Impact of Sunscreen on Preventing Each Type of Facial Skin Cancer

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Abstract. The most frequent cancer in the US is skin cancer, around 5.4 million cases of Basal Cell Carcinoma (BCC) and Squamous Cell Carcinoma (SCC) are treated every year, while BCC is more common. Exposure to ultraviolet rays is the source of four varieties of skin cancer: BCC, SCC, Melanoma, and Merkel Cell Carcinoma (MCC). Since there are several experiments done on the influence of sunscreen on skin cancer, this paper aims to offer a comprehensive and symmetric conclusion to existing research. This paper summarizes the current studies finished for each type of skin cancer that might be caused by high levels of UV exposure. This study cites 4 experiments for melanoma, and three of them show a reduction in the rate of melanoma if sun blockers were used. This paper also uses three research for SCC and BCC to analyze the relationship between sun cream application and the probability of having SCC and BCC. None of them found that sunscreen will decrease the rate of SCC and one of them contends that sun lotion can prevent some of SCC. There is no current research about MCC, as the difficulty of holding this kind of experiment. This study will provide a reference for the medical field and the general public to analyze if sun lotion should be employed to prevent skin cancers.

Keywords: Sunscreen; skin cancer; ultraviolet B; Melanoma; Basal Cell Carcinoma.

1. Introduction

The most frequent cancer in the US is skin cancer, around 5.4 million cases of Basal Cell Carcinoma (BCC) and Squamous Cell Carcinoma (SCC) are treated every year, while BCC is more common [1]. The cases of Melanoma have risen by about 27% percent in the past ten years [1]. Different types of skin cancer will lead to specific options for diagnosis as they have unique causes. Exposure to ultraviolet rays is the source of four varieties of skin cancer: BCC, SCC, Melanoma, and Merkel Cell Carcinoma (MCC) [1, 2]. Ultraviolet (UV) radiation, especially UVB (wavelength between 280-314 nm) can penetrate the skin and thus damage the Deoxyribonucleic acid (DNA) in skin cells. Although UVB is more dangerous and severe for human skin, most of them are absorbed by the ozone layer. Nevertheless, following the formation of the ozone hole, more UVB access to human skin. Then the products that absorb, scatter, or reflect UV can reduce the risk of having skin cancer. This study will mostly analyze the relationship between reducing exposure to UV radiation and the probability of getting skin cancer. This paper is mainly focused on the accessing comprehensive influences of sunscreen or equivalent products on preventing or decreasing the rate of skin cancer according to current research.

Most of the research about the impact of sun blockers or certain chemicals on skin cancer focuses on only one or several kinds of skin cancer, and few of them give an overall view of this topic. Although different varieties of skin cancer may have different causes, they have some common sources. Plenty of relevant studies are conclusions of the recent Epidemiology information of skin cancer, and not many of these give insight into sunscreen application in daily life. Therefore, this paper is dedicated to summarizing the finished research and creating an exhaustive and integral statement of current circumstances in this area.

This paper aims to provide a fundamental view of sunscreen products and summarize the conclusion of current research about the impacts of sun cream on reducing skin cancer, both directly and indirectly. Firstly, basic information about sun lotion is given. Then the indirect effect of sunscreen on skin cancer, which is preventing sunburn, and the ingredients in sun lotion are analyzed.

After this, the influences of sun blockers on four types of skin cancer that are affected by exposure to UV radiation are examined according to existing studies one by one. Finally, a conclusion is derived for each type of skin cancer.

2. Sunscreens Work Mechanism

Sun cream is an ointment or lotion that covers the surface of the skin to protect it from sun radiation. Sun blockers consist of physical ingredients like titanium dioxide and zinc oxide which can block, and scatter UV rays, and chemical sun cream ingredients such as avobenzone, octocrylene, and oxybenzone that absorb UV radiation before they penetrate the skin and damage DNA in skin cells making it able to protect skin from sun damage [3].

2.1. Sun Protection Factor (SPF)

Sun Protection Factor is usually found on sun cream, it represents the effectiveness of sun lotion to protect skin from UVB radiation. SPF is decided by the physical or chemical ingredient that block, scatter, and absorb UV. These chemicals are SPF boosters, which are the physical or chemical ingredients mentioned above. The value of SPF means the amount of UV radiation that will reach to skin or the time to burn the skin with sun cream divided by without sunscreen. A higher SPF value generally means a better effect in preventing UV radiation on the epidermis. For instance, SPF 15 refers to 1/15 of UV rays that can penetrate sun cream and sunburn begins 15 times longer with sunscreen. To assess the influence of sun blockers, SPF value can be a variable to determine the trend of getting skin cancer.

A sun lotion generally contains physical or chemical active ingredients. These chemicals make sun creams effective. Both of these two types of sun lotions are safe and effective [4]. Nonetheless, physical sun creams are less likely to cause skin irritation than chemical ingredients. Table 1 offers common sun blockers products in the market. Both of these two kinds of ingredients are widely used now.

Table 1. Ingredients in Sunscreen (Credit: Original)

Sunscreen	Cleure	Babo	Every Day Active	Neutrogena	La Roche-Posay	Banana Boat	Equate
SPF	30	40	45	50	50	65	70
Ingredients	Zinc Oxide (9%) & Titanium Dioxide (4.51%)	Zinc Oxide & Titanium Dioxide (70%)	Non-nano Zinc Oxide (19%)	Zinc Oxide (21.6%)	Titanium Dioxide (6%) & Zinc Oxide (5%)	Avobenzone (2.7%), Homosalate (13.5%), Octisalate (4.5%) & Octocrylene (6.5%)	Avobenzone (3%), Homosalate (15%), Octisalate (5%), Octocrylene (10%) & Oxybenzone (6%)

2.2. Sunburn

Skin cancer is easily induced in the skin that has been damaged or undergone sunburn, as it has a more fragile skin barrier and some cells may mutate [5]. When the skin gets sunburned, the blood vessels will dilate and some of them can be repaired with the immune system, but some of them may not be repaired with DNA mutation, which is the reason for skin cancer. Then indirect prevention of skin cancer including the impact of sun creams on the reduction of sunburn.

Sunburn can be divided into 3 stages, which correspond to 3 layers of skin. The sunburn of the epidermis is a first-degree burn, the dermis is second-degree, and the hypodermis is a third-degree

burn. Higher levels of sunburn refer to more damage to the skin and thus more likely to get skin cancer. As more blood vessels dilate, a higher risk of cell mutation takes place. Sunburn is mainly caused by UVB penetration, so SPF is a useful sign for checking the effectiveness of sun blockers in preventing UVB. Theoretically, using sun lotion will slow or decrease the level of sunburn. Therefore, it can reduce the rate of skin cancer.

3. Specific Impact on Each Type of Skin Cancer

Although all BCC, SCC, Melanoma, and MCC may be led by excess exposure to UV radiation, they have slightly different symptoms and origins. Scientists generally study them separately. Then this part mainly sought to analyze the completed research of each variety of skin cancer and figure out their similarities and differences.

Skin cancer can be divided into two main types: Melanoma and non-melanoma skin cancer (NMSC). Three of the skin cancers mentioned above are NMSC: BCC, SCC, and MCC. BCC is more frequent than the other two and MCC is relatively rare. Melanoma arises from melanocytes after transformation and NMSC originates from other epidermal cells.

3.1. Melanoma

Considering five studies from 2011 to 2018 that analyzed the relationship between sunscreen use and the risk of melanoma, three of them discovered that using sun lotion with SPF>15 will effectively reduce the rate of melanoma, and one of them contended there is no relation between sunscreen use and melanoma nowadays. These four journals used different methods to statistically analyze the relationship between sun lotion use and the probability of getting melanoma.

After 143,844 women aged 40-75 participated in a cohort trial with an average follow-up of 10.7 years, Reza Ghiasvand et al. found that the application of sun blockers with SPF>15 will reduce the incidence of 18% (with a 95% Confidence Interval (CI) of 0.04 to 0.3) compared to the control group [6]. Adèle C. Green also completed a randomized controlled trial examination on this topic. There were 11 cases out of 812 participants (with 44% male and 56% female, 25% with previous skin cancer) confirmed having melanoma with a hazard ratio (HR), 0.50; 95% CI, 0.24 to 1.02; probability value (P)=0.051, and 22 individuals out of 809 people (with 44% male and 56% female, 26% with previous skin cancer) in the control group were diagnosed with melanoma [7]. Other variables for this experiment like age, skin color, skin reaction to the sun, previous occupations, nevi on the back, clinical elastosis of the neck, and beta carotene allocation all have the same or similar percentage in the two groups with the largest difference of 4% [7]. Moreover, the randomized controlled trial study finished by Phyllis A. Gimotty and Karen Glanz in 2011 explains this topic in two categories. After 4.5 years of follow-up, with the utilization of sunscreen, the rate of getting in situ and invasive melanoma is 1.35% (with a 95% CI of 0.68 to 2.24) rather than 2.72% (with a 95% CI of 1.71 to 4.09) without the use of sun cream products [8]. They also presented that the risk of invasive melanoma for sun cream users is 0.37% (with a 95% CI of 0.08 to 1.08), while the control rate for non-sun cream users is 1.36% (with a 95% CI of 0.68 to 2.42) [8]. However, according to the meta-analysis research done by Elizabet saes da Silva et al, 9813 cases were studied. They used meta-analysis to analyze the results and get statistics: odds ratio (OR) = 1.08; 95% CI: 0.91-1.28, I2 = 89.4%. After the early 1900s, sunscreen use seems to not play a crucial role in causing melanoma [9].

All of these four papers have reasonable CI values, and three of them have a similar range of CI, which refers to the similar stability of data. The research completed by Gimotty and Glanz has a relatively wider range of CI, which represents higher instability of their data. For the second research, the HR value of P value also shows a connection between sun lotion and block melanoma. These four studies employ 3 types of methods, then the conclusion derived is relatively reliable. Overall, the relationship between the use of sun cream and melanoma is not certain, but current research tends to prove that regular use of sun cream will decrease the probability of having melanoma a little, despite the connection between them being weak.

3.2. SCC

Three studies explain the relationship between using sun lotion and preventing SCC. All of them are relatively not state-of-the-art, but they also depict a direction to figure out the connection between sun lotion and SCC. All of them discover that the impact of sunscreen on block SCC is not clear or extremely weak.

After 8 years of randomized controlled trial research, Van der Pols and the team claimed that the SCC tumor-incidence rate decreased by 25% with a rate ratio of 0.75, a 95% CI of 0.48-1.14 in Australia, which is statistically nonsignificant [10]. They also present that the incidence of SCC will be 35% lower, with a rate ratio of 0.65, and a 95% CI of 0.43-0.99 [10]. Considering these two sets of data, they found that the influence of sun blockers on stopping SCC is not obvious. Another study conducted by Ulrich and his team also believes that sun creams have only a subtle effect on stopping SCC. They used transplant participants with a total number of 120 (40 hearts grafted, 40 kidneys grafted, and 40 livers grafted) [11]. After two years of follow-up, no new SCC was found in the sun cream group with SPF>50, and 8 new cases of SCC in the control group [11]. Nonetheless, the P of this experiment is less than 0.01 [11]. Therefore, they also deem there is no huge difference in the probability of getting the SCC using sun lotion or not. The case-study experiment completed by Sánchez also got the same conclusion by using a randomized controlled trial to analyze 1621 cases. This study is relatively new to the other two papers. The RR for SCC in this study is 0.88, with a 95% CI of 0.50 to 1.54 [12]. They cannot report whether the employ of sun blockers can influence the rate of SCC.

Although these three experiments applied the same way to analyze the relationship between sun cream and block SCC, they were completed in different years and with more advanced technology and done in different areas. All of them with similar CI and have the same results by examining statistically. The result difference of their experiments is not obvious and after the calculation of CI and P, all of them believed that SCC cannot be prevented by regular use of sun blockers.

3.3. BCC

BCC occurs when the DNA of the cells in the epidermis is damaged. As the epidermis is the top layer of the skin, UV can easily hurt the DNA in epidermis cells. Thus, BCC is the most common type of skin cancer in the world. Many articles study BCC and SCC simultaneously, then this paper uses the data from the same sources in BCC. Two of these studies contend that sun lotion has nothing to do with blocking BCC, while one of them anticipates sunscreen can reduce the probability of getting BCC.

The research was conducted by Van der Pols in 2006 to analyze BCC and SCC at the same time, but he and his team got different conclusions. For BCC, the time of follow-up was also 8 years. They assert the incidence of getting BCC will decrease by about 38% if sun lotion is used, with a rate ratio of 0.62, and a 95% CI of 0.38-0.99 [10]. By doing this experiment, they believe the impact of sunscreen can be extended to 8 years after the application of sunscreen in preventing BCC [10]. Another reference cited above also studied BCC. The participants who are transplant recipients are the same, and after 2 years of observation, there were 2 cases of BCC in the sunscreen group and 9 in the control group with ns of P [11]. The last set of data listed above in the SCC part also provides a set of data for BCC. They calculate the RR of the sunscreen group and the control group as 1.03 with a 95% CI of 0.74-1.43, which does not make a big difference [12]. To put it in a nutshell, they also failed to demonstrate the relationship between using sun cream and preventing BCC.

All of them also have a reasonable interval of 95% CI, the second and third experiments cannot prove using sun cream will prevent BCC. The P of the second research is ns. This means this result is strongly unreliable. The RR value of the third data is too close to 1, so frequent use of sun lotion, even with high SPF cannot help decrease the rate of BCC.

3.4. MCC

As MCC is rarer than other types of skin cancer, there is no finished study available to analyze the relationship between using sun lotion and the cause of MCC. Only 2,000 cases of MCC were treated in the US each year [1]. Hence, it will be harder to get valuable results by analyzing the general public than other types of skin cancer. The number of populations has to be large enough to get a reliable result. Therefore, using experiments may not be practical for researchers.

4. Conclusion

As UV lights penetrate the skin, the DNA in skin cells may be damaged. Then skin cancer might happen. Sun cream can reflect, absorb, or block UV radiation to the skin. By analyzing the statistic values like 95% CI, P, HR, and RR, this paper uses the data from the current study to summarize the impact of sun lotion on preventing each type of skin cancer. Three out of four studies about preventing melanoma claim that using sun blockers can decrease the rate of melanoma. Besides, all of the studies of SCC show there is no connection between the utilization of sun lotion. According to the same sources, one of them asserts that SCC can be prevented by regular use of sun cream and the other two contend there is no connection between the frequent application of sunscreen and BCC. Unfortunately, as the rate of MCC is quite low than the other types, there is no existing experiment studied about it. There is more research with a longer time of follow-up, a larger number of participants, and more diverse geographical locations needed to study this topic deeper. This paper gives a relatively comprehensive and symmetric sight of current experiments for medical areas and the general public.

References

[1] Skin Cancer | Skin Cancer Facts | Common Skin Cancer Types.Www.cancer.org, 2023, www.cancer.org/cancer/types/skin-cancer.html.

[2] What Is Skin Cancer? | CDC. Www.cdc.gov, 2023, www.cdc.gov/cancer/skin/basic_info/what-is-skin-cancer.htm#.

[3] Sunscreen. The Skin Cancer Foundation, 2023, www.skincancer.org/skin-cancer-prevention/sun-protection/sunscreen

[4] Matouskova K., UV screening chemicals. In: Ramesh, G, (Eds.), Reproductive and Developmental Toxicology, Academic Press, Cambridge. 2022, 911-927.

[5] Bowers, Jennifer M., et al., Sun Exposure, Tanning Behaviors, and Sunburn: Examining Activities Associated with Harmful Ultraviolet Radiation Exposures in College Students. The Journal of Primary Prevention, 2021.

[6] Ghiasvand R., et al. Sunscreen Use and Subsequent Melanoma Risk: A Population-Based Cohort Study. Journal of Clinical Oncology, 2016, 34(33): 3976–83.

[7] Green A., et al., Reduced Melanoma After Regular Sunscreen Use: Randomized Trial Follow-Up. Journal of Clinical Oncology: Official Journal of the American Society of Clinical Oncology, 2011, 29(3): 257–63.

[8] Gimotty P., and Glanz K. Sunscreen and Melanoma: What Is the Evidence? Journal of Clinical Oncology, 2011, 29(3): 249–250.

[9] Silva E., et al., Use of Sunscreen and Risk of Melanoma and Non-Melanoma Skin Cancer: A Systematic Review and Meta-Analysis. European Journal of Dermatology, 2018, 28(2): 186–201.

[10] Van der Pols., et al., Prolonged Prevention of Squamous Cell Carcinoma of the Skin by Regular Sunscreen Use. Cancer Epidemiology Biomarkers & Prevention, 2006, 15(12): 2546–2548.

[11] Ulrich C., et al., Prevention of Non-Melanoma Skin Cancer in Organ Transplant Patients by Regular Use of a Sunscreen: A 24 Months, Prospective, Case-control Study. British Journal of Dermatology, 2009, 161, 78–84.

[12] Sánchez G., et al., Sun Protection for Preventing Basal Cell and Squamous Cell Skin Cancers. The Cochrane Database of Systematic Reviews, 2016, 7, CD011161.