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EFFECT OF ULTRAVIOLET ON OUTDOOR WORKERS

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Abstract: The sunlight mainly affected the development of this life on the surface of the globe, most people love and enjoy the sunlight and its warmth, but fear its harmful effects from sunburn and long-term damage to the skin due to excessive exposure to the sun, and thus people began to seek for protection from the sun's rays. To avoid the pain of sunburn and its harmful effects, and since the internal workers are protected from the sun's rays, outdoor workers are more exposed to ultraviolet rays and are more exposed to adverse consequences from the effects on the eyes and skin, although most of the body is protected by clothing, it is not sufficient, the size of the risks depends. On the skin and the increase in skin cancer incidence based on several factors, climatic factors or according to the sensitivity of the personality to ultraviolet rays, this is wholly related to personal habits related to sunlight. This research paper measured ultraviolet rays on Baghdad's outdoor workers, although temperature and UV index. At the beginning of November 2020, the results showed that exposure to ultraviolet rays is significantly related to temperature, UV index, and cloud cover, where P-vale is less than 0.001. Farther more, there is increased exposure to UVB as well as UVA.

Keywords: *outdoor worker*, *ultraviolet*, *skin cancer*, *temperature*, *relative humidity.*

1. Introduction

Everyone is exposed to UVR from the sun as a natural source and from different artificial sources[1]. Ultraviolet has a wavelength λ from 100 nm to 400 nm [2]. The solar ultraviolet radiation, including UVA 315 nm – 400 nm and UVB 280 nm - 315nm, both has a significant effect on human health [3] as well as UVC less than 280nm [4]. UVA is only fractionally affected, but Atmospheric ozone shields life at the earth's surface from about 90 percent of the UVB and almost all of the UVC [5]. Therefore UVB is biologically very effective [6].

The wavelengths for the visible spectrum and UVR are usually measured in terms of nanometers (1 nm equal to 10–9 m) and in the infrared spectrum in terms of micrometers (1 μm equal to 10-6 m) [2]. "Figure 1" shows a wavelength for the optical spectrum and the spectral band designations by wavelength for it and describes the biological effect of light rays . The spectra are repeatedly divided into 7 photo-biological spectral bands[7].

Indoor workers are usually protected from the sun's rays according to their work conditions. However, outdoor workers are exposed to a lot of ultraviolet rays from the sun[8]. Thus, they

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are more exposed to the harmful consequences of exposure to ultraviolet rays' skin and eyes[9]. At the beginning of the last twentieth century, there was a correlation between skin cancer and exposure to sunlight, and thus there was a need for protection from the sun's rays[4]. Therefore protection from the sun's rays dealt mainly with the effects of ultraviolet rays and their skin effect [6], especially in both BCC and SCC types[5]. Moreover, environmental factors and other lifestyles contributed to pigmentation and external aging of the skin, and it was evident for the workers abroad .[10]. The relationship between exposure to ultraviolet rays and non-melanoma skin cancer is still complex and may differ according to skin cancer type. Thus, in the late 1950s, researchers began to determine the total hours of exposure to sunlight (a cumulative) and a risk factor for the body[11]. Therefore, the size of the risk to the skin may depend significantly on climatic factors and personal sensitivity to ultraviolet rays. It is affected by the skin color[8], which is called the "skin prototype," and the level of adaptation to ultraviolet rays[4]. Dermatologists often classify individuals into six types of skin that react with the sun, as shown in "Table 1" and the Skin types are divided into 3 different more essential groups broad on skin pigmentation, as shown in "Table 2"[4]. But the individual sensitivity to rays does not exist for the eye because it is different from the skin. Thus people of different ethnic types are vulnerable to eye diseases related to the environment and cataract eye disease[2]. As well as UV exposure can cause an effect on the immune system's undesired immune reactions upon the skin. [8][12]

The most important benefit of the effect of UV rays on the skin is the synthesis of vitamin D[13].Thus, less than 15 min of exposure to UV rays from the sun on the face, arms, and hands fulfill this requirement [8].

The relationship between the pattern and the timing of exposure to UVRs remains unclear; Objective measurements of UV radiation may help understand the effect of different skin cancers[14]. The rate of patient exposure to skin cancer in men is higher than that of women, and the percentage of patients working in open areas are more likely to have skin cancer than working in the shadows in the city of Baghdad. [15]. However, monitoring exposure to sunlight, especially ultraviolet rays, in Iraq and especially in Baghdad is rare until now. There is only one study on ultraviolet radiation and its analysis in Baghdad[16]. The results of this study confirm that workers are exposed to ultraviolet rays significantly during working days Despite the beginning of the research in the winter, but there are high risks of ultraviolet rays. Also, the results showed that exposure to ultraviolet rays is significantly related to temperature, UV index and cloud cover, where P-vale is less than 0.001.

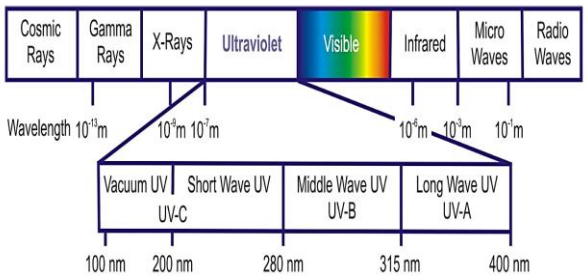

Figure 1. the wavelength bands and the electromagnetic spectrum. [7]

Table 1. Classify skin types based on their tan ability and their susceptibility to sunburn in sunlight. [8][17]

Skin phototype	Classes of individuals	Tanning achieved	Sunburn susceptibility*	Sun sensitivity
I.	Melano-compromised	No tan	(always sunburn) : <2 SED	Very sensitive
II.	Melano-compromised	Light tan	(high): 2-3 SED	Moderately sensitive
III.	Melano-competent	Medium tan	(moderate): 3-5 SED	Moderately insensitive

IV.	Melano-competent	Dark tan	(low) : 5-7 SED	insensitive
V.	Melano-protected	Natural brown skin	(very low) :7-10 SED	insensitive
VI.	Melano-protected	Natural black skin	(extremely low):> 10 SED	insensitive

*SEDs ranges are not so prescriptive but only indicative, SED standard erythematous dose.

Table 2. classify skin phototype and type of pigment

Skin Phototype	Type of pigment
I – IV (Mediterranean-Celtic)	Lightly pigmented
V (Asians)	Intermediate pigmentation
VI (black)	Deeply pigmented

2. Details of UV index Values:

To measure the effects of the UV index on human skin by measuring the amount of intensity of UV rays on the earth's surface, UV index values are classified into exposure categories as shown in "Table 3" with a different color [18].

Table 3. UV radiation exporter categories. [18]

No.	Exposure category	Uv index range
1	low	Less than 2
2	moderate	From 3 to 5
3	high	From 6 to 7
4	Very high	From 8 to 10
5	extreme	11 and more

According to the UV index within different numerical ranges, particular recommendations have been made to protect the individual from ultraviolet rays, as shown in "Table 4"[18].

Table 4. recommended with simple messages for sun protection from ultraviolet[18] [19] .

UV index	Type of Protection	person should do	Recommended protection
1 to 2	No protection is required	can safely stay outside	using minimal sun protection
3 to 7	Protection is required	Seek shade from late in the morning to mid-afternoon. if the person is outdoors	Apply sunscreen to exposed skin, wear protective clothing, sunglasses, and a wide-brimmed hat.
8to 11	Must be Extra protection	must avoid being outside during late morning through mid-afternoon	must wear protective clothing, Seek shade, a wide-brimmed hat, sunscreen on exposed skin and sunglasses.

3. Information to Protect From The Sun's Rays [18]:

- during midday hours must Limit the time of exposure.
- Seek a shade to protect from uv.
- Wear suitable protective clothing.
- Use a wide-brimmed hat to protect the body's open spaces from the head, neck, and eyes.
- Wear sunglasses to protect the eyes with sunglasses with a side or panels wrap-around design.
- Use broad-spectrum sunscreen on parts of the body that exposed, especially the hands and face.
- Avoid using tanning beds.
- It is important to protect young children and babies.

4. Materials and Methods

4.1. Study Design

The study was conducted in the winter season from the beginning of November 2020; The workers' site was chosen in Baghdad's different locations from both sides of al-Karkh and al-Rusafa.

Ask the worker a questionnaire about sun protection behaviors, job characteristics, and personal risks affected by the sun. these questions were based on the study[20] that have been used to develop UV-protective behaviors [21]The time the UV index, temperature, and cloud cover were recorded daily during the study period

4.2. Study Sample

Employees are selected who works the most time in the open air outside the buildings. For a period ranging from one hour to five hours, during the daylight. So that the worker is exposed to an enormous amount of sun and exposure to radiation Ultraviolet.

Most of the workers were construction workers, and there are also scattered workers

4.3. Data Collection

A sensor is worn by the worker during working days. A method was used similarly in the research[22] [23]. A wearable sensor was used have weighing 17.4 grams, a height of, 6 mm and a width of 12 mm, with the clip. As shown in "figure 2", an electronic sensor is placed on the worker's clothes without a battery. To monitor personal exposure to ultraviolet rays. The sensor works to capture the ultraviolet rays. The data is downloaded On the mobile app, making it easy for users to track their exposure to ultraviolet rays Plus UV index and temperature.

Figure 2. the Sensor shape.

The sensor is used by the light-emitting diode and symbolized by (LED), as it is responsible for capturing and detecting ultraviolet light. Thus transmitting data from the sensor to the target through a near field communication technology (NFC). "Figure 3" shows internal parts. When analyzing the data through The application of an intelligent algorithm supported by the impact of 25 scientific publications to help and warn the user when exposed to a high level of ultraviolet rays, according to the type of skin and environmental factors.

Figure 3. Inside Technology.

4.4. Variables and Statistical Analysis

The "max-sun stock" represents the value of personal exposure to UV rays before they affect the skin, which is considered high risk. This value is taken according to a person's skin tone and according to the UV index at the time of exposure. Max-sun stock is the percentage that a person is exposed to UV rays. Basically, it is a gauge of the level of risk and personal UV consumption. The app recommended using sunscreen when the person is out every day, even the max- sun stock is under 100%, the person must be careful. UV exposure may be detrimental to the skin. But if it is higher than this percentage, the person must be cautious so must be using equipment that to help decrease the early skin Aging with prevent the effect of skin cancer and to prevent sunburn,

The analysis of data carried out using ANOVA SINGLE ONE. Percentage and number were used to express the data. P-Value > 0.05 indicates that there is no statistically significant difference.

5. Results and Discussion:

Across 67 workers are participating in this study. Descriptive information about them in "Table 4". Data were collected over days 181 from (November 1, 2020, to April 30, 2021) for a total reading was 102 person-days in which the sensor was worn.

The average sensor was worn for 3 to 4 days a week depending on the working days, all participants identified as male from Baghdad, the workers spent 5 h out- doors while at work (50.7%), 4 h (16.4%), and from 3 to 1 h (22.9%). Work nature work outdoors under the sun (37.9%), Work under sunshine and shade together (50%) and Work with areas where sunlight can reach (12.1%). The age of workers was 20-30 (65.7%), 30 -40 years (22.4%), 40 - 50 years (9%), and More than 50 years (3%). Worker's weight range from 55 to 130 kg. Skin color workers Light tan (17.9%), Medium tan (62.7%), and Dark tan (19.4 %).

The workers were asked about the wearing personal protective equipment are 31.1% and those who do not wear 41.8% and may sometimes wear 26.9%. The equipment workers wear a hat 65.5, sunscreen 17.7%, glasses14.5%, and gloves 11.3%. If you have a history of skin cancer, the answer is no; what is the effect of working under the sun's rays? The

responses were different, the most prominent of which are (Sun sensitivity, Keratoses of the skin of the face with peeling, pigmentation of the skin, Headache, Skin tint, and sensitivity, changing skin color to brown, and Changing skin color accompanied by the appearance of small white spots).

Table 4. Descriptive statistics and numbers of workers exposed to ultraviolet rays

No.	Categorical variables	Number of workers
1	**Total worker**	67
2	**Age of workers**	
	15-20	1
	20-30	43
	30-40	15
	40-50	6
	More than 50	2
3	**Workers weight in Kg (missing 4)**	20
	50-70 Kg	33
	71-90 Kg	10
	More than 90 Kg	
4	**Skin colour**	
	Light tan	12
	Medium	42
	Dark tan	13
5	**Work nature**	
	Work outdoors under the sun	25
	Work under sunshine and shade together	36
	Work with areas where sunlight can reach	5
6	**An hour spent at work**	
	5 h	39
	4 h	11
	From 3 to 1 h	17
7	**Does the worker know the effect of ultraviolet rays?**	
	Yes	33
	no	34
8	**Does the worker wear personal protective equipment?**	39
	Yes	28
	No	
9	**The equipment is wearing**	
	Hat	35
	Sunscreen	11
	Glasses	9
	Gloves	7
10	**Are workers affected by the sun's rays?**	49
	Yes	18
	No	

Days of exposure to ultraviolet rays appear to be high-risk and safe days "Table 5". When the worker is exposed in the open air more than 100%, the exposure is dangerous. Therefore, workers should avoid working in the sun or using one of the personal UV protection methods, as shown in "Figure 4"

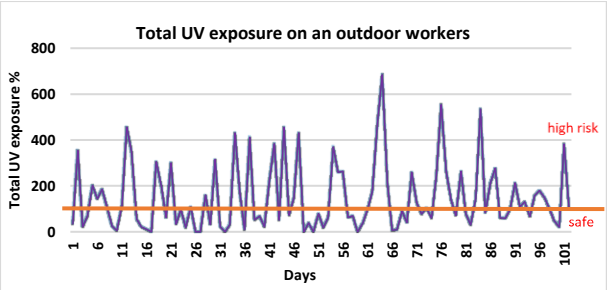

Figure 4. Total UV exposure to outdoor workers.

Table 5. the number of total readings per month with days of safe and high risk.

No	date	No. of Readings	safe days	high-risk days
1	Nov-20	15	6	9
2	Dec-20	20	10	10
3	Jan-21	27	15	12
4	Feb-21	15	6	9
5	Mar-21	18	8	10
6	Apr-21	7	2	5

Compared to UV exposure with the highest UV index every day "Table 6", The results found a relationship between them is influential. The p-value is less than 0.001, consistent with the results [24][3]. As well as, The UV exposure with the temperature for every day. The results found the relationship between them is influential. The p-value is less than 0.001, which is consistent with the results [25][3].

The ambient temperature affects exposure to UV rays, which leads to the occurrence of sunburn. It has been observed even on winter days, the temperature is moderate or low, there is exposure with a high risk of UV rays, and it is assumed that the moderate temperatures encourage workers to spend more time in the sunlight. In this way, the risk of exposure to UV rays increases. At high temperatures, most of the workers look for shade for the sake of comfort, and this conclusion agrees with the source[26].

Working hours affect UV exposure when workers spend more time at work; exposure to UVRs is influential. The p-value is less than 0.001, and this is consistent with the results [25] [21]. As well as, there is also an effect between exposure to UV rays and the presence of cloud cover is consistent with the results [25][20].

Table 6. results from data analysis by ANOVA SINGLE ONE for the UV exposure with UV index, Temperature, Working hours, and Cloud cover

Parameters	mean	Sta. dev.	p-value
UV exposure %	160.16	147.13	<0.001
UV index	4.22	1.65	
UV exposure %	160.16	147.1	<0.001
Temperature	20.92	4.2	
UV exposure %	160.16	147.13	<0.001
Working Hours	3.86	1.38	
UV exposure %	160.16	147.13	<0.001
Cloud cover	1.81	1.05	

p-value >0.05 indicate that there is not a statistically significant difference

Sta. dev. : Standard deviation

Although the outdoor workers are exposed to two types of UVR, UVA, and UVB. The exposure rate to UVA is more than UVB, "Figure 5". This corresponds to the source [16].

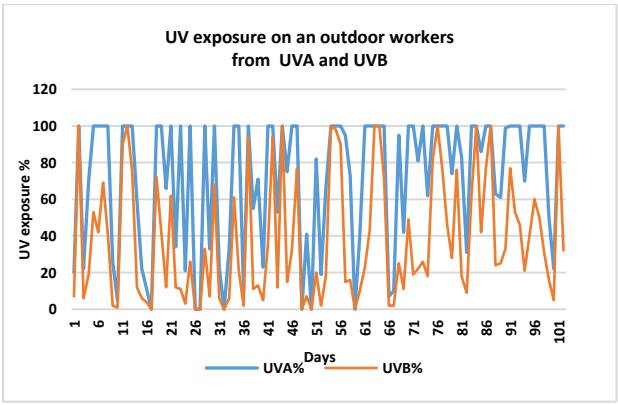

Figure 5. UV exposure on an outdoor worker from UVA and UVB

6. Conclusions

Data were taken from the beginning of November. The total reading was 102 person-days in which the sensor was worn. The results of this study confirm that workers are exposed to ultraviolet rays during working days. Despite the beginning of the research in the winter, but there are high risks of ultraviolet rays. Also, the exposure to ultraviolet rays is significantly related to temperature, UV index, and cloud cover, where P-vale is less than 0.001. Farther more, there is increased exposure to UVB, which is more dangerous than UVA, so workers should use personal protective equipment during working hours to protect themselves from excessive exposure to ultraviolet rays.

7. Recommendations for Future Work

1. Create monthly, seasonally, and annually ultraviolet radiation maps for various regions in Iraq.
2. Measuring ultraviolet rays' effect on worker productivity and comparing it with the Ministry of Labor plans for worker productivity.

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Conflict of interest

The authors confirm that the publication of this article does not cause any conflict of interest.

Abbreviations

A list of symbols:

w	radiant power
J	radiant energy
UV	Ultraviolet
NFC	Near-Field Communication
LED	light-emitting diode
SED	standard erythematous dose

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