

## A Study on the Harmful Ocular Manifestations and Visual Outcome Following Exposure to Halogen Bulbs

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### ABSTRACT

**Background:** Halogen lamp is an incandescent lamp consisting of tungsten filaments sealed in a compact transparent glass envelope, containing a mixture of inert gas. The smaller size, easy portability and more coverage area helps in its use in many indoor and outdoor events. This carried a problem with its improper use. We here in this article report one such incident that happened in Monanjipatti temple, in a village in South India, where on using unshielded halogen bulbs lead to blurring of vision, redness, watering, photophobia, irritation and eye pain amongst the temple festival attendees. So, this paper serves the purpose of showing clinical based evidence of ocular side effects on using halogen bulbs.

**Methods:** A cross sectional study was conducted by a team of ophthalmologists among the attendees of Monanjipatti temple festival to analyse the effect of UV radiation, on ocular tissues caused by using unshielded halogen bulb. A detailed questionnaire with clinical examination was done to confirm the diagnosis and to analyse the awareness on safety measures designed for these lamps.

**Results:** Out of 125 attendees we interviewed, 28 developed photokeratitis (22.4%), 80 developed conjunctival congestion (64%), 31 had watering (24.8%), had eye pain (20%), 108 had irritation of eyes others and on prolonged exposure.

**Conclusion:** The essence of this study shows that the photokeratitis and the aforesaid ocular manifestations are mainly due to UV exposure from the unshielded halogen bulb. And it also implies the need of Government of India initiative in regulating the usage of this kind of hazardous material.

**Key words:** Photokeratitis; Unshielded halogen bulbs; Ophthalmology; Tanning beds

## INTRODUCTION

Optical radiation within the electromagnetic spectrum includes Ultraviolet Radiation (UVR), visible light and infrared radiation. UVR is defined as that radiation between 100 nm and 400 nm in length. It is characterized further according to wave length into ultraviolet A (315 nm-400 nm), B (280 nm-315 nm) and C (100 nm-280 nm). Ultraviolet C (UV-C), from the sun, is virtually completely screened out by the earth's atmosphere and is thus a negligible source of adverse human health effects. Ultraviolet B (UV-B) is responsible for erythema (sunburn), skin cancer and immunosuppression. However, solar UV-B is crucial in the synthesis of vitamin D, which some recent studies suggest

may potentially reduce risk of colon, prostate and breast cancers. Ultraviolet A (UV-A) is responsible for skin aging and has more recently been implicated, along with UV-B, in the development of skin cancers in animals and in immunosuppression in humans. Although the sun is the main source of UV-A exposure, use of UV-A emitting lamps in sunbeds for recreational tanning has raised concern about artificial sources of human exposure [1].

Bright (UV) illumination is one of the few ecological dangers that might cause fiery responses in the eyes, particularly cornea. On a day-to-day basis, everybody is subjected to bright (UV) radiation exposure. Photokeratitis or UV keratitis is a painful

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condition of the eye mainly due to unprotected exposure to UV rays. UV rays form a variety of sources. The regular wellspring of UV rays is natural sunlight whereas other artificial wellsprings include welding arc (arc eye, welder's eye), reflection from snow (snow blindness) and lightning, sunlamps, tanning beds, germicidal UV lamps and damaged metal halide lights [2]. Halogen bulbs are a high performance rendition of the radiant tungsten light, their explained splendour puts less eye strain and increases colour contrast. They light a more extensive region and are utilized on stages and open air night time occasions. Halogen bulbs are commonly used in various applications, such as task lighting, accent or display lighting, outdoor security lighting and architectural lighting. Their compact size and availability in various shapes and wattages make them versatile for different lighting needs [3].

Halogen bulbs have a temperature range of around 2700-3200 Kelvin, which produces a warm white light similar to traditional incandescent bulbs. This makes them suitable for applications where a cozy and inviting atmosphere is desired. Halogen bulbs typically have a longer lifespan compared to traditional incandescent bulbs, but are still shorter-lived than LED bulbs. On average, halogen bulbs last around 2,000 to 3,000 hours [4]. UVR is an electromagnetic radiation and partitioned into 3 groups based on wavelength: UVA (315 nm-400 nm) UVB (280 nm-315 nm) and UVC (100 nm-280 nm). Shorter wavelengths have more frequency and this increases the potential for visual damage. The clinical hazard of UV rays may include damage to corneal epithelium, congestion of eyes and even macular burns. We report an incident that happened in a festive occasion in Munanjipatti temple, a village in south India [5].

## MATERIALS AND METHODS

In India there are present many villages that use subpar lighting sources for illumination. These villagers are uneducated about the dangers of UV radiation and the effects of it on their eyes. Even the few educated ones do not consider it a serious threat. We found one such temple where halogen lamps were being used without shades for lighting at nighttime. Since temples are places where villagers crowd, they were all commonly exposed to the harmful radiation from this lamp [6,7]. We report such an incident happened in Munanjipatti village on 25.08.2022 due to exposure to unshielded halogen bulb. An unshielded halogen bulb was used in a temple festival in Munanjipatti village on Aug

25, 2022. Around 7 to 8 hrs after the occasion, the festival attendees developed redness, watering. Photophobia, ocular pain, defective vision. In response to the information given by Munanjipatti PMOA, the block medical officer did a meticulous work in identifying and notifying the incident to TVMC, following which an effective ophthalmologist team from TVMC comprising of two senior ophthalmologist and junior ophthalmologists reported to the place and ophthalmic examination was done. A detailed history comprising of age, time of onset of symptoms after exposure, span of exposure and seating/standing area relative to halogen bulb during the occasion using questionnaire. A complete ocular examination including visual acuity, oblique examination by torchlight, corneal staining with fluorescein dye and fundus examination with direct ophthalmoscope was done. Patients with severe form of photophthalmitis are referred to Tirunelveli medical college hospital for further management [8].

## RESULTS AND DISCUSSION

Metal halide lights mainly of two types-'T' type and 'R'type. 'Type bulbs are self extinguishable that gets turn off within 15 mins when the outer shield gets broken but 'R'type bulbs are not self- extinguishable. India, being developing country has been using R-type bulb most commonly than T-type bulb due to its lower cost [9].

The corneal response to UV radiation can be acute or chronic. The acute responses include photokeratiis, damage to corneal epithelium and endothelium whereas chronic responses include climatic droplet keratopathy, pterygium and possible endothelium dystrophy. We pose a similar incidence that happened in many parts of India like halogen lamp burst in Ujjain, light music event in palani in 2018, an outbreak of bilateral photokeratitis among an indoor school event attendees attributable to unshielded metal halide bulbs in ervadi village in Tirunelveli [10].

Out of 125 attendees we examined, 108 had irritation of eyes (86.4%), 80 developed conjunctival congestion (64%), 31 had watering (24.8%), 28 developed photokeratitis (22.4%), 25 had eye pain (20%), 24 had photophobia (19.2%), 11 had decreased visual acuity (8.8%). Out of 125 attendees, 114 had a visual acuity>6/24, 11 had<6/24. Among these 11 patients, 3 had pre-existing ocular disease like cataract (Table 1 and Figure 1) [11].

**Table 1:** Pre-existing ocular disease like cataract.

Symptoms	Male	Female	Children<12 yrs	Total
Irritation of eyes	64	43	1	108 (86.4%)
Conjunctival congestion	57	22	1	80 (64%)
Watering	19	12	0	31 (24.8%)
Photokeratitis	21	7	0	28 (22.4%)

Eye pain	14	11	0	25 (20%)
Photophobia	12	12	0	24 (19.2%)
Decreased visual acuity	7	4	0	11 (8.8%)

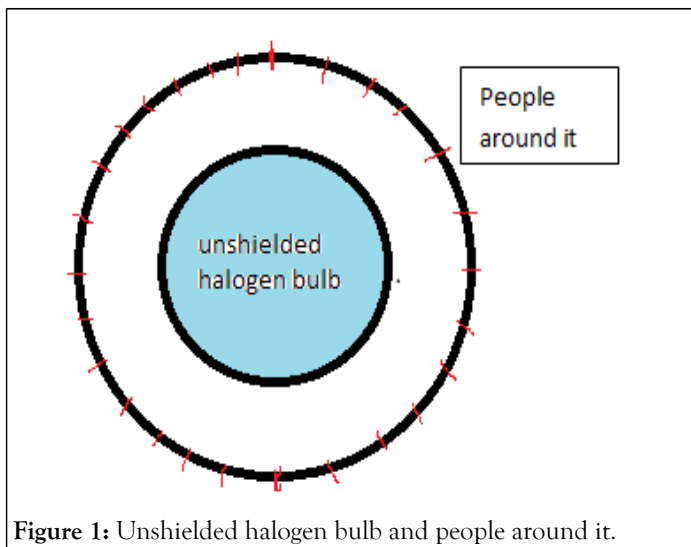


Figure 1: Unshielded halogen bulb and people around it.

The cornea being a transparent layer, it helps in transmission of light in visible spectrum (400 nm-700 nm). But it absorbs light in the UV spectrum of 100 nm-400 nm. Many animal studies have shown that maximum of 100% absorption is seen with UV light of around 290 nm (UV-C rays). This absorption of UV rays by the corneal epithelium will restrict UV rays from reaching the stroma and endothelium thus preventing its damage, it ultimately results in apoptosis and sloughing off of the corneal epithelium. This results in exposure of free nerve endings in subepithelial plexus and results in following symptoms like pain, watering, redness, blepharospasm, photophobia and defective vision. Similarly when it involves longer spectrum like infra-red rays, it can lead to stromal and endothelial damage. Short-term exposure can cause photokeratitis, leading to inflammation and discomfort of the cornea. Prolonged exposure to UV radiation, especially UV-B, has been associated with the development of pterygium and corneal degenerative changes. The lens of the eye is particularly susceptible to UV radiation damage. Cumulative exposure to UV radiation throughout life can increase the risk of cataract formation. Ultraviolet-B radiation is considered more harmful to the lens compared to UV-A. UV radiation, especially UV-A, can penetrate through the cornea and lens, reaching the retina. Long-term exposure to UV radiation has been implicated in the development of Age-related Macular Degeneration (AMD). AMD is a leading cause of vision loss among older adults. Here, the patients are treated with antibiotic eye drops and artificial tears (Figure 2) [12].

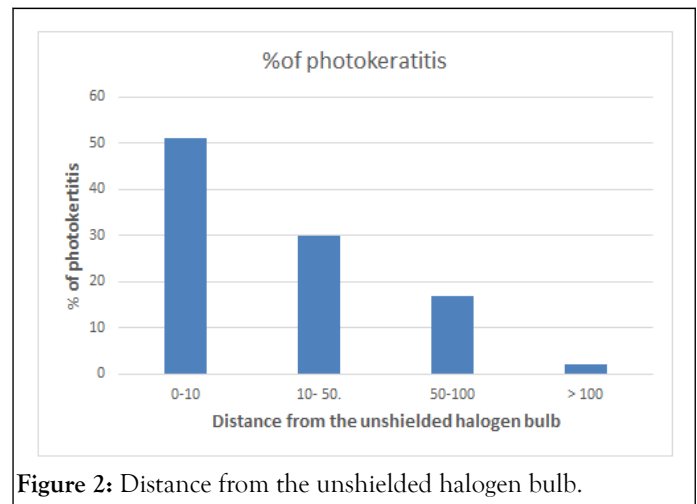


Figure 2: Distance from the unshielded halogen bulb.

Photokeratitis is a significant concern when it comes to exposure to unshielded halogen bulbs. The high levels of UV radiation emitted by these bulbs can lead to the development of this painful condition. Understanding the risks involved and taking appropriate precautions is crucial to prevent photokeratitis.

Several studies have highlighted the damaging effects of UV radiation on the eyes. Roberts found that prolonged exposure to UV radiation increases the risk of cataracts and macular degeneration. Davidoff emphasized the importance of protecting the eyes from invisible light, including UV radiation emitted by artificial light sources. The health and safety executive issued an information sheet stressing the potential ocular hazards of UV radiation. They recommend the use of protection, such as sunglasses or safety glasses labeled for 100% UV protection, to shield the eyes from the harmful effects of UV radiation. To mitigate the risk of photokeratitis due to exposure to unshielded halogen bulbs, proper shielding and barriers are crucial. Research by Pitts and Tredici demonstrated that sunglasses with adequate UV filtration effectively protected the eyes from UV radiation. Applying this principle to halogen bulbs, integral glass or plastic coverings can be employed to shield the bulbs and prevent direct exposure.

## CONCLUSION

In light of discoveries, we affirmed that the event of photophthalmitis among temple festival attendees in south India was related with openness to unshielded mercury fume light and metal halide light utilised during the occasion. In India, metal halide lights are regularly used for huge occasions in arena, assembly room and show corridors. UV rays exposure not just aims cornea (photokeratitis), it could prompt serious side effects like macular burn which can lead to permanent

visual impairment. Professional electricians inspite of having a good knowledge about its side effects they do lack the knowledge of how serious the impact would be. In light of the experience, the rules should be drafted regarding usage of these lights by the state welfare committee.

## LIMITATIONS

The reliability on duration and strength of exposure couldn't be assessed due to variability in exposure as the population was not static, accounting to falsely less strength of association.

## DECLARATION OF INTEREST

None.

## CONFLICT OF INTEREST

The authors do not have any irreconcilable circumstance.

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