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Original Article

Dermatology Section

Prevalence, Pattern and Risk Factors of Premature Hair Greying among University Students in Northern India: A Cross-sectional Study

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ABSTRACT

Introduction: Premature hair greying (PHG) is of the significant concern in adolescents which has a direct pessimistic impact on one's social wellbeing. Existing studies have focussed on epidemiology of PHG on basis of patients visiting dermatological clinics with small sample size, thus not reflecting prevalence. Therefore, an effort was made to check prevalence of PHG among the University students.

Aim: To assess the prevalence of PHG among university students, and explore its association with factors such as smoking, alcohol consumption, dietary intake, and family history.

Materials and Methods: A cross-sectional study was performed using structured questionnaire at Chitkara University, Rajpura, Punjab, India. The sample size came out to be 315; however, based on exclusion and inclusion criteria, the final sample size was 308. The structured questionnaire designed by the researcher aimed to assess the prevalence, cut-off age of PHG and risk factors associated with PHG among the Chitkara University students, Punjab belonging to different parts of Northern India. The risk factors included role of genetics, smoking, alcohol intake and dietary preferences impacting PHG. The continuous variables presented as mean ± standard deviation. The bivariate analysis was done using Fischer's exact test and Chi-square test. The significance value was set at 0.05.

Results: The prevalence of PHG was found to be 31.8%, among which 65 (66.3%) were females and 33 (33.7%) were males. Geographical distribution showed Punjab constituting the highest with 36 (36.7%) followed by Himachal Pradesh 24 (24.5%), Chandigarh 13 (13.3%), Jammu and Kashmir 11 (11.2%), Haryana 10 (10.2%) and other North Indian states 4 (4.1%). The mean age of the participants were 19.37±1.9 years. In females, the parietal area was the most affected by PHG while in males, it was more common in the frontal area of the scalp. There was an association between the family history and PHG (p-value < 0.0001); however, no association was seen concerning smoking, alcohol consumption and dietary patterns.

Conclusion: The prevalence of PHG in youngsters is escalating having an onset age as low as 10 years and variation in the hair greying pattern on the scalp Of all the factor tested, family history was found to be the significant risk factors associated with PHG. Thus, further studies at larger population are needed to reach to conclusive evidence.

Keywords: Dietary pattern, Family history, Greying of hair, Genetics, Risk factors

INTRODUCTION

In a competitive world, a person's visual or physical appearance is important in self-esteem, social interaction, cultural impact and quality of life (QoL). Hair is one of the essential attributes of 'one's physical appearance and personality regardless of any ethnic group [1]. The significant role of hair colour in the self-esteem of an individual and sociocultural synergy becomes more germane for adolescents and young adults. Hair greying is a natural biological phenomenon which occurs with growing age. In contrast, the greying occurring before the "usual" age of onset, i.e. 20 years of age in Caucasians, 25 years in Asians, and 30 years in Africans, is termed PHG [2]. The condition of PHG is frequently linked with ae and impaired health, resulting in the community's judgmental responses, which can impact an individual's self-esteem, especially in a country like India, where most of the population belongs to youth [3]. Globally, the prevalence of PHG ranges from 7.5-50.9% [4-6]. In India, the prevalence of PHG ranges from 2.5 to 33% across studies conducted in various states [7-11]. However, most of these prevalence studies have included samples from clinics and hospital setups but not from general population. Similarly, the studies from Korea and Tanzania have shown that the pattern of grey hair distribution on the scalp varies between males and females, whose hair is more evenly spread across the scalp [4,12]. A study from Northern India found no significant differences between genders regarding scalp distribution and anatomical patterns of occurrence of PHG in young adults [8]. Thus, the PHG development pattern among youth needs to be investigated for a clearer picture.

Researchers have listed a few risk factors viz genetics, smoking, alcohol consumption and diet preferences contributing to PHG; however, the critical reason for PHG or canities is still unclear. [7-9,13]. Studies in India and Korea showed a positive correlation between PHG and family history [5,14]. Literature supports both negative and nil effects of smoking and alcohol on PHG [15]. Researchers proposed that directly or indirectly, the factors mentioned above may be contributing to PHG by the production of reactive oxygen species in hair follicles. Thus, consuming antioxidant-rich elements plays a crucial role in combating the same. The intake of these nutritional elements depends on the diet type consumed [5]. National and international-level observations have shown that PHG participants preferred a vegetarian diet. However, some studies have found no significant differences in dietary habits between the PHG and non PHG cohorts [7,11,16].

Looking at the gaps in the existing literature review viz. less known prevalence on PHG, especially in Northern region of India; existing studies cannot be generalised as the population tested was mostly

restricted to hospital setups, as well as very few have focussed on identifying the risk factors, the present study was designed. The aim of the study was to assess the prevalence of PHG among university students belonging to different parts of Northern India, and explore its association with factors such as smoking, alcohol consumption, dietary intake, and family history.

MATERIALS AND METHODS

A cross-sectional study was conducted in the month of May, 2022 (1st to 20th May) among undergraduate students enrolled at Chitkara University, Punjab, India. The ethical permission was obtained from the ethical committee, Chitkara University, Punjab (letter no. IHEC/DHR/CU/PB/21/58). Informed consent was taken from each participant before administering the questionnaire.

Sample size: Keeping the power of study at 80% and the confidence interval at 95%, the sample size was calculated using the formula, $n=4pq/L^2$ where 'n' is the sample size, 'p' is the estimated prevalence based on a previous study done by Nath et al., [16], wherein p was 27%, q = 100-p = 73 and L is the least permissible error = 5%

Based on the formula, the sample required for the study was 315. A sample of 315 was selected by using a stratified random sampling technique for equal representation. The students from different programs were selected using lottery method. However, as seven participants did not fill the complete data, the final number of respondents amounted to 308.

Inclusion criteria: The undergraduate students aged between 17 and 30 years from different states of Northern India and willing to participate, were included in the study.

Exclusion criteria: Already diagnosed with a disease leading to greying of hairs such as hypothyroidism, albinism, vitiligo, skin disorders, or any other major illness, or any infection in the scalp were excluded from the study.

Questionnaire development and administration: In this study, the researcher developed a structured questionnaire to determine the prevalence and risk factors associated with PHG. The questionnaire collected data regarding the socio-demographic attributes of the respondents, i.e., gender, age, nationality, state, total yearly household income, any scalp infection past three years, lifestyle behaviours (smoking and consumption of alcohol), diet pattern (vegetarian, non vegetarian and eggetarian) and association of family history with PHG. The questionnaire design process included soliciting expert input across diverse fields to establish face validity. The insights gained from these experts were instrumental in refining the questionnaire's content. Subsequently, the researcher conducted a pilot study to validate its suitability and comprehensibility among students. The pilot study was conducted on a cohort of 30 students to assess the practicability and initial outcomes of the study. The questionnaire's reliability was assessed using Cronbach's alpha, indicating its internal consistency. The Cronbach's alpha was more than 0.7. Based on the pilot study results, the questionnaire was refined further, considering the item analysis and participant feedback. The finalised questionnaire included demographic details, questions to determine the prevalence of PHG and the impact of diet items using different scales to measure the constructs.

Section I of the questionnaire collected the data regarding the socio-demographic attributes of the respondents. It contained 10 questions ie., gender, age, nationality, state, weight, total yearly household income, any kind of medication since last three months, any scalp infection past three years, smoking and consumption of alcohol. This section also included question on assessment of scalp with the severity of PHG. The prevalence was obtained based on the presence or absence of grey hairs. The student having even one grey hair was included in the PHG group while the ones having no grey hairs were considered as non PHG group [7]. The entire scalp surface was divided in 5 zones, that is, frontal region, vertex, right and left temporal regions, and the occipital. Section II of the questionnaire focused on the impact of diet on PHG. Section III of the questionnaire focused on the impact of smoking and alcohol consumption on PHG.

Selection of students and conduct: The first step was to obtain the students list from the respective Bachelor program in charges and the students not belonging to Northern Indian states were excluded from the list. In the next step, lottery method was used to reach to the required sample size. After obtaining the consent, the questionnaires were distributed. The final questionnaire was distributed in offline mode after obtaining consent from the participants. In total, 30 minutes were given to fill the questionnaire.

STATISTICAL ANALYSIS

The responses were entered into Microsoft Excel. The data was selectively coded.The data was then imported to IBM Statistical Package for the Social Sciences (SPSS) version 26.0 for further analysis. The sample characteristics of the total sample were analysed. The data from continuous variables were presented as mean ± standard deviation, while categorical variables were presented as percentages. The bivariate analysis used was Fischer's exact test and the Chi-square test. Independent samples t-test was used to determine whether there was any significant difference in means of age and weight between PHG and non PHG respondents. The significance value was set at 0.05.

RESULTS

Age, gender and prevalence: The prevalence of PHG was found to be 31.8% in the study. The mean age for the PHG group was 19.89±2.69 years with the onset of hair greying <10 years of age in 8.2%, 10-15 years in 17.3% and 16-20 years in age in 68.4%, respectively. It was also observed that the prevalence of PHG was higher in females 65 (66.3%) as compared to males 33 (33.7%) [Table/Fig-1].

Geographical distribution and socio-economic status: The geographical distribution of the PHG group showed maximum participants were from Punjab 36 (36.7%) followed by Himachal Pradesh 24 (24.5%), Chandigarh 13 (13.3%) respectively. Family income showed that, 59 (60.2%) of PHG participants' annual family income was under 1-5 lakhs/annum group [Table/Fig-1].

Smoking and alcohol consumption: The percentage of smoking and alcohol consumption by the respondents in PHG was 10.2% and 21.4%, whereas in respondents without PHG was 7.1% and 13.8%, respectively.

Dietary preference: It was noted that 43.8% consumed a non vegetarian diet in the non PHG group, which was similar to the PHG group, which showed 49% consuming a non vegetarian diet.

Hair greying pattern: The effect of PHG in both males and females was divided into four representative scalp zones: parietal, frontal, temporal and occipital [Table/Fig-2]. The topological variation in PHG was observed in both males and females. In females, the parietal area (40.6%) was the most affected with PHG; in males, the frontal area (43.8%) of the scalp was more affected.

Association of Different Parameters to PHG and non PHG

Onset age and gender: Maximum hair greying was observed in the age range between 16-20 years in both the groups, (p-value = 0.108), whereas 21.5% of females showed early onset of hair greying in the age group of 10-15 years in contrast to males having 9.1% cases [Table/Fig-3].

Family history and PHG: The association between family history and PHG showed a strong positive relationship (p-value < 0.001) [Table/Fig-4].

Dietary preference: The comparison of a daily dietary pattern, i.e. vegetarian, non vegetarian and eggetarian, between the two groups did not show any significant difference [Table/Fig-5].

Smoking and alcohol consumption: The data analysis did not reveal any meaningful variation in smoking habits and alcohol consumption between PHG and non-PHG groups. In other words, these findings underscore that the presence or absence of PHG was not significantly influenced by smoking or alcohol use within the studied population [Table/Fig-5].

Demographic Characteristics	PHG, n (%)	Non PHG, n (%)
No of subjects	98 (31.8)	210 (68.2)
Age mean ± SD	19.89± 2.690	19.12 ± 1.515
Gender		
Male	33 (33.7)	65 (31)
Female	65 (66.3)	145 (69)
Annual Household Income		
1-5 lakhs/annum	59 (60.2)	117 (55.7)
5-10 lakhs/annum	29 (29.6)	64 (30.5)
More than 10 lakhs/annum	10 (10.2)	29 (13.8)
States		
Chandigarh	13 (13.3)	22 (10.5)
Haryana	10 (10.2)	35 (16.7%)
Himachal Pradesh	24 (24.5)	46 (21.9)
Jammu and Kashmir	11 (11.2)	21 (10)
Punjab	36 (36.7)	80 (38.1)
Others	4 (4.1)	6 (2.9)
Smoking	10 (10.2)	15 (7.1)
Alcohol	21 (21.4)	29 (13.8)
Diet preference		
Vegetarian	39 (39.8)	97 (46.2)
Non vegetarian	48 (49)	92 (43.8)
Eggetarian	11 (11.2)	21 (10)

[Table/Fig-1]: Demographics characteristics of participants with and without PHG.

	Gender				Total	
	Male		Female			
Zones of Scalp	N	%	N	%	N	%
Parietal	8	25.0%	26	40.6%	34	35.4%
Frontal	14	43.8%	18	28.1%	32	33.3%
Temporal	1	3.1%	7	10.9%	8	8.3%
Occipital	2	6.3%	4	6.3%	6	6.3%
Parietal and frontal	2	6.3%	3	4.7%	5	5.2%
Parietal, frontal and temporal	1	3.1%	0	0.0%	1	1.0%
Parietal, frontal, temporal and occipital	2	6.3%	2	3.1%	4	4.2%
Parietal, frontal and occipital	0	0.0%	1	1.6%	1	1.0%
Parietal and temporal	2	6.3%	2	3.1%	4	4.2%
Frontal and temporal	0	0.0%	1	1.6%	1	1.0%
Total	32	100.0%	64	100.0%	96	100.0%

[Table/Fig-2]: Distribution of grey hairs based on zones of scalp in PHG group based on gender [n=96; due to missing data in 2].

Variable	Male (%)	Female (%)	Total n= 98 (%)	p-value
Age of onset of greying in years				
Less than 10 years	3 (9.1)	5 (7.7)	8 (8.2)	0.108
10-15 years	3 (9.1)	14 (21.5)	17 (17.3)	
16-20 years	23 (69.7)	44 (67.7)	67 (68.4)	
21-25 years	4 (12.1)	1 (1.5)	5 (5.1)	
More than 25 years	0%	1 (1.5)	1 (1.0)	

[Table/Fig-3]: Onset of greying age wrt gender distribution in PHG participants.

Variable	n (%)	p-value
Family History of PHG Participants		
No	35 (35.7)	<0.001
Yes	63 (64.3)	
Total	98 (100)	
Family History of Non-PHG Participants		
No	153 (72.9)	-
Yes	57 (27.1)	
Total	210 (100)	

[Table/Fig-4]: Prevalence of family history and occurrence of PHG in participants with and without PHG.

Variable	PHG (%)	Non-PHG (%)	P value
Dietary habit			
Vegetarian	39 (39.8)	97 (46.2)	0.575
Non vegetarian	48 (49)	92 (43.8)	
Eggetarian	11 (11.2)	21 (10)	
Smoking	10 (10.2)	15 (7.1)	0.360
Alcohol	21 (21.4)	29 (13.8)	0.091

[Table/Fig-5]: Association of dietary habits, smoking and alcohol consumption in PHG and non PHG participants.

DISCUSSION

The PHG plays a foremost role in socio-economic and psychosocial issues, as it is considered a sign of old age and poor health and is often linked with low self-esteem. Many studies have mentioned the increasing prevalence of PHG globally [17-21]. Researchers have made several efforts to understand the vital fundamentals behind the enigma of PHG. However, there is a lack of data from the northern region of India, with very few studies from Delhi, Bathinda, Uttrakhand and Jammu & Kashmir [8-10,12,14,16]. Most of these studies have taken the patients' data visiting hospitals and are thus limited to a specified population. Further, there are discrepancies in the literature suggesting the role of genes, diet, UV, environmental and chemical factors on PHG. Thus, the present study was designed to determine the prevalence and risk factors associated with PHG in the North Indian population.

For this, the representative population from a university in North India was selected, and the prevalence of PHG was found to be 31.8%. The observation was comparable to a study in South India that reported a prevalence of PHG of 28.2% [22]. In contrast, data from other states of North India Delhi (2%) and Uttarakhand (27.3%) had lower prevalence compared to the present study [7,16]. The variation in prevalence of PHG among different states of North India might be due to the discrepancy of the population type which was mostly restricted to the hospital setup and clinics in the latter studies.

The prevalence of PHG was higher in females (66.3%) than males (33.7%). A similar trend was observed in a cross-sectional study done in Chennai, India wherein the prevalence of PHG was higher in females (54%) than males (46%) [7]. On the other hand, the study done in Mysuru, India showed the opposite trend, having more cases of males than females [10]. A similar pattern was observed by Acer et al., and Jo SJ et al., conducted in Turkey and Korea, respectively [23,24]. This observation indicates the discrepancies in the existing literature, highlighting the need to conduct additional studies with larger populations to find the association between gender and PHG.

Several survey-based studies have been done on PHG to investigate the cut-off age, area-wise assessment of the scalp, and measurement of the amount of greying; however, there still exists a lack of standard measure for PHG worldwide. One of the studies that defined the cut-off age for the Indian population included 35 students younger than 20 years suffering from PHG

[7]. Another study in North India found the mean age of cases to be below 15 years [8]. In the present investigation, the mean age of the study group was 19.89±2.690, while it was noted that the beginning age of PHG was even less than ten years in eight of the cases, followed by 17 respondents in the age group of 10-15 years and 67 respondents 16-20 years. The topological variation in the allocation of PHG was also observed in both males and females. In females, the parietal area (40.6%) was the most affected by PHG; in males, it was more common in the frontal area (43.8%) of the scalp. These results were in contrast to a study by Panhard et al., that showed a higher prevalence of greying in females in the temporal and vertex region, whereas males showed in the temporal region [6]. Though the real cause behind the difference in the pattern of PHG among males and females is yet to be fully understood, indications suggest that genetic factors are significant in scalp greying patterns, as discussed by Pandhid and Khannad [1].

As indicated by several studies, the association of family history with PHG seems to play an imperative role [5,8,24]. Similarly, a strong association of family history with PHG ($p<0.000$) was observed in the present study. Among the participants belonging to the PHG group, 64.3% the parents had a history of PHG. The study's results showed that around 27.1 of participants in the non PHG group also had a family history of PHG. The results obtained in this study are in agreement with research done by Shin H et al., Daulatabad D et al., and Kansal S A et al., [5,8,25] linking the profound relationship between family history and PHG signifying firm role of genetics" as one the intrinsic risk factor leading to PHG [26].

In addition to intrinsic, some extrinsic factor/s might affect the prevalence of PHG. One such mechanism attributed to PHG includes an accumulation of oxidative stress (formation of reactive oxygen species) in melanocyte stem cells in the hair bulb [27,28]. The association of these extrinsic risk factors have been reported with dietary pattern and consumption of alcohol and smoking. A study by Zayed AA et al., in Jordan showed a significant correlation between smoking and PHG participants [4]. Similarly, a link between alcohol consumption and PHG was shown in a study by Acer E et al., in Turkey [23]. The present study found that 21.4% of PHG participants had alcohol, and around 10.2% had smoked at some point. As the response to alcohol consumption and smoking was relatively low, it may be attributed to the inhibition issues, fear of the information if shared with parents as well as the strict guidelines issued by the government of India [28]. Thus, the authors could not draw any significant difference between PHG and non PHG groups. A similar observation was seen in a South Indian study done by Kansal S et al., wherein no correlation between PHG and alcohol consumption was likely due to the majority of the respondents being below the legal drinking age of 21 years in the region.

When the association between dietary pattern and PHG was evaluated, no association was observed in the present study. It was seen that there was no significant difference in the eating pattern as 49% were following a non vegetarian diet, followed by 39.85% with vegetarian and 11.2 % eggetarian in the PHG group respectively, which relates to Belli et al., study which found no link between dietary pattern and PHG [29]. On the contrary, research conducted by Daulatabad D et al., in North India found that participants of the non PHG group had more intake of non vegetarian diet [8]. The existing discrepancies highlight the need for more studies to determine the relationship between dietary pattern and PHG, if any.

Strength of the study was the large sample size which improved the study's statistical power. The study's thorough data collection enhanced its analytical potential. Secondly, the findings did not apply to specialised or general hospital configurations or clinics; rather it is a prevalence in general population.

Limitation(s)

The limitation of the research was that only a few parameters were compared between PHG and non PHG groups with lack of details on exact frequency of consumption. Further, research can be undertaken comparing the population from different parts of India at a larger level. Also, the data taken regarding premature hair greying was self-reported. For smoking and alcohols consumption, the question was asked using binary rather than frequency.

CONCLUSION(S)

This study delved into the prevalence of PHG among young individuals in Northern India while also investigating the associated risk factors. The findings highlight a significant association between a family history of PHG. Notably, a diffuse pattern of hair greying was observed, with variations in localisation based on gender. To comprehensively capture the trends within the broader population, it is recommended that future epidemiological investigations be carried out both at the regional and national levels, ensuring an accurate representation of the general population.

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