

UV Exposure and the Risk of Cutaneous Melanoma in Skin of Color: A Systematic Review

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ABBREVIATIONS/ACRONYMS: Fitzpatrick Skin Type (FST); Surveillance, Epidemiology, and End Results Program (SEER); Narrowband Ultraviolet-B (nbUVB); Acral Lentiginous Melanoma (ALM)

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48 **Key Points (93 words; Max: 100 words)**

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50 **Question:** What is the association between UV exposure and the risk of cutaneous melanoma in
51 skin of color?

52 **Findings:** Thirteen studies with over 7,700 melanomas in people with skin of color were

53 analyzed. Eleven studies showed no association between melanoma and UV exposure. Two

54 studies showed small, statistically significant positive associations only among black and

55 Hispanic males. The studies included were moderate to low quality.

56 **Significance:** The association between UV exposure and melanoma is weak in skin of color.

57 There is limited evidence supporting UV protection for melanoma prevention in skin of color.

Abstract (322 words; Max: 350 words)

Background: While current evidence supports UV exposure as an important risk factor for cutaneous melanoma in fair-skinned populations, the evidence for this relationship in skin of color is less certain.

Objective: To critically assess and synthesize the published data regarding the association between UV exposure and the risk of cutaneous melanoma in skin of color.

Evidence Review: A search was conducted including PubMed, Cochrane, and Web of Science databases from database origin to June 3, 2020. Only peer-reviewed original studies were screened in full-text. Eligible studies analyzed UV exposure as a risk factor for cutaneous melanoma in subjects with skin of color, which was defined broadly as any race other than non-Hispanic white, Fitzpatrick skin types IV – VI, or tanning ability of rarely or never burns. Measures of UV exposure included: UV index, irradiance, latitude, history of phototherapy, and history of sunburn. Evidence quality was assessed using criteria from the Oxford Centre for Evidence-based Medicine.

Findings: After duplicate removal, 11,059 database records were screened, 548 full-text articles were assessed, and 13 met inclusion criteria. Study types included 7 ecological studies, 5 cohort studies, and 1 case-control study. All studies used race and/or ethnicity to categorize the participants, and over 7,700 melanomas in skin of color were included. Of the 13 studies meeting inclusion criteria, 11 found no association between UV exposure and melanoma in skin of color, one study showed a small positive relationship in black males, and one showed a weak association in Hispanic males. All studies were of moderate to low quality (Oxford Centre ratings 2b to 4).

81 **Conclusions and Relevance:** The evidence suggests that UV exposure may not be an important
82 risk factor for melanoma development in people with skin of color. Current recommendations
83 promoting UV protection for melanoma prevention in skin of color are not supported by most
84 current studies. However, evidence is of moderate to low quality, and further research is required
85 to fully elucidate this relationship.

Introduction

Melanoma is a potentially deadly form of skin cancer, and its incidence has risen dramatically over time, especially among fair-skinned populations.¹ Melanoma incidence is much lower among people with skin of color; however, melanoma is often diagnosed at later stages with resulting lower survival rates.² As a result, there has been increasing interest in melanoma prevention within this population to reduce this health care disparity.³

Ultraviolet (UV) light exposure is the best studied and most consistent modifiable risk factor associated with melanoma.⁴ Numerous studies, including meta-analyses, have consistently demonstrated that increasing UV exposure is associated with higher rates of melanoma.^{4,5} However, much of the work demonstrating this relationship has been conducted exclusively in fair-skinned populations. In 2018, when the US Preventive Services Task Force (USPSTF) evaluated the evidence for recommending that clinicians counsel children and young adults about minimizing exposure to UV radiation, their grade B recommendation only applied to individuals with fair skin types.⁶ Despite this recommendation, the American Academy of Dermatology and other skin cancer organizations continue to recommend UV protection for skin cancer prevention, including melanoma prevention in skin of color.⁷

To date, there has been no comprehensive systematic review examining the association between UV exposure and melanoma in skin of color populations. The objective of this study was to critically assess and synthesize the published data regarding the association between UV exposure and the risk of cutaneous melanoma in skin of color.

Methods

This systematic review was registered in the PROSPERO database (ID: CRD42019140514) and was carried out in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines.⁸ This research project was reviewed by the University of Texas at Austin IRB and determined to be non-human subject research.

Search Strategy

Comprehensive searches of the Cochrane Library, the legacy version of PubMed, Web of Science Core Collection, KCI-Korean Journal Database, MEDLINE, Russian Science Citation Index, and SciELO Citation Index were conducted on June 26, 2019 and June 3, 2020. Search strategies for the concepts of melanoma and UV exposure were developed with input from clinical research team members in conjunction with an experienced health sciences librarian (R.B.), who conducted the searches.

Given that UV exposure can be from various sources, we used a broad array of terms to be as inclusive as possible, including: *ultraviolet, ultra-violet, ultra violet, actinic rays sunburn, sunburned, sunburning, sunburnlike, sunburns, sunburnt, burn, burns, burned, burnt, sun exposure, tanning, tanning beds, tanning lamps, indoor tanning, tanning booths, sunlamps, suntan, suntans, suntanned, suntanning*. Full search strategy information is presented in the supplement (S1).

At the conclusion of database search and screening, a forward and reverse citation search of all final eligible articles was conducted by two reviewers (M.G.S. and F.C.P.S.L.) to ensure a comprehensive collection of literature. The reverse citation search consisted of a review of all references within the final articles, and the forward citation search used Google Scholar to

examine all records which cited the final articles. Any potentially eligible records discovered through this process were screened according to established criteria and included as appropriate.

Study Selection

The articles were collected and managed using Covidence software, a web-based program used to streamline the systematic review process.⁹ Two researchers (F.C.P.S.L. and M.G.S.) independently screened titles and abstracts for inclusion using the eligibility criteria. If the abstract was unavailable or there was not enough information to decide on initial inclusion or exclusion, the article was kept for full-text review. If both reviewers agreed that the study did not meet eligibility criteria, the study was excluded. Any disagreements were settled by consensus including a third investigator (A.S.A. or K.S.).

Inclusion and Exclusion Criteria

We included only published articles in peer-reviewed journals that included human data and were written in or translated into English. Study designs considered included: ecological, observational, prospective/retrospective cohort, case-control, and randomized controlled trials (RCT). We only included studies in which UV exposure preceded the outcome of melanoma diagnosis. We excluded articles that examined transplant recipients, immunosuppressed people, or individuals with significantly elevated melanoma risk (e.g., history of xeroderma pigmentosum). We excluded articles focused on non-cutaneous (e.g., ocular, mucosal) melanoma. We also excluded any in-vitro studies.

People with skin of color constitute a wide range of racial and ethnic groups with varying melanin concentrations and varying susceptibility to UV-induced skin damage.¹⁰ Our definition

of skin of color was based on race/ethnicity and tanning ability and included the following: all races/ethnicities (e.g., African, Asian, Pacific Islander, Indigenous, Hispanics, etc.) except for non-Hispanic whites, Fitzpatrick skin type (IV - VI), or tanning ability (rarely or never burns). While there is no gold standard definition, these categories are in line with previous studies defining skin of color.^{7,10}

An objective assessment of an individual's UV exposure over time is difficult to quantify. Within the literature, there are various methods of measuring UV exposure, including: occupational exposure, childhood exposure, sunburn history, vacations to tropical destinations, measures of latitude, phototherapy sessions, tanning bed sessions, UV flux, UV index, irradiance, and estimated time spent outdoors. We included articles that attempted to quantify UV exposure by any of the above measurement methods.

Quality Assessment

To assess the overall evidence quality of each study, two reviewers (M.G.S. and F.C.P.S.L.) independently used guidelines provided by the Centre for Evidence-Based Medicine at Oxford.¹¹ Studies were classified based upon the "Therapy/Prevention, Aetiology/Harm" category, with 1a being the best quality and 5 being the poorest quality. Any discrepancies in the assessments between the initial reviewers were discussed, and if no consensus was reached, a third reviewer (A.S.A.) made a final designation.

Data Synthesis and Statistical Analysis

The following data were extracted for analysis from each record: author, year of publication, study location, type of study, skin of color classification, UV exposure

178 classification, study period, total number of melanomas, total number of melanomas in skin of
179 color, and the association between UV exposure and melanoma in skin of color.

Results

Literature Search

A total of 16,932 records were identified. After the removal of 5,873 duplicates, 11,059 unique records were screened. Of these, 10,511 records were excluded during the title and abstract screening phase, and 537 were excluded during full-text review. Eleven articles from the database search met eligibility criteria for inclusion and were subjected to further analysis. Two additional articles were discovered through forward citation search for a total of thirteen articles (Figure).

Study Characteristics

Seven studies were ecological studies, five were retrospective cohort studies, and one was a case-control study. Six studies were conducted in the United States, three in Korea, one in Taiwan, one in India, one in Chile, and one was multi-national. All studies used race and/or ethnicity to group the participants, with a few supplementing racial/ethnic classifications with Fitzpatrick skin type. UV exposure was categorized in various ways across studies, including latitude, UV index, exposure to phototherapy, UV flux, ozone, altitude, sunburn history, surface UVB, and birthplace UV irradiance. The period and follow-up studied varied from 3 to 38 years, the shortest being from 1982 to 1985 and the longest being from 1973 to 2011 (Table).

Ten of the thirteen studies reported data on the total number of melanomas diagnosed and melanomas reported in skin of color groups.¹²⁻²⁰ Among these, a total of 439,009 melanomas were identified, but only 7,727 (1.76%) were in skin of color populations. In one study, the intent was to collect the number of melanomas; however, zero melanomas were found in the group of patients exposed to narrowband UVB (nbUVB) phototherapy.¹⁵ The remaining two studies did

not report specific numbers of melanoma, but rather compared incidence rates between the general population and skin of color populations.^{21,22}

Studies without an association between UV exposure and melanoma

Eleven of the thirteen studies analyzed showed no association between UV exposure and melanoma in skin of color. Among the six US-based studies, three used the Surveillance, Epidemiology, and End Results (SEER) cancer registry, which is a program of the National Cancer Institute.^{12,13,19} In Pennello et al., SEER data on melanoma were analyzed between 1973-1994 along with UVB levels related to latitude, altitude, and sky cover.¹⁹ The authors found that melanoma in blacks was not associated with UVB levels. Eide et al. used SEER data from 1992-2000, and investigators showed that while there was an association between UV index, latitude, and melanoma in whites, there was no association in blacks, Hispanics, Native Americans, or Asian/Pacific Islanders.¹³ Adams et al. used SEER data from 1973-2011 and found that UV radiation exposure (stratified into low, medium, high) and incidence of melanoma were not associated among black men and women, but they were among white men and women.¹²

Park et al. conducted a prospective examination of UV exposure and melanoma among a Multiethnic Cohort (MEC), which included Latin American, Japanese American, and Native American people, but excluded African American individuals. Among nonwhite/multiracials in the MEC, there was no association between cutaneous melanoma and well-established risk factors, such as ever being sunburned, lifetime number of sunburns, first age of sunburn, and family history of melanoma.¹⁸ In a US-based case-control study, Wojcik et al. found no association between early UV exposure and melanoma among Hispanic patients. There was, however, a significant relationship between these variables among non-Hispanic white patients.¹⁴

In studies outside of the United States, there was also limited evidence that melanoma was associated with UV exposure in skin of color. A 1992 study by Krishnamurthy et al. examined the geography of non-ocular melanoma in India and showed a statistically non-significant association of melanoma with latitude.¹⁷ Three Korean studies examined the association between exposure to phototherapy and the risk of melanoma. In Jo et al., a retrospective study of 445 narrowband UVB-treated patients with Fitzpatrick skin phototype III-V found no evidence for increase in melanoma after a relatively short follow-up of mean 34.4 months.¹⁵ In 2019, Kim et al. compared incidence of melanoma between patients with vitiligo and controls without vitiligo stratified by phototherapy and found no difference in risk of melanoma.¹⁶ In Bae et al., a Korean nationwide population-based cohort study of 60,231 patients with vitiligo concluded that number of nbUVB sessions was not associated with an increase in risk of melanoma risk.²³ Similar to the Korean studies, Lin et al. evaluated the effect of differing levels of nbUVB phototherapy on the risk of melanoma in Taiwanese psoriasis patients.²⁴ Their nationwide retrospective cohort study conducted between 2000-2013 found no significant difference between short-term and long-term nbUVB and melanoma incidence.²⁴ Only one melanoma was diagnosed between both groups.

Godar et al. examined cutaneous melanoma using data encompassing over 50 countries and spanning five continents, collected from the International Agency for Research on Cancer. Their study found no significant relationship between increased UV dosage and melanoma incidence for any skin type, including non-Hispanic whites.²¹

Studies with an association between UV exposure and melanoma

Two studies showed a statistically significant, positive association between UV exposure and cutaneous melanoma but only in black and Hispanic males, respectively.^{14,22} Using the state cancer registries of New York, New Jersey, Illinois, California, Texas, and Florida between 1995-1999, Hu et al. examined the relationships between age-adjusted melanoma incidence rates, mean annual UV index, and latitude among whites, Hispanics, and blacks.¹⁴ The only significant correlation was among black males, specifically a positive correlation between melanoma incidence and UV index and a negative correlation between melanoma incidence and latitude. This association was not seen in black females, or in whites and Hispanics of either sex. Rivas et al. examined the effect of UV index and latitude on cutaneous melanoma in a Chilean population.²² A weak inverse correlation was found overall between melanoma rates and latitude only among males.

Quality Assessment

According to guidelines provided by the Centre for Evidence-Based Medicine at Oxford, four studies were graded as 2b, seven studies were graded as 2c, one study was graded as 3b, and one study was graded as 4. (Table 1) All classifications represent moderate to low quality evidence based on study designs.

Discussion

The findings of this systematic review suggest UV exposure is not an important risk factor for melanoma development in people with skin of color. This present study contrasts with multiple systematic reviews and meta-analyses in fair-skinned populations that demonstrate a consistent relationship between UV exposure and melanoma.^{4,5} Across all 13 studies, which included over 7,700 melanomas in skin of color from diverse racial and ethnic populations, there was little evidence of UV as a risk factor for melanoma. However, the quality of the evidence is moderate to low.

Of thirteen included articles, eleven showed no association between UV exposure and melanoma risk in skin of color. The largest studies in the United States used SEER cancer registries, which represent a geographically diverse group of registries that cover 35% of the US population, yet each of these SEER-based studies failed to show an association between UV exposure and melanoma in skin of color.²⁵ Unfortunately, these studies are limited by the fact that it is not possible to know the specific amount of UV exposure of each individual person with melanoma within the population. However, among whites in the SEER database, there was a consistent association between these broad UV measures and melanoma.

Other US-based studies included in our analysis attempted to overcome the issue of unaccounted individual UV exposure in ecological studies. Park et al. used a prospective cohort design, however, failed to show an association between well-established risk factors and melanoma (both in situ and invasive).¹⁸ However, the study did show an association among the MEC participants with a high sunburn susceptibility phenotype index, an index created by the authors based on four phenotypic factors: hair color, eye color, tanning ability, and skin's reactivity to acute sunlight.¹⁸ This finding highlights the fact that while UV exposure may be less

important in people with skin of color as a group, there may be a subset of people with high risk features predisposing them to melanoma. In another US-based study, Wojcik et al. used a case-control design and found no association between childhood UV exposure and melanoma among Hispanic patients.¹⁴ High UV exposure during childhood is one of the strongest modifiable risk factors for melanoma development.⁴

Studies conducted outside the United States also consistently failed to show an association between UV exposure and melanoma. Many of these studies were conducted in east Asia and included analysis of patients exposed to nbUVB for disorders such as psoriasis and vitiligo. While nbUVB exposure may not be equivalent to sun related UV exposure, it is reassuring as nbUVB is a valuable treatment for these various skin disorders. Importantly, among fair skin populations, data suggest no association between nbUVB and increased risk of melanoma.²⁶ Therefore, it may be unsurprising that no association was found in skin of color, who are already low risk for melanoma development at baseline.

Among the studies analyzed, two showed an association between UV exposure and melanoma in skin of color. In Hu et al., the association was only seen in black men but not for black women, Hispanic men and women, or surprisingly even for white men and women who have the highest risk of UV-associated melanoma. Rivas et al. also showed an association between melanoma and skin of color, based on latitude between cities in Chile. However, as an important caveat, the city in which melanoma incidence was higher contained a significant population of individuals of Croatian origin with skin types II and III.²² This finding highlights a central problem in the interpretation of data based on race, ethnicity, and country: these measures are imperfectly related to cutaneous melanin concentration, which is an important factor related to the risk of developing melanoma.

Ten of the thirteen studies reported data on the total number of melanomas diagnosed and melanomas reported in skin of color.¹²⁻²⁰ Data were retrieved from state, regional, and national cancer registries (three from SEER, two from Korean National Health Insurance, one from the National Cancer Registry Project of the Indian Council of Medical Research, one from Taiwan National Health Insurance Database, and three from the US states cancer registry) therefore the quality of the studies are dependent on the quality reporting to these entities.

While most of the studies analyzed in this systematic review did not differentiate the histologic subtypes of melanoma diagnosed, epidemiologic studies in skin of color indicate that the predominant melanoma subtype is acral lentiginous melanoma (ALM) on the lower extremities, palms, soles, and nailbeds.²⁷ ALMs are not considered UV-associated, therefore even if UV was a risk factor for melanoma in skin of color, only a small proportion of melanomas could even theoretically be attributed to UV exposure. It should be noted, however, that while ALMs predominate in skin of color, the incidence rate of acral melanoma is similar across all racial and ethnic groups, indicating a unique etiology.²⁷ Among the studies included in the systematic review, Park et al. was the only study that categorized cases of melanoma by histology type and excluded ALM from the calculations of risk. Therefore, it is unknown whether the exclusion of ALM from the analysis in other studies would have led to different conclusions about the association between melanoma and UV exposure.

Limitations

This systematic review has some limitations. Most studies included only race and ethnicity, which may not accurately correlate with melanin index or sunburn propensity; therefore, certain subpopulations within these groups may have differing susceptibility to UV as

a risk factor for melanoma. It is also possible that, in some cases, race and/or ethnicity may have been misclassified within the included studies. Quantifying UV exposure is challenging and differed across multiple studies, making comparisons between studies difficult. UV exposure and the outcome of melanoma may be separated by long periods of time, which may not have been captured in the studies with short follow up. UV exposure is also an important contributor to keratinocyte carcinoma, and photoprotection may be warranted for this reason; however, no systematic study of the strength of the association of UV exposure and keratinocyte carcinoma has been conducted in skin of color. Finally, the quality of these studies was moderate to low; therefore, high-quality studies should be pursued in the future to answer this important clinical question.

Conclusion

Taken together, the results of this systematic review question the notion that patients with skin of color should practice UV protection in order to reduce their risk of melanoma.⁷ The promotion of UV protection for melanoma prevention in skin of color should be tempered. Increased UV exposure does not appear to affect melanoma risk in skin of color. However, photoprotection may be associated with benefits in other UV associated disorders such as photoaging, melasma, and post-inflammatory hyperpigmentation. Importantly, our analysis excluded transplant recipients, immunosuppressed people, and individuals with potentially significantly elevated melanoma risk (e.g., history of xeroderma pigmentosum). Overall, our study shows that the evidence is of moderate to low quality; nevertheless, current guidelines suggesting photoprotection for melanoma prevention in skin of color are not supported by

current literature. Research to elucidate melanoma risk factors in skin of color populations should be sought in order to improve outcomes and reduce associated health disparities.

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Study concept and design: Adamson

Acquisition, analysis, and interpretation of data: All Authors

Drafting of the manuscript: Adamson, Lopes, Sleiman

Critical revision of the manuscript for important intellectual content: All Authors

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447 Figure. Flowchart outline of the database search and screening process.

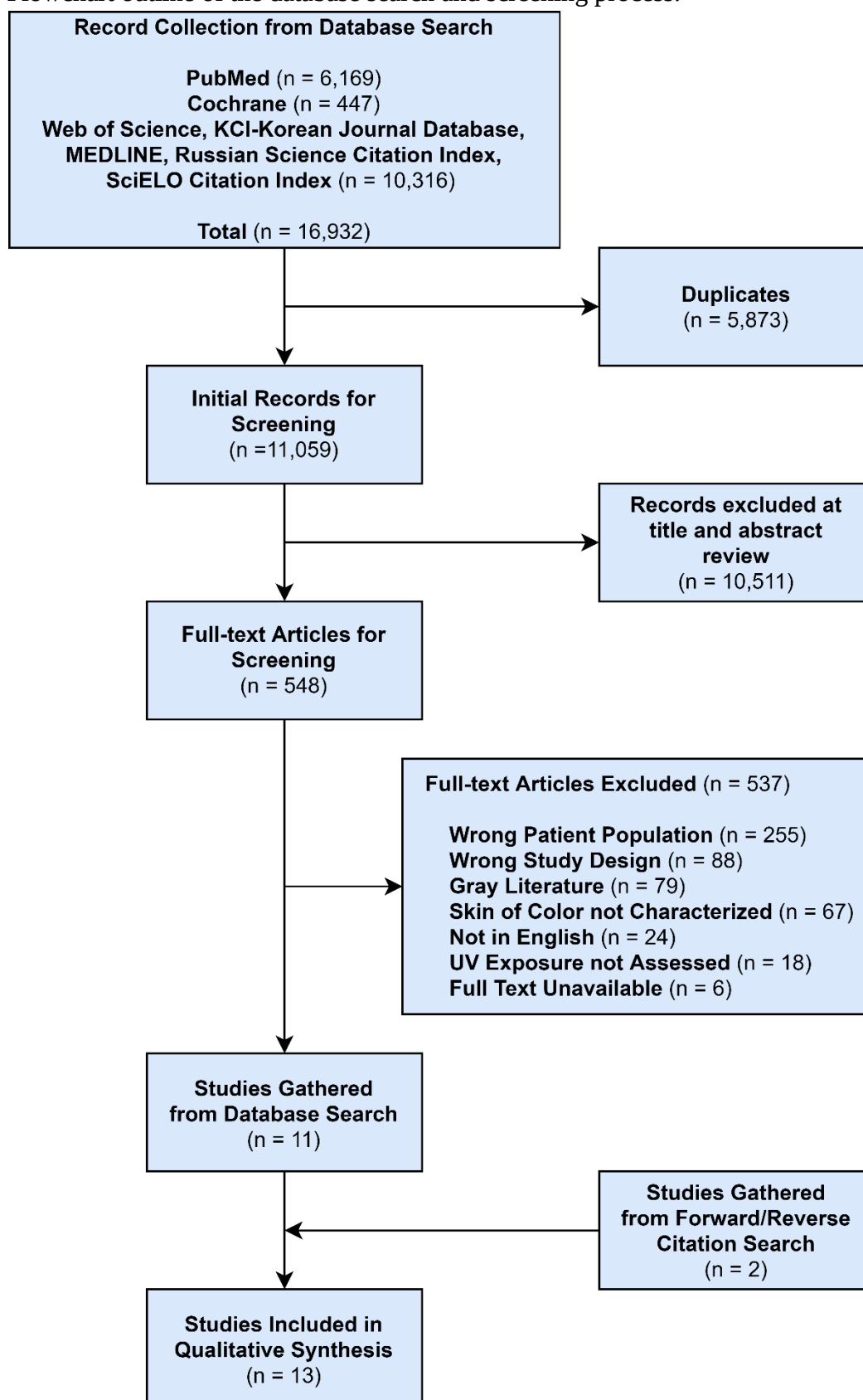


Table. Summary of Study Characteristics and Quality Assessment.

Author, Publication Year	Location	Type of Study	Race/Ethnicity/ Fitzpatrick Skin Type	UV Exposure Type	Study Period	Total Melanomas (n)	Melanomas in Skin of Color (n)	Association between UV Exposure and Melanoma in Skin of Color	Quality
Adams et al., ¹² 2016	US	Ecological	Black, White	Latitude	1973-2011	269,561	1,400	No association	2c
Bae et al., ²³ 2020	Korea	Retrospective Cohort	Asian	nbUVB ^a Phototherapy	2007-2017	34	34	No association	2b
Eide et al., ¹³ 2005	US	Ecological	Asian/Pacific Islander, Black, Hispanic White, Native American, and non-Hispanic White	Latitude and Mean UV Index	1992-2001	53,186	2,357	No association	2c
Godar et al., ²¹ 2017	Australia, US, Europe, China, Japan, South America, Italy, India	Ecological	Non-Hispanic White (FST ^b I-III); Asian, Hispanic, Latino, Polynesian (FST III-IV); African American (FST IV-VI); Eastern Indian (FST IV-V) and Mediterranean (FST III-IV)	Latitude	2003-2007	Not reported (only incidence reported)	Not reported (only incidence reported)	No association	2c
Hu et al., ¹⁴ 2004	US	Ecological	Black, Hispanic, and non-Hispanic White	Latitude and Mean UV Index	1989-2000	64,305	2,792	Positive correlation in Black males only. No association in Black women, Hispanic men, or Hispanic women	2c
Jo et al., ¹⁵ 2011	Korea	Retrospective Cohort	Asian (FST III-V)	nbUVB Phototherapy	1998-2009	Not reported (only incidence reported)	0 out of 445 nbUVB patients	No association	4
Kim et al., ¹⁶ 2020	Korea	Retrospective Cohort	Asian	Photochemotherapy or Phototherapy	2005-2017	313	313	No association	2b
Krishnamurthy, ¹⁷ 1992	India	Ecological	Indian	Latitude, Ozone, Altitude, and UV Flux	1982-1985	246	246	No association	2c
Lin et al., ²⁴ 2019	Taiwan	Retrospective Cohort	Asian (FST III-V)	Short-term nbUVB and Long-term nbUVB	2000-2013	1	1	No association	2b
Park et al., ¹⁸ 2012	US	Prospective Cohort	Non-Hispanic White, Japanese American, Latinx American, Native Hawaiian, and multiracial (excluding African American)	Sunburn History	1993-2007	993	181	No association	2b
Pennello et al., ¹⁹ 2000	US	Ecological	Black, White	Surface UVB	1973-1994	48,993	301	No association	2c
Rivas et al., ²² 2017	Chile	Ecological	Hispanic	Latitude and UV Index	2003-2007	Not reported (only incidence reported)	Not reported (only incidence reported)	Weak association in males only	2c
Wojcik et al., ²⁰ 2019	US	Case-Control	Hispanic and non-Hispanic White	Birthplace UV Irradiance	1988-2013	1,377	102	No association	3b

450^a – nbUVB = Narrowband Ultraviolet-B
451^b – FST = Fitzpatrick Skin Type

Supplemental 1 (S1). Search Tables

PubMed Search Strategy, 6/27/19

1	ultraviolet OR ultra-violet OR ultra violet OR actinic rays
2	sunburn OR sunburned OR sunburning OR sunburnlike OR sunburns OR sunburnt OR burn OR burns OR burned OR burnt OR sun exposure OR tanning OR tanning beds OR tanning lamps OR indoor tanning OR tanning booths OR sunlamps OR suntan OR suntans OR suntanned OR suntanning
3	#1 OR #2
4	melanomas
5	lentigo maligna
6	#4 OR #5
7	#3 AND #6

PubMed Search Strategy, update for 6/27/19-6/3/20

1	ultraviolet OR ultra-violet OR ultra violet OR actinic rays
2	sunburn OR sunburned OR sunburning OR sunburnlike OR sunburns OR sunburnt OR burn OR burns OR burned OR burnt OR sun exposure OR tanning OR tanning beds OR tanning lamps OR indoor tanning OR tanning booths OR sunlamps OR suntan OR suntans OR suntanned OR suntanning
3	#1 OR #2
4	melanomas
5	lentigo maligna
6	#4 OR #5
7	#3 AND #6
8	("2019/06/27"[Date - Entrez] : "3000"[Date - Entrez])
9	#7 AND #8

Cochrane Search Strategy, 6/27/19

1	(ultraviolet OR ultra-violet OR ultra violet OR actinic rays)
2	ultraviolet rays:MeSH exp
3	#1 OR #2
4	(sunburn OR sunburned OR sunburning OR sunburnlike OR sunburns OR sunburnt OR burn OR burns OR burned OR burnt OR sun exposure OR sunlight exposure OR tanning OR suntan OR sunlamp OR sunlamps OR sun-lamp OR sun-lamps)
5	sunlight:MeSH exp
6	#4 OR #5
7	#3 OR #6
8	(melanoma OR melanomas OR lentigo maligna)
9	melanoma:MeSH exp
10	#8 OR #9
11	#7 AND #10

Cochrane Search Strategy, update for 6/27/19-6/3/20

1	(ultraviolet OR ultra-violet OR ultra violet OR actinic rays)
2	ultraviolet rays:MeSH exp
3	#1 OR #2

4	(sunburn OR sunburned OR sunburning OR sunburnlike OR sunburns OR sunburnt OR burn OR burns OR burned OR burnt OR sun exposure OR sunlight exposure OR tanning OR suntan OR sunlamp OR sunlamps OR sun-lamp OR sun-lamps)
5	sunlight:MeSH exp
6	#4 OR #5
7	#3 OR #6
8	(melanoma OR melanomas OR lentigo maligna)
9	melanoma:MeSH exp
10	#8 OR #9
11	#7 AND #10
12	#11 with Cochrane Library publication date from Jun 2019 to Aug 2020

Web of Science+ Search Strategy, 6/27/19

1	ultraviolet OR ultra-violet OR ultra violet OR actinic rays
2	sunburn OR sunburnlike OR burn OR sun exposure OR sunlight exposure OR sunlamps OR sun lamps OR tanning OR suntan
3	#1 OR #2
4	melanomas
5	lentigo maligna OR Hutchinson's melanotic freckle
6	#4 OR #5
7	#3 AND #6

Web of Science+ Search Strategy, update for 6/27/19-6/3/20

1	ultraviolet OR ultra-violet OR ultra violet OR actinic rays
2	sunburn OR sunburnlike OR burn OR sun exposure OR sunlight exposure OR sunlamps OR sun lamps OR tanning OR suntan
3	#1 OR #2
4	melanomas
5	lentigo maligna OR Hutchinson's melanotic freckle
6	#4 OR #5
7	#3 AND #6
8	#7, TIMESpan=2019-2020