5-10-2017

The Skin Cancer Health Crisis and Recommended Intervention Methods

Blaire Brooks

THE SKIN CANCER HEALTH CRISIS AND RECOMMENDED INTERVENTION METHODS

By

Blaire Brooks

Submitted in Partial Fulfillment
of the Requirements for
Graduation with Honors from the
South Carolina Honors College

May, 2017

Approved:

Michael Wirth, MSPH, PhD
Director of Thesis

Jim Burch, PhD
Second Reader

Steve Lynn, Dean
For South Carolina Honors College

Table of Contents

Thesis Summary

Sun exposure has a cumulative effect on the body. Each time the skin is exposed to sun or other ultraviolet radiation, it adds to the skin's aging process. However, the sun is a source of enjoyment for so many people. In warm weather, people spend their time basking in the sun by the pool and on the beach. Individuals seek the tanning bed in order to achieve their ideal of beauty. This is especially apparent before formal events, summer, and spring breaks. There are cited claims that it makes the individual feel better and they are less likely to get burnt on their spring break adventure. This thesis research paper was designed to further understand tanning habits and skin cancer prevention methods.

This thesis looks into the effects of ultraviolet radiation. Specifically, the different types of skin cancer including melanoma and non-melanoma types. It then delves into the biological pathway of tanning and skin cancer, including the benefits that ultraviolet radiation has on the body through the production of vitamin D. Ultraviolet radiation is a primary risk factor for skin cancer and is obtained through sun exposure and tanning bed usage. The characteristics associated with those individuals that seek ultraviolet radiation are examined including psychological and biological distinctions. Additionally, the role of the media is examined as promoter of ultraviolet exposure as well as a forum of knowledge of sun protection behavior. Finally, recommendations for the reduction of harms caused by ultraviolet radiation are suggested based on the examination of prevalence, economic cost, and behaviors associated with high levels of ultraviolet radiation.

The skin cancer prevalence and mortality across the United States indicate a public health issue that requires addressing. Furthermore, the growing prevalence is having an economic

impact that further demonstrates a need for change to reduce the growing issue of skin cancer. To address the growing issue of skin cancer, it is important to develop an understanding of the source of the issue.

Introduction

Ultraviolet radiation (UVR) poses a global health risk that requires addressing through public health initiatives. UVR can be obtained through sun exposure and indoor tanning devices. The full spectrum of UVR has been classified as Group 1 carcinogens, which are considered "carcinogenic to humans" (Friedman, English, & Ferris, 2015) by the International Agency for Research on Cancer (IARC).

Furthermore, the IARC classified use of UV-emitting tanning devices as a carcinogen in 2009 (Julian, Bethel, Odden, & Thorburn, 2016). There is a paradox of the increasing evidence that skin cancer is connected to UVR and the growing use of indoor tanning facilities. Despite the well-known association of indoor tanning and skin cancer risk, indoor tanning remains highly utilized with approximately 27% of American adults utilizing an indoor tanning facility in 2007 (Julian et al., 2016; Schulman & Fischer, 2009). One proposed reason is the public relation campaigns utilized by indoor tanning facilities to assure the public that the benefit of vitamin D production in disease prevention associated with tanning outweighs the risk of skin aging and skin cancer (Schulman & Fischer, 2009). Nonetheless, ultraviolet indoor tanning should be minimized as it is an avoidable risk factor that is associated with melanoma and non-melanoma skin cancers (Schulman & Fischer, 2009). Furthermore, UVR from sun exposure is a reducible risk factor through the utilization of protective clothing, sunscreen, and limiting time in the sun (U.S. Department of Health and Human Services [USDHHS], 2014).

Despite the increasing research connecting UVR exposures to skin cancer, rates of skin cancer are rising. Skin cancer is now the most common form of cancer and there are significant health care costs associated with treating the cases (Balk et al., 2013). As a result, the United

States needs greater initiatives to increase educational programs, physician counseling, and political action regarding ultraviolet exposure and incidence of skin cancer. Evaluation of the types of skin cancer, perceptions of tanning, and current regulations and recommendations are required in order to form the initiatives to combat the growth of skin cancer.

Types of Skin Cancer

Skin cancers are classified into melanoma skin cancer and non-melanoma skin cancers. Non-melanoma skin cancers are subdivided into basal cell carcinomas or squamous cell carcinomas. Precursors to skin cancer often include atypical moles and growths known as Actinic Keratosis ("Skin Cancer Foundation").

Melanoma is a result of abnormal, uncontrolled cellular growth in the pigment producing melanocytes of the basal skin layer. Melanomas are not the most common form of skin cancer, but they are the most lethal (Lucas, McMichael, Smith, & Armstrong, 2006). Each year in the United States, approximately 63,000 people are diagnosed and 9,000 people die from melanoma (USDHHS, 2014). This form of skin cancer often resembles a mole and can even develop from within an existing mole. The World Health Organization identifies the main human risk factors for developing melanoma as a large number of atypical moles, pale complexion or fair hair, high exposure to solar UV, and history of erythema (Lucas, McMichael, Smith, & Armstrong, 2006).

Non-melanoma skin cancers account for 4.3 million of the 5 million adults treated for skin cancer each year. Specifically, basal cell carcinoma (BCC) is the most common form of skin cancer and results from tumors arising in the skin's basal cells, lining the deepest layer of the epidermis. These tumors rarely metastasize. However, when basal cell carcinomas do metastasize, the situation can be life threatening. This cancer is a result of cumulative and

intense, occasional sun exposure. According to the Skin Cancer Foundation, there are over 4 million cases of BCC diagnosed in the United States each year ("Skin Cancer Foundation").

Squamous cell carcinoma (SCC) is the uncontrolled growth of cells arising in the squamous cells, found in the outer layer of the epidermis. This is the second most common form of skin cancer with over 1 million cases diagnosed per year in the United States. Risk factors for SCC include cumulative UV exposure and tanning bed exposure. A small percentage of these cancers can metastasize to local lymph nodes, distant tissues and organs. Untreated SCC is more likely to metastasize and lead to fatality ("Skin Cancer Foundation").

Non-melanoma skin cancers are often downplayed as the less aggressive form of skin cancer compared to melanoma. However, these skin cancers do have the ability to metastasize and can become life threatening. The metastic capability of non-melanoma skin cancers could be responsible for thousands of deaths each year in the United States and should not be overlooked as non-serious (Schulman & Fisher, 2009).

Precursors to skin cancer often include atypical moles and growths known as actinic keratosis. Actinic keratosis, or AKs, are scaly, crusty, growths caused by UVR. These are often found on the hands, face, scalp, and lips. Each area has a common association with frequent sun exposure. The growths are considered precursors to cancer because approximately 10% will develop into SCC and in some rare cases can develop into BCC ("Skin Cancer Foundation").

Skin Cancer Statistics

There are 5 million people in the United States treated for skin cancer each year (U.S. Department of Health and Human Services [DHHS], 2014). Rates of skin cancer can be difficult to examine because central cancer registries do not track BCC or SCC. Information on these two

forms of non-melanoma skin cancer typically come from medical claims, surveys, and studies (Centers for Disease Control and Prevention [CDC], 2016).

For melanoma, statistics are derived from central cancer registries. Most recently, rates are available from 2013 (CDC, 2016). In 2013 alone, almost 72,000 individuals were diagnosed with melanoma and almost 9,400 people died from melanoma. There is variability among gender and ethnicity. The large majority of those diagnosed and killed by the disease were Caucasian males (CDC, 2016). Despite men being the overall majority of those diagnosed with melanoma, the sharpest rise in incidence is seen among females 15-29 years old (Friedman et al., 2015). In comparison, the primary tanning bed users are females approximately 17-30 years old (Schneider & Krämer, 2009). It is suggested that tanning bed usage accounts for 25% of the rise in melanoma (Friedman, English, & Ferris, 2015).

There also is variability among state rates of melanoma. *The Surgeon General's Call to Action to Prevent Skin Cancer* indicates that this variation could be due to several factors such as, socioeconomic status, healthcare access, patterns of UV exposure, and collection of data (CDC, 2016). For example, the incidence of melanoma in South Carolina in 2013 was 22.2 people per 100,000 and a mortality of three deaths per 100,000 (CDC, 2016). Skin cancer is on the rise. Data from Surveillance, Epidemiology, and End Results suggests that melanoma incidence doubled for women aged 15 to 39 from 1973 to 2004 (Balk, Fisher, & Geller, 2013).

Estimations on non-melanoma skin cancers come from a combination of medical claims, surveys, and studies. Of the 5 million individuals treated for skin cancer each year, it is estimated that 4.3 million adults are treated for BCC or SCC. Specifically for BCC, studies suggest that incidence is on the rise at 2% each year (DHHS, 2014). Despite non-melanoma skin cancers

being less deadly than melanoma, approximately 2,000 people still die from non-melanoma skin cancer each year (Balk et al., 2013). These rates are indicative of a complex public health issue that requires addressing.

Economic Cost

The treatment of skin cancer leads to financial burden of the United States healthcare system (Friedman, English, & Ferris 2015). Additionally, as incidence of melanoma and non-melanoma skin cancers rise, the burden will continue to grow.

One study analyzed the economic burden of skin cancer in the United States by examining data from 2002 to 2011 of prevalence and treatment cost (Guy, Machlin, Ekwueme, & Yabroff, 2015). This study compared melanoma, non-melanoma, and all other cancers from 2002 to 2006 in comparison to 2007 to 2011. Analysis was performed in 2014. The annual treatment of skin cancer increased from 3.4 million to 4.9 million and the average annual cost increased from 3.6 billion to 8.1 billion. The treatment rates of skin cancer increased by 126%. In comparison, the treatment rates of all other cancers increased at 25% (Guy et al., 2015). These results are an indicator of the growing burden caused by skin cancer. Greater time and money focused on prevention efforts and changing perceptions could provide significant savings to the healthcare system.

A systematic review also was performed to estimate the cost of skin cancer treatment, specifically for melanoma (Guy, Ekwueme, Tangka, & Richardson, 2012). Although melanoma is less common than BCC and SCC, it is the most deadly form of skin cancer. The estimates of the review revealed that melanoma costs widely varied based on stage, new diagnosis, and terminal diagnosis (Guy et al, 2012). Medicare patients with existing cases of melanoma

estimated a cost of $44.9 million compared to $932 million among those newly diagnosed. The per patient cost ranged from $506 to $23,410 among those with a new diagnosis. It is important to note that the highest costs were associated with late-stage cancer or terminal phase cancer (Guy et al, 2012). The higher costs associated with late-stage cancers suggests that lower costs would result from earlier prognosis. The review indicates that "if all melanoma patients were diagnosed in Stage 0 or I, the annual direct costs of melanoma treatment among those aged 65+ would be 40%-65% lower than their current value" (Guy et al, 2012).

Despite the indicated variability and wide range of cost estimates, the cost of melanoma treatment is substantial for a disease with largely avoidable and reducible risk factors. Furthermore, with incidence on the rise, it should be assumed that the cost of treatment would continue to have a worldwide effect. This provides evidence that programs should be put in place to promote primary and secondary prevention. Primary prevention to reduce or slow the incidence of melanoma and secondary prevention to provide earlier detection. A reduction in incidence and earlier detection will reduce the economic impact of skin cancer.

Eukweme et al., 2011 estimated the economic costs of melanoma mortality in terms of productivity losses with estimates stratified by race/ethnicity and sex in the United States. The results of the study show 20.4 years of potential life lost due to melanoma compared with 16.2 years for the four major cancers (breast, prostate, colorectal, and lung) and 16.6 for all malignant cancers. The estimated productivity lost due to melanoma was $3.5 billion (Eukweme, Guy, Li, Rim, Parelkar, & Chen, 2011). This is an indication of the strong burden of melanoma compared to other cancers. The study estimates that, on average, an individual who dies from melanoma (between 2000 and 2006) would lose $413,370 in lifetime earnings. These estimations were

much higher among non-Hispanic whites compared to non-Hispanic blacks and Hispanics. The study indicates that non-Hispanic whites account for 95.1% of estimated total melanoma cost, whereas Hispanics account for 2.3% (Eukweme et al., 2011). This highlights that prevention programs would be most effective targeting non-Hispanic white individuals. The results of these studies provide correlating evidence that there is significant economic cost associated with melanoma.

Ultraviolet Radiation

UVR is divided into 3 categories based on wavelength. These categories include UVA, UVB, and UVC. UVA comprises wavelengths greater than 315 nm to 400 nm. UVB has wavelengths greater than 280 nm to 315 nm and UVC has wavelengths of 100 nm to 280 nm (Friedman et al., 2015). In 1992, the IARC classified UVB and UVA radiation as group 2A carcinogens. Group 2A carcinogens are considered "probably carcinogenic to humans". In follow-up, the IARC reclassified the full spectrum of UVR as Group 1 carcinogens, or "carcinogenic to humans" (Friedman et al., 2015).

Biological Damage from Ultraviolet Radiation

The effects of UVR are strongly connected with wavelength. UVA has the ability to penetrate the epidermis and dermis, while UVB has the ability to penetrate the epidermis and papillary epidermis. UVB and UVA can affect DNA by causing cyclobutane pyrimidine dimers. These pyrimidine dimers cause cytosine to thymine mutations in the DNA (Friedman et al., 2015).

There is a tumor suppressor gene, p53, that plays an important role in prevention of skin cancer by stimulating apoptosis, arresting the cell cycle, and enhancing DNA damage repair.

Although p53 plays a role in repair and removal of damaged DNA, it also is capable of having the same pyrimidine dimer mutation. Therefore, UVR can mutate DNA and also the p53 protective mechanism. The mutation of p53 limits the repair and removal of damaged DNA (Friedman et al., 2015)

The tumor suppressor p53 also is part of the tanning mechanism because tanning cannot occur without DNA damage. The DNA damage in keratinocytes due to radiation activates p53. This activation increases gene expression of pro-opiomelanocortin and melanocyte stimulating hormone is produced. Stimulation of melanocytes through the melanocortin 1 receptor (MC1R) produces a tanning effect. However, if there is a loss-of-function polymorphism in the MC1R, the result is burning without tanning. This polymorphism is often seen in red-hair individuals. Furthermore, it is suggested that the up regulation of pro-opiomelanocortin stimulates beta-endorphin that has a possible role in tanning addiction (Friedman et al., 2015; Schulman & Fisher, 2009).

The biological indication that tanning cannot occur without DNA damage casts doubt on a "safe" or "responsible" tan. This is reinforced by laboratory models that indicate skin carcinogenesis can be induced even when sun exposure is not at high enough levels to result in sunburn (Schulman & Fisher, 2009). Therefore, UVR exposure even at minimal levels should be undertaken with caution.

Benefits of Ultraviolet Radiation

There are some biological and psychological benefits associated with UVR through sun exposure and tanning bed usage. The primary biological benefit of UVR exposure is associated with vitamin D production. Vitamin D has a biological benefit because it is associated with anti-

inflammatory effects and has protective effects against DNA damage. Studies indicate that UVB exposure producing vitamin D has the ability to enhance DNA repair and reduce cancer risk (Hoel, Berwick, Gruijl, & Holick, 2016). Vitamin D deficiency is associated with several diseases and disorders. Consequently, 32% of Americans are deficient in Vitamin D (Hoel et al., 2016). The argument is made that UVR is important enough to constitute sun exposure and indoor tanning usage (Hoel et al., 2016). However, those that are most likely to be vitamin D deficient are African Americans who do not constitute the main population utilizing tanning beds (American Academy of Dermatologists [AAD], 2014). This indicates that the vitamin D deficiency statistic could be reinforcing usage of tanning devices to a fairer skinned population that is not primarily at risk for the vitamin D deficiency. Furthermore, vitamin D supplements are available that can provide sufficient vitamin levels while also not exposing individuals to skin aging and potential skin cancer risk (Schulman & Fisher, 2009; AAD, 2014).

Individuals that utilize tanning beds often report a psychological benefit of relaxation and stress relief (Schneider & Krämer, 2009). As mentioned, this feeling is potentially associated with the production of beta-endorphin. This production of beta-endorphin also is associated with the addiction to tanning bed usage (Schulman & Fisher, 2009). As a result, the potential psychological and biological benefits should not outweigh the risks of utilizing indoor tanning or excessive sun exposure due to the risk of addiction and skin damage.

Tanning Beds

The Tanning Bed Industry

Tanning bed usage accounts for approximately 25% of the rise in melanoma. It also is suggested that rates of non-melanoma skin cancers are greater in those that utilize indoor tanning

devices (Friedman, English, & Ferris, 2015). There is a paradox of ever increasing evidence connecting UVR to skin cancer and the growing tanning industry. In 1988, a reported 1% of Americans utilized tanning devices compared to 27% of American adults in 2007 (Schulman & Fisher, 2009).

Reports indicate that 30 million Americans visit a tanning salon each year (Friedman, English, & Ferris, 2015). Of those visiting each year, 2.3 million are adolescents (Schneider & Krämer, 2009). Several studies suggest that the primary population utilizing tanning beds is young, non-Hispanic white women. This matches the population being targeted by the media for prom, back-to-school, and homecoming advertisements that feature tanning. This is an issue because there is a much greater risk of developing melanoma the earlier individuals are exposed to UV from tanning beds (Friedman, English, & Ferris, 2015). First exposure to indoor tanning before 35 years of age is associated with a 75% increase in skin cancer risk (Schulman & Fisher, 2009).

Tanning salons are fighting a public relations battle to promote business and discount public health campaigns (Schulman & Fisher, 2009). The marketing campaigns are a potential contributing factor to the growing tanning industry despite increased evidence of the association with skin cancer. Based on the amount of individuals that utilize indoor tanning devices, the public relations battle appears to be convincing some populations that the benefits of tanning outweigh the risks. Furthermore, public health warnings regarding tanning may not be reaching all individuals.

To challenge the industry, it is important to understand how individuals are targeted to utilize indoor tanning. An analysis of the articles and advertisements from the tanning industry

determined several themes the industry utilizes to promote tanning (Prior & Rafuse, 2015). These include beauty, youth, positive feelings, and science. In terms of beauty, they reinforce the image that individuals can be beautiful just by tanning. Youthfulness is portrayed by suggesting that tanning will reduce the appearance of wrinkles and aging. They suggest that utilizing an indoor tanning device will provide feelings of relaxation, higher self-esteem as a result of beauty, and feeling like a celebrity. Finally, they target individuals by citing science. The tanning industry advertises the benefits of Vitamin D and promotes tanning as a safe practice by commonly utilizing words such as "natural" and "organic" (Prior & Rafuse, 2015). Understanding the advertisements and literature used by the tanning industry can help establish methods to reverse the effects of the messages.

Characteristics of Tanning Bed Users

The tanning industry is a health-threatening 1 billion dollar per year industry with limited regulation in most developed nations (Schneider & Krämer, 2009). Therefore, understanding the characteristics of tanning bed users will allow intervention methods to promote behavior change via a more directed targeting plan. The first step to changing tanning behavior is to understand the biopsychosocial factors related to the indoor tanning behavior.

Biological, sociocultural, psychological, lifestyle, and appearance related factors all played a significant role in indoor tanning usage based on a systematic literature review of cross sectional studies (Schneider & Krämer, 2009). In developed countries, the primary users were women, aged 17 to 30, with skin type III or IV. These skin type classifications are distinguished based on the individuals sensitivity to burning, ranging from moderate to minimal (USDHHS, 2014).

The psychological factors associated with indoor tanning were socialization and emotional perception. In terms of socialization, users were more likely to have friends and family that utilized the tanning bed. This acceptance of the behavior from parents and peers was a strong indication that users would view the indoor tanning as an acceptable behavior in order to conform to the norm of their social group. Indoor tanning also had a psychological affect through relaxation. Many indoor tanners reported feelings of positive emotion and relaxation during use (Schneider & Krämer, 2009). This is a driving force for individuals to keep returning to the salons. The positive emotions are potentially related to the biological effects of UVR. During tanning, there is an up regulation of pro-opiomelanocortin which stimulates beta-endorphin. Beta-endorphin has a possible role in tanning addiction (Schulman & Fisher, 2009).

Primary tanning bed users had similarities in terms of several lifestyle characteristics. These users were more likely to smoke cigarettes, drink alcohol, and diet frequently (Schneider & Krämer, 2009). Cigarette smoking, drinking alcohol, and frequent dieting are unhealthy behaviors and each have associations with poor health outcomes. Frequent dieting, or going on and off a diet plan, is termed "yo-yo" dieting. This yo-yo effect can cause weight cycling and, in turn, is related to morbidity and poor health outcomes (Amigo & Fernández, 2007). Additionally, cigarette smoking and alcohol also have strong associations with poor health outcomes. According to a cross-sectional study utilizing data from the 2010 National Health Interview Survey, female and male tanners are more likely to smoke or binge drink than the non-tanning population (Julian et al., 2016). Although women are more likely to use a tanning device, both sexes have similar risky behavior. There was no clear effect on tanning bed usage by level

of education, indicating that all educational levels should be targeted in regards to prevention efforts (Schneider & Krämer, 2009).

The most important lifestyle characteristic common among tanners was the perception that tanned skin is more attractive (Schneider & Krämer, 2009). The tan beauty ideal is a strong psychosocial factor that particularly influences women and young adults. In some cases, these individuals have heard the risks and continue to utilize indoor tanning. Image and self-esteem can have a greater influence on decisions regarding UV exposure than the knowledge of harmful effects (Schneider & Krämer, 2009). This is an indication that an increased knowledge of risk may not be a strong enough intervention to result in behavior change.

Media

Mass media is an influential source of information to the public. Media has a dual role, both positive and negative, in shaping perceptions and behaviors regarding tanning. Media can be used as a forum of knowledge of skin cancer risk and promotion of skin protective behaviors. However, it also has a role in promoting the tan beauty ideal that causes some individuals to seek UV (Mcwhirter & Hoffman-Goetz, 2015).

Although men have the highest rates of skin cancer overall, rates of melanoma are particularly rising in women (CDC, 2016; Basch, Hillyer, & Berdnick, 2014). As a result, women are a particular target for intervention. An analysis of women's health and fitness magazines aimed to identify articles and advertised products related to sun protection measures. These magazines are popular in the United States and include *Fitness, Health, Shape, Self, Women's Health* (Basch, Hillyer, & Berdnick, 2014). These magazines are an important avenue for women to gain knowledge regarding health and fitness. They are sources that should be consistently

relaying a message of sun health. Very few of the articles were related to skin (2.9%), and less than half of those were related to skin cancer prevention and risk reduction. Research suggests that perceptions and behaviors can be strongly influenced by reading women's magazines for both adults and teens (Basch, Hillyer, & Berdnick, 2014). This makes women's magazines a very important source of information that can be utilized to promote safe behavior. Magazines are relaying too little information about sun health to change behavior.

Although popular US magazines relay information about UV protection in their articles, they also counteract those messages in images. Images more often promote the unhealthy behaviors that the text discourages by utilizing visuals of attractive people with tanned skin (Mcwhirter & Hoffman-Goetz, 2015). The study determined that text more often indicated using self-tanners, discouraged indoor tanning, and promoted hat, clothing, and sunscreen utilization. However, the images portrayed the tanned look causing the common public association of tanned skin and attractiveness. The study suggests that images of attractive people without a suntan would be more successful in decreasing an intention to tan (Mcwhirter & Hoffman-Goetz, 2015). Furthermore, the promotion of self-tanners within the text still creates the image of the tan ideal. Although the use of self-tanners has an association with decreased UV exposure, it is still promoting the tanned look and many individuals utilize this measure in addition to seeking UV (Mcwhirter & Hoffman-Goetz, 2015).

The portrayal of tanned models while advertising for health also can reinforce the safe tan misconception. There is a perception that individuals can tan safely by tanning without burning. However, tanning cannot occur without DNA damage. Cancer of the skin can occur even when there is not UV exposure at high enough levels to indicate sunburn or erythema (Schulman &

Fisher, 2009). An important measure to decrease the sun-seeking mentality is to change perception of the tan ideal. Changing perception will be most effective if the images correspond to the messages in the text. This begins in popular US magazines by dissociating attractiveness from tanned skin.

Harmful media messages also can reach the public through television. Specifically, reality television can be particularly harmful to the young adult's perception of beauty. A study in 2013 surveyed college students regarding reality television and tanning behaviors. Indoor tanning was significantly associated with watching reality television, most especially for females. Watching reality television also is a significant indicator of outdoor tanning behavior (Fogel & Krausz, 2013). Overall, the messages portrayed in media have a strong predictive effect on behavior to those exposed. Magazines and television can be a powerful tool to combat skin cancer by promoting UV protective behaviors.

Protective Behaviors

Avoiding UV

Laboratory models indicate that UVR exposure can induce skin carcinogenesis even at levels that do not produce sunburn (Schulman & Fisher, 2009). However, healthy and unhealthy UVR exposure varies as a result of pigmentation and skin type (Lucas et al., 2006). Despite the variation by population, the CDC has established a set of protective behaviors to minimize UVR exposure. The CDC has classified sun protective behavior as applying sunscreen greater than 15 sun protection factor (SPF), wearing sun protective clothing, and seeking shade. These protective behaviors are used at varying levels among Americans (CDC, 2016). In 2010, sun protective behavior among Americans was analyzed. Adults reported usually utilizing at least one

protective behavior at a rate of 70%. Applying sunscreen greater than 15 SPF was reported at 31%. Specifically among high school teens, rates of sunscreen use for boys and girls was much lower at 13% and 7%, respectively. Wearing protective clothing was reported at 40%. Finally, seeking shade was reported at 37%. Sun protective behaviors are an important mechanism to reduce rates of skin cancer (CDC, 2016). The low rates indicate that these protective measures should be included in further targeting of public health initiatives to reduce skin cancer. Specifically young adults and children should be targeted to form a knowledge and promote safe habits from the beginning.

Dermatology Skin Checks

Beyond utilizing UV protective behaviors, dermatology skin checks are an important factor in preventing skin cancer and catching it in early stages. It has been indicated that the perceived likelihood of getting skin cancer is significantly associated with skin cancer screening (Julian et al., 2016). In other words, individuals that are impressed upon the dangers of skin cancer are more likely to seek a dermatologist for a screening. The rates of frequent tanners that are screened for skin cancer are approximately 26% for males and 21% for females. These numbers are similar to the general population, despite tanners being at a higher risk for skin cancer (Julian et al., 2016). This comparable rate suggests that tanners may not have a higher perceived likelihood of skin cancer because they are seeking screenings at the same rate. Overall, the low levels of individuals seeking a dermatologist for a skin check indicates that individuals should be targeted based on their awareness of skin cancer probability. Individuals that believe they are at high risk for developing skin cancer will be more likely to seek consultation.

Recommendations

The overarching goal of the following recommendations is to reduce the growing incidence and mortality of skin cancer. Prevention policies and programs to combat the growth of skin cancer is an investment in the future. This is an investment to counteract the increasing financial burden of treating skin cancer, as well as in the quality of life of Americans that are affected and will be affected by UV damage. Primary and secondary prevention efforts can promote earlier diagnosis and prevention and ultimately lower the economic burden on the healthcare system (Eukweme et al., 2011; Guy et al, 2012).

The United States needs better surveillance of skin cancer. Currently, only melanoma is tracked in central cancer registries. Rates of BCC and SCC are difficult to track because they are not included in the central cancer registries. As a result, information on these two forms of non-melanoma skin cancer typically come from medical claims, surveys, and studies (CDC, 2016). Inclusion of non-melanoma skin cancer on the registries would allow for better reporting and future understanding of patterns related to the health outcomes of these individuals. Although melanoma is included on the registries, there is underreporting of outpatient melanoma skin cancers because many outpatient offices do not have a system of reporting (USDHHS, 2014). Electronic health records in doctor's offices should promote the doctor to report the cases. Furthermore, there could be better surveillance of behaviors related to sun exposure. This could be achieved through the Behavior Risk Factor Surveillance System (BRFSS) and the National Health and Nutrition Examination Survey (NHANES). Inclusion of UV related behaviors on the BRFSS and NHANES would allow for better reporting of sun protective behavior and the effectiveness of interventions (USDHHS, 2014). This would provide a more consistent forum of

behavior information. Better surveillance can improve specificity of research to more effectively understanding the cancer progression, rates, and outcomes. In turn, public health advocates and policy-makers can more effectively target the problem to reduce skin cancer rates.

Societal norms associated with tanned skin need to be adapted. As indicated, the media is a powerful tool influencing American behavior. The research suggests that a tan beauty ideal is commonly portrayed in magazines and on television and has a resulting psychological effect that influences tanning behavior (Schneider & Krämer, 2009). Combatting the tan beauty ideal is a complex issue because it is deeply ingrained and fostered by media and the public relations campaigns of the tanning industry. Studies suggest that women tend to have a knowledge base on the risks of UV exposure, but are more likely to overlook those risks in order to achieve a tanned look (Prior & Rafuse, 2015; Mcwhirter & Hoffman-Goetz, 2014). The United States can utilize an Australian model to target skin cancer through the media. Australian "SunSmart Advertising" has shown an increased preference for lack of tan, utilization of sunscreen, hat wearing, and less UV exposure in those with exposure to the TV advertising campaign. This long-term advertising campaign targeted both children and adults on tanning behaviors (Dobbinson, Volkov &Wakefield, 2015). Although the results may not be generalizable to other countries, the SunSmart media can be a model for the United States. Media advocating sun protective behaviors is a central element to a skin cancer prevention program. Furthermore, an increase in the sun protection discussion could influence the agendas of policy makers.

UV exposure can be targeted in the school and recreation settings frequented by the American youth. Sunburns in childhood are a large indicator of skin cancer later in life. Furthermore, sun exposure is cumulative with small doses from daily recess and time at the pool

adding up in the long run ("Skin Cancer Foundation", 2016). Therefore, more national implementation of programs such as RAYS and Pool Cool could lead to a reduction of skin cancer later in life. RAYS is a program implemented in New Mexico that provides funding to the elementary schools to promote sun-safety and education. Recess times are changed to avoid peak UV exposure and more shade is provided on the playground. Pool Cool targets 5-10 year olds and their parents. The children receive a short lesson on sun-safety before beginning their swim lesson. The program also promotes shaded areas and sunscreen dispensers at the pools (USDHHS, 2014). These youth-targeted programs can minimize cumulative sun-exposure by cutting down the exposure earlier in life. It also teaches protective behaviors early, allowing those behaviors to become natural habits later in life. More school and youth-targeted programs nationwide are a necessary intervention to protect America's children to reduce cumulative sun-exposure and introduce sun-protective habits.

Men have particularly high levels of skin cancers and skin cancer mortality. It has been suggested that higher levels of outdoor work and sports leads to a greater amount of unprotected sun exposure. Men also are less likely to utilize skin checks than women (CDC, 2016). As a result, men should not be overlooked as an intervention target. Men tend to have less exposure to the knowledge base of sun protection. Research has shown that women's magazines are more likely to cover topics such as sunscreen (CDC, 2016). Therefore, men also should be a focus of intervention. This can include advertisements in men's media and utilizing workplace incentives for shade and sun protection mechanisms, such as sunscreen, protective clothing, and sunglasses. Workplace health education can be prompted by the knowledge that skin cancers are a significant cause of decreased productivity (Ekwueme, et al., 2011)

The harms of indoor tanning can be targeted through policy making and enforcement of existing policies. There is no federal legislation regarding indoor tanning devices and minors. It is instead regulated at the state level. Nine states require individuals to be 18 years or older to utilize a tanning bed while 41 states require parental accompaniment or consent for a minor (Friedman, English & Ferris, 2015). The government can help enforce these regulations by ensuring compliance of the restrictions within the facilities (USDHHS, 2014). Increased discussion on skin cancer can help prompt new policies and further legal restrictions on the tanning industry.

Works Cited

American Academy of Dermatology. (2014). Retrieved December 19, 2016, from https://www.aad.org/public

Amigo, I., & Fernández, C. (2007). Effects of diets and their role in weight control. *Psychology, Health & Medicine, 12*(3), 321-327. doi:10.1080/13548500600621545

Balk, S. J., Fisher, D. E., & Geller, A. C. (2013, April 18). Teens and Indoor Tanning: A Cancer Prevention Opportunity for Pediatricians. *Pediatrics, 131*(4), 772-785. doi:10.1542/peds.2012-2404

Basch, C. H., Ethan, D., Hillyer, G. C., & Berdnik, A. (2014). Skin Cancer Prevention Coverage in Popular US Women's Health and Fitness Magazines: An Analysis of Advertisements and Articles. *Global Journal of Health Science, 6*(4). doi:10.5539/gjhs.v6n4p42

Centers for Disease Control and Prevention. (2016). *Skin Cancer Statistics*. Retrieved from https://www.cdc.gov/cancer/skin/statistics/index.htm

Julian, A. K., Bethel, J. W., Odden, M. C., & Thorburn, S. (2016, March 19). Sex differences and risk behaviors among indoor tanners. *Preventive Medicine Reports, 3,* 283-287. doi:10.1016/j.pmedr.2016.03.011

Ekwueme, D. U., Guy, G. P., Li, C., Rim, S. H., Parelkar, P., & Chen, S. C. (2011). The health burden and economic costs of cutaneous melanoma mortality by race/ethnicity–United States, 2000 to 2006. *Journal of the American Academy of Dermatology, 65*(5). doi:10.1016/j.jaad.2011.04.036

Fogel, J., & Krausz, F. (2013). Watching reality television beauty shows is associated with tanning lamp use and outdoor tanning among college students. *Journal of the American Academy of Dermatology, 68*(5), 784-789. doi:10.1016/j.jaad.2012.09.055

Friedman, B., English, J. C., & Ferris, L. K. (2015, August). Indoor Tanning, Skin Cancer and the Young Female Patient: A Review of the Literature. *Journal of Pediatric and Adolescent Gynecology, 28*(4), 275-283. doi:10.1016/j.jpag.2014.07.015

Guy, G. P., Ekwueme, D. U., Tangka, F. K., & Richardson, L. C. (2012). Melanoma Treatment Costs: A Systematic Review of the Literature, 1990–2011. *American Journal of Preventative Medicine, 43*(5), 537-545.

Guy, G. P., Machlin, S. R., Ekwueme, D. U., & Yabroff, K. R. (2015). Prevalence and Costs of Skin Cancer Treatment in the U.S., 2002−2006 and 2007−2011 . *American Journal of Preventative Medicine, 48*(2), 183-187.

Hoel, D. G., Berwick, M., Gruijl, F. R., & Holick, M. F. (2016). The risks and benefits of sun exposure 2016. *Dermato-Endocrinology, 8*(1). doi:10.1080/19381980.2016.1248325

Lucas, R., McMichael, T., Smith, W., & Armstrong, B. (2006). Global burden of disease from solar ultraviolet radiation. *Environmental Burden of Disease Series.* Retrieved from http://www.who.int/uv/health/solaruvradfull_180706.pdf?ua=1

Mcwhirter, J. E., & Hoffman-Goetz, L. (2014). North American Magazine Coverage of Skin Cancer and Recreational Tanning Before and After the WHO/IARC 2009 Classification of Indoor Tanning Devices as Carcinogenic. *Journal of Cancer Education, 30*(3), 477-481. doi:10.1007/s13187-014-0726-7

Mcwhirter, J. E., & Hoffman-Goetz, L. (2015). Coverage of Skin Cancer Risk Factors and UV Behaviors in Popular U.S. Magazines from 2000 to 2012. *Journal of Cancer Education, 31*(2), 382-388. doi:10.1007/s13187-015-0808-1

Prior, S. M., & Rafuse, L. P. (2015). "Oh yeah, they're looking": A thematic analysis of indoor UV tanning industry advertising and articles. *Journal of Public Health Policy, 37*(1), 68-79. doi:10.1057/jphp.2015.24

Schneider, S., & Krämer, H. (2009). Who uses sunbeds? A systematic literature review of risk groups in developed countries. *Journal of the European Academy of Dermatology and Venereology*, 24(6), 639-648. doi:10.1111/j.1468-3083.2009.03509.x

Schulman, J. M., & Fisher, D. E. (2009). Indoor ultraviolet tanning and skin cancer: Health risks and opportunities. *Current Opinion in Oncology, 21*(2), 144-149. doi:10.1097/cco.0b013e3283252fc5

Skin Cancer Foundation. (n.d.). Retrieved December 19, 2016, from http://www.skincancer.org/

Tran AD, Aalborg J, Asdigian NL, Morelli JG, Mokrohisky ST, Dellavalle RP, et al. Parents' Perceptions of Skin Cancer Threat and Children's Physical Activity. Prev Chronic Dis 2012;9:110345. DOI: http://dx.doi.org/10.5888/pcd9.110345

U.S. Department of Health and Human Services. *The Surgeon General's Call to Action to Prevent Skin Cancer.* Washington, DC: U.S. Dept of Health and Human Services, Office of the Surgeon General; 2014.