Knowledge of the Effects of UV Radiation and Blue Light on the Skin, the Proper use of Protective Cosmetics and Usage Patterns in Latvia

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Abstract: UV (ultraviolet) radiation is a significant risk factor for the development of skin cancers such as melanoma, basal cell carcinoma, and squamous cell carcinoma, and can contribute to other skin lesions.

Objectives: The aim of the study was to find out knowledge on the effects of UV radiation and blue light on the skin, the correct use of protective equipment, and their using habits in the Latvian population.

Materials and Methods: An anonymous questionnaire was used, which included 31 questions and 307 participants in the age group from 18 to 60 years, randomly selected were surveyed (243 (79%) - women, 64 (21%) - men).

Results: Comparing the knowledge about the effects of UV radiation and the blue light on the skin between the age groups, a statistically significant difference was found between the age groups 21-25 and 51-60 (p <0.001), as well as between 26-30 and 51-60 (p <0.001). Analyzing the data, a statistically significant difference was obtained in the gender groups who didn't sunbathe - men did not sunbathe statistically significantly less than women (p <0.05). Only 21.2% of respondents were using SPF protective creams daily. 8.1% of respondents believe that the effects of tanning on the skin are negative.

Conclusion: The level of knowledge on UV radiation, blue light and proper use of protectives are influenced by age, gender and occupation in Latvian population.

Keywords: UV radiation, sun protection, blue light, knowledge, sunscreen.

INTRODUCTION

Skin cancer is one of the most common worldwide malignancies and therefore is a global public health problem. More than 200 melanomas and over 2000 non-melanoma skin tumors are registered in Latvia every year, which confirms, that skin cancer also in Latvia is a major health issue and there is a need to evaluate the knowledge and attitude of the population of Latvia regarding skin cancer, risk factors, and sun protection [1]. The statistics are created from the data, which is made up of the epidemiological report filled out by the doctor. It is important to mention that the statistics do not include such common forms of squamous cell carcinoma in situ as Bowen's disease and actinic keratoses. Therefore, the true incidence of tumors is higher than the statistical data shows.

Skin cancer could be considered one of the most easily preventable tumors if it is detected in time, as well as preventive factors are identified and prevention is integrated into everyday life. The main risk factor for the development of melanoma and non-melanoma tumors is sun exposure [2, 3]. Harmful UVA and UVB rays cause damage to the DNA of skin cells, which contributes to the proliferation of abnormal cells and the formation of skin formations. Minimizing ultraviolet light exposure by limiting the time spent in the sun during peak hours, using correctly sunscreen, and wearing protective clothing is the most effective primary prevention strategy to reduce the incidence of skin cancer [3].

The aim of our study was to find out knowledge on the effects of UV radiation and blue light on the skin, the correct use of protective equipment, and its usage habits in the Latvian population.

MATERIALS AND METHODS

This was a descriptive cross-sectional questionnaire-based study, spread over a period of 2 months (November 2021-December 2021) in Latvia including respondents aged 18 to 60 years. A convenience sampling method was used in this study. The sample size was estimated using single proportion formula with a 6% margin of error, 95% confidence level, a power of 80%, and an expected proportion of 60%. The minimum sample size required was 245 for this study. The only inclusion criterion was age - participants from 18 to 60 years could participate in the study. The questionnaire was offered to be filled out

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through an online link in the Google Forms software platform. The research was done according to ethical principles, subject to the informed consent of participants, and voluntary participation, as well as to ensure the protection and confidentiality of individuals' physical data. Analysis of data was done using SPSS (Statistical Package for Social Sciences).

Questionnaire and Data Collection

The self–reported questionnaire for data collection was created through a search of relevant literature and had two sections. The questionnaire included 31 questions. It was available online in the Latvian language.

The first section contained sociodemographic data (gender, age, educational level, occupation), skin type (Fitzpatrick's skin type classification), which was self-reported using relevant pictures with each skin type description and also sun-protective attitude and behavior, contained questions that assessed knowledge towards harmful effects of sunlight, skin cancer's risk factors and prevention using yes/no and multiple-choice questions. The second section studied knowledge of the effects of blue light, protective attitude and behavior.

The research was done according to ethical principles, subject to informed consent of the participants, voluntary participation, as well as ensuring the protection and confidentiality of individuals' physical data.

Statistical Analysis

Analysis of data was done using SPSS (Statistical Package for Social Sciences) for Windows version 25.0 and Microsoft Excel – 2016. Descriptive statistics such as means and standard deviations (for normally distributed data) or median and interquartile range (IQR) (for non-normally distributed data), as well as frequency and percentages were provided. For normally distributed variables, an independent sample T-test or one-way ANOVA test and for non-normally distributed variables Kruskal-Wallis test were used. For the analysis, the significance level was set at a p-value less than 0.05, with a confidence interval of 95%.

Kruskal-Wallis tests were used to determine statistically significant associations of sociodemographic variables (i.e., gender, age, educational level, occupation), respondents Fitzpatrick skin type with knowledge score.

RESULTS

Questionnaires were opened for public filling between November 2021 - December 2021. 11 of the returned questionnaires were excluded due to incomplete filling. A total of 307 questionnaires were accepted as valid and used in the final analysis and corresponding to a completion rate of 96.5%. The only inclusion criterion was age - 18 years to 60 years. All participants of the questionnaire were divided into age groups - 23 participants (7.5%) in age group 18-20, 146 (47.6%) participants in age group 21-25, 40 participants (13 %) in age group 26-60, 30 (9.8%) in age group 31-40, 42 participants (13.7%) in age group 41-50 and 26 participants (8.5%) in age group 51-60.

Table 1: Demographic Characteristics Background of Participants

|	N	%
Gender		
Women	243	79.1
Men	64	20.8
Age		
18-20	23	7.5
21-25	146	47.6
26-30	40	13
31-40	30	9.8
41-50	42	13.7
51-60	26	8.5
Educational level		
General basic	6	2
General secondary	92	30
Vocational secondary	49	16
Higher	159	51.8
No education	1	0.3
Occupation		
Employed or self-employed	154	50.2
Pupil, student	120	39.1
Unemployed	21	6.8
Other	12	3.9
Fitzpatrick skin type		
1st	17	5.5
2nd	103	33.6
3rd	125	40.7
4th	57	18.6
5th	5	1.6
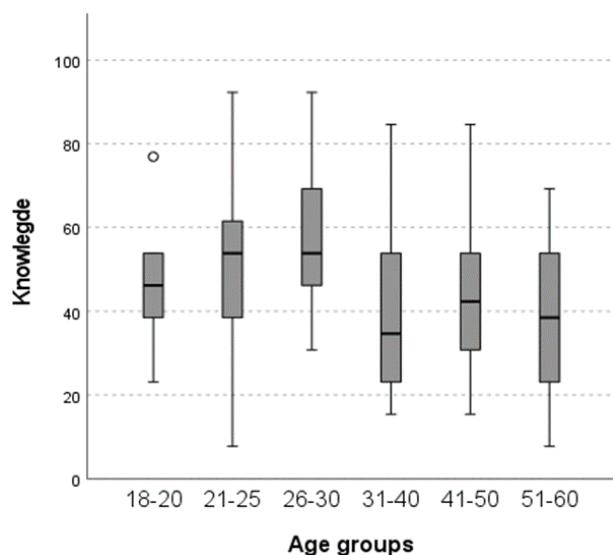
Chart 1: Knowledge about the effects of UV radiation and blue light on the skin between age groups.
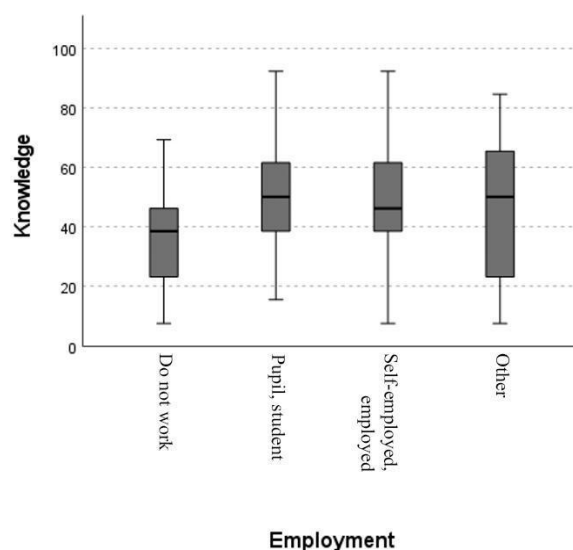

Chart 2: Knowledge about the effects of UV radiation and blue light on the skin between occupation groups.

There was a female predominance - 243 (79.1%) of participants were women and only 64 (20.8%) were men. Slightly more than half of the participants had higher education (n=159, 51.8%), and the second-largest part was composed of participants with secondary education (n=92, 30.0%). The two main occupations were employed or self-employed (n=154, 50.2%) and pupil or student (n=120, 39.1%). All sociodemographic characteristics are summarized in Table **1**.

Kruskal-Wallis test showed that there was more knowledge about the effects of UV radiation and the

blue light on the skin in the age group 21-25 than in age group 51-60 and between age group 26-30 and 51-60 (H(5)= 30.81 p<0.001) (Chart **1**). Kruskal-Wallis test also showed that there was more knowledge about the effects of UV radiation and blue light on the skin in pupil, student group than in the respondent group who do not work (H(3)= 11.77 p<0.001) (Chart **2**). The study did not find that there was more knowledge about the effects of UV radiation and blue light on the skin in any groups of education levels (p>0,05, Kruskal-Wallis test). No other statistically significant relationships were found. Correct responses to knowledge questions are presented in Table **2**.

Table 2:   Correct Responses to Knowledge Questions

Question	Correct answer	N	%
Does SPF stand for sun protection factor:	Yes	244	79.5
Does the SPF value indicate the allowed time you can spend in the sun without getting burned?	No	217	70.7
Does a waterproof sunscreen only last 40-80 minutes?	Yes	100	32.6
Is it necessary to use SPF cream also on a cloudy day/winter?	Yes	157	51.1
How often should you reapply SPF during the day?	every 1.5-2 hours	88	28.7
How many minutes before going out in the sun should you apply sunscreen?	15-30 minutes before	87	28.3
Is UV radiation a risk factor for skin cancer?	Yes	268	87.3
Is blue light a part of the spectrum of light visible to the human eye?	Yes	199	64.8
Do LED devices also emit blue light (phone, computer, TV, tablet and other)?	Yes	232	75.6
Can blue light accelerate skin aging?	Yes	161	52.4
Are there sunscreens that provide protection against blue light?	Yes	48	15.6
Does blue light reach the deeper layers of the skin compared to UV radiation?	Yes	61	19.9
Does blue light cause damage to cells in the skin and affect their function?	Yes	116	37.9

Usage Pattern

Results show that 39.1% (n=120) of respondents spend 1 to 2 hours in the sun during the day in the summer and spring months and 28.0% (n=28) of respondents spend 3 to 4 hours. 40.8% (n=125) of respondents most often sunbathe from 11 am to 3 pm (Charts **3**, **4**).

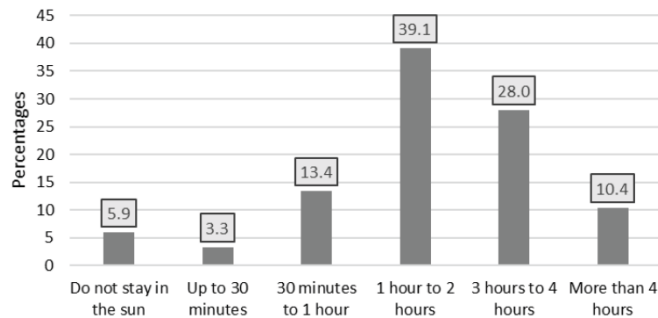**What is your average time in the sun during the day in the summer and spring months?**

Chart 3: Average time in the sun during the day in the summer/spring months.

At what time of the day do you sunbathe the most often?
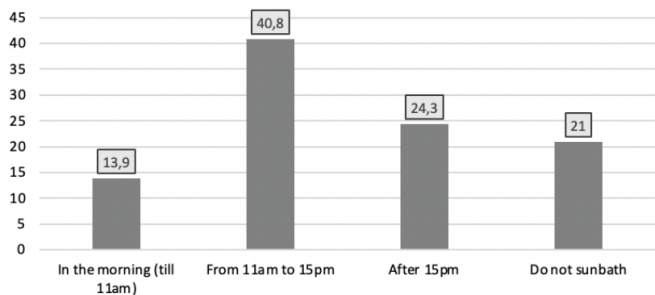
Chart 4: Time of the day when sunbathing the most often.

In this study only 16.9% (n=52) of respondents use SPF sunscreen daily. 30.4% (n=94) of respondents use SPF sunscreen only when sunbathing. 17.1% (n=53) of respondents did not use SPF sunscreen at all (Chart
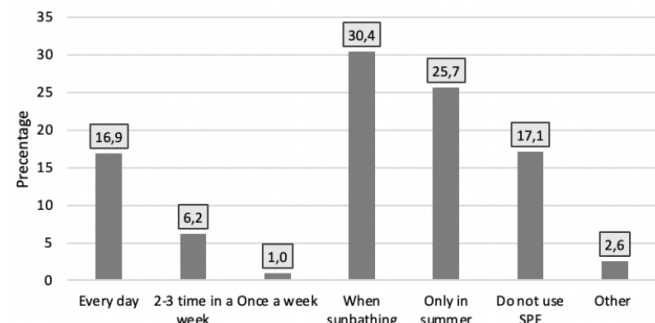
How often do you use SPF sunscreen?

Chart 5: Frequency of SPF application.

5). 32% (n=32.2%) of respondents are using SPF 30, 22.1% (n=68) - SPF50, 15.3% (n=47) are using SPF 15. 51.5% (n=158) of respondents do not reapply the sunscreen, but after intense perspiration and swimming 62.2% (n=191) of respondents reapply sunscreen.

The majority of the respondents 94.1% (n=289) thought that a specific period of the day increases the effects of the sun, 83.3 % (n= 255) thought that skin type could increase the effects of the sun on the skin (Chart **6**).

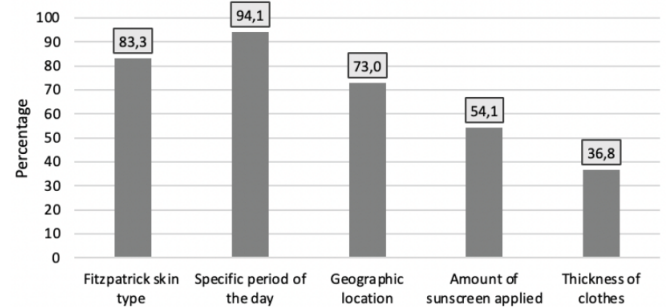**What do you think increase the effects of the sun on the skin?**

Chart 6: The enhancing effects of the sun on the skin.

42.7% of respondents believe that the effects of tanning are rather negative than positive, and 28.7% think that sunbathing effects are positive (Chart **7**). 90.2% (n=277) of respondents consider that people sunbathe for aesthetic reasons. More than half of respondents (51.8%, n=159) believe that sunbathing improves the condition of the skin as it reduces rashes, and improves eczema. Also, 78.2% (n=240) admit that sunbathing is a way of relaxation and leisure.

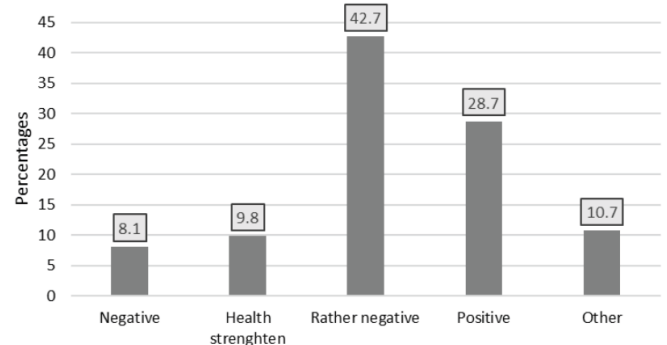**Effect estimate of sunbathing on human health**

Chart 7: Effect estimate of sunbathing on human health.

DISCUSSION

In recent decades, a significant increase in the incidence of skin melanoma and non-melanoma skin cancers has been observed worldwide. The main risk

factors for the development of skin malignancies are excessive exposure to ultraviolet radiation (UVR) and a combination of phenotypic factors such as fair skin color, sun sensitivity, and inability to tan [4, 5]. In addition, excessive and unprotected sun exposure can cause premature aging and unwanted changes in the skin structure. All of these effects of chronic UVR exposure are potentially preventable through public education and behavioral change [5].

Almost one-third of the study participants answered that sunbathing has positive effects on human health. The reason for this high proportion may be the fact that in Latvia there is a lack of information from mass media or organized campaigns on the hazards of tanning. While SPF is a prime way to protect the skin, it will not block UV radiation completely. Additionally, wide hats, sunglasses, umbrellas and sun-protective clothes should be used. It is also important to avoid peak UV hours between 10 am and 4 pm and seek shaded places [9]. Unfortunately, the results of our study showed that the majority of people sunbathe exactly in the time interval from 11 am to 15 pm.

In addition, body parts such as palms, soles, nails and genitalia which usually are not exposed to the sun can be affected by melanoma. Acral melanoma that occurs on the palms and soles is 2–3% of all melanoma cases [9].

It is also a very common myth that in cloudy weather there is no need to use protection, but clouds do not fully block UV radiation. Even when it is cloudy, it is important to use sunscreen according to the WHO, up to 80% of UV radiation can pass through clouds [9]. Compared to our study, only half of the respondents believe that it is necessary to use SPF even when it is cloudy.

As many of the respondents (77.5%) believe that sunbathing helps to make vitamin D, it is important to educate people that there are safer ways of obtaining vitamin D without getting direct sunlight. It is well known that sunbathing and tanning is not the way to treat vitamin D deficiency [10]. Sunlight is composed of approximately 95% UVA and 5% UVB, but only UVB is required for vitamin D synthesis. UVA is the dominant light source used in tanning beds and the dose of UVA in tanning beds can be up to 12 times that provided by the sun [10]. The main recommendation is vitamin D supplementation from a multivitamin or a separate vitamin D supplement [9]. Singh *et al.* observed that vitamin D deficiency requires 5,000 IU per day, and a typical maintenance dose should be at least 2,000 IU daily [11].

Only 52% of respondents know that blue light accelerates skin aging. Blue light-induced skin damage is dose-dependent [6]. According to the literature, blue light causes oxidative damage to DNA by generating reactive oxygen species (ROS), such as superoxide [6, 7]. Blue light at different wavelengths may induce varying degrees of intracellular oxidative stress in the dermal fibroblasts and reduced proliferation [8]. The mechanism by which blue light causes skin damage has been suggested by some sources to be similar to UVA [6]. However, the biological effects of prolonged or repeated exposure are not yet fully known [7]. Smartphones, tablets, computers, notebooks and other digital devices have LED screens that emit blue light. According to recent data exposure for even one hour (and 1 cm distance) can lead to premature skin aging by causing ROS generation in fibroblasts [8]. According to the study data, it would be valuable to inform people about the harmfulness of blue light and the options for protection, for example, with blue light skin-protecting products.

The results of this study indicate that skin cancer campaigns in Latvia should focus on particular population subgroups that have sun-seeking and less protective behavior, such as older people. According to recent research, the mean age of melanoma diagnosis is 65 years [12]. Human life expectancy is increasing and skin cancer is developing simultaneously, which is why longer life increases the chance of dying from skin cancer [12]. One of the ways to educate the elderly would be education from family doctor's practices, where that part of the population could receive booklets and other sources of information in addition to education. There is a need for more appealing approaches that are more sensitive, such as photography or leaflets showing sun-damaged skin may be more successful in inducing a more sun-protective behavior.

This is the first study to evaluate the knowledge and some behaviors that affect skin among the Latvian population and to plan further studies there is a need for a deeper understanding of the subgroup's specific preferences and health education programs.

CONCLUSION

The level of knowledge about UV radiation, blue light, and proper use of protectives is influenced by age

and occupation amongst the Latvian population. There is more knowledge about UV radiation, blue light, and proper use of protectives in the group of students and pupils than in the group of people who do not work. Older people have less knowledge than younger people and also do not use sun-protectives as often as the younger part of the Latvian population. The results showed a need for continuing people's education campaigns, especially for the elderly, about UV radiation and the blue light impact on the skin.

ACKNOWLEDGEMENTS

APPENDIX: QUESTIONNAIRE

1.   Gender

    a. Woman

    b. Man

2.   Age

    a. 18-20 years old

    b. 21-25 years old

    c. 26-30 years old

    d. 31-40 years old

    e. 41-50 years old

    f. 51-60 years old

3.   Educational level

    a. General basic

    b. General secondary

    c. Vocational secondary

    d. Higher

    e. No education

4.   Occupation

    a. Employed or self-employed

    b. Pupil or student

    c. Unemployed

    d. Other

5.   Fitzpatrick skin type

    a. 1st skin type

    b. 2nd skin type

    c. 3rd skin type

    d. 4th skin type

    e. 5th skin type

    f. 6th skin type

SKIN TYPE	DETAILS
I	Skin burns very easily and doesn't tan. Likely to have light blonde or red hair.
II	Skin will usually burn in the sun, and has difficulty tanning.
III	Skin will sometime burn and will tan gradually.
IV	Skin will tan easily and rarely burn.
V	Skin will tan without burning.
VI	Skin never burns and will tan very quickly.

6.   Do you tend to sunbathe/spend a long time in the sun?

    a. Yes

    b. No

7.   At what time of the day do you sunbathe the most often?

    a. In the morning (till 11 am)

    b. From 11 am to 3 pm

    c. After 3 pm

    d. Do not sunbath

8.   What is your average time in the sun during the day in the summer and spring months?

    a. Do not stay in the sun

    b. Up to 30 minutes

    c. 30 minutes to 1 hour

      d. 1 hour to 2 hours

      e. 3 hours to 4 hours

      f. More than 4 hours

9.   What is your average time in the sun during the day in the autumn and winter months?

      a. Do not stay in the sun

      b. Up to 30 minutes

      c. 30 minutes to 1 hour

      d. 1 hour to 2 hours

      e. 3 hours to 4 hours

      f. More than 4 hours

10.   Does SPF stand for sun protection factor?

      a. Yes

      b. No

11.   Do you use sun protection products with SPF (creams, oils, lotions, etc.)?

      a. Yes

      b. No

12.   What strength SPF do you use?

      a. Less than SPF15

      b. SPF15

      c. SPF30

      d. SPF50

      e. SPF100

      f. Do not use SPF

      g. Other _____

13.   How often do you use SPF sunscreen?

      a. Every day

      b. 2-3 times a week

      c. Once a week

      d. When sunbathing

      e. Only in the summer

      f. Do not use SPF

      g. Other

14.   Does the SPF value indicate the allowed time you can spend in the sun without getting burned?

      a. Yes

      b. No

15.   Do you reapply SPF during the day?

      a. Yes

      b. No

16.   How often should you reapply SPF during the day?

      a. No need to reapply

      b. 2 times a day

      c. 3 times a day

      d. Every 3 hours

      e. Every 1,5-2 hours

17.   Does a waterproof sunscreen only last 40-80 minutes?

      a. Yes

      b. No

18.   What do you think increase the effects of the sun on the skin?

      a. Fitzpatrick skin type

      b. Specific period of the day

      c. Geographic location

      d. Thickness of clothes

      e. Amount of sunscreen applied

19.   Is it necessary to use SPF cream also on a cloudy day/winter?

      a. Yes

      b. No

20.   Is UV radiation a risk factor for skin cancer?

      a. Yes

      b. No

      c. I do not know

21. How many minutes before going out in the sun should you apply sunscreen?

    a. 5-10 minutes before

    b. 10-15 minutes before

    c. 15-30 minutes before

    d. 30-60 minutes before

    e. 1 hour and sooner

22. Why do you think people sunbathe? (It is possible to mark several variants)

    a. To get a tan (aesthetic reason)

    b. Sunbathing increases vitamin D

    c. UV radiation may help reduce skin inflammation (rash, eczema)

    d. Sunlight increase the brain's release of a hormone called serotonin

    e. Sunbathing as a leisure activity

    f. Other

23. Effect estimate of sunbathing on human health

    a. Negative

    b. Health-promoting

    c. Rather negative

    d. Positive

    e. Other

24. Do you think that there is enough quality information available about the effects of sun and UV radiation on the skin?

    a. Yes

    b. No

25. Is blue light a part of the spectrum of light visible to the human eye?

    a. Yes

    b. No

26. Do LED devices also emit blue light (mobile phones, computers, TV, tablet and others?

    a. Yes

    b. No

    c. I do not know

27. Can blue light accelerate skin aging?

    a. Yes

    b. No

    c. I do not know

28. Are there sunscreens that provide protection against blue light?

    a. Yes

    b. No

    c. I do not know

29. Do you use sunscreen that provides protection against blue light?

    a. Yes

    b. No

30. Does blue light reach the deeper layers of the skin compared to UV radiation?

    a. Yes

    b. No

    c. I do not know

31. Does blue light cause damage to cells in the skin and affect their function?

    a. Yes

    b. No

    c. I do not know

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