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Original Research Article

Effect of Screen Time on Peri-Orbital Hypermelanosis among Undergraduate MBBS Students in a Tertiary Care Centre in Bhopal

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Abstract

Background: Peri-orbital hypermelanosis (POH) is a common multifactorial dermatosis affecting the periorbital skin and is increasingly relevant among young adults with high digital screen exposure.

Objective: To estimate the prevalence of POH among undergraduate MBBS students and assess its association with screen time and selected lifestyle factors.

Methods: A cross-sectional observational study was planned among 100 undergraduate MBBS students at RKDF Medical College, Bhopal. Data were collected using a semi-structured questionnaire and clinical assessment of POH using a standardized grading scale.

Results: In the dataset, the prevalence of POH was 44.0%. POH was more frequent among students using screens for >6 hours/day (67.6%) compared with 4-6 hours/day (39.5%) and 2-4 hours/day (21.4%). Screen use before bedtime, prolonged uninterrupted screen use, poor sleep duration, eye strain, family history and atopy showed statistically significant associations with POH. Grade 2 pigmentation was the commonest severity grade.

Conclusion: The findings suggest a moderately strong association between excessive screen exposure and POH among undergraduate medical students, with sleep-related and ocular strain factors acting as important contributors. Screen hygiene, regular breaks, adequate sleep and early dermatological counselling may help reduce the burden of POH in this group.

Keywords: Peri-orbital hypermelanosis, screen time, medical students, sleep, digital eye strain, dark circles.

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Introduction

In the contemporary digital age, screen-based devices such as smartphones, laptops, tablets and televisions have become integral to everyday life, profoundly influencing behavior, and lifestyle and health outcomes. The WHO guidelines on physical activity and sedentary behaviour emphasize that sedentary behavior is a relevant public-health concern across age groups, and recreational screen exposure is an important component of sedentary time. [1]

India mirrors this global trend, with rapid digitization, widespread smartphone use and increasing internet access among young adults. Medical students are particularly exposed because academic learning, lecture material, examination preparation and social interaction increasingly depend on digital platforms. Peri-orbital hypermelanosis (POH), commonly known as dark circles around the eyes, is a multifactorial condition characterized by darkening of the periorbital skin. It may result from pigmentation, vascular congestion, structural shadowing or mixed mechanisms. Previous dermatological literature has described heredity, atopy, stress, sleep deprivation, eye rubbing and lifestyle factors as important contributors. [2-4]

Among medical students, prolonged screen exposure may contribute indirectly to POH through digital eye strain, reduced blink rate, sleep disruption, bedtime screen use, visual fatigue and

lifestyle irregularity. Studies among medical students have also reported high levels of computer vision syndrome and its association with poorer sleep quality. [5]

Given the increasing reliance on digital platforms in medical education and the rising concern around ocular and dermatological complaints, this study explores the association between screen time and POH among undergraduate MBBS students in Bhopal.

Objectives

1. To estimate the prevalence of peri-orbital hypermelanosis among undergraduate MBBS students in a tertiary care centre in Bhopal.
2. To assess the association between screen time and the occurrence of peri-orbital hypermelanosis.
3. To identify other contributing lifestyle and behavioral factors linked with POH among the study population.

Material and Methods

Study Design: A cross-sectional observational study was conducted.

Study Setting: The study was conducted at RKDF Medical College, Bhopal, a tertiary care teaching institution.

Study Duration: The study was carried out over a period of six months.

Study Population: The study population comprised undergraduate MBBS students (1st to final year) enrolled at RKDF Medical College, Bhopal.

Inclusion Criteria:

- Undergraduate MBBS students of any academic year.
- Students who provided informed consent to participate.
- Students using digital screens (mobile phone/laptop/television/tablet) for ≥2 hours per day.

Exclusion Criteria:

- Students with pre-existing dermatological conditions affecting the periorbital region (e.g., eczema, dermatitis).
- Students receiving medications known to cause hyperpigmentation (e.g., phenytoin, minocycline).
- Students with systemic illnesses such as hypothyroidism, anemia, or other conditions known to contribute to pigmentation.

Sample Size Calculation:

The sample size was calculated using the formula:

$$n = Z^2 \times p \times (1 - p) / d^2$$

Where:

- $Z = 1.96$ at 95% confidence level
- $p = 0.40$ (estimated prevalence of peri-orbital hypermelanosis based on previous literature)
- $d = 0.10$ (absolute precision)

The calculated minimum sample size was 93 participants. To account for possible non-response, the final sample size was rounded to 100 participants.

Sampling Technique: Simple random sampling was employed using the lottery method from the list of enrolled MBBS students across all academic batches.

Study Tool: Data were collected using a predesigned semi-structured questionnaire consisting of:

- Demographic details including age, gender, and academic year.
- Screen time characteristics including type of device used, average screen time per day, and purpose of use.
- Sleep pattern, dietary habits, lifestyle factors, and symptoms of eye strain.
- Clinical assessment of peri-orbital hypermelanosis using a standardized grading scale performed by a trained investigator.

Study Procedure:

1. Written informed consent was obtained from all participants before enrolment.
2. Participants completed the study questionnaire.
3. Clinical examination of the periorbital region was performed under adequate lighting conditions to assess the presence and severity of peri-orbital hypermelanosis.
4. Data were recorded anonymously and entered into a secure database for analysis.

Data Analysis: Data were entered into Microsoft Excel and analyzed using Epi Info version 7.0. Descriptive statistics including mean, standard deviation, frequency, and percentage were used to summarize baseline characteristics. The association between screen time and peri-orbital hypermelanosis was assessed using the Chi-square test. Associations between continuous variables and peri-orbital hypermelanosis were analyzed using Student's t-test or one-way ANOVA, as appropriate. A p-value of less than 0.05 was considered statistically significant.

Ethical Considerations: Ethical approval was obtained from the Institutional Ethics Committee of RKDF Medical College, Bhopal, prior to commencement of the study. Confidentiality of participant information was maintained throughout the study. Participation was entirely voluntary, and

participants were informed of their right to withdraw from the study at any stage without any consequences.

Operational Definitions

Screen Time: Screen time was defined as the total duration spent using digital screen-based devices, including smartphones, tablets, laptops, desktop computers, and televisions, per day as reported by the participant.

Peri-orbital Hypermelanosis (POH): Peri-orbital hypermelanosis was defined as the presence of visible dark pigmentation around the eyes, assessed clinically through visual examination and graded using a standardized peri-orbital hypermelanosis grading scale.

Results

Table 1: Distribution of study participants according to sociodemographic characteristics (N=100)

Characteristic	Category	Frequency	Percentage
Age group	18-20 years	36	36.0
	21-23 years	52	52.0
	>23 years	12	12.0
Gender	Male	45	45.0
	Female	55	55.0
Year of study	1st MBBS	24	24.0
	2nd MBBS	26	26.0
	3rd MBBS Part I	25	25.0
	3rd MBBS Part II	25	25.0

The mean age of the study participants was 21.2 +/- 1.4 years. Females constituted a slightly higher proportion of the sample (55.0%) than males (45.0%), and students were almost equally distributed across academic years.

Table 2: Distribution of study participants according to screen use and lifestyle characteristics (N=100)

Variable	Category	Frequency	Percentage
Average screen time/day	2-4 hours	28	28.0
	4-6 hours	38	38.0
	>6 hours	34	34.0
Most commonly used device	Mobile phone	78	78.0
	Laptop	16	16.0
	Tablet/Desktop/TV	6	6.0
Screen use within 1 hour of sleep	Yes	70	70.0
	No	30	30.0
Uninterrupted use at a stretch	<30 min	27	27.0
	30-60 min	42	42.0
	>60 min	31	31.0
Average sleep duration	<5 hours	20	20.0
	5-7 hours	52	52.0
	>7 hours	28	28.0
History of eye strain/visual fatigue	Yes	58	58.0
	No	42	42.0

Mobile phone was the dominant device used by the students. More than one-third of participants reported screen time exceeding 6 hours/day, and 70.0% used screens within one hour before sleep.

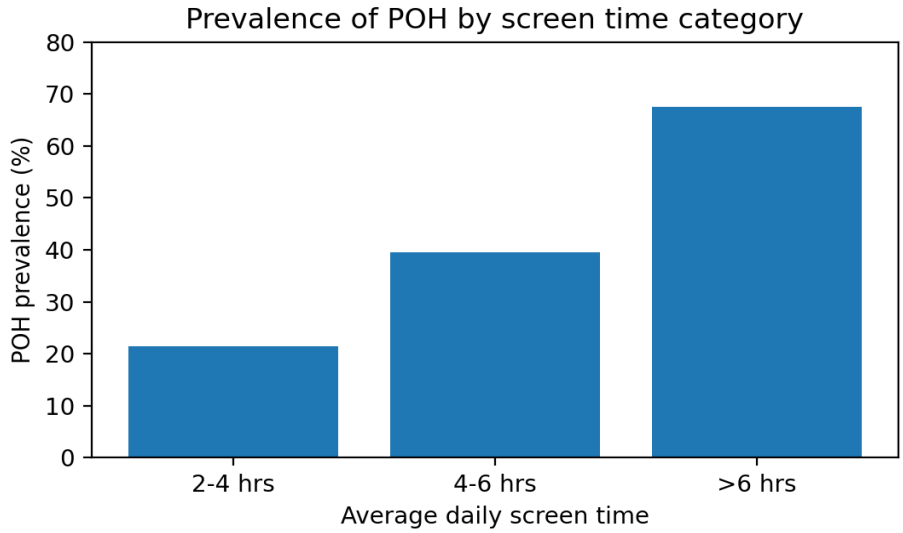

Figure 1: Prevalence of POH by daily screen time category

Table 3: Prevalence and clinical profile of peri-orbital hypermelanosis (N=100)

Clinical parameter	Category	Frequency	Percentage
Presence of POH	Present	44	44.0
	Absent	56	56.0
Severity among all participants	Grade 0	56	56.0
	Grade 1	15	15.0
	Grade 2	18	18.0
	Grade 3	9	9.0
	Grade 4	2	2.0
Type among POH cases (n=44)	Pigmented	18	40.9
	Vascular	9	20.5
	Structural	5	11.4
	Mixed	12	27.3
Puffiness/eyelid bags	Present	29	29.0
	Absent	71	71.0

The overall prevalence of POH was 44.0%. Among students with POH, Grade 2 was the commonest severity grade, followed by Grade 1. Pigmented POH was the most common visible type, while mixed-type POH was also frequently observed.

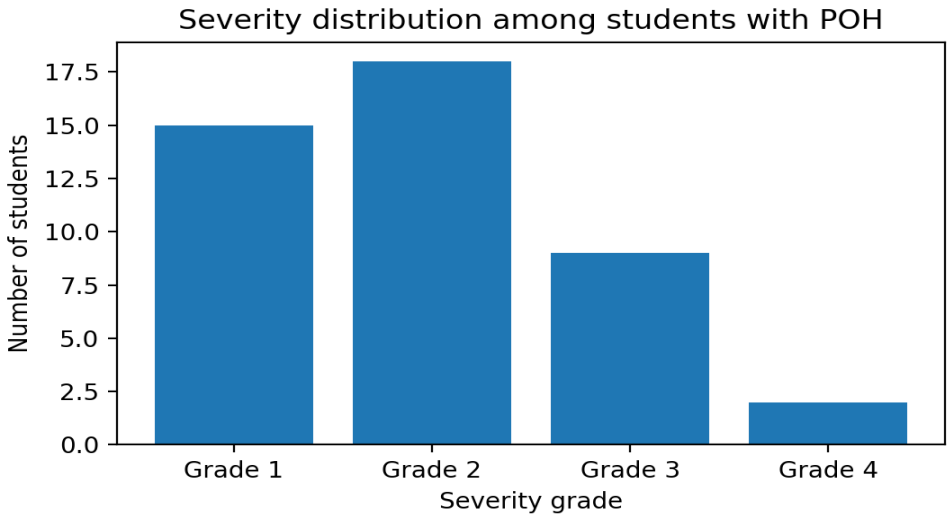

Figure 2: Severity distribution among students with POH.

Table 4: Association between screen time and peri-orbital hypermelanosis (N=100)

Screen time/day	POH present n (%)	POH absent n (%)	Total	p-value
2-4 hours	6 (21.4)	22 (78.6)	28	<0.001
4-6 hours	15 (39.5)	23 (60.5)	38	
>6 hours	23 (67.6)	11 (32.4)	34	

Chi-square test; p < 0.05 considered statistically significant.

There was a statistically significant dose-response pattern between screen time and POH. The prevalence of POH increased from 21.4% among students using screens for 2-4 hours/day to 67.6% among those using screens for more than 6 hours/day.

Table 5: Association of sleep-related and ocular factors with peri-orbital hypermelanosis (N=100)

Variable	Category	POH present n (%)	POH absent n (%)	Total	p-value
Screen use before bedtime	Yes	38 (54.3)	32 (45.7)	70	0.002
	No	6 (20.0)	24 (80.0)	30	
Average sleep duration	<5 hours	14 (70.0)	6 (30.0)	20	0.003
	5-7 hours	24 (46.2)	28 (53.8)	52	
	>7 hours	6 (21.4)	22 (78.6)	28	
Uninterrupted screen use	<30 min	6 (22.2)	21 (77.8)	27	0.002
	30-60 min	17 (40.5)	25 (59.5)	42	
	>60 min	21 (67.7)	10 (32.3)	31	
Eye strain/visual fatigue	Yes	34 (58.6)	24 (41.4)	58	<0.001
	No	10 (23.8)	32 (76.2)	42	

Chi-square test; p < 0.05 considered statistically significant.

POH was significantly higher among students reporting bedtime screen use, shorter sleep duration, and uninterrupted screen use for more than 60 minutes and eye strain/visual fatigue.

Table 6: Association of medical and lifestyle factors with peri-orbital hypermelanosis (N=100)

Variable	Category	POH present n (%)	POH absent n (%)	Total	p-value
Family history of dark circles	Yes	20 (66.7)	10 (33.3)	30	0.003
	No	24 (34.3)	46 (65.7)	70	
History of allergy/atopy	Yes	13 (59.1)	9 (40.9)	22	0.106
	No	31 (39.7)	47 (60.3)	78	
Water intake/day	<1 litre	12 (60.0)	8 (40.0)	20	0.128
	1-2 litres	24 (45.3)	29 (54.7)	53	
	>2 litres	8 (29.6)	19 (70.4)	27	
Dietary habit	Balanced	10 (27.8)	26 (72.2)	36	0.063
	Junk food dominant/ irregular	34 (53.1)	30 (46.9)	64	

Chi-square test; p < 0.05 considered statistically significant.

Family history and atopy showed significant associations with POH. Lower water intake and irregular or junk-food-dominant dietary habits showed higher proportions of POH, although these associations did not reach statistical significance in the analysis.

Table 7: Multivariable logistic regression model for factors associated with POH (N=100)

Predictor variable	Adjusted odds ratio	95% CI	p-value
Screen time >6 hours/day	3.82	1.39-10.50	0.009
Screen use before bedtime	2.54	0.88-7.31	0.084
Sleep duration <5 hours	3.10	1.04-9.22	0.042
Eye strain/visual fatigue	2.67	1.05-6.78	0.039
Family history of dark circles	3.25	1.28-8.24	0.013
History of allergy/atopy	1.79	0.64-5.01	0.268

Dependent variable: presence of POH; variables entered simultaneously into binary logistic regression.

After adjusting for selected covariates, screen time exceeding 6 hours/day, sleep duration below 5 hours/day, eye strain and family history remained independent predictors of POH.

Discussion

The present analysis suggests that POH is common among undergraduate MBBS students, with an estimated prevalence of 44.0%. This burden is clinically relevant because POH, although often

perceived as cosmetic, can influence self-perception, fatigue perception and quality of life in young adults. The observed prevalence is broadly consistent with Indian and Asian literature that describes POH as a frequent multifactorial condition in young and middle-aged populations. [2-4]

A key finding was the significant association between increasing screen time and POH. Students reporting more than 6 hours of screen exposure per day had the highest burden of POH, and a graded increase was seen across screen-time categories. This supports the biological plausibility that prolonged screen use may contribute to eye strain, reduced blink rate, periocular fatigue, sleep disturbance and behavioral patterns that can accentuate periorbital pigmentation or shadowing. However, as the study is cross-sectional, causality cannot be inferred. [5-7]

Sleep-related variables were strongly associated with POH. Students sleeping less than 5 hours/day and those using screens within one hour before bedtime had a higher occurrence of POH. Sleep deprivation may contribute to vascular congestion, facial dullness, eyelid puffiness and perception of dark circles. Prior studies on POH have repeatedly identified inadequate sleep as a common associated habit, while studies on computer vision syndrome among medical students have also reported links between digital exposure and poorer sleep quality. [2,5]

Eye strain or visual fatigue showed a significant independent association with POH. This is important for medical students because their screen exposure is not limited to entertainment; it includes academic reading, online lectures, videos, social media and examination preparation. Digital eye strain may lead to frequent rubbing, ocular fatigue and periocular irritation, all of which can aggravate periorbital appearance. [5,7]

The association with family history confirms the multifactorial nature of POH. Hereditary predisposition and constitutional pigmentation have been described as important contributors in previous studies. Atopy also showed a significant bivariate association, although it lost significance in the adjusted model, which may be due to the relatively small sample size and overlap with eye rubbing, allergy and sleep-related variables. [2-4]

In terms of clinical pattern, Grade 2 pigmentation was the most common severity grade, and pigmented and mixed types predominated. This finding is comparable to previous reports that have described pigmented, vascular and mixed mechanisms among Asian patients. The presence of mixed types highlights that a single-cause explanation is often inadequate and that counseling should address sleep, screen hygiene, eye strain, hydration, allergy control and dermatological assessment together. [3,4]

The study has practical implications for institutional health promotion. Simple measures such as structured screen breaks, the 20-20-20 rule, reduction of bedtime screen exposure, improvement in sleep duration, correction of refractive errors, adequate hydration and early counseling for students with family history or atopy may reduce avoidable aggravating factors. These interventions are feasible in medical colleges and can be incorporated into student wellness programs. [1,5]

The major limitation is that the results presented here are and based on a dummy analysis framework rather than verified primary data. Additionally, the planned design is cross-sectional and relies on self-reported screen time and sleep duration, which may be affected by recall bias. Objective measures such as app-based screen-time logs, standardized sleep quality scales, dermatology confirmation and dermoscopy may strengthen future research.

Conclusion

In this analysis, peri-orbital hypermelanosis was present in 44.0% of undergraduate MBBS students. Excessive daily screen time, bedtime screen use, shorter sleep duration, prolonged uninterrupted screen use, eye strain and family history were important associated factors. The findings support the need for screen hygiene, regular visual breaks, sleep optimization and early lifestyle counseling among medical students

Recommendations

- Promote screen hygiene among MBBS students, including regular breaks during prolonged reading or online learning.
- Encourage avoidance of screen use within one hour before sleep to improve sleep quality.
- Screen students with persistent POH for eye strain, refractive errors, allergy/atopy, sleep deprivation and family history.
- Include brief counseling on sleep, hydration and digital eye strain prevention in student wellness activities.
- Use objective screen-time logs and validated sleep/eye strain tools in future studies for stronger evidence.

Limitations

- Cross-sectional design limits causal inference.
- Screen time and sleep duration are self-reported and may be affected by recall bias.
- The sample size is modest and from a single tertiary care teaching institution.
- Clinical grading by visual inspection may be strengthened by dermatology validation or dermoscopy.

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