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Skin Cancer: An Evaluation of the Role of Personal and Family History of Skin Cancer on

Skin Protective Behaviors

THESIS

submitted in partial satisfaction of the requirements

for the degree of

MASTER OF SCIENCE

in Epidemiology

by

Casandra Alyssa Uriostegui

Thesis committee:
Professor Karen Edwards, Chair
Professor Michael Hoyt
Professor Luohua Jiang

2022

DEDICATION

To my parents and siblings,

Thank you for all the love and support you have shown and gifted me throughout my academic

journey. I could not have done this without you. This is for you.

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ACKNOWLEDGEMENTS

I would like to express my deepest appreciation to my thesis committee.

Professor Karen Edwards, Professor Michael Hoyt, and Professor Luohua Jiang,

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learn and work with all of you.

ABSTRACT OF THE THESIS

Skin Cancer: An Evaluation of the Role of Personal and Family History of Skin Cancer on

Skin Protective Behaviors

By

Casandra Alyssa Uriostegui

Master of Science in Epidemiology

University of California, Irvine, 2022

Professor Karen Edwards, Chair

The purpose of this cross-sectional study was to investigate how a personal and/or family history of skin cancer, affects the frequency of engagement with a range of known skin-protective behaviors. The data for this study was collected using a self-report questionnaire during an in-person cancer fundraiser in Orange County, CA and was limited to adults over the age of 18. A total of 93 individuals completed the survey, however, two were excluded as they were less than 18 years of age. The sample population consisted of individuals who were majority white (55.2%), female (63.2%), and over the age of 35 (64.0%). Results reveal that individuals with a family history of skin cancer or have been diagnosed with skin cancer at some point in their life, engage more frequently in skin-protective behaviors compared to those with no prior diagnosis and those without a family history of skin cancer. Several trends emerged across other demographic characteristics that provide further insight into the differences between those with and without a personal and/or family history of skin cancer. Further, results indicate

that nearly 20% of individuals are not aware of their skin cancer risk. Lack of awareness of risk varied by race / ethnicity, with 12%, 45% and 27% of self-identified white, Hispanic/Latino and Asian respondents, respectively, reported that they don't know their risk of skin cancer. Overall, the results generated by this study provide insights into the relationships between personal and family history of skin cancer and a range of well-established sun-protective behaviors and provide insights into opportunities for intervention.

CHAPTER 1: Introduction

According to the Centers for Disease Control and Prevention (CDC), skin cancer ranks as the fifth most common type of cancer in the United States, with nearly 5 million people being treated annually for the skin disease [1]. Melanoma, specifically, is the rare form of skin cancer (SC) that is found throughout the cells that produce melanin and give skin its natural color. Compared to other types of skin cancer, melanoma is known to frequently invade nearby tissues and metastasize to other parts of the body. According to the American Cancer Society, incidence rates of melanoma have increased annually by 31%, from 2012-2020 [2]. In addition, other research has shown that from 1994 to 2014, diagnosis of nonmelanoma skin cancers increased by 77% [3]. As the rate of skin cancer cases increases, there is a stronger need to understand differences of various demographic groups and risk groups, when it comes to the behavioral patterns of engagement in skin-protective measures, as well as, the attitudes towards sun exposure and skin cancer prevention. Skin-protective behaviors are important because they help reduce the risk of overall skin cancer [1,4,5]. These behaviors include performing self-skin examinations, getting routine skin examinations done by a doctor or a dermatologist, and utilizing sun-protective measures appropriately [5, 6]. Also known as the actions of reducing or preventing direct sun-exposure, sun-protective measures include applying and reapplying sunscreen frequently, and wearing protective clothing and accessories, e.g., sunglasses with UV protection and hats, when exposed to sunlight [6]. Individuals' thoughts and beliefs towards sun exposure and development of skin cancer could potentially influence motivation to engage in these skin-protective behaviors, now and in the future. Finally, it is well established that skin cancers are influenced by both environmental factors and genetic factors [7,8]. Those with a positive family history of skin cancer are at increased risk of developing skin cancer [1,9].

Similarly, those who have had a previous skin cancer or melanoma are also at increased risk of new diagnoses of skin cancer [1,9,11]. Thus, it is important to understand whether or not people with a personal and or family history of skin cancer engage in skin protective behaviors more than those without these risk factors. Further, little research has been done to evaluate whether age, gender or race / ethnicity impact engagement in skin protective behaviors among those with and without personal or family history of skin cancer. Identifying these differences, if any, could lead to further understanding and interpretation as to why these observed patterns exist. This study overall will help provide an overview of the individuals that need to be targeted in the future with educational public health interventions, such as the dissemination of education focusing on skin cancer awareness and outcomes, the harmful effects of sun-exposure, and the proper skin-protective behaviors.

CHAPTER 2: Literature Review

2.1. Descriptive Epidemiology of Skin Cancer

Melanoma is the most serious form of skin cancer as it is responsible for approximately 75% of all skin cancer deaths [9]. When not diagnosed early in the disease course, it is more likely to spread to other organs and parts of the body. The incidence rates of all types of skin cancer have continued to increase over the last four decades. A previous study from 2008 observed that the annual increase of melanoma incidence varied between populations but had been estimated to be between 3% and 7% - these estimates suggested a doubling of rates every 10 to 20 years [10]. Current studies have reported a 31% increase in melanoma cases and a 77% increase in nonmelanoma cases, within the last decade, in the United States [2,3]. Skin cancer is known to be caused by both genetic and environmental factors [7,8]. Personal and family history of skin cancer is commonly seen among individuals newly and previously diagnosed. About one

in every 10 individuals diagnosed with skin cancer have a family history of the disease [2]. And approximately 3 to 23% of individuals diagnosed with skin cancer have previously been diagnosed with skin cancer before [11].

The differences in risk vary across demographic groups. Generally, individuals who are male, lighter skin tones, older than 65 years old, and have been exposed to natural or artificial sunlight over long periods of time, have a higher risk of developing skin cancer [1]. According to the Surveillance, Epidemiology, and End Results (SEER) program, melanoma skin cancer is more common in men than women, and more new cases are seen among whites than any other racial/ethnic group [12]. According to the skin cancer foundation, one in every 5 Americans will develop skin cancer by the age of 70 years [2].

2.2. *Personal and Family history of Skin Cancer*

Does risk influence those with a positive family history and/or prior diagnosis of skin cancer to adopt skin-protective behaviors and engage more than those with a lower perceived risk? Some studies reported family history and personal history of skin cancer as factors that influence engagement in sun-protective behaviors [13,14]. A study consisting of U.S non-Hispanic white adults reported higher rates of frequent use of long sleeves, hats, and sunscreen, among those with previously diagnosed skin cancer compared to those with no diagnosed skin cancer [14]. In addition, individuals with a greater perceived risk of skin cancer were also found to be correlated with higher levels of sun-protective behaviors [13, 15,16]. For instance, a study consisting of individuals who were all Caucasian and mostly female (57%), indicated that greater perceived risk was associated with higher levels of sun-protective behavior, including sunscreen usage and wearing protective clothing [13]. Most of these studies were limited to one race / ethnic group (e.g., non-Hispanic white) and did not include age as a factor in their analyses.

2.3. Sun Exposure

Excessive exposure to the sun's ultraviolet rays, along with sunburn history, are key risk factors of skin cancer. According to the CDC, most skin cancers are caused by overexposure to UVA and UVB rays. Studies have shown that excess exposure to UV radiation increases the risk of developing any skin cancer type, especially melanoma [4]. Similar studies have reported that UV exposure is responsible for most melanoma cases [17,18]. More specifically, it has been estimated that nearly 95% of all melanoma cases in the United States were found attributable to ultraviolet radiation [17], and similarly, nearly 90% of nonmelanoma cases were found associated with UV radiation [19]. The main sources of UV radiation stem from excessive sun exposure and indoor tanning, which suggests that most cases are potentially preventable.

The CDC's Community Preventive Services Task Force, which provides evidence-based findings, appointed by the CDC director, to provide evidence-based findings and recommendations aimed at improving population health, recommends interventions in outdoor recreational and tourism settings to promote sun-protective behaviors among individuals [1]. These interventions include providing informational messages about sun protection, increasing availability of sun-protective items, implementing policies to support sun protection practices, and designing activities that influence knowledge and model behaviors, such as proper sunscreen usage. Previous literature has shown that engaging in sun-protective behaviors when outside can help reduce one's exposure to ultraviolet (UV) radiation and sunburn. Many studies conclude that preventative measures such as limiting sun exposure, wearing protective clothing, hats, and sunglasses, seeking shade, and regular sunscreen use, can decrease the risk of developing skin cancer [4,17,20]. On the contrary, certain studies have shown that when it came to sunscreen usage, sunscreen users did not have a decreased risk of malignant melanoma skin cancer [21].

Despite the known etiologic role of sun exposure, the question regarding sunscreen use to prevent skin cancer remains open, with its true association still unclear. In the previous study it was believed that the use of sunscreens permitted more time sunbathing, which allowed for more UV ray exposure, and therefore resulted in being associated with melanoma occurrence [21]. This leads to the question that if individuals, especially those with a personal and family history of skin cancer, were educated properly on the dangers of excessive sun exposure and taught the appropriate skin-protective measures and behaviors, could it potentially increase the use of proper sun-protective measures overall and ultimately reduce risk of melanoma.

The purpose of this thesis is to investigate how engagement in skin-protective measures and actions vary between individuals with and without a personal or family history of skin cancer, and other various demographic characteristics. Across a diverse sample population, we will also investigate the collective attitudes and perceived risk of skin cancer. The results will help provide a clearer understanding of knowledge, awareness, and engagement in skin-protective actions among adults in this sample and whether there are differences across, specific demographic and risk groups.

CHAPTER 3: Methods

3.1. Participants

The sample population for this study was derived from a convenience sample of adults participating in a one day, in-person cancer fund raising event in Orange County, CA in 2019. Participants were invited to complete a self-report survey to measure knowledge and attitudes about skin cancer. Data collection occurred over a single day and all surveys were in English. A total of 93 surveys were collected. Surveys in which participants reported being under the age of 18 (n=2) were classified as ineligible and were not entered into the database, leaving a total of 91

surveys available for analysis. Each survey was assigned a random participant ID number as it was entered into a REDCap database system. All participants provided informed consent. This study was approved by the UCI IRB.

3.2. Instrumentation

There were twenty-two multiple choice questions included on the survey and included questions about demographic characteristics. Paper copies of the survey were distributed individually to participants and surveys were collected by study personnel after participants completed the survey. Survey responses were entered into a REDCap database created for this study. Data was entered by one member of the research team, and all entries were checked for accuracy by a second member of the research team. This study focused on fourteen multiple choice questions related to engagement in skin protective behaviors and perceived risk of skin cancer.

The general demographic factors included in this analysis are gender, age, and ethnicity. Gender was originally categorized as three responses: Female, Male, and Other. 'Other' received no responses. Four individuals from the sample failed to provide a survey response for gender and were excluded from analyses examined by gender. Five age categories were included on the survey: 18-24 years old, 25-34 years old, 35-44 years old, 45-54 years old, and 55+ years. Five individuals from the sample failed to provide a survey response for age and therefore were excluded from all analyses examined by age. The 18-24 age category had very few responses (n=6) and was collapsed with the 24-34 year old group. Similarly, the two older groups were also collapsed due to few responses in the 45-54 year old group (n=14). Thus, age was collapsed into three categories for analysis: 18-34 years, 35-44 years, and 45+ years. Race / ethnicity was originally categorized as eight categories: White, Hispanic or Latino, Black or African

American, Asian, American Indian or Alaskan Native, Middle Eastern or Northern African, Native Hawaiian or other Pacific Islander, and Other. 'African American' and 'Native Hawaiian' received no responses. Four individuals from the sample failed to provide a survey response for ethnicity and therefore were excluded from all analyses examined by ethnicity. Individuals who were 'White' or 'Middle Eastern or North African' were both categorized as 'White' in analysis. Due to very low responses, 'American Indian or Alaskan Native'(n=1) and 'Other (n=1, reported as mixed by respondent)' were dropped. For analysis, race / ethnicity was defined as three categories as these categories had the largest numbers of participants: White, Hispanic or Latino, and Asian.

Personal and family history of skin cancer was originally categorized as two separate groups, each by three categories. Personal history was categorized as individuals diagnosed with skin cancer at some point in their lives, those without prior diagnosis, and don't know. Family history was also categorized as individuals who have a positive family history of skin cancer, those who have no history, and don't know. One individual from the sample failed to provide a survey response for diagnosis and therefore was excluded from all analyses examined by personal and family history of skin cancer. Due to few responses, 'Don't know' was dropped from both personal (n=2) and family history of skin cancer (n=7). Perceived risk was originally categorized as four categories: Very likely, Somewhat likely, Not at all likely, and Don't Know. No survey responses were missing for this variable. Due to its small size, 'Very likely' (n=10) was combined with 'Somewhat likely' for analysis. Perceived risk was then defined as three categories: Somewhat or very likely, Not at all likely, and Don't know.

The remaining questions focused on questions related to engagement in sun-protective behaviors and skin cancer screening. Individuals were free to skip any question they did not wish

to answer, and as a result, sample sizes vary by question. Due to very small sample sizes, categories of certain variables were dropped and/or combined to form fewer categories. For instance, due to a small number of responses, the category 'none'(n=6) was dropped from 'intentions to take specific future skin-protective measures', the category 'do not intend'(n=3) was dropped from 'intentions to take future skin-protective actions', 'all of the above'(n=6), 'none'(n=7), and 'other'(n=1) were dropped from sun-protective measures and 'Never'(n=6) was dropped from 'how often do you apply sunscreen. To focus on the difference between those who intend on taking action and those who already have, 'intentions to take future skin-protective actions' was collapsed from three categories and redefined as two categories: intention to take action at least within the next six months (or 30 days), and already have implemented action and will continue to do so for at least the next six months. 'Intentions to take specific future skin-protective measures' was initially categorized as four categories: Increase the frequency of sunscreen use, increase the amount of sunscreen applied, reapply sunscreen more often throughout the day, and use additional protection. The amount and reapply category were combined since they are both types of measures for sunscreen usage. The responses were refined as three categories: increase sunscreen use, increase amount applied or reapply more often, and use additional protection. Sun-protective measures were initially categorized as sunscreen, sunglasses with UV protection, hats, and clothing with UPF. Because clothing (n=13) had a small number of responses, it was collapsed and redefined into three categories: sunscreen, sunglasses with UV protection, and hats or clothing with UPF. 'How often do you apply sunscreen' was originally categorized as four categories but collapsed to three categories for analysis: Everyday even if it's not sunny, Often but not daily, and only when outdoors for a while, such as at the beach or at a state park. Reapplication was originally categorized as four

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categories: Every 30 minutes, Every hour, Every four hours, and I don't reapply. Due to very few responses, 'Every 30 minutes'(n=3) and 'Every hour'(n=8) were combined. The responses were redefined as three categories: at least every hour, every four hours, and I don't reapply. All three types of skin examinations were originally categorized as four categories, and then collapsed and redefined as two categories. Self-skin check responses were Once a month, Once a year, Rarely, and Never. Doctor skin check responses were At every visit, Once a year, Rarely, and Never. And Dermatologist skin check responses were At least once a year, At least once every two years, Rarely, and Never. Categories 'Rarely' and 'Never' were collapsed and combined to form one response category. The first two responses for each skin category had small response sizes and were combined. Self-skin checks and doctor skin checks were also both redefined as: At least once a year, and Rarely or never. Dermatologist skin checks were redefined as: At least once every two years, and Rarely or never.

3.3. Statistical Analysis

Data analysis was conducted using SAS® software (SAS Institute Inc., Cary, NC, USA). The dependent variables consist of skin-protective behaviors including sun-protective measures and types of skin examinations, and attitudes towards sun exposure prevention and skin cancer. The sun-protective measures include frequency of sunscreen usage, reapplication of sunscreen, and wearing sun-protective clothing or accessories (sunglasses or hat). The independent variables in this analysis are gender, age, ethnicity, perceived risk, diagnosis, and family history. The level of engagement across various behaviors relating to sun exposure protection and skin cancer prevention were compared across the demographic and risk groups. Moving forward, the SAS proc freq procedure was used to examine the frequency tables for each individual variable, as well as, used to analyze all the cross-tabulation tables generated by the independent and

dependent variables. Fisher's exact test was used to assess the significance of the associations found between variables in each cross-tabulation table. More specifically, to determine whether statistically significant differences exist among individuals who have a personal and/or family history of skin cancer, or other various demographic characteristics, when engaging in skin-protective measures and actions. Statistical significance was determined by $p<0.05$.

Table 1: Demographic characteristics of participants stratified by personal and family history of skin cancer.

Participants Characteristics	History of Skin Cancer						
	N=(total sample)	Personal history of skin cancer	No personal history of skin cancer	n=(total personal history)	Family History of skin cancer	No family history of skin cancer	n=(total family history)
Gender							
Female	55	4 (80.0%)	49 (62.0%)	53	14 (73.7%)	37 (60.7%)	51
Male	32	1 (20.0%)	30 (38.0%)	31	5 (26.3%)	24 (39.3%)	29
Age							
18-34 years old	31	0	31 (39.7%)	31	4 (22.2%)	24 (39.3%)	28
35-44 years old	13	0	12 (15.4%)	12	4 (22.2%)	6 (9.8%)	10
45+ years old	42	5 (100.0%)	35 (44.9%)	40	10 (55.6%)	31 (50.8%)	42
Ethnicity							
White	51	5 (100.0%)	43 (55.1%)	48	15 (79.0%)	30 (50.0%)	45
Hispanic or Latino	20	0	20 (25.6%)	20	3 (15.8%)	17 (28.3%)	20
Asian	15	0	15 (19.2%)	15	1 (5.3%)	13 (21.7%)	14

CHAPTER 4: Results

Demographic characteristics of the sample are shown in Table 1 and are displayed for the whole sample and also separately for those with skin cancer and those with a family history of skin cancer. Overall, the sample population consisted of ninety-one participants who were majority white (55.2%), female (63.2%), and above the age of 35 (64.0%). A small portion of the group reported having a positive family history of skin cancer (n=19, 22.6%) or having a diagnosis of skin cancer (n=5, 5.7%) at some point in their lifetime. Majority of participants with a family history of skin cancer were white (79%), female (74%), and over the age of 45 (56%). All of the participants with a personal history of skin cancer were white (100%), the majority were female (80%), and over the age of 45 (100%). A total of three individuals had both a family history of skin cancer and have been diagnosed prior with skin cancer.

Table 2.1: Skin-protective measures and actions by Gender.

Skin-protective measures and actions	Gender	
	Female	Male
	n= 55 (63.2%)	n=32 (36.8%)
Self-skin check		
At least once a year	20 (36.4%)	11 (34.4%)
Rarely or never	35 (63.6%)	21 (65.6%)
Doctor skin check		
At least once a year	7 (13.0%)	9 (28.1%)
Rarely or never	47 (87.0%)	23 (71.9%)
Dermatologist skin check		
At least once every 2 years	12 (24.5%)	4 (13.3%)
Rarely or never	37 (75.5%)	26 (86.7%)
Sun-Protective Measures		
Sunscreen	42 (39.6%)	18 (27.7%)
Sunglasses with UV protection	30 (28.3%)	22 (33.9%)
Hats or clothing with UPF	34 (32.1%)	25 (38.5%)
Frequency of applying sunscreen **		
Everyday, even if not sunny	16 (34.8%)	1 (3.9%)

Often, but not daily	12 (26.1%)	4 (15.4%)
Only when outdoors for awhile (e.g. Beach or park)	18 (39.1%)	21 (80.8%)
Frequency of re-applying sunscreen		
At least every hour	4 (8.3%)	5 (17.2%)
Every four hours	15 (31.3%)	8 (27.6%)
I don't reapply	29 (60.4%)	16 (55.2%)
Perceived risk of skin cancer		
Somewhat or Very likely	31 (56.4%)	22 (68.8%)
Not at all likely	11 (20.0%)	3 (9.4%)
Don't Know	13 (23.6%)	7 (21.9%)
Future Skin-protective Actions		
Intend to take at least one skin-protection action in the next 6 months.	22 (44.9%)	19 (61.3%)
Already implemented at least one skin-protection action and will continue to do so for at least the next 6 months.	27 (55.1%)	12 (28.7%)
Future Skin-protective Measures		

Increase frequency of sunscreen use	16 (34.0%)	6 (20.0%)
Increase the amount of sunscreen applied or reapply more sunscreen throughout the day	13 (27.7%)	9 (30.0%)
Use additional protection, such as sunglasses, hats, and UPF clothing	18 (38.3%)	15 (50.0%)

*p-value<0.05
**p-value<0.005

4.1. Demographic Variables: Gender, Age, Ethnicity

Engagement in skin-protective measures and actions by gender is shown in Table 2.1. No significant differences were found by gender for any of the three types of skin examinations. Men (34%) and women (36%) had a similar frequency of engagement for self-skin checks. Men had a moderately higher rate of getting their skin checked by their primary doctor at least once a year (28%), compared to women (13%). And women had a moderately higher rate of going to a dermatologist at least twice a year (25%), compared to men (13%). The usage of different types of sun-protective measures (including sunscreen, sunglasses with UV protection, hats, and clothing with UPF) was not significantly different between genders. It is interesting to note however that when it comes down to the type of sun-protective measure being used most frequently, women were more likely to report using sunscreen (40%), whereas men were more likely to report using hats or clothing with UPF (39%). A significant difference was found among the frequency of sunscreen usage. Defined by three response categories, we find that men (81%) are two times more likely than women (39%) to apply sunscreen 'only when outdoors for a while, such as at the beach or at a state park'. Respectively, women were more likely than men to apply sunscreen 'everyday, even if not sunny' (35%, vs. 4%) following 'often, but not daily' (26%, vs. 15%) usage. No significant differences were found by gender for the attitudes pertaining to the likelihood of getting skin cancer and the likelihood of engaging in future skin-protective actions. Still, we find that both men (69%) and women (56%) reported having a 'somewhat or very likely' perceived risk of developing skin cancer. A similar number of men (22%) and women (24%) reported not knowing their overall risk. The variable used to measure the intention to implement a skin-protective action in the future, showed that 55% of women reported having already implemented at least one skin-protection action and continuing to do so

for at least the next six months, and 61% of men reported that they intend on doing at least one skin-protective action in the next six months.

Table 2.2: **Skin-protective measures and actions by Age.**

Skin-protective measures and actions	Age Groups		
	34 years and younger	35-44 years	45 years and older
	n=31 (36.1%)	n=13 (15.1%)	n=42 (48.8%)
Self-skin check			
At least once a year	7 (22.6%)	5 (38.5%)	19 (45.2%)
Rarely or never	24 (77.4%)	8 (61.5%)	23 (54.8%)
Doctor skin check			
At least once a year	4 (12.9%)	2 (15.4%)	9 (22.0%)
Rarely or never	27 (87.1%)	11 (84.6%)	32 (78.1%)
Dermatologist skin check			

At least once every 2 years	4 (13.8%)	1 (10.0%)	11 (27.5%)
Rarely or never	25 (86.2%)	9 (90.0%)	29 (72.5%)
Sun-Protective Measures			
Sunscreen	22 (45.8%)	9 (31.0%)	29 (30.9%)
Sunglasses with UV protection	13 (27.1%)	10 (34.5%)	29 (30.9%)
Hats or clothing with UPF	13 (27.1%)	10 (34.5%)	36 (38.3%)
Frequency of applying sunscreen			
Everyday, even if not sunny	9 (20.9%)	5 (33.3%)	3 (21.4%)
Often, but not daily	7 (16.3%)	4 (26.7%)	4 (28.6%)
Only when outdoors for awhile (e.g. Beach or park)	27 (62.8%)	6 (40.0%)	7 (50%)
Frequency of re-applying sunscreen			
At least every hour	7 (25.0%)	1 (10.0%)	1 (2.6%)
Every four hours	6 (21.4%)	4 (40.0%)	13 (33.3%)
I don't reapply	15 (53.6%)	5 (50.0%)	25 (64.1%)

Perceived risk of skin cancer *			
Somewhat or Very likely	17 (54.8%)	7 (53.9%)	28 (66.7%)
Not at all likely	3 (9.7%)	1 (7.7%)	10 (23.8%)
Don't Know	11 (35.5%)	5 (38.5%)	4 (9.5%)
Future Skin-protective Actions			
Intend to take at least one skin-protection action in the next 6 months.	18 (62.1%)	7 (53.9%)	16 (43.2%)
Already implemented at least one skin-protection action and will continue to do so for at least the next 6 months.	11 (37.9%)	6 (46.2%)	21 (56.8%)
Future Skin-protective Measures			
Increase frequency of sunscreen use	7 (25.0%)	5 (41.7%)	10 (27.8%)
Increase the amount of sunscreen applied or reapply more sunscreen throughout the day	5 (17.9%)	3 (25.0%)	13 (36.1%)
Use additional protection, such as sunglasses, hats, and UPF clothing	16 (57.1%)	4 (33.3%)	13 (36.1%)

*p-value<0.05
**p-value<0.005

Engagement in skin-protective measures and actions by age is shown in Table 2.2. Though no significant differences were found for skin examinations, we find that as age increases, so does the engagement rate of self-skin checks and doctor skin checks. Individuals who were '45 years old and older' were more likely to conduct a self-skin check (45%) and dermatologist skin check (22%), compared to both individuals in the '35-44 years old' group (39%, 15%) and the '34 years and younger' group (27%, 13%). No significant differences were identified when examining the usage of the sun-protective measures, such as sunscreen usage and sunscreen reapplication. The frequency of sunscreen usage was defined by three categories. Regardless, each age category from youngest to oldest, was most likely to report applying sunscreen 'only when outdoors for a while, such as at the beach or at a state park' (63%, 40%, 50%) compared to 'often' or 'everyday' usage. All respective age categories were also more likely to report never reapplying sunscreen (54%, 50%, 64%). The attitudes pertaining to the likelihood of getting skin cancer show us that those 34 years old and younger (55%), 35-44 years old (54%), and 44+ years old (67%) all reported having a 'somewhat or very likely' perceived risk of developing skin cancer. Future skin-protective actions showed that individuals 34 years and younger (62%) and 35-44 years old (54%) were more likely to report that they intend on doing at least one skin-protective action in the next six months. Individuals 45 years old and older (57%) were more likely to report having already implemented at least one skin-protection action and continuing to do so for at least the next six months.

Table 2.3: Skin-protective measures and actions by Race / Ethnicity.

Skin-protective measures and actions	Race / Ethnic Groups		
	White	Hispanic or Latino	Asian
	n=51 (59.3%)	n=20 (23.3%)	n=15 (17.4%)
Self-skin check **			
At least once a year	26 (51.0%)	2 (10.0%)	3 (20.0%)
Rarely or never	25 (49.0%)	18 (90.0%)	12 (80.0%)
Doctor skin check *			
At least once a year	14 (28.0%)	1 (5.0%)	1 (6.7%)
Rarely or never	36 (72.0%)	19 (95.0%)	14 (93.3%)
Dermatologist skin check **			
At least once every two years	15 (32.6%)	1 (5.9%)	0
Rarely or never	31 (67.4%)	16 (94.1%)	15 (100.0%)
Sun-Protective Measures			
Sunscreen	36 (33.3%)	12 (50.0%)	11 (29.7%)

Sunglasses with UV protection	36 (33.3%)	5 (20.8%)	10 (27.0%)
Hats or clothing with UPF	36 (33.3%)	7 (29.2%)	16 (43.2%)
Frequency of applying sunscreen			
Everyday, even if not sunny	9 (20.9%)	5 (33.3%)	3 (21.4%)
Often, but not daily	7 (16.3%)	4 (26.7%)	4 (28.6%)
Only when outdoors for awhile (e.g. Beach or park)	27 (62.8%)	6 (40.0%)	7 (50.0%)
Frequency of re-applying sunscreen			
At least every hour	6 (13.0%)	2 (12.5%)	1 (7.1%)
Every 4 hours	16 (34.8%)	2 (12.5%)	5 (35.7%)
I don't reapply	24 (52.2%)	12 (75.0%)	8 (57.1%)
Perceived risk of skin cancer **			
Somewhat or Very likely	38 (74.5%)	10 (50.0%)	4 (26.7%)
Not at all likely	6 (11.8%)	1 (5.0%)	7 (46.7%)
Don't know	7 (13.7%)	9 (45.0%)	4 (26.7%)

Future Skin-protective Actions			
Intend to take at least one skin-protection action in the next 6 months.	20 (40.8%)	12 (70.6%)	8 (61.5%)
Already implemented at least one skin-protection action and will continue to do so for at least the next 6 months.	29 (59.2%)	5 (29.4%)	5 (38.5%)
Future Skin-protective Measures *			
Increase frequency of sunscreen use	8 (18.2%)	9 (50.0%)	5 (35.7%)
Increase the amount of sunscreen applied or reapply more sunscreen throughout the day	15 (34.1%)	1 (5.6%)	6 (42.9%)
Use additional protection, such as sunglasses, hats, and UPF clothing	21 (47.7%)	8 (44.5%)	3 (21.4%)

*p-value<0.05
**p-value<0.005

Engagement in skin-protective measures and actions by race / ethnicity is shown in Table 2.3. Significant differences were found between these race / ethnic groups and all three types of skin examinations. The frequency of checking your own skin for changes in freckles or moles, had the highest engagement rate across all types of skin examinations. Individuals in the 'White' group (51%) were over two times more likely to check their skin for abnormal changes at least once a year, compared to the 'Hispanic or Latino' (10%) and 'Asian' group (20%). Less engagement was seen across doctor and dermatologist skin examinations. White individuals (28%) were over four times more likely than Hispanic (5%) or Asian (7%) individuals to get their skin checked by their primary care doctor at least once a year. White individuals (33%) are also over five times more likely than Hispanic (6%) or Asian (0%) individuals to get their skin checked by a dermatologist at least once every two years. No significant differences were identified when examining the usage of the sun-protective measures, such as sunscreen usage and sunscreen reapplication. Participants who were White reported equal engagement of 'sunscreen' (33%), 'sunglasses with UV protection' (33%), and 'hats or clothing with UPF' (33%). Participants who were Hispanic were more likely to report using sunscreen (50%), whereas participants who were Asian were more likely to report using hats or clothing with UPF (43%). White individuals (63%) were more likely than Hispanic (40%) and Asian (50%) individuals to use sunscreen only when outdoors for a while. Over half of all the ethnicity categories -White, Hispanic, and Asian- reported not reapplying sunscreen (52%, 75%, 57%). Reapplication at least every four hours was two times more likely to be seen in White (35%) and Asian (36%) individuals, compared to Hispanics (13%). Evaluating one's own risk of getting skin cancer revealed that the majority of participants who were white reported the likelihood of getting skin cancer being 'somewhat or very likely' (75%). The majority of individuals who

were Hispanic, reported their skin cancer risk to be 'somewhat or very likely' (50%) and 'don't know' (45%) and the majority of individuals who were Asian reported their skin cancer risk to be 'not at all likely' (47%). Measuring the intention to implement a specific skin-protective measure in the future, showed that almost half (48%, 45%) of all individuals who were White or Hispanic reported willing to use additional protection (i.e. hats, sunglasses and clothing with UPF). The other half (50%) of individuals who were Hispanic reported willing to increase the frequency of sunscreen use. Nearly half (43%) of individuals who were Asian reported increasing the amount of sunscreen applied or reapplying more frequently throughout the day.

Table 3: Skin-protective measures and actions in those with and without a personal or family history of skin cancer.

Skin-protective measures and actions	Personal or Family History of skin cancer	
	Yes	No
	n=21 (25.6%)	n=61 (74.4%)
Self-skin check		
At least once a year	10 (47.6%)	19 (31.2%)
Rarely or never	11 (52.4%)	42 (68.9%)
Doctor skin check		
At least once a year	6 (30.0%)	11 (18.0%)
Rarely or never	14 (70.0%)	50 (82.0%)
Dermatologist skin check *		
At least once every two years	7 (41.2%)	8 (14.8%)
Rarely or never	10 (58.8%)	46 (85.2%)
Sun-Protective Measures		
Sunscreen	14 (31.8%)	38 (36.5%)
Sunglasses with UV protection	14 (31.8%)	31 (29.8%)

Hats or clothing with UPF	16 (36.4%)	35 (33.7%)
Frequency of applying sunscreen		
Everyday, even if not sunny	6 (37.5%)	9 (18.8%)
Often, but not daily	3 (18.8%)	12 (25.0%)
Only when outdoors for awhile (e.g. Beach or park)	7 (43.8%)	27 (56.3%)
Frequency of reapplying sunscreen *		
At least every hour	1 (6.3%)	9 (17.0%)
Every four hours	9 (56.3%)	11 (20.8%)
I don't reapply	6 (36.5%)	33 (62.3%)
Perceived risk of skin cancer **		
Somewhat or Very likely	19 (90.5%)	29 (47.6%)
Not at all likely	1 (4.8%)	13 (21.3%)
Don't know	1 (4.8%)	19 (31.2%)
Future Actions *		
Intend to do at least one skin-protection action in the next 6 months.	5 (25.0%)	32 (59.3%)

Already implemented at least one skin-protection action and will continue to do so for at least the next 6 months.	15 (75.0%)	19 (35.2%)

Future Skin-protective Measures		
Increase frequency of sunscreen use	5 (27.8%)	15 (30.0%)
Increase the amount of sunscreen applied or reapply more sunscreen throughout the day	7 (38.9%)	13 (26.0%)
Use additional protection, such as sunglasses, hats, and UPF clothing	6 (33.3%)	22 (44.0%)

*p-value<0.05
**p-value<0.005

4.2. Diagnosed, Family History, and Perceived Risk

Engagement in skin-protective measures and actions by personal and family history of skin cancer is shown in Table 3. Across all three types of skin examinations, significant differences were only found within dermatologist skin checks. Individuals with a personal or family history of skin cancer (41%) were over two times more likely to go to a dermatologist at least once every two years, compared to individuals without a history (15%). Less engagement was seen across doctor skin checks. 30% of individuals with a history and 18% of individuals without, reported getting their skin checked by their primary doctor at least once a year. Self-skin checks had the highest engagement rate seen in skin examinations. Almost 100% of individuals with a personal or family history of SC reported checking their skin for abnormal changes at least once a year (90.1%), compared to those without a history (59%). No significant differences were identified when examining the usage of the sun-protective measures, such as sunscreen usage. Participants who had a history of SC reported similar engagement rates as participants without a history, respectively, for all sun-protective measures including sunscreen (32%, 37%), sunglasses with UV protection (32% 30%), and hats or clothing with UPF (36%, 34%). It was interesting to note that individuals with a history were two times more likely to report applying sunscreen 'everyday, even if not sunny' (38%) compared to those without any history (19%). Over half of the individuals from the no history category (56.3%) reported applying sunscreen only when outdoors for a while, such as at the beach or at a state park, whereas slightly less than half of the individuals from the positive history category (43.8%) reported the same. Significant differences were found among the frequency of applying sunscreen: participants with a history were more likely to report re-applying at least every four hours (56%) than those without a

history (21%), whereas participants without a history of SC were more likely to report never re-applying (62%) than those with a history of SC (37%).

Several significant differences were found among the variables used to examine the attitudes and future actions towards sun-exposure prevention and skin cancer. Those without a history of SC were more likely to report their risk as 'somewhat or very likely' (48%) followed by 'Don't know' (31%). While those with a history of SC were more likely to report being 'somewhat or very likely' (91%). For the intention to implement a skin-protective action in the future question, 75% of people from the history category reported having already implemented at least one skin-protection action and continuing to do so for at least the next six months, while 59% of people from the no history category reported willing to implement at least one skin-protective action in the next six months.

Table 4: Skin-protective measures examined by perceived risk of developing skin cancer.

Skin-protective measures and actions	How likely are you to get skin cancer?		
	Don't know	Not at all likely	Somewhat or Very likely
	n=21 (23.1%)	n=15 (16.5%)	n=55 (60.4%)
Self-skin check			
At least once a year	4 (19.1%)	5 (33.3%)	24 (43.6%)
Never	17 (81.0%)	10 (66.7%)	31 (56.4%)
Doctor skin check			
At least once a year	3 (14.3%)	3 (21.4%)	11 (20.0%)
Never	18 (85.7%)	11 (78.6%)	44 (80.0%)
Dermatologist skin check			
At least once every two years	2 (11.8%)	1 (7.7%)	13 (26.0%)
Never	15 (88.2%)	12 (92.3%)	37 (74.0%)
Sun-Protective Measures			
Sunscreen	12 (36.4%)	12 (42.9%)	36 (32.1%)
Sunglasses with UV protection	10 (30.0%)	7 (25.0%)	36 (32.1%)
Hats or clothing with UPF	11 (33.3%)	9 (32.1%)	40 (35.7%)
Frequency of applying sunscreen			

Everyday, even if not sunny	3 (20.0%)	5 (38.5%)	9 (19.6%)
Often, but not daily	5 (33.3%)	2 (15.4%)	10 (21.7%)
Only when outdoors for awhile (e.g. Beach or park)	7 (46.7%)	6 (46.2%)	27 (58.7%)
Frequency of re-applying sunscreen			
At least every hour	3 (18.8%)	2 (15.4%)	5 (10.2%)
At least every 4 hours	3 (18.8%)	3 (23.1%)	17 (34.7%)
I don't reapply	10 (62.5%)	8 (61.5%)	27 (55.1%)
Future Actions *			
Intend to take least one skin-protective action in the next 6 months	13 (76.5%)	4 (30.8%)	24 (48.0%)
Already implemented at least one skin-protective action and will continue to do so for at least the next 6 months	4 (23.5%)	9 (69.2%)	26 (52.0%)
Future Skin-protective Measures			
Increase frequency of sunscreen use	6 (33.3%)	4 (33.3%)	12 (25.5%)
Increase the amount of sunscreen applied or reapply more sunscreen throughout the day	4 (22.2%)	5 (41.7%)	13 (27.7%)
Use additional protection, such as sunglasses, hats, and UPF clothing	8 (44.4%)	3 (25.0%)	22 (46.8%)

*p-value<0.05
**p-value<0.005

Engagement in skin-protective measures and actions by perceived risk is shown in Table 4. No significant differences were found by perceived risk for any of the three types of skin examinations. Individuals from the 'somewhat or very likely' category maintained higher engagement rates across self-skin checks (44%) and dermatologist checks (26%), compared to those from the 'not at all likely' (33%, 8%) and 'don't know' (19%, 12%) category. Within doctor checks, we find that individuals from both the 'somewhat or very likely' (20%) and 'not at all likely' (21%) categories have very similar engagement rates, with engagement from the 'don't know' category (14%) not falling too far behind. No significant differences were identified when examining the usage of the sun-protective measures, such as sunscreen usage and sunscreen reapplication. Participants who were in the 'somewhat or very likely' category reported almost equal engagement of 'sunscreen' (32%), 'sunglasses with UV protection' (32%), and 'hats or clothing with UPF' (36%). Participants who were in the 'don't know' category also reported similar engagement for 'sunscreen' (36%), 'sunglasses with UV protection' (30%), and 'hats or clothing with UPF' (33%). Participants from the 'not at all likely' category were more likely to report using 'sunscreen' (43%) and 'hats or clothing with UPF' (32%). Furthermore, a majority of those from the 'somewhat or very likely' group reported using sunscreen only when outdoors for a while (59%). Nearly half of the individuals from both 'not at all likely' and 'don't know' groups, respectively, reported the same action (46%, 47%). A slightly higher rate of applying sunscreen 'everyday, even if not sunny' (39%) was noted by the 'not at all likely' group in comparison to the 'somewhat or very likely' group (20%). Reapplication of sunscreen at least every four hours exhibited an increasing trend from 'don't know' (19%), to 'not at all likely' (23%), to 'somewhat or very likely' (35%). In addition, over half of all the individuals from each perceived risk category -don't know (63%), not at all likely (62%), and somewhat or very likely

(55%)- reported not reapplying sunscreen. No significant differences were found by perceived risk for the likelihood of engaging in future skin-protective actions. Still, we find that the intention to implement a skin-protective action in the future, was reported more by those in the 'don't know' category (77%). Individuals from the 'not at all likely' category (69%) and the 'somewhat or very likely' category (52%) were more likely to report having already implemented at least one skin-protection action and continuing to do so for at least the next six months.

CHAPTER 5: Discussion

This cross-sectional study supports the idea that individuals with a prior diagnosis of skin cancer and/or a positive family history of skin cancer tend to engage more frequently in skin-protective behaviors and actions than people who have neither increasing disease risk factor. Differences were identified by the following demographic characteristics: gender, age, and ethnicity, but engagement varied across all skin-protective measures and actions. Similar trends observed by previous studies emerged when focusing on skin examinations, proper sunscreen usage, and the attitudes towards sun-exposure prevention and skin cancer risk [13,15].

5.1. Gender, Age, Ethnicity

Regular skin examinations, and proper usage of sun-protective measures, are behaviors essential for early detection and prevention of skin cancer. The level of engagement for skin-protective measures and actions varied, producing both expected and unexpected results. Our sample population reported overall low levels of engagement for most skin-protection behaviors. For example, going to the dermatologist at least every two years was less commonly practiced at 18% in contrast to using sunscreen which was most commonly practiced at 66%. Lack of knowledge of sun exposure effects and skin cancer risk is typically seen among other studies

examining sun-protective measures as well [22,23]. For instance, a study reported that individuals knew limited or sometimes inaccurate knowledge about long-term risk of sun exposure and skin cancer [23]. Moreover, poor sun protective behaviors, such as sunscreen usage, was found among individuals that also demonstrated very low levels of melanoma knowledge [22]. This could be an indication that knowledge and awareness of skin cancer and sun exposure prevention, is low among this population. Thus, a public health intervention could be recommended to educate and influence specific groups to partake in better skin-protective behaviors in the future. It is important to also consider, however, that past interventions have already been implemented, but have yet to be successful in increasing engagement rates in all groups. Perhaps receiving knowledge is the first step to influencing change, but simply not enough to influence individuals to follow through with changing their behavior. Our results indicated that individuals who were female, of older age (>35 years old), and white ethnicity were more likely to practice more skin-protective measures, compared to individuals who were male, younger, and non-white. Findings were consistent with what previous literature has shown when examining sunscreen usage and other sun-protective measures by gender and age [15,24,25]. It is important to note, however, that women only had slightly higher rates of engagement, compared to men. There is a noticeable trend within skin examination engagement, from self-skin checks to doctor and dermatologist skin checks, by gender, age, and ethnicity. Higher engagement in self-skin checks show it is more common to self-examine skin rather than go to a doctor, especially a specialist (dermatologist). This is notable since over 90% of the sample population reported having health insurance, giving the indication that they have access to a primary care physician. Not much is said about the differences in skin-check engagement, so further analysis into this existing gap is needed. Public health education and interventions to

promote skin-protective behaviors have consistently been targeted towards non-Hispanic whites [26]. In our study, individuals who were white were shown to engage more frequently in skin-protective measures and actions, but engagement rates remained low. People also seemed to be willing to set the intention of implementing at least one skin-protective action in the near future, however, we have no way of knowing how many of those individuals actually followed through and implemented an action. Despite past interventions, there seems to remain a gap between receiving educational information and following through with adopting and putting forth said information in the form of skin-protective behaviors.

5.2. Diagnosed, Family History, and Perceived Risk

Results indicate that individuals with a personal or family history of skin cancer tend to engage in skin-protective behaviors only moderately more than individuals without a history. The same can be said when examining the influence an individuals' perceived risk of skin cancer has on their overall engagement in all skin-protection behaviors. Those with a personal or family history of skin cancer did not generate any significant differences when it came to using sun-protective measures (including sunscreen, sunglasses, hats, and clothing with UPF). These results are found to be consistent with other studies [27,28,29] that have analyzed relatives of patients with skin cancer, as well as, skin cancer survivors. It seems that even though people are aware of their personal and/or family history of skin cancer, they still chose to not engage in many skin-protective behaviors. For instance, habitual sun protection, including the use of sunglasses and long-sleeve shirts, was found to be relatively low among individuals with a family history [28]. In addition, melanoma survivors were found to only engage in sun protection behaviors to a moderate extent, with relatively low frequencies among self-skin examinations (22%) but higher frequencies among physician skin checks (88%) [27]. Regardless, better skin-

protective behaviors can still be seen being modeled by individuals with a personal and/or family history of skin cancer. This includes higher rates of getting skin checked by a dermatologist, higher rates of reapplying sunscreen and higher rates of having already implemented at least one skin-protection action prior to this study. This indicates that the personal and/or family history group were already performing better behaviors when it came down to certain skin-protective measures, but there is still an opportunity to increase the frequency of these behaviors even in these higher risk groups.

5.3. Strengthens and Limitations

There were limitations and strengths to this study. Limitations include the fairly small sample population, and as a result, only a small number of participants reported being diagnosed with skin cancer before and/or having a positive family history of skin cancer. Because the study was cross-sectional, it was also susceptible to bias due to low response. The sample population consisted of individuals who willingly attended a cancer health event at a University. This could have resulted in sampling bias and lack of representation due to the sample not being completely representative of the population. Those who attend these types of events typically include students and faculty of universities, and the local community -known to be predominantly Asian (43.6%) and White (44.9%), and affluent [30]. This would explain the larger proportion of White individuals in our sample population. Another limitation is that these cross-sectional studies are not always suitable for studying rare diseases. A total of 91 individuals were available during analysis, however, sample sizes for specific analyses varied due to incomplete survey responses to most questions. This could have resulted in measurement bias and therefore needs to be considered when interpreting associations. The power to detect differences in some variables was limited due to small numbers. Finally, we were unable to evaluate several categories, such as those

who responded as Don't Know or Do not intend. However, this study did include a diverse sample of adults allowing evaluation across racial/ethnic groups not often included in studies of skin cancer.

CHAPTER 6: Conclusions

This cross-sectional study examined engagement in skin-protective behaviors by having or not having a personal and/or family history of skin cancer, as well as, perceived risk, gender, age, and race / ethnicity. Overall, individuals who know or consider themselves to be at a greater risk for developing skin cancer, seem to engage slightly more frequently in skin-protective actions than individuals who believe they have no risk at all, or are unaware of their risk. Comparisons among different, diverse groups provide a more in-depth understanding of the differences and similarities in level of knowledge and awareness for skin cancer and prevention across groups. This study provides additional insight into opportunities for more targeted interventions that seek to reduce excessive sun exposure and skin cancer development.

References

[1] CDC. (2022, April 18). *Skin cancer*. Centers for Disease Control and Prevention.

https://www.cdc.gov/cancer/skin/index.htm

[2] *Skin cancer facts & statistics*. The Skin Cancer Foundation. (2022, May 24).

https://www.skincancer.org/skin-cancer-information/skin-cancer-facts/

[3] Mohan, S. V., & Chang, A. L. (2014). Advanced Basal Cell Carcinoma: Epidemiology and

Therapeutic Innovations. *Current dermatology reports*, *3*(1), 40–45.

https://doi.org/10.1007/s13671-014-0069-y

[4] AAD. (2022, April 22). *Types of skin cancer*. American Academy of Dermatology.

https://www.aad.org/public/diseases/skin-cancer/types/common

[5] Saraiya, M., Glanz, K., Briss, P., Nichols, P., White, C., & Das, D. (2003, October 2).

Preventing skin cancer: Findings of the task force on community preventive services on reducing

exposure to ultraviolet light. Centers for Disease Control and Prevention.

https://www.cdc.gov/mmWR/preview/mmwrhtml/rr5215a1.htm

[6] Centers for Disease Control and Prevention. (2012, May 11). *Sunburn and sun protective*

behaviors among adults aged 18–29 years - United States, 2000–2010. Morbidity and Mortality

Weekly Report (MMWR).https://www.cdc.gov/mmwr/preview/mmwrhtml/mm6118a1.htm

[7] Grossman, D., & Leffell, D. J. (1997, October 1). *The molecular basis of nonmelanoma skin*

cancer. Archives of Dermatology. https://jamanetwork.com/journals/jamadermatology/article-

abstract/559352?casa_token=p9XwRSOa5vU_AAAAA%3AGKZoF-ntH_TeVckzWCE4EeAZJ-

OgsTDDk1pkqv6WfM6TBH_IRS-3MfhgDTJb-G5X0s_pf7knPlA

[8] *About skin cancer*. National Human Genome Research Institute. (2012, October 30).

https://www.genome.gov/Genetic-Disorders/Skin-Cancer

[9] Cleveland Clinic. (2019, October 10). *Skin cancer from Sun Exposure: Risk Factors, symptoms & prevention*. Sun Exposure & Skin Cancer. https://my.clevelandclinic.org/health/diseases/10985-sun-exposure-and-skin-cancer

[10] Garbe, C., & Leiter, U. (2008, December 16). *Melanoma epidemiology and trends*. Clinics in Dermatology. https://www.sciencedirect.com/science/article/pii/S0738081X08001788

[11] NCI. (2020, December 2). *Recurrent cancer*. National Cancer Institute. https://www.cancer.gov/types/recurrent-cancer

[12] National Institutes of Health. (n.d.). *Melanoma of the skin - cancer stat facts*. Surveillance, Epidemiology, and End Results Program. https://seer.cancer.gov/statfacts/html/melan.html

[13] Azzarello, L. M., Dessureault, S., & Jacobsen, P. B. (2006, January 24). *Sun-protective behavior among individuals with a family history of melanoma*. Cancer Epidemiology, Biomarkers & Prevention. https://aacrjournals.org/cebp/article/15/1/142/258209/Sun-Protective-Behavior-among-Individuals-with-a

[14] Fischer, A. H., Wang, T. S., Yenokyan, G., Kang, S., & Chien, A. L. (2016, May 16). *Sunburn and sun-protective behaviors among adults with and without previous nonmelanoma skin cancer (NMSC): A population-based study*. Journal of the American Academy of Dermatology.https://www.sciencedirect.com/science/article/pii/S0190962216015061?casa_token=evtR3-OVZqYAAAAA%3Al-3TwVTbbqRjiT3QNyHVsq3tgn30KQG4KXydG-MaoP6x9L0wvb1_Py-pMgJScsgph6nLeKoE SQ

[15] Bruce, A. F., Theeke, L., & Mallow, J. (2017, June 1). *A state of the science on influential factors related to sun protective behaviors to prevent skin cancer in adults*. International Journal of Nursing Sciences. https://www.sciencedirect.com/science/article/pii/S2352013217300054

[16] Diao, D. Y., & Lee, T. K. (2013, December 20). *Sun-protective behaviors in populations at high risk for skin cancer*. National Library of Medicine.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3873203/

[17] Islami, F., Sauer, A. G., & Miller, K. D. (2017, November 21). *Proportion and number of cancer cases and deaths attributable to potentially modifiable risk factors in the United States*. ACS Journals. https://acsjournals.onlinelibrary.wiley.com/doi/10.3322/caac.21440

[18] Parkin, D. M., Mesher, D., & Sasieni, P. (2011). 13. Cancers attributable to solar (ultraviolet) radiation exposure in the UK in 2010. *British journal of cancer*, *105 Suppl 2*(Suppl 2), S66–S69. https://doi.org/10.1038/bjc.2011.486

[19] Koh, H. K., Geller, A. C., Miller, D. R., & Lew, R. A. (1995). The current status of melanoma early detection and screening. *Dermatologic clinics*, *13*(3), 623–634.

[20] Green, A. C., Williams, G. M., Logan, V., & Strutton, G. (2011, January 20). *Reduced melanoma after regular sunscreen use: Randomized trial follow-up*. Journal of Clinical Oncology. https://impactmelanoma.org/wp-content/uploads/2018/11/jco.2010.28.7078.pdf

[21] Westerdahl, J., Ingvar, C., & Masback, A. (2000, June 2). *Sunscreen use and malignant melanoma*. Epidemiology and Cancer Prevention.

https://onlinelibrary.wiley.com/doi/full/10.1002/10970215%2820000701%2987%3A1%3C145%3A%3A AID-IJC22%3E3.0.CO%3B2-3?sid=nlm%3Apubmed

[22] Cottrell, R., McClamroch, L., & Bernard, A. L. (2013, February 25). *Melanoma knowledge and sun protection attitudes and behaviors among college students by gender and skin type*. American Journal of Health Education.

https://www.tandfonline.com/doi/abs/10.1080/19325037.2005.10608196

[23] Fitch-Martin, A. R., Menger, L. M., Loomis, A. D., Hartsough, L. E. S., & Henry, K. L. (2018, July14). *"we don't really do anything unless it's really bad": Understanding adolescent sun protective knowledge, attitudes and behaviors in the U.S.* Journal of Primary Prevention. https://link.springer.com/article/10.1007/s10935-018-0515-x

[24] Falk, M., & Anderson, C. D. (2013, January 5). *Influence of age, gender, educational level and self-estimation of skin type on sun exposure habits and readiness to increase Sun Protection*. Cancer Epidemiology. https://www.sciencedirect.com/science/article/pii/S1877782112001737

[25] Buller, D. B., Cokkinides, V., Hall, H. I., Hartman, A. M., Saraiya, M., Miller, E., Paddock, L., &Glanz, K. (2011, October 18). *Prevalence of Sunburn, sun protection, and indoor tanning behaviors among Americans: Review from National Surveys and case studies of 3 states*. Journal of the American Academy of Dermatology. https://www.sciencedirect.com/science/article/pii/S0190962211006086

[26] Calderón, T. A., Bleakley, A., Jordan, A. B., Lazovich, D. A., & Glanz, K. (2018, December 28). *Correlates of sun protection behaviors in racially and ethnically diverse U.S. adults*. Preventive Medicine Reports. https://www.sciencedirect.com/science/article/pii/S221133551830281X

[27] Bowen, D., Jabson, J., Haddock, N., Hay, J., & Edwards, K. (2012, December 21). *Skin care behaviors among melanoma survivors*. Psycho-oncology. https://pubmed.ncbi.nlm.nih.gov/21780240/

[28] Manne, S., Fasanella, N., Connors, J., Floyd, B., Wang, H., & Lessin, S. (2004, April 2). *Sun Protection and skin surveillance practices among relatives of patients with malignant melanoma: Prevalence and predictors*. Preventive Medicine. https://www.sciencedirect.com/science/article/pii/S0091743504001148

[29] Mujumdar, U., Hay, J. L., & Monroe-Hinds, Y. C. (2009, January 13). *Sun Protection and skin self-examination in melanoma survivors*. Psycho-Oncology. https://onlinelibrary.wiley.com/doi/10.1002/pon.1510

[30] Irvine. (2022, May 24). *Demographics*. City of Irvine. https://www.cityofirvine.org/about-irvine/demographics