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ORIGINAL ARTICLE

Exploring Perceptions and Awareness of Artificial Light: A Qualitative Study Among Medical and Non-Medical College Students in an Urban Area of Southern India

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Abstract

Background/Aim: Exposure to artificial light is linked to increased productivity but may also contribute to sleep disturbances, eye strain and psychological issues. This qualitative study investigated the perceptions and awareness of artificial light among professional college students in Mangalore, Karnataka.

Methodology: This qualitative analysis included two focus group discussions (FGD) conducted between April and May 2023. One FGD each was conducted among the second-year medical undergraduate (MBBS) students from the study institute and non-medical students from another Professional College in the urban area of Mangalore. This college was selected using a convenience sampling technique. Two FGDs were held with 20 participants to explore artificial light's benefits and harmful effects in daily life.

Results: Participants acknowledged the essential role of artificial light in enhancing productivity, enabling late-night study sessions and facilitating work in poorly lit environments. Comments highlighted that artificial light is integral to modern activities, including cinematography and navigation. However, concerns emerged regarding its adverse effects, including eye strain, headaches, sleep disturbances and potential psychological issues like anxiety and depression. Many noted that excessive exposure to artificial light disrupts circadian rhythms, contributing to insomnia and other health problems.

Conclusion: The findings emphasise the need for greater awareness of the implications of artificial light use, promoting healthier practices and informed decisions among students. Educational initiatives and public health strategies should focus on promoting healthier practices and informed decisions to mitigate its risks. Future studies could explore broader sample sizes, diverse demographics and long-term interventions to develop comprehensive measures for balancing artificial light use in daily life.

Key words: Light, artificial; Light pollution; Lighting; Perception.

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Introduction

Thomas Alva Edison secured the patent for the incandescent bulb in 1880 and since then, electric lighting has illuminated the modern world.[1] Artificial light has extended productive hours, enabling

more time for work and recreational activities. This advancement has driven economic growth by improving industries and creating sustainable communities.[2]

However, while artificial light boosts productivity and facilitates essential activities, increasing evidence suggests that improper exposure can harm human health.[2, 3] Misuse of artificial light, such as over-lighting, failure to use timers and sensors, incorrect colour choices and unnatural outdoor light levels, results in light pollution.[4] Experts, including environmentalists, naturalists and medical researchers, view light pollution as one of the most rapidly increasing and widespread environmental challenges. Research indicates that it poses long-term risks to both human and wildlife health.[2, 3] While the positive impact took us closer, the negative impact on human life and on the ecosystem disrupting wildlife, are barriers in achieving Sustainable Development Goals (SDGs) 3, 13, 14 and 15.[5]

Exposure to artificial light at night (ALAN) disrupts circadian rhythm and has been linked to sleep deprivation, which can lead to various health issues. ALAN suppresses melatonin secretion contributing to mood disorders and negatively impacting overall well-being. In industrialised countries, about 75 % of the workforce participates in shift work, which is associated with increased rates of obesity and diabetes. Alarmingly sustained night work has been linked to a 50–100 % higher incidence of breast cancer. In recognition of these risks, the International Agency for Research on Cancer (IARC) classified night shift work as a Group 2A probable carcinogen due to its role in circadian disorganisation.[6]

Given the widespread use of artificial lighting and its profound health and environmental impacts, understanding public perception and awareness of its benefits and risks is crucial. This study targeted professional college students, a population particularly reliant on artificial light due to their academic schedules and lifestyle. These students, as tomorrow's working class, represent a critical demographic for fostering awareness. By exploring their perceptions and awareness levels, this study aimed to inform educational initiatives and public health strategies to promote healthier practices in the use of artificial light. A qualitative approach was adopted to achieve these objectives.

Methods

This qualitative study was conducted through two focus group discussions (FGD): one among medical undergraduate (MBBS) students in the South Indian city of Mangalore and the other among non-medical students of a professional degree college in the same city. The research was carried out between April and May 2023, with a total of 20 professional college-going students participating. In the first FGD, 10 participants from the second professional year of the MBBS program were involved, while the second FGD included 10 non-medical students in second year of their professional degree (bachelors in various forms visual communication/ mass media) from a nearby college. Both focus groups included male and female participants, all within the age range of 18 to 21 years.

Participants were selected using a convenience (non-random) sampling technique. Following the approval from the Institutional Ethics Committee (IEC), necessary permissions were obtained from the Dean of Medical College and the Principal of the other College. Selected participants were approached by investigators SP, YA, AV, SA, SM, SP, MM and MMP, on the day of the FGD to ensure there is no prior familiarity between researchers and participants and to receive unbiased statements and opinions. The interviewers comprised of undergraduate students (including both males and females) trained in qualitative interview techniques by PM and a formally trained postgraduate student. The objectives of the study were explained and written informed consent was obtained from each participant for their involvement and audio recording. All the approached participants agreed to participate in the discussion.

Data were collected using a pre-validated FGD guide, which contained specific questions aimed at assessing the perceptions and awareness of professional college-going students regarding artificial light in their daily lives.

The FGDs were conducted at mutually convenient times and locations, in the respective campuses, in a room with only the investigators and participants. One investigator moderated the discussions, one acted as the scribe and audio recorder, while another assisted with sociogram creation. At the beginning of each session, the moderator

greeted the participants and provided a brief introduction to explain the study objectives. Participants were invited to introduce themselves, fostering rapport and comfort for the discussion.

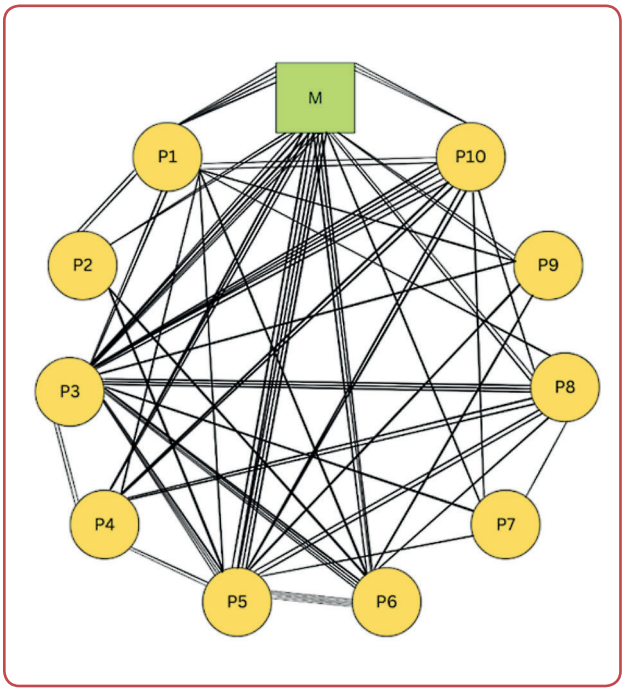

Figure 1: Sociogram of focus group discussions (FGD) among medical students

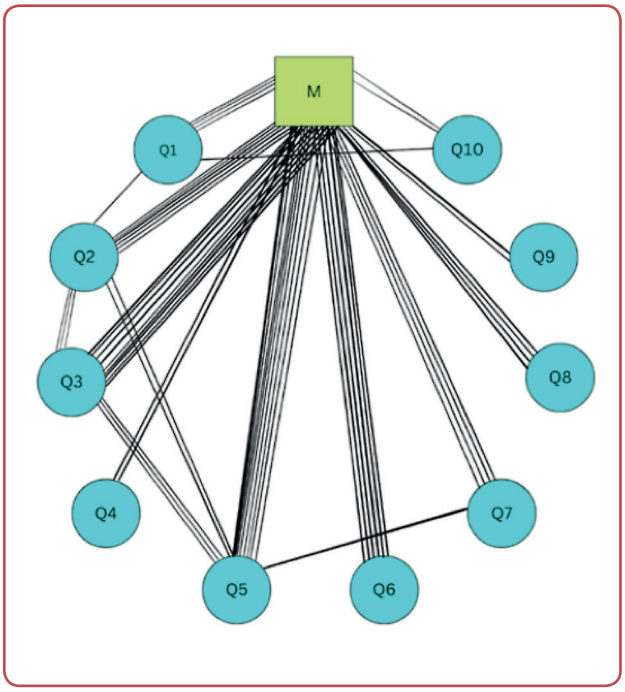

Figure 2: Sociogram of focus group discussions (FGD) among non-medical students

The moderator initiated the conversation using questions from the FGD guide, fostering active engagement and encouraging participants to share personal experiences. The discussions centred on the role of artificial light in the daily lives of professional college students. Sociograms were created to illustrate the dynamics of each discussion, as represented in Figures 1 and 2. These sociograms reflected the extent of participation by each participant. They were used for surface reading of data and mapping. Also, notes were taken during each session. Each session lasted approximately one hour, with the first session lasting around 55 minutes and the second approximately 40 minutes. The FGDs were concluded upon achieving data saturation, which was determined when no new ideas emerged and the discussions began to repeat previously mentioned concepts. All interactions were audio-recorded using a mobile phone's digital recorder. After each discussion, the moderator expressed gratitude to the participants for their time. Following both FGDs, all data, including notes and audio recordings, were transcribed by the investigators. Three investigators: PM, RT and AM independently verified the transcripts and assigned codes to each participant during transcription. Participant perspectives were documented as statements and manually analysed through content analysis, with themes and subthemes generated from these statements and visually represented as diagrams. This study has been reported in adherence to the Consolidated Criteria for Reporting Qualitative Research (COREQ) guidelines. To enhance transparency the COREQ checklist detailing each criterion has been uploaded to the Open Science Framework (OSF) and can be accessed at *10.6084/m9.figshare.27860988.*

Results

The main findings from the content analysis reveal four key themes: convenience, productivity, eco-unfriendliness and deleterious effects. Supporting quotes from both medical and non-medical student groups are presented under each of these themes and Figure 3 visually represents these themes alongside their subthemes.

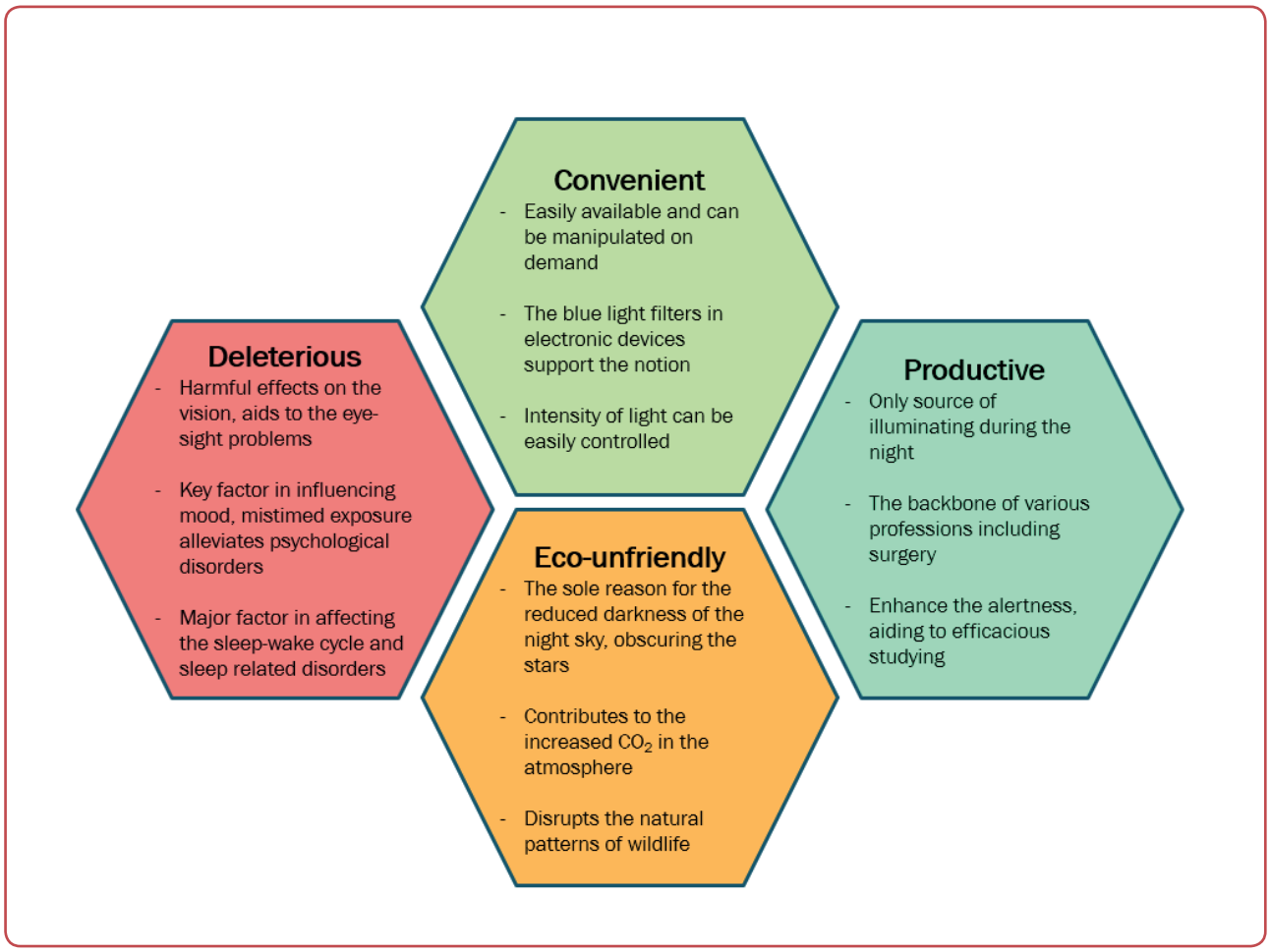

Figure 3: Themes and sub themes regarding perception and awareness of artificial light

FGD 1

Convenient

Participants emphasised the importance of artificial light in facilitating daily tasks. P1 noted, "Without artificial light, none of us would be able to see." P6 added, "Artificial light can be regulated to suit our study needs." P4 remarked, "Artificial light allows us to stay inside without environmental heat exposure." P10 highlighted its role in hostels, where "even during the daytime, artificial light is essential for studying and working." P1 commented on the customisability, stating, "Artificial light gives flexibility in how and when we use it." P5 and P1 discussed the importance of artificial light for operating devices, with P1 adding that "yellow lights on devices are beneficial for eye protection." Participants also mentioned how artificial light aids in recreational activities, such as in clubs and parties where flashing lights enhance moods (P3, P10). Furthermore, P3 pointed out its utility in clinical settings and for safety, as streetlights help with navigation, especially for women.

Productive

Artificial light was noted for its significant role in productivity. P3 remarked, "It allows us to study and travel at night and daily activities would be hindered without it." P5 highlighted its adaptability for study purposes, while P9 and P10 agreed that artificial light keeps people alert, enhancing productivity. P7 emphasised that artificial light extends working hours, contributing to human advancement. P4 pointed out that artificial light is essential in hospitals, especially in emergency situations, despite its potential to cause light pollution.

Eco-unfriendly

The environmental impact of artificial light was discussed, with P4 sharing how excessive use in cities leads to light pollution, masking the beauty of the night sky. P10 warned, "Artificial lights

might be hazardous in the future." P2 noted, "At present, artificial light is so integrated into daily life that replacing it is not feasible."

Deleterious

Participants voiced concerns about the negative effects of artificial light. P3 noted, "Bright light strains eyes, causing fatigue." P5 agreed, adding that prolonged exposure leads to headaches and decreased efficiency. P6 and P8 mentioned the impact on concentration, irritability and the exacerbation of migraines. P10 warned about mistimed exposure disrupting sleep patterns and the circadian rhythm, while P1, P3 and P5 linked artificial light to psychological symptoms such as anxiety and depression. P2 pointed out that excessive exposure causes dry eyes and pain and P7 discussed the risk of vitamin D deficiency due to limited sunlight exposure, leading to conditions like osteocalcin.

FGD 2

Convenient

Similar to FGD 1, participants in FGD 2 highlighted the necessity of artificial light. Q2 noted, "Once the sun sets, we need artificial light to work." Q3 echoed, "Artificial light is essential for studying at night." Q5 emphasised its importance in workspaces where natural light is insufficient. Q6 discussed its role in video editing and photography, stating that without artificial light, tasks like using keyboard backlights or shooting would be impossible. Q3 also mentioned the usefulness of phone flashlights for travellers and people in remote areas.

Productive

Q5 highlighted the critical role of artificial light in cinematography, where it enhances photographs and video shoots. Q9 emphasised that bright artificial light is necessary for concentration and productivity. Q3 noted that his work, which involves night photography, relies heavily on artificial light. Despite its potential harmful effects, Q5 acknowledged that artificial light has been integral to advancements and is now indispensable.

Eco-unfriendly

Q3 commented on the impact of artificial light on astrophotography, noting that light pollution in cities hinders the ability to capture the night sky. Q6 added that artificial light disrupts nocturnal animals' natural behaviours.

Deleterious

Participants in FGD 2 echoed concerns about the negative effects of artificial light. Q5 mentioned that increased exposure at night disrupts sleep, while Q3 and Q9 linked long-term exposure to insomnia, dark circles and irritability. Q1, Q2 and Q5 discussed the physical effects, including dry eyes, strain and headaches. Q4 noted that prolonged exposure to artificial light also triggers fatigue and decreased concentration. Q7 highlighted light sensitivity, while Q2 mentioned that exposure could also lead to migraines. Q1 found that dimmer, warmer light alleviates some of these symptoms, reducing fatigue and discomfort.

Discussions

This study qualitatively examined the perceptions of artificial light among participants, exploring both its perceived advantages and disadvantages and contextualising these within existing research on artificial light exposure. Participants across focus groups expressed mixed views, acknowledging artificial light's role in enhancing productivity and convenience but also recognising its potential deleterious effects on health and the environment. All participants actively contributed to the discussions, reflecting widespread engagement and diverse perspectives as illustrated in the sociograms.

Artificial light as a tool for productivity

Participants highlighted artificial light's role in sustaining productivity and extending work hours, aligning with prior findings on artificial light's impact on alertness and cognitive performance. For instance, P9 remarked, "It helps to keep us alert and awake," while P10 observed that artificial light "increases our productivity, as we are able to do more work... compared to when it is turned off." Similarly, Q9 shared, "I need bright artificial light to focus while studying... It increases my concentration and alertness, which ultimately enhances my productivity." These observations are consistent with studies by Vandewalle et al and Cajochen et al,[7,8] which suggest that artificial light can enhance alertness and improve performance under certain conditions. Participants noted artificial light's ability to counteract feelings of sleepiness, as expressed by P6 and P8, who stated that "artificial light is of immense benefit as it makes us do work even

if we don't feel like doing it." This finding aligns with Gooley et al,[9] who found that artificial light can delay melatonin onset and increase nighttime alertness, supporting cognitive tasks that require prolonged focus.

Convenience in using artificial light to improve mood and well-being

Participants also discussed artificial light's potential to positively influence mood, particularly when colour and intensity are adjusted for comfort, which are in line with findings from a study by Blume C et al and Gizycki HV et al.[10, 11] P7 commented, "Artificial light plays an important role in elevating moods," and P5 and P10 agreed, noting that "some people like yellow-coloured artificial light." The preference for warmer tones is echoed in research by Rohde EJ,[12] who found that yellow lighting is generally perceived as more pleasant and less strain-inducing compared to blue light.

Deleterious effects of artificial light on health: eye strain, sleep disruption and fatigue

Participants identified several adverse effects of artificial light on physical and mental health, especially concerning prolonged exposure. As P3 explained, "Increased usage of bright light strains the eyes... leading to significant fatigue and making many people feel drained while working." P5 noted that "prolonged exposure to artificial light causes headaches," while Q4 remarked on its impact on "fatigue, exhaustion and tiredness." These comments are consistent with findings from many studies,[13, 14] which emphasises that prolonged artificial light exposure, particularly for night shift workers, can contribute to eye strain, headaches, fatigue, mental health issues like depression etc.

Sleep disturbances were also prominent, with participants noting artificial light's effects on circadian rhythms and sleep quality. P10 observed, "Mistimed exposure to artificial light negatively affects the sleep-wake cycle... Some people feel lethargic even after getting adequate sleep," which they attributed to disrupted melatonin secretion. This is consistent with studies that show exposure to artificial light at night can impair melatonin production, impacting sleep duration and quality.

Eco-unfriendliness of artificial light and the need for sustainable lighting practices

The discussions also touched on artificial light's environmental impact. P4 and Q3 noted the issue of light pollution, which obscures the night sky and can interfere with practices such as astrophotography. Q3 further suggested that artificial light is "actually bad for the environment because all the power generated and heat emission is involved with other forms of pollution." This sentiment highlights an area of growing research interest around sustainable lighting, as artificial light's extensive use has broader implications on energy consumption and ecosystem disruption.[15]

Conclusion

In summary, artificial light emerged as both an enabler and a potential disruptor in participants' lives. Medical students particularly emphasised its productivity benefits, highlighting its role in supporting extended work hours and concentration. However, both groups recognised the health risks, particularly regarding eye strain, sleep disturbances and mood impacts. Non-medical participants emphasised artificial light's creative and functional uses, such as in photography and videography, but they, too, noted its environmental consequences.

These findings bring out the complex role of artificial light tightly interwoven with day-to-day life, as both a necessary and potentially problematic technology. Future research should explore sustainable lighting solutions, such as adaptive lighting that aligns with circadian rhythms, as well as the effects of artificial light on specific subpopulations. Additionally, larger sample sizes, diverse demographics and long-term interventions are needed to develop comprehensive measures for balancing artificial light use in daily life.

Ethics

This study was approved by the institutional Ethics Committee of Kasturba Medical College, Man-

galore, decision No IEC KMC MLR 05/2023/238, dated 18 May 2023. Permissions from the Dean of Medical College and the Principal of Professional College was taken to undertake this study in their institution. Informed consent was also taken from each of the participants.

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Conflicts of interest

The authors declare that there is no conflict of interest.

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Data access

The data that support the findings of this study are available from the corresponding author upon reasonable individual request.

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