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PREMATURE HAIR GREYING AND ITS ASSOCIATION WITH STRESS, ANXIETY, AND DEPRESSION AMONG COLLEGE STUDENTS: A CROSS-SECTIONAL STUDY

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Abstract

Background: Premature greying of hair (PGH) is increasingly observed in young adults, especially college students. Genetic, nutritional, lifestyle, and psychological factors contribute to its onset. College students in face unique stressors, making them vulnerable to both PGH and mental health problems.

Aim: To investigate the association between PGH and mental health parameters—stress, anxiety, and depression—among college students.

Methods: This cross-sectional study was conducted at Index Medical College, Indore, India, over 12 months. A total of 385 students aged 18–25 years from medicine, nursing, and allied health sciences were recruited using stratified random sampling. PGH was assessed using the Graying Severity Score (GSS), and mental health outcomes were measured with the Depression, Anxiety, and Stress Scale-21 (DASS-21). Quality of life and study-related burnout were evaluated with WHOQOL-BREF and the Maslach Burnout Inventory-Student Survey (MBI-SS). Statistical analyses included chi-square tests, t-tests, and correlation measures, with significance set at $p<0.05$.

Results: The prevalence of PGH was 34.8%. Students with PGH had significantly higher mean scores for stress (22.4 vs. 13.8), anxiety (14.5 vs. 9.2), and depression (12.8 vs. 8.5) compared to those without PGH (all $p<0.001$). PGH was also associated with poorer quality of life across all WHOQOL-BREF domains and higher burnout scores on MBI-SS. Lifestyle factors such as smoking (35.1% vs. 15.1%, $p<0.001$), undernutrition (29.9% vs. 15.1%, $p=0.003$), and reduced sleep duration (6.1 vs. 6.9 hours, $p<0.001$) were more prevalent among the PGH group.

Conclusion: PGH is common among health sciences students and is strongly associated with higher stress, anxiety, depression, reduced quality of life, and study-related burnout. PGH may serve as a visible marker of psychological distress in high-pressure academic environments. Early screening and intervention strategies are recommended.

Keywords: Premature greying of hair; Canities; Stress; Anxiety; Depression; Quality of life; Burnout; Health sciences students; Mental health; Cross-sectional study

Introduction

Premature greying of hair (PGH), also known as canities, is defined as the onset of grey or white hair before the age of 20 in Caucasians, 25 in Asians, and 30 in Africans(1). In the Indian population, where the majority are of Asian descent, PGH typically manifests in the late teens or early twenties, affecting a significant proportion of young adults(1). This condition arises from the depletion or dysfunction of melanocytes, the pigment-producing cells in hair follicles, leading to a loss of melanin(1). While genetics play a predominant role, environmental and lifestyle factors such as oxidative stress, nutritional deficiencies (e.g., vitamin B12, ferritin, and HDL-C), smoking, sedentary behavior, and psychological stressors have been increasingly implicated(2–6).

In the context of young adults, college-going students and even late adolescents, PGH is emerging as a visible marker of underlying mental health issues. College life, is characterized by intense academic pressure, long study hours, competitive environments, and sleep deprivation, all of which exacerbate stress, anxiety, and depression. A cross-sectional study among Indian medical undergraduates in Rajasthan reported a 34.5% prevalence of PGH, with higher rates in females (54%) and an early onset between 15-19 years in 73% of cases(7). Another Indian study linked PGH to lower serum levels of essential nutrients and higher body mass index, suggesting multifactorial influences including lifestyle stressors(8).

Mental health disorders among students are alarmingly prevalent globally and in India. The World Health Organization estimates that 20-25% of young adults experience anxiety or depression, with medical students facing even higher risks—up to 30-40%—due to burnout and performance anxiety(9). Research from Saudi Arabia and Pakistan has associated PGH with anxiety (46.9%) and depression (24.8%), while Indian investigations highlight its impact on socio-cultural adjustment and self-esteem, particularly among females who report greater psychological distress from visible greying(9–12). Another Indian youth under 30 found high PGH prevalence with minimal psychological impact reported, yet it underscored the need for deeper exploration into mental health correlates(7,8). Despite these insights, the bidirectional relationship—whether PGH exacerbates mental health issues through lowered self-esteem or if stress primarily drives greying—remains underexplored in specific cohorts like health sciences students(14,15).

The rising incidence of premature greying of hair (PGH) among Indian youth, particularly college students, underscores an urgent need for targeted research. Existing studies indicate a 34-37% prevalence in medical and non-medical students in India, linked to nutritional deficiencies, obesity, and high stress levels, yet few focus on health sciences cohorts who endure unique academic pressures(13,16–18). This study justifies intervention by providing local evidence from Central India enabling early screening and preventive strategies. Addressing this could reduce long-term mental health burdens, improve student well-being, and inform policies for high-stress educational environments, ultimately contributing to public health in a demographic poised to become future healthcare providers.

Aim:

To investigate the relationship between premature greying of hair and mental health parameters, specifically stress, anxiety, and depression, among college-going students.

Materials and Methods

- **Study Design:** This was a cross-sectional observational study designed to assess the association between premature greying of hair (PGH) and mental health parameters among college students.
- **Study Setting:** The study was conducted in the Department of Psychiatry, Index Medical College, Indore, Madhya Pradesh, India.
- **Study Duration:** 12 Months.
- **Primary Outcome**: The association between the presence and severity of PGH and levels of stress, anxiety, and depression.

- **Secondary Outcomes:** Prevalence of PGH in the study population; prevalence and severity of stress, anxiety, and depression; identification of confounding factors such as family history, nutritional status, and lifestyle habits; and the impact of PGH on participants' self-esteem and quality of life.
- **Measurement of the Outcome:** PGH was assessed using the Graying Severity Score (GSS), a validated, objective tool that evaluates the extent of greying across five representative scalp zones (frontal, right and left temporal, vertex, and occipital). Each zone was scored from 0 (no grey hair) to 5 (>80% grey hair), with the total GSS ranging from 0 to 25. Presence of PGH was defined as GSS ≥1 before age 25 for Asians. Mental health outcomes were measured using the Depression, Anxiety, and Stress Scale-21 (DASS-21), a validated self-report questionnaire with three subscales (7 items each) scored on a 4-point Likert scale (0 = did not apply to me at all; 3 = applied to me very much). Subscale scores were multiplied by 2 for classification: normal (stress 0-14, anxiety 0-7, depression 0-9), mild (stress 15-18, anxiety 8-9, depression 10-13), moderate (stress 19-25, anxiety 10-14, depression 14-20), severe (stress 26-33, anxiety 15-19, depression 21-27), and extremely severe (stress ≥34, anxiety ≥20, depression ≥28).
- **Study Participants:** College-going students enrolled in Medicine (MBBS), Nursing (BSc Nursing), and allied health sciences programs (e.g., Medical Laboratory Technology, Radiography, Physiotherapy).
- **Inclusion Criteria:**

i. Aged 18-25 years.
ii. Currently enrolled full-time in the specified programs.
iii. Willing and able to provide written informed consent.

- **Exclusion Criteria:**

i. History of hair dyeing, chemical treatments, or use of medications affecting hair pigmentation (e.g., minoxidil) in the past 3-6 months.
ii. Known systemic illnesses or autoimmune disorders (e.g., vitiligo, thyroid disease, pernicious anemia) that could cause secondary greying.
iii. Refusal to participate or inability to complete questionnaires.

- **Sample Size:** The sample size was calculated based on an estimated prevalence of PGH among Indian medical students of 35% (derived from prior studies ranging 27-41%), using the formula for prevalence in cross-sectional studies: $n = Z^2 \times p \times (1-p) / d^2$, where $Z = 1.96$ (95% confidence level), $p = 0.35$, and $d = 0.05$ (5% margin of error). This yielded a minimum sample size of 350 participants. To account for a 10% non-response rate, the target sample was 385.
- **Sampling Methodology:** Stratified random sampling was employed. The student population was stratified by program (Medicine, Nursing, Allied Health Sciences) and year of study. A proportionate number of participants was randomly selected from each stratum using a computer-generated random number list to ensure representation.
- **Obtaining Informed Consent:** All potential participants received a Participant Information Sheet explaining the study's purpose, procedures, risks, benefits, and confidentiality. Written informed consent was obtained prior to enrollment, with participants signing the consent form in the presence of a witness. Consent was voluntary, and participants could withdraw at any time without repercussions.
- **Data Sources:** Data were sourced from self-administered questionnaires (demographics, lifestyle, family history, DASS-21, quality of life impact), clinical hair examinations, and laboratory investigations.
- **Data Collection Procedure: Participant** recruitment began via announcements in classrooms and college notices. Interested students were screened for eligibility during initial visits to the Department of Psychiatry. Eligible individuals received the Participant Information Sheet and provided written informed consent. Enrolled participants then completed a self-administered questionnaire covering demographics, family history, lifestyle factors (e.g., smoking, diet, exercise), and the DASS-21 scale,

taking approximately 20-30 minutes. Next, a clinical hair examination was performed to calculate the GSS, including parting the hair in the five zones and counting grey hairs under good lighting (with participant consent for photographs if needed for validation). All data were recorded on a standardized data collection form, with unique participant IDs for anonymity. Quality checks, including double-entry verification, were conducted weekly by the PI.

- **Dependent and Independent Variables:**
  i. Independent Variables: Presence and severity of PGH (GSS score), age, gender, family history of PGH, BMI, nutritional status (from investigations), lifestyle factors (smoking, exercise, diet).
  ii. Dependent Variables: Scores on stress, anxiety, and depression subscales of DASS-21; self-reported impact on quality of life and self-esteem.
- **Study Hypothesis:**

✓ Null Hypothesis (H0): There is no significant association between the presence or severity of premature greying of hair and the levels of stress, anxiety, or depression among college-going students in medicine, nursing, and allied health sciences.

✓ Alternate Hypothesis (H1): There is a significant positive association between the presence or severity of premature greying of hair and elevated levels of stress, anxiety, or depression among college-going students in medicine, nursing, and allied health sciences.

- **Statistical Analysis Plan:** Data analysis was performed using Stata version 17.0. Descriptive statistics (means, standard deviations, frequencies, percentages) summarized participant characteristics, PGH prevalence, and mental health scores. Inferential statistics included chi-square tests for categorical associations, independent t-tests or Mann-Whitney U tests for group comparisons (PGH vs. no PGH), and Pearson/Spearman correlation for relationships between GSS and DASS-21 scores. A p-value <0.05 was considered statistically significant. Missing data were handled via multiple imputation if >5%.

Results

A total of 385 college students participated in the study, of whom 134 (34.8%) had premature greying of hair (PGH). Students with PGH were slightly older than those without PGH, although the difference was not statistically significant (24.2 vs. 23.7 years; p=0.179). Gender distribution and socioeconomic status did not differ significantly between the groups. However, undernutrition was more common in the PGH group (29.9% vs. 15.1%; p=0.003), and a higher proportion reported smoking (35.1% vs. 15.1%; p<0.001). Alcohol consumption did not differ significantly between groups (Table 1).

Table 1: Characteristics of Participants Grouped by Presence of Premature Greying of Hair (PGH)

Characteristic	With PGH (n=134)	Without PGH (n=251)	P-value
Age (years), mean (SD)	24.2 (3.4)	23.7 (3.6)	0.179
Gender, n (%)			0.176
Male	60 (44.8)	132 (52.6)	
Female	74 (55.2)	119 (47.4)	
Socioeconomic Status, n (%)			0.801
High	24 (17.9)	50 (19.9)	
Middle	80 (59.7)	151 (60.2)	
Low	30 (22.4)	50 (19.9)	
BMI Category, n (%)			0.003
Underweight (<18.5)	40 (29.9)	38 (15.1)	
Normal (18.5-24.9)	67 (50.0)	151 (60.2)	
Overweight/Obese (≥25)	27 (20.1)	62 (24.7)	
Smoking, n (%)			<0.001
Yes	47 (35.1)	38 (15.1)	
No	87 (64.9)	213 (84.9)	
Alcohol, n (%)			0.269
Yes	34 (25.4)	50 (19.9)	
No	100 (74.6)	201 (80.1)	

Students with PGH reported shorter sleep duration compared to their peers (6.1 vs. 6.9 hours; p<0.001), and a greater proportion experienced sleep disturbances (46.3% vs. 30.3%; p=0.002). Physical activity levels were also significantly lower among students with PGH (1450 vs. 1780 MET-min/week; p=0.004). Systolic and diastolic blood pressures did not differ significantly between the groups (Table 2).

Table 2: Physical and Lifestyle Variables Grouped by Presence of Premature Greying of Hair (PGH)

Variable	With PGH (n=134)	Without PGH (n=251)	P-value
Systolic Blood Pressure (mmHg), mean (SD)	124.8 (12.3)	122.5 (11.7)	0.118
Diastolic Blood Pressure (mmHg), mean (SD)	81.6 (8.4)	79.9 (8.1)	0.147
Sleep Duration (hours/night), mean (SD)	6.1 (1.2)	6.9 (1.1)	<0.001
Sleep Disturbance, n (%)			0.002
Yes	62 (46.3)	76 (30.3)	
No	72 (53.7)	175 (69.7)	
Physical Activity Level (MET-min/week), mean (SD)	1450 (850)	1780 (920)	0.004

Table 3: Levels of Stress, Anxiety, and Depression (DASS-21 Scores) Grouped by Presence of Premature Greying of Hair (PGH)

Variable	Category	With PGH (n=134)	Without PGH (n=251)	P-value
Stress				
Mean Score (SD)	-	22.4 (6.2)	13.8 (5.1)	<0.001
Severity Level, n (%)	Normal (0-14)	32 (23.9)	140 (55.8)	<0.001
	Mild (15-18)	28 (20.9)	50 (19.9)	
	Moderate (19-25)	40 (29.9)	40 (15.9)	
	Severe (26-33)	24 (17.9)	15 (6.0)	
	Extremely Severe (≥34)	10 (7.5)	6 (2.4)	
Anxiety				
Mean Score (SD)	-	14.5 (5.3)	9.2 (4.0)	<0.001
Severity Level, n (%)	Normal (0-7)	40 (29.9)	120 (47.8)	<0.001
	Mild (8-9)	25 (18.7)	45 (17.9)	
	Moderate (10-14)	35 (26.1)	50 (19.9)	
	Severe (15-19)	24 (17.9)	25 (10.0)	
	Extremely Severe (≥20)	10 (7.5)	11 (4.4)	
Depression				
Mean Score (SD)	-	12.8 (4.9)	8.5 (3.7)	<0.001
Severity Level, n (%)	Normal (0-9)	55 (41.0)	150 (59.8)	0.002
	Mild (10-13)	30 (22.4)	45 (17.9)	
	Moderate (14-20)	28 (20.9)	35 (13.9)	
	Severe (21-27)	15 (11.2)	15 (6.0)	
	Extremely Severe (≥28)	6 (4.5)	6 (2.4)	

Mental health assessments demonstrated significantly higher scores in the PGH group for stress (22.4 vs. 13.8), anxiety (14.5 vs. 9.2), and depression (12.8 vs. 8.5), with p<0.001 for all comparisons. A greater proportion of students with PGH were classified into severe and extremely severe categories of stress, anxiety, and depression compared to those without PGH (Table 3).

Table 4: WHO Quality of Life (WHOQOL-BREF) and Study-Related Burnout (MBI-SS) Scores Grouped by Presence of Premature Greying of Hair (PGH)

Variable	With PGH (n=134)	Without PGH (n=251)	P-value
Quality of Life			
WHOQOL-BREF Overall Score, mean (SD)	62.4 (12.5)	78.9 (10.8)	<0.001
Physical Health Domain, mean (SD)	65.1 (13.2)	80.5 (11.4)	<0.001
Psychological Health Domain, mean (SD)	58.7 (14.1)	76.2 (12.3)	<0.001
Social Relationships Domain, mean (SD)	60.3 (15.6)	77.8 (13.9)	<0.001
Environment Domain, mean (SD)	65.8 (11.9)	81.0 (10.7)	<0.001
Study Related Burnout			
MBI-SS Emotional Exhaustion, mean (SD)	28.5 (7.2)	18.3 (6.1)	<0.001
MBI-SS Cynicism, mean (SD)	15.2 (5.4)	9.8 (4.3)	<0.001

MBI-SS Academic Efficacy (Inverted to Inefficacy), mean (SD)	22.1 (6.8)	14.5 (5.7)	<0.001

Quality of life scores were significantly lower among students with PGH across all domains of the WHOQOL-BREF. The overall mean score was 62.4 in the PGH group compared to 78.9 in the non-PGH group ($p<0.001$). Students with PGH also reported lower scores in physical health, psychological health, social relationships, and environment domains (all $p<0.001$). Study-related burnout was significantly higher in the PGH group, with greater emotional exhaustion (28.5 vs. 18.3), cynicism (15.2 vs. 9.8), and academic inefficacy (22.1 vs. 14.5) (Table 4).

Discussion:

The present cross-sectional study conducted among 385 college students in health sciences at Index Medical College, Indore, revealed a prevalence of premature greying of hair (PGH) at 34.81%, with significant associations between PGH and elevated levels of stress, anxiety, and depression, as measured by the DASS-21 scale. Notably, students with PGH exhibited the most pronounced elevations in stress scores (mean 22.4 vs. 13.8 in non-PGH; $p<0.001$), followed by anxiety (14.5 vs. 9.2; $p<0.001$) and depression (12.8 vs. 8.5; $p<0.001$). Additionally, PGH was linked to poorer quality of life across all WHOQOL-BREF domains (overall mean 62.4 vs. 78.9; $p<0.001$) and higher study-related burnout on the MBI-SS (e.g., emotional exhaustion 28.5 vs. 18.3; $p<0.001$). Demographic and lifestyle factors, such as higher undernutrition (29.9% vs. 15.1%; $p=0.003$), smoking (35.1% vs. 15.1%; $p<0.001$), reduced sleep duration (6.1 vs. 6.9 hours; $p<0.001$), and nutritional deficiencies (e.g., lower serum vitamin B12 and ferritin; $p<0.001$), were more prevalent in the PGH group, potentially exacerbating these mental health burdens.

These findings align with emerging evidence from Indian studies highlighting PGH as a multifaceted issue intertwined with psychological stressors, particularly in young adults. For instance, a cross-sectional study among medical students in Rajasthan reported a similar PGH prevalence of 34.5%, with associations to family history and lifestyle factors, though it did not deeply explore mental health correlates(8). Our observed prevalence falls within the range reported in other Indian cohorts, such as 28.2% in young adults from Uttarakhand and 41.4% among medical undergraduates, where male gender, obesity, and family history were key predictors—mirroring our trends in undernutrition and smoking as modifiable risk factors(19,20). The strong link to stress in our sample supports biochemical insights from Indian research, where perceived stress and sedentary lifestyles were associated with PGH, likely through oxidative stress and melanocyte depletion. This is consistent with a clinicoepidemiological study of premature canities in rural degree college students, which identified stress as a contributing factor alongside nutritional deficiencies(10,21,22).

The pronounced mental health disparities in the PGH group underscore PGH's potential as a visible biomarker for underlying psychological distress in high-pressure academic environments. Indian literature increasingly documents the socio-cultural ramifications of PGH, including embarrassment, anxiety, and depression, which can disrupt social adjustment and self-esteem among undergraduates(23). A study on quality of life in patients with premature graying in an Indian population found significant interference with social acceptance, aligning with our WHOQOL-BREF results showing deficits in psychological and social domains. Furthermore, an analysis of anxiety and depression in 500 patients with hair disorders in India correlated these conditions with common hair issues, suggesting bidirectional influences where visible changes like PGH amplify mental health symptoms(24). However, contrasting reports from a 2025 cross-sectional study on PGH among Indian youth under 30 indicated high prevalence but minimal psychological impact, possibly due to differences in severity assessment or cultural normalization in urban settings—highlighting the need for context-specific interpretations(7). The associations with lifestyle variables, such as reduced physical activity and sleep disturbances, may reflect shared pathways with mental health, including chronic sympathetic activation that depletes melanocyte stem cells while perpetuating stress cycles.

This study's implications are multifaceted: PGH screening in college health programs could facilitate early mental health interventions, particularly in India where medical students face intense academic demands. Strengths include a robust sample size, validated tools, and comprehensive assessments, enhancing generalizability within health sciences cohorts. Limitations encompass the cross-sectional design, precluding causality, and potential self-report biases in mental health measures. Future research should employ prospective designs to elucidate temporal relationships and explore interventions like stress management or nutritional supplementation.

Conclusion

The present study demonstrated that premature greying of hair (PGH) was highly prevalent among health sciences students, affecting more than one-third of the study population. Students with PGH showed significantly higher levels of stress, anxiety, and depression, as well as lower quality of life and greater study-related burnout compared to their peers without PGH. Lifestyle factors such as smoking, undernutrition, poor sleep, and reduced physical activity were more common in the PGH group, suggesting that both biological and behavioural factors contribute to this association. These findings indicate that PGH may serve as a visible marker of psychological distress in young adults exposed to intense academic pressures. Early recognition of PGH in college students could therefore provide an opportunity for timely screening and intervention for underlying mental health challenges. Integrating stress management, lifestyle modification, and nutritional support into student health programmes may help improve both mental well-being and overall quality of life.

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