Tabari Biomedical Student Research Journal

OPEN ACCESS

ORIGINAL: Evaluation of the Amount of Emitted Ultraviolet Radiation from Existing Light Lamps in Iran

Masoud Maleki
Yalda Nahidi
Department of Dermatology, Cutaneous Leishmaniasis Research Center, School of Medicine, Mashhad University of Medical Sciences, Mashhad, Iran

Mohammad Taghi Shakeri
Department of Biostatistics, School of Health, Mashhad University of Medical Sciences, Mashhad, Iran
Naeemeh Ebrahimabadi
Department of Dermatology, School of Medicine, Birjand University of Medical Sciences, Birjand,, Iran
Somayeh Ghadamkheyri
Mashhad University of Medical Sciences, Mashhad, Iran

ARTICLE INFO

Submitted: 17 Mar 2024
Accepted: 10 Apr 2024
Published: 22 Jun 2024

Keywords:
Light lamps;
Ultraviolet radiation;
Measurement

Correspondence:
Naeemeh,Ebrahimabadi,
Department of Dermatology, School of Medicine, Birjand University of Medical Sciences, Birjand,, Iran.
Email: nea217@gmail.com
ORCID: 0000-0001-6494-106x

Citation:
Maleki M, Nahidi Y, Shakeri M T, Ebrahimabadi N, Ghadamkheiri S. Evaluation of the Amount of Emitted Ultraviolet Radiation from Existing Light Lamps in Iran. Tabari Biomed Stu Res J. 2024;6(2):44-51.

10.22034/6.2.44

ABSTRACT

Introduction: There are many skin diseases which are caused and aggravated by exposure to ultraviolet rays and it is reported that most of commonly used lights emit a low level of UV, but it is still under discussion whether this low level is dangerous for people especially those with photosensitivity. So, in this study we investigated the levels of emitted UV from present lamps in Iran by UV-meter.

Material and Methods: In this cross-sectional study, 300 lamps of different brands were sampled, with different powers present in Iran markets and examined the amounts of emitted UVA and UVB in 5, 60 and 100cm distance from lamps by using UV-meter.

Results: Except for the 400 Watts Helium lamps (Unique-China) which have UVA rays in each three distances of 5, 60 and 100cm and also the Chinese 500 and 1000 Watts pencil-shaped lamps called Barmika which have UVA and UVB in distance of 5cm and 1000 Watts type have UVA in distance of 60cm, in other lamps, there has been no emitted UV in distance of more than 5cm.

Conclusion: Our results showed that in most of the light lamps, there has been no emitted ultraviolet ray in intervals of more than 5cm. According to data, individuals usually do not put themselves on distances less than 5cm from lamps, so it seems that the present lamps in Iran markets do not have any side effect causing aggravating skin diseases.

Introduction

Ultraviolet radiation is a physical mutagenic and carcinogenic factor. About 95% of ultraviolet A (UVA) (320–400 nm) and 5% of UVB (280–320 nm) reach the Earth's surface. Melanin is a natural skin protective factor against UV radiation(1). The acute and chronic effects are the normal responses of the skin to UVR; acute reactions considered will be erythema (sunburn) and vitamin D production. Skin aging and skin cancer will be discussed as those reactions produced by prolonged or repeated UVR exposure(2). Skin cancers associated with long-term exposure to UV radiation are: basal cell carcinoma (BCC), squamous cell carcinoma (SCC) and cutaneous malignant melanoma (CMM)(1).

A combined assessment of natural and artificial light shows that adverse health effects due to optical radiation can either occur acutely at certain levels of exposure, or after long-term repeated exposures at

lower levels(3). Depending on the effect (endpoint) of concern (e.g. skin burn, skin cancer, retinal damage, cataract) either the intensity or duration of exposure is of most relevance. In general, the probability that artificial lighting for visibility purposes induces any acute pathologic conditions is low, since expected exposures are much lower than the levels where effects are known to occur in healthy people and are also much lower than in typical summer daylight(4). The available lamp emission data show that for all investigated hazard outcomes, the absolute majority of lamps are classified as Risk Group 0 (RG0; "exempt from risk"). Most of the rare exceptions are classified as Risk Group 1 (RG1; "low risk")(5). The very few lamps assigned to higher Risk Groups were either measured without the required UV shielding glass cover, or at a very short distance (20cm) which is not the intended use distance for this lamp type. There is strong evidence that UV and, in some patients visible light, can induce skin lesions of true photo-dermatoses(6). Although sunlight is reported by most patients as the main trigger of disease activity, occasionally severely affected patients over the range of endogenous and exogenous diseases report a provocative role for artificial lighting(7). Nowadays, exposition to UV radiation of most varied types of lamps used indoors has high rate, as well as to other light sources, so it is important to determine the radiation levels emitted by them and the safe distance to be kept between the emitting source and the individuals(8). Due to the effect of ultraviolet rays in causing skin diseases and also, because so far many lamps have entered the electrical market and the consumption of energy saving lamps is increasing by individuals, in this study we evaluated the amount of ultraviolet radiation emitted from various lamps used in the Iranian market.

Methods

The study was performed on 300 lamps in Mashhad, Iran in 2012-2013 after identifying the types of lamps available in various electrical shops. A portable UV meter was used to measure UV radiations and before starting the measurements, all the lights were turned off. At intervals of 5, 60 and 100cm of the lighted lamp, we recorded the amount of UVA at the mentioned intervals.

The lamps that were to be measured were turned on for 10 min. The device was calibrated before any measurement to ensure the proper functioning of that. The ultraviolet radiation was measured when the lamps were turned on for the first time. The UV radiations emitted from the lamps were measured using an ultraviolet meter (Waldmann, Germany, sensitivity: 0.01 mw/cm2) (Figure 1), and consists of a sensor for UVA and UVB. According to the experts' recommendation that there be no difference between each model with a specific watt, the number of repetitions in each experiment was only once.

Results

According to the present study, most lamps measured at distances greater than 5cm did not emit any UV with the exception of the 400 Watts Unique China helium lamp, which had UVA rays at all distances of 5, 60 and 100cm, as well as pencil lamps Barmika China 500 and 1000 Watts with UVA and UVB at a distance of 5cm and its 1000 Watts type with UVA at a distance of 60cm.

Energy saving lamps which mentioned in **Table 1** also had no radiation at a distance of 5cm.Energy saving lamps had UVA radiation at a distance of 5cm (mw/cm^2) but not at distances of 60 and 100cm, none of them emitted UVB (**Table2**), among these energy saving lamps, the most UVA emitted at a distance of 5cm was Shoaa Pars lamp (150 W=0.85), followed by Pars Shoaa Toos lamps (105W=0.45), Ettehad model, Paramis (105W=0.42), Khazar Shir (40W=0.40), Pars Shoaa Toos (85W = 0.40), Afratab (90W=0.40), Paramis (18W=0.40) and radiation of other energy saving lamps was below 0.40.

Table1. Energy saving lamps

Lamp name	Watt
Mahtab	11W
Sahand	11W-18W-25W-32W-40W
Hytronic	11W-40W-60W-105W
Carlite	18W
Superlight	9W-11W-16W
ZA lighting	40w
BRITMAX	60W
ZFR lighting	18W-60W
SM lighting	11w
Oppli	21w
SMN	30W
Superlight	11W-16W
Nimpich	9W-25W-29W-46W-52W
Pars Shoaa Toos	12W
Wester Shark	15W-30W-35W-40W-45W
Namanoor China	40W
Namanoor Iran	9W-12W-15W-18W
Lumin	11W
Economy China	12W-30W
Noorsaram	9W-11W-15W-20W-23W
Paramis	15W
Khazar Shir	20W
Osram Germany	24W
Berjis	11W

Table2. Energy saving lamps which had UVA radiation at a distance of 5cm (mw/cm2) but not at 60 and 100cm.

Lamp Name	Watt:	Lamp Name	Watt:	Lamp Name	Watt:	Lamp Name	Watt:
Pooya Noor Saram	55W:0.28	Lcan China	65W:0.13	Pars	45W:0.13, 26W:0.25	Afrough	20W:0.2, 23W:0.24
Philips	23W:0.2	Ecoshine	40W:0.13	Ava	30W:0.16, 25W:0.22	Rasa Nour	9W:0.1, 70W:0.26
Savanoor	23W:0.2	Tandis Light	25W:0.12	Energy China	50W:0.15, 40W:0.16	Hytronic lamps	05, 60, 11, 40W:0, 29W:0.11, 11W Candles:0.13, 75W:0.14, 16W:0.17, 18W:0.17, 38W:0.19, 48W:0.22, 50W:0.31
CixinG	40W:0.19	Soofar	25W:0.12	Berjis	11W:0, 23W:0.08, 50W:0.15, 40W:0.18	Khazar Shir,	20W:0, 40W:0.4
Uni Star	37W:0.17	Xueming	30W:0.11	Osram Germany	24W:0, 50W:0.32	Paramis	15 Ettehad Models, 15W:0, 11W:0.1, 13W:0.15, 90W:0.22, 70W:0.27, 40W:0.22, 27W:0.30,

Table2 Continue

							120W:0.31, 105W:0.32, 18W:0.40, 35W:0.32, 105 Ettehad Models:0.42
Harry Amaling China	105W:0.15	Faranoor	50W:0.11	Noor Saram	9, 11, 15, 20, 23W:0, 30W:0.15, 40W:0.16, 55W:0.21	Economy China	12, 30W:0, 40W:0.08, 50W:0.12
105W:0.15	30W:0.14	Balastiran	40W:0.1	Namanoor Iran,	9, 12, 15, 18W:0, 28W:0.09, 16W:0.10, 11W:0.12, 42W:0.20, 21W:0.27, 60W:0.29	Lumin	11W:0, 40W:0.15, 65W:0.16, 70W:0.17, 85W:0.21, 105W:0.24
Shoan	50W:0.13	Screws	29W:0.12, 25W:0.13, 46W:0.23, 52W:0.28	Wester Shark, ,	15, 30, 35, 40, 45W:0.1, 3W:0.11, 25W:0.14	Namanoor China	40W:0.1, 8W:0.09, 16W:0.16, 30W:0.17
Tandis Light	25W:0.12	Half Screws	0.16, All:0.11, 29W:0.12, 25W:0.13, 46W:0.23, 52W:0.28	Afratab	11W:0.11, 15W:0.13, 25W:0.17, 35W:0.18, 105W:0.18, 45W:0.2, 55W:0.21, 20W:021, 90W:0.41,	Pars Shoaa Toos	12W:0.1, 8W:0.11, 23W:0.13, 40W:0.13, 30W:0.17, 14W:0.20, 100W:0.24, 40W:0.26, 85W:0.40, 105W:0.45
Ecoshine	40W:0.13	Karalight	18W:0, 9W:0.09, 16W:0.11, 29W:0.15, 38W:0.23	Norin,	30W:0.12, 40W:0.13, 32W:0.14, 49W:0.17, 59W:0.2	Shoaa Pars	25W:0.13, 45W:0.19, 95W:0.3, 200W:0.32, 150W:0.85
Lcan China	65W:0.13	Hytronic lamps	105, 60, 11, 40W:0, 29W:0.11, 11W Candles:0.13, 75W:0.14, 16W:0.17, 18W:0.17, 38W:0.19, 48W:0.22, 50W:0.31	Lumix	23W:0.1, 28W:0.15, 16W:0.31	KEN	45W:0.14, 26W:0.2, 30W:0.25
Energy China	50W:0.15, 40W:0.16	Pars Khazar	32W:0.14, 40W:0.18	Samir	30W:0.13, 40W:0.16	Saba Noor	20W:0.18, 23W:0.21

The incandescent lamps of Spot Germany, Naron, Pars Shahab, Philips, Osram, Wester Shark, Pars Khazar, Mahtab, Afrough, Yazdshahab had no radiation at the distance of 5cm. Pars Khazar incandescent lamps (200W=0.17), ALITE (100W=0.13), EMKAY (500W=0.21) had UVA rays at a distance of 5cm (**Table 3**). LED lamps (**Table 4**) at different Watts at distances of 5, 60 and 100cm were devoid of radiation. With the exception of the Htach lamp (50W=0.29) which had UVA rays at a distance of 5cm.

Table 3. UVB and UVA rays emitted from incandescent lamps in MW/CM2 at distances of 5, 60 and100cm

Lamp Model	Sample in Watt	UVA(mw/cm^2)			UVB (mw/cm^2)
		5cm	60cm	100cm	5, 60 and100cm
ALITE China	100	0.13	0	0	0
Pars Khazar	200	0.17	0	0	0
EMKAY China	500	0.21	0	0	0

Table 4. LED and gas lamps with UVB and UVA rays in terms of MW/CM2 at distances of 5, 60 and100cm

Type	Lamp Model	Sample in Watt	UVA(mw/cm^2)			UVB(mw/cm^2)
			5cm	60cm	100cm	5, 60 and 100cm
LED	Htach China	50	0.29	0	0	0
Gas	EYC China	250	0	0	0	0
	German Gas	125-160	0	0	0	0
	Osram Iran (Non-trans)	150-160-250	0	0	0	0
	Osram Germany	50	0.2	0	0	0

Chinese model EYC (250W) lamp, German gas (125W-160W), Osram Iran (150W-160W-250W) had no radiation at 5cm, with the exception of the Osram Germany (50W=0.20), which had UV radiation at a distance of 5cm (**Table 4**). Sunny and moonlit Sung FPL lamp (36W) had no radiation at a distance of 5cm and among other measured items, Chel Ava FPL (36W=0.34) had the most and FML Sun Sung (55W=0.11) had the least UVA radiation at a distance of 5cm (**Table 5**). Osram sodium lamp (400W=0.55) had UVA rays at a distance of 5cm (Table 6). China Unique helium lamp 400W (5cm=26.12), (60cm= 17.14), (100cm=6.9) had UVA rays at all distances (**Table 6**).

Table 5. The amount of UVB and UVA rays emitted by FPL and FML lamps in terms of MW/CM2 at distances of 5, 60 and100cm

Lamp Model	Sample in Watt	UVA (mw/cm^2)			UVB (mw/cm^2)
		5cm	60cm	100cm	5, 60 and 100cm
FPL Sun Sung Iran	36Sunny	0	0	0	0
FPL Sun Sung Iran	36 Moonlight	0	0	0	0
FPL Show on	36	0.13	0	0	0
FPL Pars Radius of Tus	36	0.14	0	0	0
FPL Afrough	36	0.3	0	0	0
Chel Ava FPL	36	0.34	0	0	0
FPL Sun Sung	36	0.3	0	0	0
FPL Pars Radius of Tus	80	0.12	0	0	0
FML Sun Sung	36 Moonlight	0.2	0	0	0
FML Sun Sung	36 Sunny	0.22	0	0	0
FML Sun Sung	55	0.11	0	0	0
FML Sun Sung	55 Moonlight	0.22	0	0	0
Afrough FML	55	0.24	0	0	0

Table 6. UVB and UVA rays emitted from sodium, helium and pencil lamp in MW/CM2 at distances of 5, 60 and100cm

Lamp Model	Sample in Wat	UVA(mw/cm2)			UVB(mw/cm^2)
		5cm	60cm	100cm	5, 60 and100cm
Osram Iran (sodium)	400	0.55	0	0	0
Unique China (helium)	400	26.12	17.14	6.9	0
Barmika China (pencil)	500	0.44	0	0	0.2 in 5 cm
	1000	0.85	0.04	0	0.31 in 5 cm

Barmika Chinese pencil lamp (500W=0.44), (500W=0.20) and (1000W=0.85), (1000W= 0.31) had UVA and UVB emitted radiation at a distance of 5cm respectively, and (1000W=0.04) at distance of 60cm also had UVA rays.Except Barmika China 500 and 1000 Watts pencil lamps that emitted UVB at a distance of 5cm, all other lamps did not contain UVB (**Table 6**).

Discussion

According to previous studies lamps emitted different amounts of UV, however in our study, lamps measured at a distance of more than 5cm did not emit any UV except for Unique China 400W helium lamp that had UVA rays in all three distances of 5, 60 and 100cm and also Barmika pencil lamp of China 500 and 1000 Watts that had UVA and UVB at a distance of 5cm and its type 1000 Watts had UVA at a distance of 60 cm. The conventional results in different study may due that lamps have been studied in different Watt and brands, many of which do not specify the type of lamp, while a recent study tried to take a sample from each brand and also selected lamps with different Watt available in the Iranian market. The type of measuring device can also be mentioned, because in the recent study a portable UV meter was used, however, other studies used different types of measuring device.In this regards, Tavakoli et al used S2000 optical fiber spectrophotometer, manufactured by Ocean Optic. Also, Eadie et al used Bentham Instruments double grating spectroradiometer (Bentham Instruments Ltd, Reading, U.K.), and Sayre et al evaluated by a Optronic Laboratories (Orlando, FL) model OL 754 spectroradiometer (9).

Moreover, measuring time of the radiation emitted from the lamps may be important, because in our study, the measurement was made after ten minutes of heating of the lamp, while in previous studies, the time may have been more or even less than this period. In the study of Safari et al. UVR values measured at different times (0, 100 and 2000 hours) showed negligible differences; the highest values were detected in zero times and our study showed that this value for three times was not significant statistically(3).

Furthermore, the distance between UV meter and the lamp is important since in our recent study, the distances was 5, 60 and 100 cm while previous studies used diffrent distances for their evaluations. For instance, in Asadi & Tavakoli, the distance was 10cm. Azizi (10) used the tangible distance of 10cm. Moreover, Klein et al(11) set the distances to 1 and 10cm and Keim et al(12) conducted their evaluations in 10, 25, 50 and 100cm distances. The location of the angle of the radiation of the lamp can be indicated. Because in previous studies such as the study of Asadi & Tavakoli, in positions perpendi-cular to the lamp or in the study of Azizi et al.(10) measuring position was tangent to the lamp, Also, in the study of Eadie et al,(9) the lamps were oriented in the horizontal position, while in the recent study, measurements were made only in the center of the lamp.

In the study of Safari et al. negligible amounts of UVA and UVB were detected at 150 and 200 cm from all compact fluorescent lamps (CFLs), like our study that was measured up to a distance of 100cm. In the former study UV irradiance compared in three angles (0, 45 and 90), and the highest amount of UV irradiance was detected in 90° but this difference was not significant statically. In our study, UV radiation was measured at a 90-degree angle, too(10).

Another reason for the differences is the type of lamps examined. Because in previous studies, most studies were done on fluorescent lamps and then halogen, while in the recent study, different models of energy saving, incandescent, LED, FPL, FML, sodium, helium and pencil lamps were examined. Also in a recent study a total of 300 types of lamps were examined, 75 of which were energy saving lamps, while in other studies, a maximum of 42 energy saving lamps were examined.

UVC levels have also been studied in previous studies, but in a recent study only UVA-UVB levels were studied. For example in the study of Dehghani et al.(13) the results proved that the intensity of UVA emitted from the lamps was

less than the permissible limit at all distances. However, this value is higher than the permissible limit for UVC at 150cm.
So it is clear that most lamps used in the workplace or at home emit very little UV, but whether these small amounts are clinically relevant for light-sensitive patients is questionable for most of our patients.

Conclusion

Based on the findings of the present study, most lamps at a distance of more than 5cm, did not emit any UV and people usually do not stay less than 5cm from the lamp even when using reading lamps and lampshades, it can be concluded that they have no effect on causing skin lesions.
Contrary to some reports from the mass media about the dangers of energy saving lamps and LED lamps, which today have largely replaced incandescent and tungsten lamps, these lamps are safe for the usual use of lighting at homes and workplaces of people with UV sensitive diseases. Due to the fact that helium and pencil lamps emit more UV than other lamps, it is better individuals who are photosensitive or concerned about their health not to use these lamps, especially at close distance.

Acknowledgments

In the end, it is necessary to express our gratitude and thanks to the esteemed Vice Chancellor for Research and Technology of Mashhad University of Medical Sciences, who provided us with the opportunity for this research and provided us with all the necessary material facilities.
We also thank the efforts and cooperation of the Deputy Director of Education of Imam Reza (AS) Hospital who had the necessary cooperation with us in conducting this research. This article is the result of a thesis code 6781.

Conflicts of interest

The authors declare that they have no competing interests.

Authors' contributions

MM and YN involved in the conception and designing the study. SG collected data. MTS performed the data analysis and interpretation. NE wrote the manuscript and acted as corresponding author. MM and YN supervised the development of work, helped in data interpretation and manuscript evaluation. NE helped to edit the manuscript. Finally, all authors have approved the manuscript for submission to the Health Promotion Perspectives.

Funding

This study received no funding or external support.

References

1. Pacholczyk M, Czernicki J, Ferenc T. Wpływ słonecznego promieniowania ultrafioletowego (UV) na powstawanie raków skóry. Medycyna Pracy. 2016;67 (2):255-66.
2. Safari S, Eshraghi Dehkordy S, Kazemi M, Dehghan H, Mahaki B. Ultraviolet radiation emissions and illuminance in different brands of compact fluorescent lamps. International Journal of Photo-energy. 2015;2015.
3. International Commission on Non-Ionizing Radiation Protection. Light-emitting diodes (LEDs): implications for safety. Health physics. 2020;118(5):549-61.
4. Bernhard GH, Neale RE ,Barnes PW, Neale P, Zepp RG, Wilson SR, et al. Environmental effects of stratospheric ozone depletion, UV radiation and interactions with climate change: UNEP Environmental Effects Assessment Panel, update 2019. Photochem Photobiol Sci. 2020 May 20;19(5):542-84.
5. Mattsson M-O, Jung T, Proykova A, Behar-Cohen F, Zissis G, de Gruijl F, et al. Health effects of artificial light. European Commission-Scientific Committee-

SCENIHR; 2012: 978-92-79-26314-9.
6. Dinkova-Kostova AT, Jenkins SN, Fahey JW, Ye L, Wehage SL, Liby KT, et al. Protection against UV-light-induced skin carcinogenesis in SKH-1 high-risk mice by sulforaphane-containing broccoli sprout extracts. Cancer letters. 2006;240(2):243-2.
7. Santoro FA, Lim HW, editors. Update on photodermatoses. Seminars in cutaneous medicine and surgery; WB Saunders.2011.
8. Duarte IAG, Hafner MdFS, Malvestiti AA. Ultraviolet radiation emitted by lamps, TVs, tablets and computers: are there risks for the population? An Bras Dermatol. 2015;90:595-7.
9. Eadie E, Ferguson J, Moseley H. A preliminary investigation into the effect of exposure of photosensitive individuals to light from compact fluorescent lamps. British Journal of Dermatology. 2009;160(3):659-64.
10. Azizi M, Golmohammadi R, Aliabadi M. Comparative analysis of lighting characteristics and ultraviolet emissions from commercial compact fluorescent and incandescent lamps. J Res Health Sci. 2016;16(4):200.
11. Klein RS, Werth VP, Dowdy JC, Sayre RM. Analysis of compact fluorescent lights for use by patients with photosensitive conditions. Photochem Photobiol. 2009;85(4):1004-10.
12. Nuzum-Keim A, Sontheimer R. Ultraviolet light output of compact fluorescent lamps: comparison to conventional incandescent and halogen residential lighting sources. Lupus. 2009; 18(6):556-60.
13. Dehghani MH, Bazargani A, Mirdoraghi M. Assessment of UV radiation emitted by linear fluorescent lamps in Iran. MethodsX. 2019;6:477-81.