rennie G, Selwood T. The relationship of basal cell carcinomas and squamous cell carcinomas to solar keratoses. <i>Arch Dermatol.</i> 1988;124:1039-1042.	Study design
Memon AA, Tomenson JA, Bothwell J, Friedmann PS. Prevalence of solar damage and actinic keratosis in a Merseyside population. <i>Br J Dermatol.</i> 2000;142:1154-1159.	Study design
Moore DH, Patterson HW, Hatch F, et al. Case-control study of malignant melanoma among employees of the Lawrence Livermore National Laboratory. <i>Am J Ind Med.</i> 1997;32:377-391.	Quality
Morales Suarez-Varela M, Llopis GA, Ferrer CE. Non-melanoma skin cancer: an evaluation of risk in terms of ultraviolet exposure. <i>Eur J Epidemiol.</i> 1992;8:838-844.	Study design
Naldi L, Altieri A, Imberti GL, et al. Cutaneous malignant melanoma in women. Phenotypic characteristics, sun exposure, and hormonal factors: a case-control study from Italy. <i>Ann Epidemiol.</i> 2005;15:545-550.	Study design
Naldi L, Altieri A, Imberti GL, et al. Sun exposure, phenotypic characteristics, and cutaneous malignant melanoma. An analysis according to different clinico-pathological variants and anatomic locations (Italy). <i>Cancer Causes Control.</i> 2005;16:893-899.	Study design
Naldi L, DiLandro A, D'Avanzo B, Parazzini F. Host-related and environmental risk factors for cutaneous basal cell carcinoma: evidence from an Italian case-control study. <i>J Am Acad Dermatol.</i> 2000;42:446-452.	Study design
Naldi L, Gallus S, Imberti GL, Cainelli T, Negri E, La Vecchia C. Sunlamps and sunbeds and the risk of cutaneous melanoma. Italian Group for Epidemiological Research in Dermatology. <i>Eur J Cancer Prev.</i> 2000;9:133-134.	Study design
Naldi L, Gallus S, Imberti GL, Cainelli T, Negri E, La Vecchia C. Sunscreens and cutaneous malignant melanoma: an Italian case-control study. <i>Int J Cancer.</i> 2000;86:879-882.	Study design
Naylor MF, Boyd A, Smith DW, Cameron GS, Hubbard D, Neldner KH. High sun protection factor sunscreens in the suppression of actinic neoplasia. <i>Arch Dermatol.</i> 1995;131:170-175.	No relevant outcomes
Nelemans PJ, Groenendal H, Kiemeneij LA, Rampen FH, Ruiters DJ, Verbeek AL. Effect of intermittent exposure to sunlight on melanoma risk among indoor workers and sun-sensitive individuals. <i>Environ Health Perspect.</i> 1993;101:252-255.	No relevant outcomes
Nelemans PJ, Rampen FH, Ruiters DJ, Verbeek AL. An addition to the controversy on sunlight exposure and melanoma risk: a meta-analytical approach. <i>J Clin Epidemiol.</i> 1995;48:1331-1342.	Used as source document

Appendix C Table 2. Studies Excluded From the Review for Key Question 4

Reference	Reason for exclusion
Nijsten T, Leys C, Verbruggen K, et al. Case-control study to identify melanoma risk factors in the Belgian population: the significance of clinical examination. <i>J Eur Acad Dermatol Venereol</i> . 2005;19:332-339.	Study design
Nikolaou NA, Sypsa V, Stefanaki I, et al. Risk associations of melanoma in a Southern European population: results of a case/control study. <i>Cancer Causes Control</i> 2008;19(7):671-679.	Quality
Oliveria SA, Saraiya M, Geller AC, Heneghan MK, Jorgensen C. Sun exposure and risk of melanoma. <i>Arch Dis Child</i> . 2006;91:131-138.	Used as source document
Pelucchi C, Di Landro A, Naldi L, La Vecchia C; Oncology Study Group of the Italian Group for Epidemiologic Research in Dermatology (GISED). Risk factors for histological types and anatomic sites of cutaneous basal-cell carcinoma: an Italian case-control study. <i>J Invest Dermatol</i> . 2007;127:935-944.	Study design
Pion IA, Rigel DS, Garfinkel L, Silverman MK, Kopf AW. Occupation and the risk of malignant melanoma. <i>Cancer</i> . 1995;75:637-644.	No relevant outcomes
Prawer SE. Sun-related skin diseases. <i>Postgrad Med</i> . 1959;89:51-54.	Study design
Pukkala E, Saarni H. Cancer incidence among Finnish seafarers, 1967-92. <i>Cancer Causes Control</i> . 1996;7:231-239.	Study relevance
Purdue MP, From L, Armstrong BK, et al. Etiologic and other factors predicting nevus-associated cutaneous malignant melanoma. <i>Cancer Epidemiol Biomarkers Prev</i> . 2005;14:2015-2022.	Study design
Rafnsson V, Hrafnkelsson J, Tulinius H, Sigurgeirsson B, Olafsson JH. Risk factors for malignant melanoma in an Icelandic population sample. <i>Prev Med</i> . 2004;39:247-252.	Study design
Ramos J, Villa J, Ruiz A, Armstrong R, Matta J. UV dose determines key characteristics of nonmelanoma skin cancer. <i>Cancer Epidemiol Biomarkers Prev</i> . 2004;13:2006-2011.	Study design
Robinson JK, Rademaker AW. Relative importance of prior basal cell carcinomas, continuing sun exposure, and circulating T lymphocytes on the development of basal cell carcinoma. <i>J Invest Dermatol</i> . 1992;99:227-231.	Study design
Rodenas JM, Gado-Rodriguez M, Herranz MT, Tercedor J, Serrano S. Sun exposure, pigmentary traits, and risk of cutaneous malignant melanoma: a case-control study in a Mediterranean population. <i>Cancer Causes Control</i> . 1996;7:275-283.	Study design
Rosso S, Zanetti R, Martinez C, et al. The multicentre south European study "Helios," II: different sun exposure patterns in the aetiology of basal cell and squamous cell carcinomas of the skin. <i>Br J Cancer</i> . 1996;73:1447-1454.	Study design
Rosso S, Zanetti R, Pippione M, Sancho-Garnier H. Parallel risk assessment of melanoma and basal cell carcinoma: skin characteristics and sun exposure. <i>Melanoma Res</i> . 1998;8:573-583.	Study design
Sahl WJ, Glore S, Garrison P, Oakleaf K, Johnson SD. Basal cell carcinoma and lifestyle characteristics. <i>Int J Dermatol</i> . 1995;34:398-402.	Quality
Saladi RN, Persaud AN. The causes of skin cancer: a comprehensive review. <i>Drug Today</i> . 2005;41:37-53.	Study design
Schmieder GJ, Yoshikawa T, Mata SM, Streilein JW, Taylor JR. Cumulative sunlight exposure and the risk of developing skin cancer in Florida. <i>J Dermatol Surg Oncol</i> . 1992;18:517-522.	Quality
Scrivener Y, Grosshans E, Cribier B. Variations of basal cell carcinomas according to gender, age, location and histopathological subtype. <i>Br J Dermatol</i> . 2002;147:41-47.	No relevant outcomes
Shah CP, Weis E, Lajous M, Shields JA, Shields CL. Intermittent and chronic ultraviolet light exposure and uveal melanoma: a meta-analysis. <i>Ophthalmology</i> . 2005;112:1599-1607.	Study relevance
Singh B, Bhaya M, Shaha A, Har-EI G, Lucente FE. Presentation, course, and outcome of head and neck skin cancer in African Americans: a case-control study. <i>Laryngoscope</i> . 1998;108:t-63.	Study design
Siskind V, Aitken J, Green A, Martin N. Sun exposure and interaction with family history in risk of melanoma, Queensland, Australia. <i>Int.J.Cancer</i> 2002;97(1):90-95.	Quality
Stender IM, Andersen JL, Wulf HC. Sun exposure and sunscreen use among sunbathers in Denmark. <i>Acta Derm Venereol</i> . 1996;76:31-33.	Study design

Appendix C Table 2. Studies Excluded From the Review for Key Question 4

Reference	Reason for exclusion
Strickland PT, Vitasa BC, West SK, Rosenthal FS, Emmett EA, Taylor HR. Quantitative carcinogenesis in man: solar ultraviolet B dose dependence of skin cancer in Maryland watermen. <i>J Natl Cancer Inst.</i> 1989;81:1910-1913.	Study design
Suarez-Varela MM, Llopis GA, Ferrer CE. Non-melanoma skin cancer: a case-control study on risk factors and protective measures. <i>J Environ Pathol Toxicol Oncol.</i> 1996;15:255-261.	Study design
Sunscreen use in children may lower risk of developing future skin cancer. <i>Oncology (Williston Park).</i> 2005;19:1139-1140.	No relevant outcomes
Swerdlow AJ, English JS, MacKie RM, et al. Fluorescent lights, ultraviolet lamps, and risk of cutaneous melanoma. <i>BMJ.</i> 1988;297:647-650.	Study design
The association of use of sunbeds with cutaneous malignant melanoma and other skin cancers: a systematic review. <i>Int J Cancer.</i> 2007;120:1116-1122.	Used as source document
Thompson SC, Jolley D, Marks R. Reduction of solar keratoses by regular sunscreen use. <i>N Engl J Med.</i> 1993;329:1147-1151.	No relevant outcomes
Ting W, Schultz K, Cac NN, Peterson M, Walling HW. Tanning bed exposure increases the risk of malignant melanoma. <i>Int J Dermatol.</i> 2007;46(12):1253-1257.	Quality
Vagero D, Ringback G, Kiviranta H. Melanoma and other tumors of the skin among office, other indoor and outdoor workers in Sweden 1961-1979. <i>Br J Cancer.</i> 1986;53:507-512.	No relevant outcomes
Vainio H, Bianchini F. Cancer-preventive effects of sunscreens are uncertain. <i>Scand J Work Environ Health.</i> 2000;26:529-531.	Study design
Vainio H, Miller AB, Bianchini F. An international evaluation of the cancer-preventive potential of sunscreens. <i>Int J Cancer.</i> 2000;88:838-842.	Study design
Vajdic CM, Kricke A, Giblin M, et al. Artificial ultraviolet radiation and ocular melanoma in Australia. <i>Int J Cancer.</i> 2004;112:896-900.	Study relevance
van-der-Pols JC, Williams GM, Neale RE, Clavarino A, Green AC. Long-term increase in sunscreen use in an Australian community after a skin cancer prevention trial. <i>Prev Med.</i> 2006;42:171-176.	No relevant outcomes
Vitaliano PP, Urbach F. The relative importance of risk factors in nonmelanoma carcinoma. <i>Arch Dermatol.</i> 1980;116:454-456.	Study design
Vitaliano PP. The use of logistic regression for modelling risk factors: with application to non-melanoma skin cancer. <i>Am J Epidemiol.</i> 1978;108:402-414.	Study relevance
Vitasa BC, Taylor HR, Strickland PT, et al. Association of nonmelanoma skin cancer and actinic keratosis with cumulative solar ultraviolet exposure in Maryland watermen. <i>Cancer.</i> 1990;65:2811-2817.	Study design
Walther U, Kron M, Sander S, et al. Risk and protective factors for sporadic basal cell carcinoma: results of a two-centre case-control study in southern Germany. Clinical actinic elastosis may be a protective factor. <i>Br J Dermatol.</i> 2004;151:170-178.	Study design
Weinstock MA, Colditz GA, Willett WC, et al. Moles and site-specific risk of nonfamilial cutaneous malignant melanoma in women. <i>J Natl Cancer Inst.</i> 1989;81:948-952.	No relevant outcomes
Weinstock MA. Do sunscreens increase or decrease melanoma risk: an epidemiologic evaluation. <i>J Invest Dermatol Sym Proc.</i> 1999;4:97-100.	Study design
Weinstock MA. Sunscreen use can reduce melanoma risk. <i>Photodermatol Photoimmunol Photomed.</i> 2001;17:234-236.	Study design
Whiteman DC, Stickley M, Watt P, Hughes MC, Davis MB, Green AC. Anatomic site, sun exposure, and risk of cutaneous melanoma. <i>J Clin Oncol.</i> 2006;24:3172-3177.	Study design
Whiteman DC, Valery P, McWhirter W, Green AC. Risk factors for childhood melanoma in Queensland, Australia. <i>Int J Cancer.</i> 1997;70:26-31.	Study design
Whiteman DC, Whiteman CA, Green AC. Childhood sun exposure as a risk factor for melanoma: a systematic review of epidemiologic studies. <i>Cancer Causes Control.</i> 2001;12:69-82.	Used as source document
Wiecker TS, Luther H, Buettner P, Bauer J, Garbe C. Moderate sun exposure and nevus counts in parents are associated with development of melanocytic nevi in childhood: a risk factor study in 1,812 kindergarten children. <i>Cancer.</i> 2003;97:628-638.	No relevant outcomes

Appendix C Table 2. Studies Excluded From the Review for Key Question 4

Reference	Reason for exclusion
Wolf P, Quehenberger F, Mullegger R, Stranz B, Kerl H. Phenotypic markers, sunlight-related factors and sunscreen use in patients with cutaneous melanoma: an Austrian case-control study. <i>Melanoma Res.</i> 1998;8:370-378.	Quality
Woolley T, Buettner PG, Lowe J. Sun-related behaviors of outdoor working men with a history of non-melanoma skin cancer. <i>J Occup Environ Med.</i> 2002;44:847-854.	Study design
Xu LY, Koo J. Predictive value of phenotypic variables for skin cancer: risk assessment beyond skin typing. <i>Int J Dermatol.</i> 2006;45:1275-1283.	Study relevance
Youl P, Aitken J, Hayward N, et al. Melanoma in adolescents: a case-control study of risk factors in Queensland, Australia. <i>Int J Cancer.</i> 2002;98:92-98.	Population
Zanetti R, Rosso S, Martinez C, et al. The multicentre south European study "Helios," I: skin characteristics and sunburns in basal cell and squamous cell carcinomas of the skin. <i>Br J Cancer.</i> 1996;73:1440-1446.	Study design

Appendix C Table 3. Evidence Table for Adverse Effects of Sun-Protective Behaviors

Study reference USPSTF quality	Study objective	Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Intervention description (if trial)
Vitamin D deficiency					
Marks 1995 ⁹⁸ Fair	To determine whether the regular use of sunscreens in the normal adult population may put individuals at risk of vitamin D deficiency (measures of 25 and 1,25 OHD)	RCT Victoria, Australia General population undergoing longitudinal intervention study on the effect of regular sunscreen use in people with solar keratoses	Age 40 yr or more, White, with 1-30 solar keratoses	N: 153 randomized, 113 analyzed IG: 58 CG: 55 Age: 52% under age 70 yr Sex: 41% men Skin phenotype: 27% burn 50% burn/tan 23% tan	IG: SPF 17 sunscreen, participants were given specific instructions on the application of sunscreen; in addition they were given other 'sun protective behavior' instructions CG: placebo cream, given same instructions
Brot 2001 ⁹⁹ Fair	To assess the prevalence of vitamin D insufficiency in a population of normal perimenopausal women, to estimate the relative influences of sun exposure and vitamin D intake on the concentration of 25OHD and to examine the relationship between PTH and 25OHD	Prospective cohort from larger multicenter RCT Denmark General perimenopausal women	Age 45-58 years and 3-24 months past last menstrual bleeding or perimenopausal symptoms and elevated FSH; if hysterectomized, age 45-52 with elevated FSH Excluded women with osteoporotic fractures, metabolic bone disease, current estrogen use, hyper or hypothyroidism, newly diagnosed or uncontrolled chronic disease, liver disease, unstable cardiac disease, current or past malignant disease, hospitalization for alcohol or drug abuse, history of deep thrombophlebitis or stroke	N: 2016 Age range: 45-58 yr Sex: 0% men Skin phenotype: NR	N/A

Study reference USPSTF quality	Measurement of exposure (or intervention if applicable)	Confounders considered (if observational study)	Followup	Measurement of adverse outcomes	Comments
Vitamin D deficiency					
Marks 1995 ⁹⁸ Fair	All participants given diaries to record sunscreen use and sunscreen container were weighed to determine amount of cream used In addition, participants were also given polysulfone film badges and diaries to record sun exposure	Age, sex, self-reported skin type; NOT adjusted for UV exposure, but trial reports not detectable difference in UV exposure between the two groups	7 months: 74%	(Table 2) change in 25 and 1,25 OHD at 7 mo 25 OHD (nmol/L) mean change, [95% CI], % change, p-value IG: 11.8, [7.6, 15.9], 21% CG: 12.8, [8.4, 17.1], 25% p=0.75 1,25 OHD (nmol/L) mean change, [95% CI], % change, p-value IG: 1.3, [-2.3, 4.9], 1% CG: 10.8, [6.7, 14.8], 14% p=0.0009 (Table 3) change in 25 and 1,25 OHD at 7 mo by age, sex, and skin type No statistically significant changes Also reported "no person using sunscreen developed serum vitamin D levels below the reference range over the period of the study"	These vitamin D levels appear to be low

Appendix C Table 3. Evidence Table for Adverse Effects of Sun-Protective Behaviors

Study reference USPSTF quality	Measurement of exposure (or intervention if applicable)	Confounders considered (if observational study)	Followup	Measurement of adverse outcomes	Comments
Vitamin D deficiency					
Brot 2001 ⁹⁹ Fair	All participants were interviewed by 2 physicians to determine sun exposure (never, occasionally, regularly); and sunbed use (no, yes)	Dietary vitamin D, and vitamin D supplementation (no, yes); did NOT assess for sunscreen use	2.5 years: unclear, 95% with diet records	(Table 2) prevalence of low vit D status during winter and spring according to sun exposure and vitamin supplementation <i>mean serum 25OHD (nmol/L) no vitamin supplement, vitamin supplement</i> Never: 36.5, 45.3 Occasionally: 41.5, 49.3 Regularly: 53.5, 62.3 <i>Percent of subgroup with low vitamin D status, 25 OHD ≤25nmol/L</i> Never: 32.8, 12.9 Occasionally: 17.6, 10.7 Regularly: 9.8, 2.8	

Study reference USPSTF quality	Study objective	Study design Location Population	Participant inclusion/ exclusion criteria	Baseline demographics	Intervention description (if trial)
Decreased physical activity (see KQ3 which has one trial in addition to Milne 2007)					
Milne 2007 ⁹⁴ Fair	To determine if adherence to the sun safety message could inadvertently have a detrimental effect on children's body mass index (BMI)	Cluster CCT by school (non-randomized to minimize contamination) Perth, Australia General grade school children	Children, age 5 or 6 in 1995 attending participating schools (schools within 30km of Perth with 50 or more first-grade students)	N: 33 schools randomized, N: 1615 children analyzed IG high: 8 schools IG moderate: 11 schools CG: 14 schools Age: 5-6 yrs at entry; 11-12 years at last followup Sex: NR Skin phenotype: 100% of European ethnicity	IG high and moderate: specially designed sun protection curriculum that was administered over 4 consecutive years beginning at age 6, curriculum integrated into a range of subjects, including physical education; children in the high intervention group were sent program materials over the summer vacation and offered low-cost sun protective swimwear CG: standard Western Australian health education curriculum

Study reference USPSTF quality	Measurement of exposure (or intervention if applicable)	Confounders considered (if observational study)	Followup	Measurement of adverse outcomes	Comments
Decreased physical activity (see KQ3 which has one trial in addition to Milne 2007)					
Milne 2007 ⁹⁴ Fair	Parents of children were sent self-administered questionnaire to determine total time spent outdoors	Random effects model for school, and adjusted for study group, total time spent outdoors at baseline, gender, ethnicity, parental education level, and tendency to sunburn	4 years: 90% 6 years: 69%	(Table 3) adjusted differences in z scores (BMI for age), adjusted for sex, ethnicity, parent education, z score at baseline <i>@ 4 years, z-score [95%CI]</i> IG high: -0.08 [-0.22, 0.06] IG moderate: 0.01 [-0.12, 0.14] CG: ref <i>@ 6 years, z-score [95%CI]</i> IG high: -0.11 [-0.27, 0.05] IG moderate: 0.05 [-0.09, 0.20] CG: ref Adjusted relative difference, total time spent outdoors, adjusted for sex, ethnicity, parent education, tendency to burn, and total time spent outdoors at baseline <i>@ 4 years, relative difference [95%CI]</i> IG high: 0.90 [0.78, 1.05] IG moderate: 1.0 [0.87, 1.15] CG: ref <i>@ 6 years, relative difference [95%CI]</i> IG high: 0.98 [0.83, 1.15] IG moderate: 0.94 [0.81, 1.09] CG: ref	Non-randomized, were differences at baseline among children; time spent outdoors is a proxy for physical activity, lack of adjustment for nutritional intake

Appendix C Table 3. Evidence Table for Adverse Effects of Sun-Protective Behaviors

Study reference USPSTF quality	Study objective	Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Intervention description (if trial)
Increased sun exposure (with sunscreen use)					
Autier 1999 ³⁵ Good	To determine if sunscreen use encourages longer sun exposure duration	RCT Lyon, France and Lausanne, Switzerland Healthy volunteers from universities	Age 18-24 years, positive history of sunburn in the past and regular sunscreen users intending to have at least 15 days of holiday in sunny areas during the next 2 months Excluded persons with current or history of skin diseases that lasted for more than 1 year, pregnant women, persons with chronic physical illness, persons taking photosensitizing medication	N: 87 IG1: 44 IG2: 43 (42 analyzed) Age range: 18-24 years Sex: 41% men Skin phenotype: 2% skin type I, burns 33% skin type II, burns/tans 65% skin type III, tans 0% skin type IV, tans/never burns	IG1: SPF 10 sunscreen IG2: SPF 30 sunscreen

Study reference USPSTF quality	Measurement of exposure (or intervention if applicable)	Confounders considered (if observational study)	Followup	Measurement of adverse outcomes	Comments
Increased sun exposure (with sunscreen use)					
Autier 1999 ³⁵ Good	Daily diary to record detailed data about sun exposure (hours and type of sun exposure, amount of clothing, number of sunscreen applications, time of application, and sunburn or skin-reddening experience, as well as use of other sunscreen products (if applicable))	Skin phenotype, lifetime sun exposure habits, sunburn experience, sunscreen use	2 months: 99%	<p>(Table 2) mean total hours of sun exposure per participant @ 2 months mean hours, [95%CI], p-value IG1: 58.2 [52.0, 64.4] IG2: 72.6 [63.5, 81.7] p=0.011</p> <p>@ 2 months mean hours daily sun exposure, [95%CI], p-value IG1: 4.0 [3.3, 4.7] IG2: 4.6 [3.9, 5.3] p=<0.0001</p> <p>@ 2 months mean hours daily outdoor activity, [95%CI], p-value IG1: 3.6 [2.9, 4.3] IG2: 3.8 [3.0, 4.6] p=0.62</p> <p>@ 2 months mean hours daily sunbathing, [95%CI], p-value IG1: 2.6 [2.1, 3.1] IG2: 3.1 [2.5, 3.7] p=0.0013</p> <p>Number of sunburn or skin-reddening episodes, p-value IG1: 159 IG2: 159 p=0.99</p> <p>Number of sunburns, p-value IG1: 42 IG2: 34 p=0.90</p>	

Appendix C Table 3. Evidence Table for Adverse Effects of Sun-Protective Behaviors

Study reference USPSTF quality	Study objective	Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Intervention description (if trial)
Increased sun exposure (with sunscreen use)					
Autier 2000 ⁹⁶ Good	To determine if sunscreen use encourages longer sun exposure duration, and sunbathing in particular	RCT Paris and Thionville, France and Brussels, Belgium Healthy volunteers from hospitals	Age 18-24 years, positive history of sunburn in the past and regular sunscreen users intending to have at least 15 days of holiday in sunny areas during the next 2 months Excluded persons with current or history of skin diseases that lasted for more than 1 year	N: 62 randomized, 58 analyzed IG1: 29 IG2: 29 Age range: 18-24 years Sex: 26% men Skin phenotype: 5% skin type I, burns 53% skin type II, burns/tans 41% skin type III, tans 0% skin type IV, tans/never burns	IG1: SPF 10 sunscreen IG2: SPF 30 sunscreen

Study reference USPSTF quality	Measurement of exposure (or intervention if applicable)	Confounders considered (if observational study)	Followup	Measurement of adverse outcomes	Comments
Increased sun exposure (with sunscreen use)					
Autier 2000 ⁹⁶ Good	Daily diary to record detailed data about sun exposure and personal dosimeters (n=50) to measure UVA and UVB exposure	Sunscreen use (SPF and quantity), in-trial sunburn experience, skin phenotype	After participants' summer holiday: 94% (only 71% for dosimeters)	(Table 2) median hours daily sunbathing, [95%CI], % change, p-value IG1: 2.4 [NR] IG2: 3.0 [NR] +25% p=0.054 Median UVB exposure (Joules/m2) per day with sunbathing, [95%CI], % change, p-value IG1: 841 [NR] IG2: 984 [NR] +17% p=0.15 Median UVA exposure (KJoules/m2) per day with sunbathing, [95%CI], % change, p-value IG1: 136 [NR] IG2: 125 [NR] -8% p=0.50	

Study reference USPSTF quality	Study objective	Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Intervention description (if trial)
Increased sun exposure (with sunscreen use)					
Dupuy 2005 ⁹⁷ Fair	To determine whether high-SPF sunscreens have an impact on the sun-exposure behavior in people spending family holidays; and to determine the impact of the actual high protection and the impact of the impression of being well protected	RCT French Mediterranean and Atlantic coasts Healthy volunteers from holiday resorts	Adults on holiday who considered themselves sunscreen users Excluded persons with history of skin cancer, recent history of severe sunburn, contraindication to sun exposure, known contact dermatitis to sunscreen, pregnancy or breast feeding, participation of another family member in the study	N: 367 randomized, 359 analyzed IG1: 122 IG2: 121 CG: 124 Mean age: 39 ± yr Sex: 18% men Skin phenotype: 35% fair complexion: blond, red, or light brown hair 15% neither fair nor dark complexion 49% dark complexion; dark hair	IG1: High protection label, SPF 40 sunscreen IG2: Basic protection label, SPF 40 sunscreen CG: Basic protection label, SPF 12 sunscreen

Appendix C Table 3. Evidence Table for Adverse Effects of Sun-Protective Behaviors

Study reference USPSTF quality	Study objective	Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Intervention description (if trial)																				
Increased sun exposure (with sunscreen use)																									
Green 1999 ^{57,108} Good	To investigate the effectiveness of daily sunscreen application and dietary betacarotene supplement in reducing the incidence of BCC and SCC; secondary endpoint reported in "letter to editor" included sun exposure behaviors, self reported and dosimetry (in a random sub-sample)	RCT Queensland, Australia Community sample	Adults age 20-69, residents of Nambour, Queensland from electoral roll 1986, who attended a second survey in 1992 Excluded persons taking vitamin supplements containing betacarotene, already applying sunscreen on a strict daily basis	N= 1,621 IG1: 404 IG2: 408 IG3: 416 CG: 393 Mean age: IG1: 48.5 (12.9) IG2: 48.7 (13.6) IG3: 48.1 (13.6) CG: 49.8 (12.7) Sex: (% men) IG1: 44.3 IG2: 42.9 IG3: 40.9 CG: 46.8 Skin type: <table border="1"> <thead> <tr> <th></th> <th>IG1</th> <th>IG2</th> <th>IG3</th> <th>CG</th> </tr> </thead> <tbody> <tr> <td>% Burn</td> <td>22</td> <td>20</td> <td>22</td> <td>20</td> </tr> <tr> <td>%Burn/tan</td> <td>67</td> <td>69</td> <td>66</td> <td>69</td> </tr> <tr> <td>% Tan</td> <td>11</td> <td>11</td> <td>12</td> <td>11</td> </tr> </tbody> </table>		IG1	IG2	IG3	CG	% Burn	22	20	22	20	%Burn/tan	67	69	66	69	% Tan	11	11	12	11	IG1: Sunscreen, SPF 15 plus betacarotene IG2: Sunscreen, SPF 15 and placebo tablet IG3: Betacarotene 30mg, and placebo cream CG: no sunscreen and placebo tablet
	IG1	IG2	IG3	CG																					
% Burn	22	20	22	20																					
%Burn/tan	67	69	66	69																					
% Tan	11	11	12	11																					

Study reference USPSTF quality	Measurement of exposure (or intervention if applicable)	Confounders considered (if observational study)	Followup	Measurement of adverse outcomes	Comments
Increased sun exposure (with sunscreen use)					
Dupuy 2005 ⁹⁷ Fair	Daily self-administered questionnaire to record details of sun exposure, final exit interview to detail occurrences of sunburn or painful skin reddening, and sunscreen consumption by weighing sunscreen tubes	Sunscreen use, center, week, skin phenotype	1 week: 95%	(Table 2) mean total hours of sun exposure per participant @ 1 week mean hours while sunbathing, [SD], p-value IG1: 14.2 [7.6] IG2: 12.9 [7.2] CG: 14.6 [6.7] Label comparison (IG1 vs. IG2): p=0.13; SPF Comparison (IG2 vs. CG): p=0.06 @ 1 week proportion of persons with sunburn, [SD], p-value; OR [95%CI] IG1: 0.15 [NR] IG2: 0.14 [NR] CG: 0.24 [NR] Label comparison (IG1 vs. IG2): p=0.80; SPF Comparison (IG2 vs. CG): p=0.06 Label comparison (IG1 vs. IG2): OR 0.91 [0.43, 1.91]; SPF comparison (IG2 vs. CG): OR 1.96 [0.98, 3.92]	
Green 1999 ^{57,108} Good	7 day diaries to record refquency of sun exposure habits and ambient ultraviolet light by polysulphone badges (dosimetry) in the penultimate year of the trial in a random sub-sample of 175 participants		4.5 years: 85% For sub-sample of persons with dosimetry: 98%	Spent less than 50% of time outdoors on weekends in the previous summer @ 4.5 years IG1 and IG2: 79.3% (549/692), p value NR IG3 and CG: 77.4% (535/691) Median (range) % of ambient UV exposure received by polysulphone badges Over summer IG1 and IG2: 2.8 (0-32.2), p=0.55 IG3 and CG: 3.5 (0-23.8) Over winter IG1 and IG2: 6.5 (0-36.2), p=0.36 IG3 and CG: 7.1 (1.0-35.8)	

Appendix C Table 3. Evidence Table for Adverse Effects of Sun-Protective Behaviors

Study reference USPSTF quality	Study objective	Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Intervention description (if trial)															
Increased sun exposure (with sunscreen use)																				
Gallagher 2002 ¹⁰⁹ Fair	To determine whether use of broad-spectrum, high SPF sunscreen attenuates development of nevi in White children; secondary endpoint included sun exposure	RCT British Columbia, Canada White children	Children in grades 1 (ages 6 and 7), and 4 (ages 9 and 10) and their parents from six Vancouver area elementary schools in 1993 Excluded non-White children after randomization	N: 458 randomized, 309 analyzed IG1: 222, 145 CG: 236, 164 Mean age: 50.9% ages 6-7, 49.1% ages 9-10 Sex: NR Skin phenotype: <table border="0"> <tr> <td></td> <td>IG</td> <td>CG</td> </tr> <tr> <td>% skin reflectance (c)</td> <td></td> <td></td> </tr> <tr> <td>Dark</td> <td>33%</td> <td>34%</td> </tr> <tr> <td>Medium</td> <td>32%</td> <td>34%</td> </tr> <tr> <td>Light</td> <td>35%</td> <td>32%</td> </tr> </table>		IG	CG	% skin reflectance (c)			Dark	33%	34%	Medium	32%	34%	Light	35%	32%	IG: SPF 30 sunscreen plus advice CG: no advice, no placebo
	IG	CG																		
% skin reflectance (c)																				
Dark	33%	34%																		
Medium	32%	34%																		
Light	35%	32%																		
Bauer 2005 ¹¹⁰ Fair	To determine if children receiving education or education and sunscreen develop less incident nevi; secondary endpoint included sun exposure and sun protection habits	Cluster RCT Stuttgart and Bochum, Germany White children, skin type I-IV	Children age 2-7 in public nursery schools and their parents in two cities in Germany with similar latitude Excluded parents who did not attend the first educational session, non-White children, or children with skin Type V or VI, immunosuppressed children, or those who refused skin exam	N: 1887 IG1: 626 IG2: 624 CG: 637 Mean age: 4.3 years Sex: 51.4% boys Skin phenotype: 10.1% skin Type I	IG1: education (see below) and sunscreen (SPF 25) with instructions on how to apply sunscreen IG2: education only, letter three times a year with more detailed information on proper sunscreen use and sun protection, and melanoma CG: control, initial educational session only															

Study reference USPSTF quality	Measurement of exposure (or intervention if applicable)	Confounders considered (if observational study)	Followup	Measurement of adverse outcomes	Comments
Increased sun exposure (with sunscreen use)					
Gallagher 2002 ¹⁰⁹ Fair	Activity-based questionnaire at the end of each summer vacation, and after the Christmas and spring breaks each year Minimal erythema dose (MED) information for clear sky conditions by latitude and month were obtained from standard tables	Clothing adjustment based on type of activity and clothing preference	3 years: 67.5%	Median UV exposure from 1993 to 1996 Time spent outdoors IG: 357.0, p value NR CG: 361.5 Vacation sun exposure (MED) IG: 962.5, p value NR CG: 962.5 Total sunlight exposure for whole body, adjusted for clothing coverage (MED) IG: 1252.2 p value NR CG: 1214.3	
Bauer 2005 ¹¹⁰ Fair	Questionnaire at approximately 3 year follow-up	Multivariate analysis done for nevi, but unclear if conducted for sun exposure	3 years: 65.3%	Sun exposure 2001 and changes between 1998-2001 Median weeks on holidays in sunny climates (IQR) IG1: 4 (2,7.5), p=0.021 IG2: 6 (2,8) CG: 5 (2,8) Median difference in h/day in sun during sunny holidays (IQR) IG1: 0 (-1,1), p=0.061 IG2: 0 (-1,1) CG: 0 (-1,1) Mean difference of h/day outside at home (SD) IG1: 0.15 (1.12), p=0.353 IG2: 0.14 (1.13) CG: 0.24 (1.09)	

Appendix C Table 3. Evidence Table for Adverse Effects of Sun-Protective Behaviors

Study reference USPSTF quality	Study objective	Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Intervention description (if trial)
Cancer risk					
John 1999 ¹⁰⁰ Fair	To examine the possible protective role of vitamin D (sun exposure and dietary and supplemental vitamin D) on breast cancer risk	Retrospective cohort (information collected prospectively, but analytic cohort for this study was established retrospectively) US General, non-institutionalized, population (from NHANES)	Adult women ages 25-74 from the NHANES I cohort, those who participated in at least one of four follow-up surveys Excluded women with personal history of cancer, women without dietary or dermatological data, and non-White women	N =5009 (analytic cohort derived from larger cohort n=8596) Age: range: 25-74 yr Sex: 0% men Skin phenotype: NR, however all women were White	N/A

Study reference USPSTF quality	Measurement of exposure (or intervention if applicable)	Confounders considered (if observational study)	Followup	Measurement of adverse outcomes	Comments																
Cancer risk																					
John 1999 ¹⁰⁰ Fair	In-person interviews, medical examinations to determine usual sunlight exposure, sun-induced skin damage, residential sunlight exposure, and dietary and supplemental intake of vitamin D	Age, education, income, age at menarche, age at menopause, nulliparity/age at first birth, BMI, measure of physical activity, frequency of alcohol consumption, and family history of breast cancer	17-21 years (average 17.3): cannot calculate followup	<p>(Table 1) sun exposure and breast cancer risk <i>Recreational sun exposure, # ca cases, age-adj RR, [95%CI], multivar-adj RR, [95%CI]</i> Rare or never: 40, 1.0 [n/a], 1.0 [n/a] Occasional: 55, 0.70 [0.46, 1.06], 0.65 [0.43, 0.98] Frequent: 60, 0.70 [0.47, 1.05], 0.66 [0.44, 0.99] p-value (trend): 0.12, 0.08 <i>Occupational sun exposure, # ca cases, age-adj RR, [95%CI], multivar-adj RR, [95%CI]</i> Rare or never: 81, 1.0 [n/a], 1.0 [n/a] Occasional: 44, 1.05 [0.73, 1.51], 1.06 [0.73, 1.53] Frequent: 29, 0.60 [0.39, 0.91], 0.64 [0.41, 0.98] p-value (trend): 0.03, 0.07 <i>Combined recreational and occupational sun exposure, # cases, age-adj RR, [95%CI], multivar-adj RR, [95%CI]</i> Low: 32, 1.0 [n/a], 1.0 [n/a] Medium: 99, 0.67 [0.45, 1.01], 0.81 [0.56, 1.17] High: 23, 0.50 [0.29, 0.86], 0.67 [0.42, 1.06] p-value (trend): 0.01, 0.06 (Table 3) sunlight exposure by region of residence (low, medium, or high solar radiation) <i>Combined recreational and occupational sun exposure, # cases, multivar-adj RR, [95%CI]</i></p> <table border="1"> <thead> <tr> <th></th> <th>Low</th> <th>Medium</th> <th>High</th> </tr> </thead> <tbody> <tr> <td>Low:</td> <td>15, 1.0 [n/a]</td> <td>9, 1.0 [n/a]</td> <td>8, 1.0 [n/a]</td> </tr> <tr> <td>Medium:</td> <td>44, 0.53 [0.29, 0.97]</td> <td>34, 0.83 [0.39, 1.76]</td> <td>19, 0.54 [0.23, 1.25]</td> </tr> <tr> <td>High:</td> <td>9, 0.40 [0.17, 0.94]</td> <td>10, 0.77 [0.31, 1.93]</td> <td>4, 0.35 [0.10, 1.20]</td> </tr> </tbody> </table> <p>(Table 5) vitamin D from sun exposure and diet (sun exposure as determined by physician) <i>Sun exposure and dietary vit D, # ca cases, age-adj RR, [95%CI], multivar-adj RR, [95%CI]</i> Low sun and <200IU: 71, 1.0 [n/a], 1.0 [n/a] Low sun and ≥ 200IU: 18, 0.79 [0.57, 1.11], 0.75 [0.54, 1.06] High sun and <200IU: 65, 0.78 [0.46, 1.31], 0.77 [0.46, 1.29] High sun and ≥ 200IU: 22, 0.72 [0.45, 1.17], 0.71 [0.44, 1.14] p-value (trend): 0.11, 0.08 Multi-var adj for age, education, age at menarche, age at menopause, BMI, alcohol consumption, physical activity, and calcium</p>		Low	Medium	High	Low:	15, 1.0 [n/a]	9, 1.0 [n/a]	8, 1.0 [n/a]	Medium:	44, 0.53 [0.29, 0.97]	34, 0.83 [0.39, 1.76]	19, 0.54 [0.23, 1.25]	High:	9, 0.40 [0.17, 0.94]	10, 0.77 [0.31, 1.93]	4, 0.35 [0.10, 1.20]	Did not adjust for skin phenotype
	Low	Medium	High																		
Low:	15, 1.0 [n/a]	9, 1.0 [n/a]	8, 1.0 [n/a]																		
Medium:	44, 0.53 [0.29, 0.97]	34, 0.83 [0.39, 1.76]	19, 0.54 [0.23, 1.25]																		
High:	9, 0.40 [0.17, 0.94]	10, 0.77 [0.31, 1.93]	4, 0.35 [0.10, 1.20]																		

Appendix C Table 3. Evidence Table for Adverse Effects of Sun-Protective Behaviors

Study reference USPSTF quality	Study objective	Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Intervention description (if trial)
Cancer risk					
Kampman 2000 ¹⁰¹ Fair	To evaluate potential sources of inconsistencies of the association between calcium and vitamin D (dietary or sun exposure) and colon cancer	Case-control Multi-state, US General population from large HMO	Cases: diagnosis of first primary colon cancer from HMO database, identified from Oct 1991 through Sep 1994, age 30-79 at diagnosis, English speaking, and mentally competent; cases with tumors of the rectum, rectosigmoid, history of familial adenomatous polyposis, ulcerative colitis, or Crohn's disease were excluded Controls: age, sex matched persons from HMO database; same criteria as cases, and in addition without a history of colon cancer	Men Cases Controls N: 1095 1286 Age (SD): 65 (9.8) 64 (10.3) Women Cases Controls 888 1114 65 (10.0) 65 (10.3) Sex: n/a Skin phenotype: NR Text states that population was 91.3% White, but skin phenotype is not otherwise recorded/reported	N/A
Hughes 2004 ¹⁰³ Hughes 2004 ¹⁰² Fair	To determine whether high sun exposure is associated with an increased risk of NHL	Case-control New South Wales, Australia General population from regional cancer registry and electoral rolls	Cases: Diagnosis of NHL from regional cancer registry (and dx independently validated), identified from Jan 1990 through Aug 2001, age 20-74, English speaking, and able to complete a 60 min telephone interview; cases with chronic lymphocytic leukemia, plama cell meyloma, precursor B and T lymphoblastic leukemia, and lymphomatoid granulomatosis grades 1 and 2, or history of immunosuppression for organ transplantation or HIV infection were excluded Controls: Age, sex, and residence matched persons from electoral roles, with same exclusion criteria, although HIV status was not asked of controls	Cases Controls N: 704 694 Age (<50): 73.9 73.3 Sex (% men): 26.6 26.1 Skin phenotype: Skin color (%) Brown or olive 31.5 31.1 Fair 53.7 57.6 Very fair 14.8 11.2 Ability to tan (%) Deep tan 27.0 29.1 Moderate tan 43.6 42.1 Mild tan 20.9 22.8 No tan 8.1 5.8 (skin phenotype calculated from Table 2, I1a)	N/A

Study reference USPSTF quality	Measurement of exposure (or intervention if applicable)	Confounders considered (if observational study)	Followup	Measurement of adverse outcomes	Comments																		
Cancer risk																							
Kampman 2000 ¹⁰¹ Fair	In-person interviews to recall behaviors 2 years before the date of selection to determine dietary intake, supplement use, and sun exposure	Adjusted for age, BMI, family history of colorectal cancer, lifetime vigorous physical activity, total energy intake, dietary fiber, and regular use of ASA or NSAIDs, and calcium intake Additionally all analyses were stratified by sex, age at diagnosis, location of cancer, and family history of colon cancer	Response rate: 76% cases, 64% controls Additional attrition after interview due to ineligibility and missing data: 66% cases, 62% controls	(Table 2) association between sun exposure (per quintile) and colon cancer <i>Quintile of sun exposure, # cases/controls, multivar-adj OR, [95%CI]</i> <table border="1"> <thead> <tr> <th></th> <th>men</th> <th>women</th> </tr> </thead> <tbody> <tr> <td>Low</td> <td>236, 260, 1.0 [n/a]</td> <td>196, 239, 1.0 [n/a]</td> </tr> <tr> <td>2</td> <td>224, 264, 1.0 [0.8, 1.3]</td> <td>198, 203, 1.3 [1.0, 1.7]</td> </tr> <tr> <td>3</td> <td>230, 252, 1.1 [0.8, 1.4]</td> <td>155, 231, 0.9 [0.7, 1.2]</td> </tr> <tr> <td>4</td> <td>211, 273, 0.9 [0.7, 1.2]</td> <td>171, 216, 1.1 [0.8, 1.5]</td> </tr> <tr> <td>High</td> <td>185, 235, 0.9 [0.7, 1.1]</td> <td>160, 216, 1.0 [0.8, 1.4]</td> </tr> </tbody> </table> Multi-var adj for age, BMI, family history, aspirin or NSAIDs, energy intake, physical activity, fiber and calcium		men	women	Low	236, 260, 1.0 [n/a]	196, 239, 1.0 [n/a]	2	224, 264, 1.0 [0.8, 1.3]	198, 203, 1.3 [1.0, 1.7]	3	230, 252, 1.1 [0.8, 1.4]	155, 231, 0.9 [0.7, 1.2]	4	211, 273, 0.9 [0.7, 1.2]	171, 216, 1.1 [0.8, 1.5]	High	185, 235, 0.9 [0.7, 1.1]	160, 216, 1.0 [0.8, 1.4]	Did not adjust for skin phenotype
	men	women																					
Low	236, 260, 1.0 [n/a]	196, 239, 1.0 [n/a]																					
2	224, 264, 1.0 [0.8, 1.3]	198, 203, 1.3 [1.0, 1.7]																					
3	230, 252, 1.1 [0.8, 1.4]	155, 231, 0.9 [0.7, 1.2]																					
4	211, 273, 0.9 [0.7, 1.2]	171, 216, 1.1 [0.8, 1.5]																					
High	185, 235, 0.9 [0.7, 1.1]	160, 216, 1.0 [0.8, 1.4]																					

Appendix C Table 3. Evidence Table for Adverse Effects of Sun-Protective Behaviors

Study reference USPSTF quality	Measurement of exposure (or intervention if applicable)	Confounders considered (if observational study)	Followup	Measurement of adverse outcomes	Comments
Cancer risk					
Hughes 2004 ¹⁰³ Hughes 2004 ¹⁰² Fair	Brief paper questionnaire and telephone interview to determine sun exposure In addition three measures of ambient solar irradiance were assigned to each residential location for each subject using latitude/longitude coordinates, SES assessed using census data	Adjusted for age, sex, state of residence, skin phenotype, and ethnicity	Response rate: 85% cases, 61% controls	<p>(Table 1) risk of NHL with sun exposure (per quartile) Sun exposure during the decade years, multivar-adj OR, [95% CI] Lowest: 1.0 [n/a] 25-50%: 0.72 [0.53, 0.98] 50-75%: 0.66 [0.48, 0.91] Highest: 0.65 [0.46, 0.91] p-value (trend): 0.01</p> <p>Lifetime occupational sun exposure, multivar-adj OR, [95% CI] Lowest: 1.0 [n/a] 25-50%: 1.03 [0.76, 1.40] 50-75%: 1.04 [0.76, 1.43] Highest: 1.21 [0.87, 1.69] p-value (trend): 0.30</p> <p>(Table 2) risk of NHL with vacation sun exposure Sun exposure during the decade years, multivar-adj OR, [95% CI] Lowest: 1.0 [n/a] 25-50%: 0.98 [0.72, 1.32] 50-75%: 0.82 [0.60, 1.12] Highest: 0.60 [0.43, 0.85] p-value (trend): 0.003 Multi-var adj for age, sex, state, ethnicity, skin colour and ability to tan</p>	Baseline data from I1a Hughes 2004, RM 4564

Study reference USPSTF quality	Study objective	Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Intervention description (if trial)																											
Cancer risk																																
Smedby 2005 ¹⁰⁴ Fair	To determine whether exposure to UV radiation increases lymphoma risk	Case-control Denmark and Sweden General population from SCALE study (Scandinavian lymphoma etiology) and population registers	<p>Cases: Diagnosis of lymphoma from national pathology registries (and diagnosis independently validated in random subsample), identified from October 1999/June 2000 through April/August 2002, ages 18-74, Danish or Swedish speaking, and able to complete telephone interview; cases with other hematopoietic malignancy or with history of immunosuppression for organ transplantation or HIV infection were excluded</p> <p>Controls: Age, sex, and country matched persons from comprehensive population registers</p>	<table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>N:</td> <td>3740</td> <td>3187</td> </tr> <tr> <td>Age (median):</td> <td>59</td> <td>59</td> </tr> <tr> <td>Sex (% men):</td> <td>58</td> <td>55</td> </tr> <tr> <td>Skin phenotype (%):</td> <td></td> <td></td> </tr> <tr> <td>Type I, burns</td> <td>17</td> <td>15</td> </tr> <tr> <td>Type II, burns/tans</td> <td>20</td> <td>25</td> </tr> <tr> <td>Type III, tans</td> <td>28</td> <td>31</td> </tr> <tr> <td>Type IV, tans/never burns</td> <td>32</td> <td>29</td> </tr> </tbody> </table>		Cases	Controls	N:	3740	3187	Age (median):	59	59	Sex (% men):	58	55	Skin phenotype (%):			Type I, burns	17	15	Type II, burns/tans	20	25	Type III, tans	28	31	Type IV, tans/never burns	32	29	N/A
	Cases	Controls																														
N:	3740	3187																														
Age (median):	59	59																														
Sex (% men):	58	55																														
Skin phenotype (%):																																
Type I, burns	17	15																														
Type II, burns/tans	20	25																														
Type III, tans	28	31																														
Type IV, tans/never burns	32	29																														

Appendix C Table 3. Evidence Table for Adverse Effects of Sun-Protective Behaviors

Study reference USPSTF quality	Measurement of exposure (or intervention if applicable)	Confounders considered (if observational study)	Followup	Measurement of adverse outcomes	Comments																																																																																																
Cancer risk																																																																																																					
Smedby 2005 ¹⁰⁴ Fair	Telephone interview to determine host factors and exposure (sun, and sunbed/lamps), as well as self-reported skin cancers	Adjusted for skin type, occupational exposure to pesticides	Response rate: 81-91% of cases, 71% of controls	<p>(Table 3) risk of lymphoma with sun exposure</p> <p><i>Sunbathing past 5-10 years, multivar-adj OR, [95%CI]</i></p> <table border="1"> <thead> <tr> <th></th> <th># controls</th> <th>NHL</th> <th>Hodgkin</th> </tr> </thead> <tbody> <tr> <td>Never</td> <td>799</td> <td>946, 1.0 [n/a]</td> <td>122, 1.0 [n/a]</td> </tr> <tr> <td>Once/wk or less</td> <td>1013</td> <td>938, 0.9 [0.7, 1.0]</td> <td>236, 0.8 [0.6, 1.0]</td> </tr> <tr> <td>2-3x/week</td> <td>666</td> <td>555, 0.8 [0.7, 0.9]</td> <td>141, 0.7 [0.5, 1.0]</td> </tr> <tr> <td>4x/week or more</td> <td>666</td> <td>581, 0.7 [0.6, 0.9]</td> <td>118, 0.7 [0.5, 1.0]</td> </tr> <tr> <td>p-value (trend)</td> <td></td> <td><0.001</td> <td>0.06</td> </tr> </tbody> </table> <p><i>Sunbathing @20 years old, multivar-adj OR, [95%CI]</i></p> <table border="1"> <thead> <tr> <th></th> <th># controls</th> <th>NHL</th> <th>Hodgkin</th> </tr> </thead> <tbody> <tr> <td>Never</td> <td>434</td> <td>568, 1.0 [n/a]</td> <td>49, 1.0 [n/a]</td> </tr> <tr> <td>Once/wk or less</td> <td>931</td> <td>918, 0.8 [0.7, 0.9]</td> <td>84, 0.8 [0.5, 1.2]</td> </tr> <tr> <td>2-3x/wk</td> <td>674</td> <td>635, 0.7 [0.6, 0.9]</td> <td>50, 0.6 [0.4, 1.0]</td> </tr> <tr> <td>4x/wk or more</td> <td>653</td> <td>642, 0.7 [0.6, 0.9]</td> <td>73, 0.9 [0.6, 1.4]</td> </tr> <tr> <td>p-value (trend)</td> <td></td> <td>0.001</td> <td>0.84</td> </tr> </tbody> </table> <p><i>Sun vacations abroad, multivar-adj OR, [95%CI]</i></p> <table border="1"> <thead> <tr> <th></th> <th># controls</th> <th>NHL</th> <th>Hodgkin</th> </tr> </thead> <tbody> <tr> <td>Never</td> <td>830</td> <td>910, 1.0 [n/a]</td> <td>146, 1.0 [n/a]</td> </tr> <tr> <td>1-5x</td> <td>1002</td> <td>1000, 1.0 [0.9, 1.1]</td> <td>234, 0.8 [0.6, 1.0]</td> </tr> <tr> <td>6-20x</td> <td>919</td> <td>822, 0.9 [0.8, 1.0]</td> <td>177, 0.7 [0.5, 0.9]</td> </tr> <tr> <td>>20x</td> <td>410</td> <td>305, 0.7 [0.6, 0.8]</td> <td>60, 0.8 [0.6, 1.2]</td> </tr> <tr> <td>p-value (trend)</td> <td></td> <td><0.001</td> <td>0.06</td> </tr> </tbody> </table> <p><i>Sunbed/sunlamp use, multivar-adj OR, [95%CI]</i></p> <table border="1"> <thead> <tr> <th></th> <th># controls</th> <th>NHL</th> <th>Hodgkin</th> </tr> </thead> <tbody> <tr> <td>Never</td> <td>1254</td> <td>1317, 1.0 [n/a]</td> <td>203, 1.0 [n/a]</td> </tr> <tr> <td><10x</td> <td>742</td> <td>790, 1.0 [0.9, 1.2]</td> <td>134, 0.8 [0.6, 1.0]</td> </tr> <tr> <td>10-49x</td> <td>765</td> <td>643, 0.9 [0.8, 1.0]</td> <td>161, 0.7 [0.5, 0.9]</td> </tr> <tr> <td>50+x</td> <td>377</td> <td>270, 0.8 [0.7, 1.0]</td> <td>116, 0.7 [0.5, 0.9]</td> </tr> <tr> <td>p-value (trend)</td> <td></td> <td>0.01</td> <td>0.004</td> </tr> </tbody> </table>		# controls	NHL	Hodgkin	Never	799	946, 1.0 [n/a]	122, 1.0 [n/a]	Once/wk or less	1013	938, 0.9 [0.7, 1.0]	236, 0.8 [0.6, 1.0]	2-3x/week	666	555, 0.8 [0.7, 0.9]	141, 0.7 [0.5, 1.0]	4x/week or more	666	581, 0.7 [0.6, 0.9]	118, 0.7 [0.5, 1.0]	p-value (trend)		<0.001	0.06		# controls	NHL	Hodgkin	Never	434	568, 1.0 [n/a]	49, 1.0 [n/a]	Once/wk or less	931	918, 0.8 [0.7, 0.9]	84, 0.8 [0.5, 1.2]	2-3x/wk	674	635, 0.7 [0.6, 0.9]	50, 0.6 [0.4, 1.0]	4x/wk or more	653	642, 0.7 [0.6, 0.9]	73, 0.9 [0.6, 1.4]	p-value (trend)		0.001	0.84		# controls	NHL	Hodgkin	Never	830	910, 1.0 [n/a]	146, 1.0 [n/a]	1-5x	1002	1000, 1.0 [0.9, 1.1]	234, 0.8 [0.6, 1.0]	6-20x	919	822, 0.9 [0.8, 1.0]	177, 0.7 [0.5, 0.9]	>20x	410	305, 0.7 [0.6, 0.8]	60, 0.8 [0.6, 1.2]	p-value (trend)		<0.001	0.06		# controls	NHL	Hodgkin	Never	1254	1317, 1.0 [n/a]	203, 1.0 [n/a]	<10x	742	790, 1.0 [0.9, 1.2]	134, 0.8 [0.6, 1.0]	10-49x	765	643, 0.9 [0.8, 1.0]	161, 0.7 [0.5, 0.9]	50+x	377	270, 0.8 [0.7, 1.0]	116, 0.7 [0.5, 0.9]	p-value (trend)		0.01	0.004	
	# controls	NHL	Hodgkin																																																																																																		
Never	799	946, 1.0 [n/a]	122, 1.0 [n/a]																																																																																																		
Once/wk or less	1013	938, 0.9 [0.7, 1.0]	236, 0.8 [0.6, 1.0]																																																																																																		
2-3x/week	666	555, 0.8 [0.7, 0.9]	141, 0.7 [0.5, 1.0]																																																																																																		
4x/week or more	666	581, 0.7 [0.6, 0.9]	118, 0.7 [0.5, 1.0]																																																																																																		
p-value (trend)		<0.001	0.06																																																																																																		
	# controls	NHL	Hodgkin																																																																																																		
Never	434	568, 1.0 [n/a]	49, 1.0 [n/a]																																																																																																		
Once/wk or less	931	918, 0.8 [0.7, 0.9]	84, 0.8 [0.5, 1.2]																																																																																																		
2-3x/wk	674	635, 0.7 [0.6, 0.9]	50, 0.6 [0.4, 1.0]																																																																																																		
4x/wk or more	653	642, 0.7 [0.6, 0.9]	73, 0.9 [0.6, 1.4]																																																																																																		
p-value (trend)		0.001	0.84																																																																																																		
	# controls	NHL	Hodgkin																																																																																																		
Never	830	910, 1.0 [n/a]	146, 1.0 [n/a]																																																																																																		
1-5x	1002	1000, 1.0 [0.9, 1.1]	234, 0.8 [0.6, 1.0]																																																																																																		
6-20x	919	822, 0.9 [0.8, 1.0]	177, 0.7 [0.5, 0.9]																																																																																																		
>20x	410	305, 0.7 [0.6, 0.8]	60, 0.8 [0.6, 1.2]																																																																																																		
p-value (trend)		<0.001	0.06																																																																																																		
	# controls	NHL	Hodgkin																																																																																																		
Never	1254	1317, 1.0 [n/a]	203, 1.0 [n/a]																																																																																																		
<10x	742	790, 1.0 [0.9, 1.2]	134, 0.8 [0.6, 1.0]																																																																																																		
10-49x	765	643, 0.9 [0.8, 1.0]	161, 0.7 [0.5, 0.9]																																																																																																		
50+x	377	270, 0.8 [0.7, 1.0]	116, 0.7 [0.5, 0.9]																																																																																																		
p-value (trend)		0.01	0.004																																																																																																		

Study reference USPSTF quality	Study objective	Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Intervention description (if trial)																		
Cancer risk																							
John 2005 ¹⁰⁵ Fair	To determine whether measures of sun exposure is associated with an increased risk of advanced prostate cancer	Case-control California General population from SEER cancer registry, random digit dialing, and beneficiaries of Health Care Financing Administration	<p>Cases: diagnosis of advanced prostate cancer from SEER registry, identified from Jul 1997 to Feb 2000, age 40-79, English speaking, non-Hispanic White, (African American initially included but ultimately excluded from analysis); cases with prior prostate cancer, or those living outside designated area were excluded</p> <p>Controls: age, race and residence matched persons from random digit dialing or Health Care Financing Administration rosters with same exclusion criteria</p>	<table border="1"> <thead> <tr> <th></th> <th>Cases</th> <th>Controls</th> </tr> </thead> <tbody> <tr> <td>n:</td> <td>450</td> <td>455</td> </tr> <tr> <td>Age (median):</td> <td>64</td> <td>65</td> </tr> <tr> <td>Sex (% men):</td> <td>100</td> <td>100</td> </tr> <tr> <td>Skin phenotype:</td> <td colspan="2">NR</td> </tr> <tr> <td>Ethnicity:</td> <td colspan="2">100% non-Hispanic White</td> </tr> </tbody> </table>		Cases	Controls	n:	450	455	Age (median):	64	65	Sex (% men):	100	100	Skin phenotype:	NR		Ethnicity:	100% non-Hispanic White		
	Cases	Controls																					
n:	450	455																					
Age (median):	64	65																					
Sex (% men):	100	100																					
Skin phenotype:	NR																						
Ethnicity:	100% non-Hispanic White																						

Appendix C Table 3. Evidence Table for Adverse Effects of Sun-Protective Behaviors

Study reference USPSTF quality	Measurement of exposure (or intervention if applicable)	Confounders considered (if observational study)	Followup	Measurement of adverse outcomes	Comments
Cancer risk					
John 2005 ¹⁰⁵ Fair	in-person interviews, administered structured questionnaires, plus exam with measurement of skin pigmentation with portable reflectometer, DNA sample (blood or mouthwash) in addition solar radiation level by state of residence assessed from National Weather Service Stations	adjusted for age, family history of prostate cancer	response rate: 72% cases, 63% controls	(Table 2) risk of advanced prostate cancer with sun exposure lifetime outdoor activities (h/wk), # cases, # controls, age-adj OR, [95%CI], multivar-adj OR [95%CI] <2.7: 85, 91, 1.0 [n/a], 1.0 [n/a] 2.7-5.6 99, 91, 1.16 [0.77, 1.75], 1.15 [0.76, 1.73] 5.7-10.4 92, 91, 1.08 [0.72, 1.64], 1.09 [0.72, 1.65] 10.5-19.8 94, 91, 1.11 [0.73, 1.67], 1.10 [0.73, 1.67] 19.9+ 80, 91, 0.94 [0.62, 1.44], 0.95 [0.62, 1.45] p-value (trend) 0.8 lifetime outdoor jobs (h/wk), # cases, # controls, age-adj OR, [95%CI], multivar-adj OR [95%CI] 0 123, 120, 1.0 [n/a], 1.0 [n/a] <1.4 84, 84, 0.99 [0.67, 1.47], 0.96 [0.65, 1.43] 1.4-5.6 100, 83, 1.19 [0.81, 1.75], 1.20 [0.81, 1.77] 5.7-14.7 81, 84, 0.94 [0.63, 1.40], 0.95 [0.64, 1.41] 14.8+ 62, 84, 0.73 [0.48, 1.10], 0.73 [0.48, 1.11] p-value (trend) 0.3 facultative pigmentation, # cases, # controls, age-adj OR, [95%CI], multivar-adj OR [95%CI] light 100, 90, 1.0 [n/a], 1.0 [n/a] 2 107, 90, 1.08 [0.73,1.61], 1.08 [0.73,1.62] 3 86, 91, 0.85 [0.56,1.28], 0.83 [0.55,1.26] 4 86, 91, 0.85 [0.56,1.28], 0.83 [0.55,1.26] dark 68, 90, 0.68 [0.44,1.03], 0.66 [0.43,1.01] p-value (trend) 0.03 sun exposure index ((facultative pigmentation-constitutive pigmentation)/constitutive pigmentation) # cases, # controls, age-adj OR, [95%CI], multivar-adj OR [95%CI] low 106, 89, 1.0 [n/a], 1.0 [n/a] 2 93, 90, 0.85 [0.57,1.28], 0.87 [0.58,1.30] 3 89, 92, 0.81 [0.54,1.21], 0.80 [0.53,1.20] 4 103, 91, 0.94 [0.63,1.40], 0.95 [0.64,1.42] high 56, 90, 0.52 [0.33, 0.80], 0.51 [0.33,0.80] p-value (trend) 0.02 multivar adj for age, family history of prostate cancer, +/- month of pigmentation measurements	

Study reference USPSTF quality	Study objective	Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Intervention description (if trial)																																							
Cancer risk																																												
Hartge 2006 ¹⁰⁶ Fair	To determine whether measures of UV exposure is associated with an increased risk of Non-Hodgkin Lymphoma	Case-control Multi-state, US General population from SEER cancer registry and random digit dialing and Centers for Medicare and Medicaid population rosters	Cases: Diagnosis of first primary NHL from SEER registry, identified from July 1998 to June 2000, age 20-74, assumed English speaking; cases with HIV were excluded Controls: Age, sex, race and study area matched persons from random digit dialing or Centers for Medicare and Medicaid Services population roster	<table border="0"> <tr> <td></td> <td>Cases</td> <td>Controls</td> </tr> <tr> <td>n:</td> <td>551</td> <td>462</td> </tr> <tr> <td>Age (<55):</td> <td>41</td> <td>27</td> </tr> <tr> <td>Sex (% men):</td> <td>53</td> <td>52</td> </tr> <tr> <td>Skin phenotype:</td> <td></td> <td></td> </tr> <tr> <td> dark</td> <td>30</td> <td>20</td> </tr> <tr> <td> medium</td> <td>306</td> <td>252</td> </tr> <tr> <td> light</td> <td>215</td> <td>189</td> </tr> <tr> <td><u>Ethnicity:</u></td> <td></td> <td></td> </tr> <tr> <td> % White</td> <td>90</td> <td>91</td> </tr> <tr> <td> % African Amer</td> <td>NR (assumed 0, not c/w descrip in methods)</td> <td></td> </tr> <tr> <td> % Hispanic</td> <td>5</td> <td>5</td> </tr> <tr> <td> % Asian</td> <td>4</td> <td>3</td> </tr> </table>		Cases	Controls	n:	551	462	Age (<55):	41	27	Sex (% men):	53	52	Skin phenotype:			dark	30	20	medium	306	252	light	215	189	<u>Ethnicity:</u>			% White	90	91	% African Amer	NR (assumed 0, not c/w descrip in methods)		% Hispanic	5	5	% Asian	4	3	
	Cases	Controls																																										
n:	551	462																																										
Age (<55):	41	27																																										
Sex (% men):	53	52																																										
Skin phenotype:																																												
dark	30	20																																										
medium	306	252																																										
light	215	189																																										
<u>Ethnicity:</u>																																												
% White	90	91																																										
% African Amer	NR (assumed 0, not c/w descrip in methods)																																											
% Hispanic	5	5																																										
% Asian	4	3																																										

Appendix C Table 3. Evidence Table for Adverse Effects of Sun-Protective Behaviors

Study reference USPSTF quality	Measurement of exposure (or intervention if applicable)	Confounders considered (if observational study)	Followup	Measurement of adverse outcomes	Comments
Cancer risk					
Hartge 2006 ¹⁰⁶ Fair	in-person interviews, plus mailed questionnaire, to determine demographic, diet, and sun exposure history in addition measurements of solar radiation obtained from Robertson-Berger (RB) meters located in many states	adjusted for age, sex, center, ethnicity, education, alcohol consumption, weekly exercise, residential UV radiation, dietary vitamin D	response rate: 59% cases, 44% controls	(Table 3) risk of NHL with various measures of sun exposure hours mid-day sun last 10 years, # cases, #controls, multivar-adj OR [95%CI] <7 216, 159, 1.0 [n/a] <14 145, 126, 0.85 [0.62, 1.18] <28 131, 123, 0.75 [0.54, 1.05] 28+ 59, 51, 0.73 [0.46, 1.15] p-value (trend) 0.07 hours mid-day sun during teens years, # cases, #controls, multivar-adj OR [95%CI] <7 62, 46, 1.0 [n/a] <14 89, 68, 0.97 [0.59, 1.61] <28 185, 155, 0.81 [0.52, 1.27] 28+ 211, 187, 0.75 [0.48, 1.18] p-value (trend) 0.12 hours mid-day sun during twenties, # cases, #controls, multivar-adj OR [95%CI] <7 143, 107, 1.0 [n/a] <14 143, 124, 0.86 [0.60, 1.22] <28 156, 132, 0.83 [0.58, 1.18] 28+ 105, 94, 0.75 [0.50, 1.11] p-value (trend) 0.15 hours mid-day sun during thirties, # cases, #controls, multivar-adj OR [95%CI] <7 183, 137, 1.0 [n/a] <14 135, 135, 0.75 [0.54, 1.04] <28 145, 112, 0.95 [0.68, 1.33] 28+ 68, 66, 0.78 [0.50, 1.19] p-value (trend) 0.44 use of sunlamp or sunbed, # cases, #controls, multivar-adj OR [95%CI] never 401, 338, 1.0 [n/a] <5x 32, 33, 0.78 [0.46, 1.32] 5-9x 32, 25, 0.90 [0.52, 1.58] 10+x 84, 66, 0.90 [0.61, 1.30] p-value (trend) 0.49 history of blistering sunburns, # cases, #controls, multivar-adj OR [95%CI] never 224, 177, 1.0 [n/a] 1x 117, 103, 0.87 [0.62, 1.23] 2-4x 114, 84, 1.02 [0.72, 1.46] 5+x 92, 96, 0.68 [0.47, 0.97] p-value (trend) 0.10	

Study reference USPSTF quality	Study objective	Study design Location Population	Participant inclusion/exclusion criteria	Baseline demographics	Intervention description (if trial)																											
Cancer risk																																
John 2007 ¹⁰⁷ Good	To determine whether measures of sun exposure is associated with an increased risk of breast cancer	Case-control California General population from SEER cancer registry and RDD	Cases: diagnosis of primary invasive breast cancer from SEER registry, identified from 1995 to 1999, age 35-79, English or Spanish speaking, Hispanic, non-Hispanic White, African American Controls: age, race matched persons from RDD	<table border="0"> <tr> <td></td> <td>Cases</td> <td>Controls</td> </tr> <tr> <td>n:</td> <td>1786</td> <td>2127</td> </tr> <tr> <td>Age (%50-64):</td> <td>40</td> <td>39</td> </tr> <tr> <td>Sex (% men):</td> <td>0</td> <td>0</td> </tr> <tr> <td>Skin phenotype:</td> <td></td> <td>NR</td> </tr> <tr> <td><u>Ethnicity</u></td> <td></td> <td></td> </tr> <tr> <td>% White</td> <td>33.4</td> <td>30.4</td> </tr> <tr> <td>% African Amer</td> <td>30.4</td> <td>28.1</td> </tr> <tr> <td>% Hispanic</td> <td>36.2</td> <td>41.5</td> </tr> </table>		Cases	Controls	n:	1786	2127	Age (%50-64):	40	39	Sex (% men):	0	0	Skin phenotype:		NR	<u>Ethnicity</u>			% White	33.4	30.4	% African Amer	30.4	28.1	% Hispanic	36.2	41.5	
	Cases	Controls																														
n:	1786	2127																														
Age (%50-64):	40	39																														
Sex (% men):	0	0																														
Skin phenotype:		NR																														
<u>Ethnicity</u>																																
% White	33.4	30.4																														
% African Amer	30.4	28.1																														
% Hispanic	36.2	41.5																														

Appendix C Table 3. Evidence Table for Adverse Effects of Sun-Protective Behaviors

Study reference USPSTF quality	Measurement of exposure (or intervention if applicable)	Confounders considered (if observational study)	Followup	Measurement of adverse outcomes	Comments
Cancer risk					
John 2007 ¹⁰⁷ Good	in-person interviews, administered structured questionnaires, plus exam with measurement of skin pigmentation with portable reflectometer, DNA sample (blood or mouthwash)	adjusted for age, race/ethnicity, education, family history of breast cancer, personal history of benign breast disease, age at menarche, number of full-term pregnancies, breastfeeding, menopausal status, hormone therapy use, BMI, height, lifetime physical activity, alcohol consumption; and stratified by constitutive skin pigmentation	response rate: 87% cases, 84% controls	(Table 3) risk of advanced breast cancer with sun exposure lifetime outdoor activities (h/wk by quartile), # cases, # controls, multivar-adj OR [95%CI] light pigmentation medium pigmentation dark pigmentation low 37, 153, 1.0 [n/a] 43,180, 1.0 [n/a] 49,174, 1.0 [n/a] 2 41, 167, 0.97 [0.58,1.62] 47,154, 1.17 [0.72, 1.91] 52,180, 1.01 [0.65, 1.59] 3 59, 188, 1.29 [0.80,2.09] 55,169, 1.23 [0.76, 1.97] 61,165, 1.31 [0.84, 2.03] high 37, 180, 0.86 [0.51,1.45] 36,175, 0.77 [0.46, 1.29] 50,153, 1.14 [0.72, 1.81] p-value (trend) 0.90 0.82 0.36 facultative pigmentation, # cases, # controls, multivar-adj OR [95%CI] light pigmentation medium pigmentation dark pigmentation light 55, 171, 1.0 [n/a] 48,171, 1.0 [n/a] 53,169, 1.0 [n/a] 2 48, 183, 0.73 [0.45,1.17] 54,161, 1.22 [0.76, 1.98] 48,169, 0.89 [0.52, 1.55] 3 35, 167, 0.56 [0.33,0.94] 38,180, 0.86 [0.51, 1.46] 56,169, 1.00 [0.56, 1.81] dark 37, 173, 0.54 [0.32,0.94] 41,171, 1.07 [0.62, 1.85] 57,174, 1.00 [0.55, 1.81] p-value (trend) 0.02 0.88 0.81 sun exposure index ((facultative pigmentation-constitutive pigmentation)/constitutive pigmentation) light pigmentation medium pigmentation dark pigmentation low 56, 174, 1.0 [n/a] 47,172, 1.0 [n/a] 50,171, 1.0 [n/a] 2 47, 174, 0.78 [0.49,1.26] 55,173, 1.29 [0.80, 2.08] 52,170, 1.15 [0.73, 1.82] 3 37, 171, 0.62 [0.37,1.04] 35,167, 0.90 [0.53, 1.55] 59,168, 1.39 [0.89, 2.17] high 35, 175, 0.53 [0.31, 0.91] 44,171, 1.26 [0.74, 2.15] 53,172, 1.28 [0.81, 2.05] p-value (trend) 0.01 0.68 0.20	
John 2007 ¹⁰⁷ Good				(Table 3) risk of localized breast cancer with sun exposure lifetime outdoor activities (h/wk by quartile), # cases, # controls, multivar-adj OR [95%CI] light pigmentation medium pigmentation dark pigmentation low 85, 153, 1.0 [n/a] 97,180, 1.0 [n/a] 101,174, 1.0 [n/a] 2 91, 167, 0.95 [0.65,1.40] 70,154, 0.79 [0.53, 1.17] 89,180, 0.80 [0.56, 1.15] 3 103, 188, 0.89 [0.61,1.29] 129,169, 1.35 [0.94, 1.93] 96,165, 0.94 [0.66, 1.35] high 107, 180, 1.05 [0.72,1.54] 92,175, 1.02 [0.70, 1.50] 64,153, 0.70 [0.47, 1.04] p-value (trend) 0.85 0.20 0.18 facultative pigmentation, # cases, # controls, multivar-adj OR [95%CI] light pigmentation medium pigmentation dark pigmentation light 95, 171, 1.0 [n/a] 101,171, 1.0 [n/a] 73,169, 1.0 [n/a] 2 109, 183, 1.18 [0.82,1.71] 118,161, 1.34 [0.93, 1.94] 87,169, 1.22 [0.76, 1.97] 3 97, 167, 1.10 [0.75,1.61] 90,180, 1.04 [0.70, 1.54] 88,169, 1.20 [0.71, 2.01] dark 89, 173, 1.11 [0.74,1.67] 81,177, 1.12 [0.73, 1.71] 102,174, 1.40 [0.83, 2.33] p-value (trend) 0.72 0.80 0.24 sun exposure index ((facultative pigmentation-constitutive pigmentation)/constitutive pigmentation) light pigmentation medium pigmentation dark pigmentation low 104, 174, 1.0 [n/a] 108,172, 1.0 [n/a] 75,171, 1.0 [n/a] 2 103, 174, 1.09 [0.76,1.58] 107,173, 1.12 [0.78, 1.62] 99,170, 1.43 [0.97, 2.10] 3 87, 171, 0.96 [0.65,1.41] 90,167, 1.01 [0.68, 1.49] 87,168, 1.30 [0.88, 1.93] high 96, 175, 1.10 [0.74,1.63] 84,171, 1.06 [0.71, 1.60] 89,172, 1.11 [0.74, 1.67] p-value (trend) 0.81 0.86 0.74 multivar adj for age, race/ethnicity, education, family history of breast cancer, personal history of breast disease, age at menarche, number full-term pregnancies, breastfeeding, BMI, height, physical activity, alcohol consumption	

OHD=hydroxyvitamin D; RCT=randomized controlled trial; IG=intervention group; CG=control group; SPF=sun protection factor; N/A=not applicable; PTH=parathyroid hormone; FSH=follicle stimulating hormone; UV=ultraviolet; nmol=nanomole; L=liter; BMI=body mass index; CCT=clinical controlled trial; km=kilometer; CI=confidence interval; NR=not reported; NHANES=National Health and Nutrition Examination Survey; multivar=multivariate; adj=adjusted; RR=relative risk; IU=international unit; HMO=health maintenance organization; NSAID=nonsteroidal anti-inflammatory drug; SES=socioeconomic status; HIV=human immunodeficiency virus; x=times; NHL=nonHodgkins lymphoma

Appendix C Table 4. Studies Excluded From the Review for Key Question 5

Reference	Reason for Exclusion
Adami J, Gridley G, Nyren O, et al. Sunlight and non-Hodgkin's lymphoma: a population-based cohort study in Sweden. <i>Int J Cancer</i> . 1999;80:641-645.	No relevant outcomes
Armstrong BK, Kricger A. Sun exposure and non-Hodgkin lymphoma. <i>Cancer Epidemiol Biomarkers Prev</i> . 2007;16:396-400.	Study design
Autier P, Boniol M, Dore JF. Sunscreen use and increased duration of intentional sun exposure: still a burning issue. <i>Int J Cancer</i> . 2007;121(1):1-5.	Study quality
Autier P, Dore JF, Cattaruzza MS, et al. Sunscreen use, wearing clothes, and number of nevi in 6- to 7-year-old European children. European Organization for Research and Treatment of Cancer Melanoma Cooperative Group. <i>J Natl Cancer Inst</i> . 1998;90:1873-1880.	Study design
Autier P, Dore JF, Lejeune F, et al. Cutaneous malignant melanoma and exposure to sunlamps or sunbeds: an EORTC multicenter case-control study in Belgium, France and Germany. EORTC Melanoma Cooperative Group. <i>Int J Cancer</i> . 1994;58:809-813.	Study design
Autier P, Dore JF, Schiffers E, et al. Melanoma and use of sunscreens: an EORTC case-control study in Germany, Belgium and France. EORTC Melanoma Cooperative Group. <i>Int J Cancer</i> . 1995;61:749-755.	Study design
Bodiwala D, Luscombe CJ, French ME, et al. Associations between prostate cancer susceptibility and parameters of exposure to ultraviolet radiation. <i>Cancer Lett</i> . 2003;200:141-148.	Study quality
Boniol M, Autier P, Dore JF. Photoprotection. <i>Lancet</i> . 2007;370:1481-1482.	Study design
Boscoe FP, Schymura MJ. Solar ultraviolet-B exposure and cancer incidence and mortality in the United States, 1993-2002. <i>BMC Cancer</i> . 2006;6:264.	Study design
De Vries E, Soerjomataram I, Houterman S, et al. Decreased risk of prostate cancer after skin cancer diagnosis: a protective role of ultraviolet radiation? <i>Am J Epidemiol</i> . 2007;165:966-972.	No relevant outcomes
Dixon A. Arc welding and the risk of cancer. <i>Aust Fam Physician</i> . 2007;36:255-256.	No relevant outcomes
English DR, Milne E, Simpson JA. Sun protection and the development of melanocytic nevi in children. <i>Cancer Epidemiol Biomarkers Prev</i> . 2005;14:2873-2876.	No relevant outcomes
Farrerons J, Barnadas M, Lopez-Navidad A, et al. Sunscreen and risk of osteoporosis in the elderly: a two-year follow-up. <i>Dermatology</i> . 2001;202(1):27-30.	Study quality
Farrerons J, Barnadas M, Rodriguez J, et al. Clinically prescribed sunscreen (sun protection factor 15) does not decrease serum vitamin D concentration sufficiently either to induce changes in parathyroid function or in metabolic markers. <i>Br J Dermatol</i> . 1998;139 (3):422-427.	Study quality
Freedman DM, Dosemeci M, McGlynn K. Sunlight and mortality from breast, ovarian, colon, prostate, and non-melanoma skin cancer: a composite death certificate based case-control study. <i>Occup Environ Med</i> . 2002;59:257-262.	No relevant outcomes
Geller AC, Colditz G, Oliveria S, et al. Use of sunscreen, sunburning rates, and tanning bed use among more than 10,000 US children and adolescents. <i>Pediatrics</i> . 2002;109:1009-1014.	No relevant outcomes
Grant WB. A meta-analysis of second cancers after a diagnosis of nonmelanoma skin cancer: additional evidence that solar ultraviolet-B irradiance reduces the risk of internal cancers. <i>J Steroid Biochem Mol Biol</i> . 2007;103:668-674.	Study design
Gruber SB, Armstrong B. Cutaneous and ocular melanoma. In: Schottenfeld D, Fraumeni JF, eds. <i>Cancer Epidemiology and Prevention</i> . 2006:1196-229.	Study design
Heckmann M, Zogelmeier F, Konz B. Frequency of facial basal cell carcinoma does not correlate with site-specific UV exposure. <i>Arch Dermatol</i> . 2002;138:1494-1497.	Study design
Holick MF, Chen TC, Lu Z, Sauter E. Vitamin D and skin physiology: a D-lightful story. <i>J Bone Mineral Res</i> . 2007;22(Suppl 2):28-33.	Study quality
Holick MF. Sunlight "D"ilemma: risk of skin cancer or bone disease and muscle weakness. <i>Lancet</i> . 2001;357:4-6.	Study design
John EM, Dreon DM, Koo J, et al. Residential sunlight exposure is associated with a decreased risk of prostate cancer. <i>J Steroid Biochem Mol Biol</i> . 2004;89-90:549-552.	No relevant outcomes

Appendix C Table 4. Studies Excluded From the Review for Key Question 5

Reference	Reason for Exclusion
Lawler S, Sugiyama T, Owen N. Sun exposure concern, sun protection behaviors and physical activity among Australian adults. <i>Cancer Causes Control</i> . 2007;18:1009-1014.	Study quality
Lim JL, Stern RS. High levels of ultraviolet B exposure increase the risk of non-melanoma skin cancer in psoralen and ultraviolet A-treated patients. <i>J Invest Dermatol</i> . 2005;124:505-513.	Population
Lucas RM, Repacholi MH, McMichael AJ. Is the current public health message on UV exposure correct? <i>Bull World Health Organ</i> . 2006;84:485-491.	Study design
Matsuoka LY, Wortsman J, Hanifan N, Holick MF. Chronic sunscreen use decreases circulating concentrations of 25-hydroxyvitamin D. A preliminary study. <i>Arch.Dermatol</i> . 1988;124(12):1802-1804.	Study quality
Moan J, Porojnicu AC, Robsahm TE, et al. Solar radiation, vitamin D and survival rate of colon cancer in Norway. <i>J Photochem Photobiol B</i> . 2005;78:189-193.	Study relevance
Ness AR, Frankel SJ, Gunnell DJ, Smith GD. Are we really dying for a tan? <i>BMJ</i> . 1999;319:114-116.	Study design
Porojnicu AC, Robsahm TE, Ree AH, Moan J. Season of diagnosis is a prognostic factor in Hodgkin's lymphoma: a possible role of sun-induced vitamin D. <i>Br J Cancer</i> . 2005;93:571-574.	Study relevance
Reichrath J. Protecting against adverse effects of sun protection. <i>J Am Acad Dermatol</i> . 2003;49:1204-1206.	Study design
Reichrath J. Sunlight, skin cancer and vitamin D: What are the conclusions of recent findings that protection against solar ultraviolet (UV) radiation causes 25-hydroxyvitamin D deficiency in solid organ-transplant recipients, xeroderma pigmentosum, and other risk groups? <i>J Steroid Biochem Mol Biol</i> . 2007;103:664-667.	Study design
Robsahm TE, Tretli S, Dahlback A, et al. Vitamin D3 from sunlight may improve the prognosis of breast-, colon- and prostate cancer (Norway). <i>Cancer Causes Control</i> . 2004;15:149-158.	No relevant outcomes
Samaneck AJ, Croager EJ, Gies P, et al. Estimates of beneficial and harmful sun exposure times during the year for major Australian population centres. <i>Med J Aust</i> . 2006;184:338-341.	Study design
Sayre RM, Dowdy JC. Darkness at noon: sunscreens and vitamin D3. <i>Photochem Photobiol</i> . 2007;83:459-463.	Study design
The Cancer Council Australia. Risks and benefits of sun exposure: position statement. 2005.	Study design
Thompson SC, Jolley D, Marks R. Reduction of solar keratoses by regular sunscreen use. <i>N Engl J Med</i> . 1993;329:1147-1151.	No relevant outcomes
Thieden E, Philippsen PA, Sandby-Moller J, Wulf HC. Sunscreen use related to UV exposure, age, sex, and occupation based on personal dosimeter readings and sun-exposure behavior diaries. <i>Arch Dermatol</i> . 2005;141(8):967-973.	Study quality
van der Rhee HJ, De Vries E, Coebergh JW. Does sunlight prevent cancer? A systematic review. <i>Eur J Cancer</i> . 2006;42:2222-2232.	Reported only intermediate outcomes
Weinstock MA. Do sunscreens increase or decrease melanoma risk: an epidemiologic evaluation. <i>J Invest Dermatol Sym Proc</i> . 1999;4:97-100.	Study design
Westerdahl J, Olsson H, Masback A, et al. Use of sunbeds or sunlamps and malignant melanoma in southern Sweden. <i>Am J Epidemiol</i> . 1994;140(8):691-699.	No relevant outcomes
Westerdahl J, Olsson H, Masback A, Ingvar C, Jonsson N. Is the use of sunscreens a risk factor for malignant melanoma? <i>Melanoma Res</i> . 1995;5(1):59-65.	No relevant outcomes
Wiecker TS, Luther H, Buettner P, et al. Moderate sun exposure and nevus counts in parents are associated with development of melanocytic nevi in childhood: a risk factor study in 1,812 kindergarten children. <i>Cancer</i> . 2003;97:628-638.	No relevant outcomes
Xu LY, Koo J. Predictive value of phenotypic variables for skin cancer: risk assessment beyond skin typing. <i>Int J Dermatol</i> . 2006;45:1275-1283.	Study relevance
Youl P, Aitken J, Hayward N, et al. Melanoma in adolescents: a case-control study of risk factors in Queensland, Australia. <i>Int J Cancer</i> . 2002;98:92-98.	No relevant outcomes
Zlotkin S. Vitamin D concentrations in Asian children living in England. Limited vitamin D intake and use of sunscreens may lead to rickets. <i>BMJ</i> . 1999;318:1417.	Study design

Appendix D. Ongoing Trials

Principal investigators	Location	Population	Approximate size	Investigations	Outcomes	Status as of 2008
KQ1: Is there direct evidence that counseling patients in sun protective behaviors reduces intermediate outcomes or skin cancer (melanoma, SCC, or BCC)?						
None						
KQ2: Does primary care feasible counseling change sun protective behaviors?						
Ellen R. Gritz, PhD ¹	Houston, Texas	Melanoma patients with children ages ≤12 years	570	Describe the sun exposure and sun protection practices of patients and their children	Protective practices and sun exposure	Currently recruiting, expected completion April 2009
Ellen R. Gritz, PhD ²	Houston, Texas	Melanoma patients and their families	170	Collect information on the ultraviolet radiation (UVR-E) reduction and early detection practices of melanoma patients and their family members		Expected primary completion November 2008
Richard G. Roetzheim, MD, MSPH ³	Florida	Children ages 8-11 years	2000	Effectiveness of a school-based intervention to increase hat use	Use of hats in and outside of school	Continuing through 2008-2009 school year, completion date unknown
KQ3: Do primary care feasible counseling interventions have adverse effects?						
None						
KQ4: Are sun protective behaviors associated with incidence of or morbidity and mortality from skin cancer?						
Julia Newton Bishop, MD ⁴	United Kingdom	Families with melanoma	3,700	Determine what lifestyle factors and which genes govern relapse from melanoma Compare sun exposure and genes that cause melanoma in patients with melanoma vs healthy participants Assess how unusual moles relate to sun exposure and genes that cause melanoma	Melanoma	Currently recruiting, expected completion December 2020
KQ5: Are sun protective behaviors associated with adverse effects?						
None						

References

1. Available at: ClinicalTrials.gov: <http://www.clinicaltrials.gov/ct2>. Accessed on November 28, 2008.
2. Available at: ClinicalTrials.gov: <http://www.clinicaltrials.gov/ct2>. Accessed on November 28, 2008.
3. Available at: Sun Protection for Florida's Children: <http://www.safeplay.org>. Accessed on November 28, 2008.
4. Available at: ClinicalTrials.gov: <http://www.clinicaltrials.gov/ct2>. Accessed on November 28, 2008.

Appendix E. Glossary and Abbreviations

Behavioral counseling: Any intervention that includes some provision of education, skills training, and support providing guidance to clients/patients on how to change sun-protective behavior, delivered alone or in combination with other interventions intended to promote sun-protective behavior.

Confidence interval (CI): 95 percent confidence interval.

Melanoma: Cutaneous melanoma includes four major subtypes: superficial spreading, nodular, lentigo maligna, and acral lentiginous. For the purposes of this review, acral melanoma, as well as mucosal melanoma, ocular melanoma, and pre-pubertal melanoma (“childhood melanoma”), are excluded.

Nevus, nevi (plural): Benign pigmented spot on the skin, such as a mole, that is a cluster of melanocytes and supportive tissue. In contrast, *dysplastic nevi*, or atypical moles, are melanocytic lesions that can be precursors to melanoma. Dysplastic nevi are distinguished by histology; however, they may also have certain clinical characteristics (e.g., increased diameter, lack of pigment uniformity).

Not reported (NR)

Odds ratio (OR)

Primary care relevant: Behavioral counseling interventions conducted in primary care, judged to be feasible to conduct in primary care, or can be referred from primary care.

Randomized controlled trial (RCT)

Relative risk (RR), also risk ratio

Skin phenotype: Skin (as well as hair and eye) color and skin type (i.e., ability to tan or burn that is genetically determined). A common measure of skin type is the Fitzpatrick Skin Type Scale.

Sun exposure: Intermittent, chronic, or total exposure to ultraviolet light. Intermittent patterns of exposure are most often related to recreational activities, versus chronic or continuous patterns of exposure, which are related to occupational exposure. For the purposes of this review, studies that included only crude measures of sun exposure (e.g., place of residence or type of occupation) were excluded.

Indoor tanning: Home or commercial ultraviolet light for the purposes of sun tanning; in the early 1980s UVA was added (before, it was primarily UVB). For the purposes of this review, medical uses of sunlamps or sunbeds, primarily UVA, are excluded.

Sunburn: Inflammation of the skin in response to ultraviolet light, manifested by painful erythema with or without blistering.

Sunscreen or sunblock: Lotion with sun protection factor (SPF) 15 or higher that is used to protect against ultraviolet light, both UVA and UVB. Protection against UVA was added in 1989. SPF was introduced in 1978 and is reported when available. For the purposes of this review, sun tan lotions or oils were excluded.

Vitamin D: Fat-soluble prohormone, the two major forms of which are vitamin D2 (ergocalciferol) and vitamin D3 (cholecalciferol). Vitamin D3 is produced in the skin when it is exposed to sunlight (UVB); vitamin D3 can be made in the skin at least two times per week after only 10 to 15 minutes of sun exposure to the face, arms, hands, or back without sunscreen. Vitamin D3 is hydroxylated in the liver and stored as 25-hydroxyvitamin D3 (calcidiol); calcidiol is again hydroxylated in the kidney to the main biologically active hormone 1,25-dihydroxyvitamin D3 (calcitriol). Vitamin 25-hydroxyvitamin D3 (25-OHD) is the commonly accepted serum marker for vitamin D status.

Appendix E. Glossary and Abbreviations

VDR gene: Vitamin D receptor gene. The effects of 1,25-dihydroxyvitamin D3 are mediated by this gene, which is expressed in breast and many other types of tissue. The expression and/or function of the VDR protein may be influenced by polymorphisms in the gene.