Synergistic effect of family history and substance abuse on premature graying of hair: a population based study among the adult Bengalee Hindu of North 24 Parganas, W.B., India

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ABSTRACT:

Background: Premature graying of hair (PGH) is sign of rapid progression of old age, health issues and often leads to loss of self-esteem. Countless mechanisms and factors are responsible for this phenomenon including genetic, psycho-social stress, autoimmune disorders, vitamin deficiencies and substance abuse. ***Objectives:*** The present study was therefore undertaken to study the synergistic effect of substance abuse and family history on PGH. ***Materials and Methods:*** The data consisted of 116 cases (PGH+) of males and 134 controlled (PGH-) males and 119 cases of females with 131 controlled females (total 250) with age range between 20 and 30 years with a mean age of 25.6 years among the Bengalee Hindus of the urban areas of Northern fringe of Kolkata, India. Subjects were graded as 1-5 scale for the cases depending on the presence of premature gray hair. Subjects with smoking history of more than 3 pack-years as smokers and alcohol intake more than three times a week as drinkers were selected (Jo SJ et al, 2012).***Results*:** Among both males and females it was indicating that individuals with both family history and adverse lifestyle had significantly higher ($\chi^2 = 46.19$, $p < 0.00001$ among males and $\chi^2 = 38.75$, $p < 0.0001$ among females) PGH than individuals who had either of it or neither of it. ***Conclusion*:** PGH is a multifactorial trait where several genetic and environmental vis-à-vis lifestyle factors are associated to the ultimate phenotype of the individual, irrespective of sex.

Keywords: Substance abuse, family history of premature graying of hair. Bengalee.

INTRODUCTION

Premature graying of hair (PGH) has no clear etiology (Naieni, 2012) and it is considered as a sign of rapid progression of old age, health issues and often leads to loss of self-esteem (Pandhi and Khanna, 2013). PGH has a common dermatological entity (Naieni, 2012) and also has major psychosocial and socioeconomic impact (Pandhi and Khanna, 2013). PGH is defined as if all or most of one individual's hair is becoming gray before the age of 40 (Morton, 2007, Rosen, 1994). Trueb (2006) adopted the threshold of PGH to be at the age of 20 in Caucasian, and among Africans at the age of 30, but he did not specify the percentage of gray hair. Cichorek (2013) proposed that after the age of 30, for every decade in pigment-producing epidermal melanocytes there is a decrease of 10-20% and this decrease in pigment production is one of the proposed mechanisms of hair graying. Though the exact etiopathogenesis of PGH is not clear (Kocaman et al, 2012), different scholars tried to understand the underneath reason of such incidence. According to Acer et al. (2020) the oxidative (Seiberg, 2013, Belli et al, 2016) and emotional stress (Belli et al, 2016) play an important role in pathogenesis of PGH. It can also occur as an autosomal dominant primary disease (Kumar et al, 2018). Premature aging disorders such as Progeria and Pangeria also cause PGH. Another condition that is associated with PGH is Vitiligo. Moreover, it is also associated with various systemic diseases (Kocamon et al (2012), Agarwal et al. (2020), autoimmune diseases and atopic diathesis (Daulatabad et al., 2016). PGH is subjected to be associated with so many other factors like low serum ferritin, Vitamin B12, and HDL-C levels (Chakrabarty et al., 2016) and also with low serum copper concentration (Naieni et al, 2012).

Countless mechanisms including the loss of melanocyte stem cells, melanocyte migration defects, melanocyte apoptosis, anagen defects and pigmentary machinery malfunction or loss were suggested for graying of hair (Seiberg, 2013). However, the process of depigmentation of the hair shaft begins much earlier in some of the individuals than the average individuals (Black, 2015) and an unknown percentage of individuals experience premature graying from familial inheritance or pathologic conditions. (McDonough and Schwartz, 2012). Apart from these, stress, substance abuse, nutritional deficiencies, genetics, and a variety of syndromes are associated with PGH.

The present study was an attempt to understand the synergistic effect of substance abuse and family history with PGH among Bengali community in Kolkata, West Bengal, India.

MATERIALS AND METHOD

The present study is a cross sectional case control study having information of family history with PGH consisted data of 116 cases of males and 134 controlled males (total 250 males) and 119 cases of females with 131 controlled females (total 250 females) with age range between 20 and 30 years (mean age 25.6) from the Bengalee community of Kolkata, West Bengal, India. Data regarding the demographic information, substance abuse, and lifestyle factors were collected along with family history. The study was approved by the Institutional Ethics Committee of West Bengal State University and written consent was obtained from every study participants. The gray hair samples from the cases were collected mainly from the temporal and occipital areas in case of males and from frontal areas in case of females (Jo SJ et al, 2012). Subjects were graded as 1-5 scale for the cases depending on the presence of gray hair, Grade 1 (less than 20% of total hair), grade 2 (20~40%), grade 3 (40~60%), grade 4 (60~80%), and grade 5 (more than 80%) (Jo SJ et al, 2012). Apart from this, the data regarding Demographic profile, family history, substance abuse such as smoking and drinking behaviors were also recorded. Subjects with a smoking history of more than 3 pack-years were considered as smokers and regarding alcohol abuse, those who drank alcohol more than three times a week were regarded as drinkers (Jo SJ et al, 2012).

The Chi-square test for nominal variables was used to identify significant differences between individuals with and without PGH by family history and substance abuse. Odds Ratio with 95% confident interval was calculated to find out the risk of odds of premature graying against family history and substance abuse. All statistical analyses were performed using SPSS (IBM version 25) and level of significance was set at $p<0.05$ (two-tailed).

RESULTS

Associations between individuals with and without PGH by family history and substance abuse are shown in Table 1a and 1b respectively for males and females. Among the males the differences between individuals with and without PGH by family history and substance abuse showed significant difference ($\chi^2 = 46.19$, $p < 0.00001$) which showed that individuals with both family history and adverse lifestyle had significantly higher PGH than individuals who had either of it or neither of it. Similarly among females the differences between individuals with and without PGH by family history and substance abuse showed significant difference ($\chi^2 = 38.75$, $p < 0.0001$) indicating that individuals with both family history and adverse lifestyle had significantly higher PGH than individuals who had either of it or neither of it.

Table 1a: Association of Family History and Substance Abuse on PHG among males

Males	PGH+	PGH-	Total	Chi-square test
Both	89	30	119	
Either	18	52	70	75.17
Neither	09	52	61	p<0.00001
Total	116	134	250	

Table 1b: Association of Family History and Substance Abuse on PHG among females

Females	PGH+	PGH-	Total	Chi-square test
Both	56	17	73	
Either	50	74	124	38.75
Neither	13	40	53	p<0.0001
Total	119	131	250	

PHG+ : with family history; PHG- : without family history

DISCUSSION

The present study was an attempt to understand the synergistic effect of substance abuse and family history on PGH and interestingly it shows that substance abuse like smoking and alcohol intake are important etiological agents in early-onset achromotrichia or PGH and there is also a strong association of PGH with family history of PGH regardless of sex. The prooxidant effect of smoking on the body increases the reactive oxygen species (ROS) damage to hair follicle melanocytes (Mosley and Gibbs, 1996, Trüeb, 2003, Jo et al., 2012, Zayed et al, 2013) which leads to PGH. Alcohol abuse is also a known contributor to oxidative stress and thus significantly associated with the occurrence of PGH (Belli et at., 2016).

Smoking and alcohol drinking are known as contributors to Oxidative Stress, hence; they are playing an important role in the aetiopathogenesis of PGH among the individuals who are addicted to these substance abuse. This study showed that the individuals who are more addicted to higher smoking and alcohol drinking amount and frequency are at higher risk to have PGH. This resembles with the results obtained in the studies conducted by Shin et al. (2015), Zayed et al. (2013), TS et al (2016), and Belli et al. (2016). Regarding alcohol drinking, the result of this study is contradictory to that obtained in the study conducted by Kansal et al (2021) which showed that there is no significant difference between individuals with PGH and without PGH as the subjects of the studied population were below the age of 21 years. Comparative studies between the smokers and the controls revealed that the smokers show earlier onset of hair graying and higher prevalence of hair graying [Sharma and Dogra (2018), Aggarwal et al. (2015), Sabharwal et al. (2014), Zayed et al. (2013)]. Continued smoking history increases the risk of hair graying each year among individuals who are smokers (Jo et al., 2012), but this correlation was not found to be true among smokers below age of 21-year old, mainly because of pressure of study and shorter duration of smoking [Belli et al. (2019), Acer et al. (2019), Gould et al. (1978)].

Like the environmental factors there are genetic influences on PGH and the present study showed a strong association of PGH with family history of PGH which resembles with the other studies conducted by Kansal et al. (2021), TS et al. (2016), Belli et al. (2016), Daulatabad et al. (2016) , and Shin et al. (2015). Thereby, it indicates a strong genetic component involved in the aetiopathogenesis of PGH. Considering PHG as a multifactorial incident, the present study reveals a strong genetic link, originating from both the paternal and the maternal side of the family irrespective of sex. The underlying pathology of premature graying of hair is unknown but it is thought to be inherited in autosomal dominant pattern (Tobin and Trueb, 2010). It appears that the genotype responsible for melanin production includes multiple genes and peptides that affect the tyrosinase enzyme which is important for the process of hair graying (Black, 2015). In a study on albino-mouse hair follicles, in some of the murine follicles with RNA-DNA chimeric oligonucleotides a point mutation in the tyrosinase gene was corrected and a recombinant retrovirus (pLmelSN) was used to induce melanin production in vitro from the locus of Streptomyces Antibioticus genome (Hoffman, 2006). These indicate that the tyrosinase inactivity may be a possible cause for hair graying prematurely. However, other genes are also thought to be responsible for this very complex process. In a study Tobin and Trueb (2010) revealed that mice deficient in Bcl2 and Bcl-x genes are normal at birth but they show canities after a few weeks. Another study in horses revealed, a germ line mutation in Syntaxin 17 gene causes premature canities in the homozygous genotype (Zhao et al., 2009). Based on the patient's medical and family history, there seems to be a strong genetic link to the cause of this particular phenotype. Apart from these so many other factors like many diseases, deficiencies, and syndromes are said to be responsible for premature graying of hair. Some of these factors include Vitiligo, Werner's syndrome, thyroid disease, vitamin B12, iron, and calcium deficiencies. Sharma et al., in a cross-sectional, case-controlled study proposed that family history of PGH was noted in 65.83% of the subjects. It was also reported by Daulatabad et al. (2016) that family history of PGH in 75% of the cases with an equal prevalence on both maternal and paternal sides. Another study by Shin et al. (2015) found that the participants with PGH had a paternal family history of PGH in 33% and a maternal family history in 11.2% along with smoking and obesity. In women with PGH the rates of maternal and paternal PGH were high, and the rate of paternal PGH was high in men with PGH (Akin et al, 2016). In a study Black (2015) opined that, PGH is thought to be inherited in autosomal dominant pattern without any underlying pathology [Tobin and Trueb, 2010]. The genotype responsible for PGH includes multiple genes and peptides that affect the enzymes (probably Tyrosinase enzyme) responsible for melanin production (Black, 2015).

Other studies have been made to understand the association of different other factors with PGH individually. In the present study it was attempted to understand the synergistic effect of substance abuse and family history of PGH with PGH. Among both males and females the differences between individuals with and without PGH by family history and substance abuse are showing significant difference ($p < 0.0001$) which indicates that individuals with both family history and adverse lifestyle had significantly higher PGH than individuals who had either of it or neither of it. Hence, it can be said that PGH is a multifactorial trait where several genetic and environmental vis-à-vis lifestyle factors are associated to the ultimate phenotype of the individual, irrespective of sex. Further advanced studies are needed to understand the causes of hair graying.

CONCLUSION

Young adults irrespective of sex with regular substance abuse and having family history of PGH are more susceptible to premature graying of human scalp hair. It can be said that PGH is a multifactorial trait where numerous genetic and lifestyle factors are associated with. PGH can also said to be associated with the lifestyle disorders and the genetic ones as well. Necessary steps are required for proper screening and awareness to overcome this public health burden.

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