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Evaluation of Serum Paraoxonase and Prolidase Levels in Patients with Premature Graying Of Hair

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Abstract

Background: Premature greying of hair (PGH) is described as hair greying before the age of 20 in Caucasians, 25 in Asians, and 30 in blacks. This work aimed to evaluate demographic and clinical features of individuals with premature greying of the hair. **Methods:** This case-control study included 60 patients with PGH and 30 healthy controls of comparable age and gender. They were selected from the Outpatient Clinic of the Dermatology and Andrology Department at Benha University Hospital. **Results:** Statistically significant difference was seen among two groups of study concerning mean age and smoking distribution. Mean age of PGH onset among studied patients was 18.93 years (± 5.6 SD). The mean triglyceride and Cholesterol levels were moderately but not substantially higher in patients of PHG than controls. The mean HDL level considerably decreased among PGH patients than controls although the mean LDL level of PGH patients was substantially greater than that of controls. although the mean LDL level of PGH patients was substantially greater than that of controls. Comparing the proportion of people with low blood ferritin levels between the sick group (18.3 percent) and the control group (3.3 percent), a meaningful statistical difference was found. No substantial change in haemoglobin and VLDL concentrations among two groups. **Conclusion:** To elucidate the clinical and epidemiological features and linked reasons of PGH, there is a need for further epidemiological research on people of many ethnic backgrounds.

Key words: Premature, Graying, Hair – PGH

1. Introduction

Healthy hair is a predictor for well-being and youth in general. Hair color and style can significantly alter person's physical appearance and thus alter the body image. As hair greying is seen as a symptom of aging, PGH might have a negative impact on self-esteem. of the individual **[1].**

Graying of hair also called canities or achromotrichia occurs with normal aging, the average gray-free life span is 45 years. However, the age at which PGH occurs varies in different races. PGH is known as graying of hair prior to of 20 years old in caucasians, 25 in asians and prior 30 years in blacks **[2].**

The development of canities involves three stages: the progressive loss of pigmentation of hairs across several cycles, pigment loss during the anagen phase of the same hair cycle, and the emergence of the totally hypopigmented hair from the epidermal surface **[3].**

The reason for ageing is only partially known. It is a complicated, multi-factor process that is mostly attributed to the interaction of dietary, genetic, and environmental variables. Many deficiencies, including vitamin B12 insufficiency, severe iron shortage, chronic protein loss, and copper deficiency, have been linked to PGH **[4].**

Situations characterised by the production of large quantities of reactive oxygen species that result in higher oxidative stress and injury to melanin-producing cells, melanocytes, and cause PGH. It is believed that extended exposure to UV radiation begins comparable mechanisms in hair follicles that lead to PGH **[5, 6].**

This work aimed to evaluate demographic and clinical profiles of premature graying of hair patients.

2. Patients and Methods

2.1Patients

This case-control study included 60 patients with PGH and 30 healthy subjects suited for age and gender. They were picked from Benha University Hospital's Dermatology & Andrology Department Outpatient Clinic patients.

2.2Type of Study

Cross sectional case control study.

2.3Administrative design

The Research Ethical Committee of Benha Faculty of Medicine authorised this research.

2.4Ethical consideration

Prior to actually collecting samples of blood, informed written permission was obtained from each patient or healthy control volunteer.

2.5Inclusions criteria

1. Subjects with complaints of before

the age of 30 and age- and gender-matched healthy controls who were ready to participate in the research.

2.6Exclusion criteria

Participants exhibiting any of the following criteria will be omitted;

1. An existing hypopigmentary disorder.
2. Any inflammatory lesions associated with hypopigmention
3. Medication (eg; multivitamin supplements) that might cause hypopigmentation and baldness (except androgenetic alopecia).
4. Cigarette smokers.
5. Acute or chronic disease (liver or renal impairment).

participants will be split into two groups

Group I: 60 participants with PGH (before age of 30).

Group II: 30 healthy controls matching age and gender.

Methods

Participants were exposed to the subsequent:

1. Informed written consent

It will be administered before the beginning of the trial. No hazards were identified, and any unanticipated risks that emerge throughout the trial will be promptly disclosed to patients and the committee. Every record was private. The findings of this research were exclusively utilized for scientific purposes. Participating is optional, and patients may withdraw at any time without incurring penalties or losing advantages.

2. Complete history taking

- Onset, course, duration and relation of the disease to stress will be documented.
- History of hypopigmentary disorder.
- Past history of hair dying.
- History of smoking.
- History of drug intake.
- Any systemic diseases history eg; liver or renal diseases.
- Family history of PGH and its degree.
- Educational level.

3. General examination to exclude any systemic diseases. Evaluate obesity and BMI.

4. Local examination

Local clinical examination of premature graying of hair of scalp and eyebrow :- site, distribution, severity and duration.

Local clinical assessment of skin aging especially; face and dorsum of the hand.

5. Laboratory investigations including:

a) Hb%.
b) Lipid profile.
c) Serum ferritin.

3. Results

Table (1) Comparison between the studied groups regarding demographic characteristics& BMI (n=90)

Variable	PGH Group n=60	Control Group n=30	Test	p
Age (years)	Mean ± SD (Range)	Mean ± SD (Range)		
	24.45 ± 4.63 (8 – 30)	22.4 ± 3.72 (16 – 30)	t=2.11	0.038
Sex	n (%)	n (%)		
Male	30 (50%)	15 (50%)	χ^2=0	1
Female	30 (50%)	15 (50%)		
Smoking				
Non-smoker	34 (56.7%)	30 (100%)	χ^2=18.28	<0.001
Smoker	26 (43.3%)	0 (0%)		
BMI (kg/m^2)				
	Mean ± SD (Range)	Mean ± SD (Range)		
	25.25 ± 4.39 (16.5 – 34.8)	25.28 ± 4.22 (18 – 35)	t= - 0.027	0.97
BMI category	n (%)	n (%)		
Underweight (BMI < 18.5)	4 (6.7%)	3 (10%)		
Normal (BMI = 18.5 – 24.9)	28 (46.7%)	10 (33.3%)		
Overweight (BMI = 25 – 29.9)	19 (31.7%)	15 (50%)	FET = 3.96	0.26
Obese (BMI ≥ 30)	9 (15%)	2 (6.7%)		

PGH=Premature graying of hair

Table (1) shows that the mean age in Premature greying of hair Group (PGH Group) was 24.45 ± 4.63 SD and it included 50% males and 50% females and 43.3% of them were smoker. Their mean BMI was 25.25 ± 4.39 SD. The mean age in Control Group was 22.4 ± 3.72 SD and it included 50% males and 50% females. All participants in Control group were nonsmoker and their mean BMI was 25.28 ± 4.22. The majority of patients (46.7%) were in the normal BMI category, (6.7%) were underweight, and (31.7%) and (15%) patients were overweight and obese, respectively. No substantial connection was found between the severity of PGH and an increase in BMI ($p = 0.26$). A statistically critical difference was found among studied groups concerning mean age and smoking distribution ($p < 0.05$)

Table (2) Clinical characteristics of premature graying of hair among studied patients (n=60)

Variable			PGH Group (n=60)
Age of onset (years)			Mean ± SD (Range)
			18.93 ± 5.6 (2 – 27)
Area of onset			n (%)
Frontal			24 (40%)
Vertex			10 (16.7%)
Temporal			20 (33.3%)
Parietal			6 (10%)
Course			n (%)
	Stationary		33 (55%)
	Progressive		27 (45%)
Family history			n (%)
	Negative family history		22 (36.7%)
	Positive family history		38 (63.3%)
		father	14 (36.8%)
		mother	8 (21.1%)
		brother	7 (18.4%)
		sister	9 (23.7%)
Graying severity score (GSS)			Mean ± SD (Range)
			7.37 ± 2.57 (4 – 13)

GSS = Total of the scores at the five typical locations with the patient's maximum possible score 15 (3 × 5).

Mild = a score of 0–5; Moderate= score of 6–10; and Severe= score of 11–15.

Table (2) shows that mean age of PGH onset in studied patients was 18.93 years (± 5.6 SD). PGH founded in frontal region, temporal region and vertex of the scalp in (40%), (33.3%), and (16.7%) patients, respectively. Fifty five percent of patients reported stationary course compared with 45% who reported progressive course. Positive family history of PGH among first degree relatives was observed among two thirds of PGH Group patients (63.3%), where paternal history reported in 14/38 (36.8%), maternal history reported in 8/38 (21.1%), history in brother and sister reported in 7/38 (18.4%) and 9/38 (23.7%) respectively. The maximum Graying severity score (GSS) obtained was 13, while the minimum was 4, (GSS mean value = 7.37 ± 2.57). It was found that, 20/60 (33.3%) cases had a mild GSS, 34/60 (56.7%) had moderate GSS, and only 6/60 (10%) had severe GSS.

Table (3) Density and degree of greying in the five typical zones in PGH Group (n=60)

Variable	PGH Group (n=60)
	Mean ± SD (range)
Frontal	1.95 ± 0.79 (1 - 3)
Vertex	1.82 ± 0.79 (1- 3)
Right temporal	1.43 ± 0.59 (1 - 3)
Left temporal	1.27 ± 0.48 (1 - 3)
Occipital	0.9 ± 0.51 (0 - 2)

On the basis of the hair count, each zone was awarded a score calculated on the basis of grey hair in each square: - Score 3 (more than 30 percent grey hair/cm2); Score 2 (from 10 to 30 percent gray hair/cm2) and Score 1 (ascribed to less than 10percent grey hair/cm2).

Table (3) shows that density of grey hair was highest in the frontal region (mean score = 1.95 ± 0.79) followed by vertex (mean score = 1.82 ± 0.79), followed by right and left temporal regions (mean scores = 1.43 ± 0.59, 1.27 ± 0.48, respectively). Occipital region was least affected (mean score = 0.9 ± 0.51).

Table (4) Comparison between the studied groups regarding history of chronic telogen effluvium (CTE) and androgenetic alopecia (AGA).

Variable	PGH Group n=60	Control Group n=30	Test	p
	n (%)	n (%)		
Telogen effluvium (CTE)				
Yes	17 (28.3%)	9 (30%)		
No	43 (71.7%)	21 (71%)	χ^2=0.03	1
Androgenetic alopecia (AGA)				
Yes	26 (43.3%)	14 (46.7%)		
No	34 (56.7%)	16 (53.3%)	χ^2=0.09	0.82

** Significant at the 0.05 level (2-tailed).*

*** Significant at the 0.01 level (2-tailed).*

Table (4) No significant difference was seen among PGH patients and controls regarding history of chronic telogen effluvium (CTE) and androgenetic alopecia (AGA) ($p > 0.05$). Minority 17/60 (28.3%) and 9/30 (30%) of PGH patients and controls, respectively, who reported CTE. Also, about 43.3%, 46.7% of PGH patients and controls, respectively who reported AGA.

4. Discussion

In the current results, Triglyceride and cholesterol levels in PHG patients were marginally but not substantially higher than in controls (***P***= 0.26, 0.22). The mean HDL level was significantly lower among PGH patients than controls (***P***= 0.01) although the mean LDL level of PGH patients was substantially greater than that of controls (***P***= 0.009).

These results were matched with **[7]** who found that Triglyceride and total cholesterol levels in PGH patients were not significantly different from those in controls. The authors also reported that, serum HDL-cholesterol was significantly higher in controls compared to PHG grou. While serum LDL was considerably higher in the PHG group than in the control group, this difference was not statistically significant.

Also **[8]** recorded that This difference was statistically significant (P = 0.01): (21.67%) of PGH patients had elevated blood LDL levels, relative to (9.17%) of the controls. The difference is statistically significant (P = 0.03) (22.50 percent of PGH patients had low blood HDL vs 11.67 percent of controls).

PGH has been associated with early cardiovascular disease, and this dyslipidemia may represent a connection in this association **[8].** PGH was also shown to be substantially associated with CAD risk, and dyslipidemia was considerably elevated in CAD patients with PGH compared to controls **[9].**

No significant difference was identified between the mean blood ferritin levels of PGH patients and healthy controls in our investigation (***P***= 0.11). Comparing the proportion of people with low blood ferritin levels between the sick group (18.3 percent) and the control group (3.3 percent), a statistically significant difference was found (***P***= 0.048). No significant difference between both groups regarding Hb (***P***>0.05).

Our findings are consistent with research done by **[8]** who investigated that 48.33 percent more PGH patients than controls had low serum ferritin (20.83 percent). The difference between the two groups was extremely significant from a statistical standpoint (***P*** < 0.0001). Furthermore, the mean serum ferritin concentration of patients was lower than that of controls, with the difference being highly significant (***P*** < 0.0001).

Also, **[10]** found that compared with controls, serum ferritin was considerably lower in PGH patients (***P*** = 0.03). Additionally, **[7]**found that comparing PGH cases to controls, the mean serum ferritin concentration was considerably lower in PGH patients (***P*** < 0.0001).

In addition to **[11]** who discovered that the mean blood ferritin level in PGH patients

was considerably lower than in control groups. Iron has been implicated in a tautomerization process involving DOPAchrome tautolase (DT). DT catalyses the conversion of DOPAchrome to 5,6-dihydroxyindole-2-carboxylic acid (DHICA) from DOPAchrome. Iron binds the innermost part of DT **[12]**. These studies give evidence of iron's function in the melanogenesis process **[11].**

Concerning Hb level, **[10]** agreed with our results as They discovered no difference in the mean Hb among PGH patients and controls.

Our results revealed that majority of patients (46.7%) were in the normal BMI category, (6.7%) were underweight, (31.7%) were overweight and (15%) were obese. only (3%) of PGH patients were smokers and all participants in control group were nonsmoker. No significant connection between PGH severity and BMI gain was found (***P***= 0.26). There was no statistically significant difference between the two groups in terms of mean age, mean BMI, gender distribution, or smoking prevalence (***P*** > 0.05).

Regarding BMI, there were some previous studies that supported our results such as **[13]** who showed that (77.5%) of PGH patients were normal BMI, (8.7%) were under weight, (13.5%) were overweight and obese.

Also, **[8]** found that 65 percent of PGH patients had a normal BMI, followed by 20 percent who were underweight, 12.50 percent who were overweight, and 2.50 percent who were obese, which was statistically equivalent to controls. In their investigation, there was no substantially considerable difference among the mean BMI of patients and controls.

While, a study done by **[14]** reported link among BMI and the PGH incidence and severity. The authors showed that considerably greater chances of getting PHG were associated with being overweight (***P*** = 0.002) and obese (***P*** < 0.001) groups than group of normal weight.

Obesity is related with reduced melanogenesis and melanocyte DNA repair, that may be owing to a change in leptin sensitivity and an elevation in circulatory melanocyte-stimulating hormone inhibitors **[15].**

In relation to smoking, our results were disagreed with results of**, [8]** who discovered that 11.67 percent of PGH patients were smokers relative to 0.83 percent of controls, a substantially critical difference (***P*** = 0.000).

Additionally, **[14]** noticed that The percentage of PGH patients who smoked was greater than that of controls (***P*** = 0.013).

Furthermore, **[16]** and **[17]** showed a substantial association between the start of PHG and cigarette smoking.

Uncertainty surrounds the methods by which smoking promotes greying of the hair **[18]**. This notion is further bolstered by the fact that melanocytes in grey hair bulbs are typically heavily vacuolated, which is a frequent reaction to elevated oxidative stress. **[19]**.

[16] illustrated that Smoking results in the production of hydrogen peroxide, which depletes catalase and methionine sulphur reductase, enzymes that have been linked to PGH.

In our results, mean age of PGH onset among studied patients was 18.93 years (±5.6 SD) with a range of 2-27 years. PGH founded in the frontal region, temporal region and vertex of the scalp in (40%), (33.3%), and (16.7%) patients, respectively.

Regarding mean age of onset, our findings were supported by **[8]** who reported that the mean age of onset of PGH was 13.80 (± 4.68) years with a range of 2–22 years. Also, **[2]** the mean age at onset was 11.6 ± 3.6 years with a range of 3–18 years.

Concerning the origin of graying results, an opposite study done by **[8]** who showed that In 47.5% of instances, the vertex was the origin of greying, followed by the frontal (40%), temporal (8.33%) and occipital regions (4.17 percent). Also, **[2]** found that The cause of greying was most often seen in the frontal area (48.1%), followed by the vertex (34.6%), the occipital (13.5%), and the temporal region (1.5%). (3.8 percent).

The variation between the results may be due to the difference in the cases numbers.

In our findings, positive family history of PGH among first degree relatives was observed among two thirds of PGH patients (63.3%), where paternal history reported in 14/38 (36.8%), maternal history reported in 8/38 (21.1%), history in brother and sister reported in 7/38 (18.4%) and 9/38 (23.7%) respectively.

There were previous studies matched with our findings such as **[10]** There was a parental history of PGH in 42.6% of patients, and relatives were implicated in 14.2% of patients.

Also, **[14]** found that PGH family history was paternal in 33.3% of cases and maternal in 33% cases (11.2 percent). 4.6% of patients were engaged with both parents.

Furthermore, **[2]** investigated that PGH family history was identified in 55.8% (1st degree), 25% (2nd degree), and 38.4% (3rd degree) of the relatives of Indian PGH patients.

[8] showed that PGH family history was seen in (65.83 percent) of cases.

Additionally, **[13]** discussed that The PGH family tree revealed the strongest relationship with PHG. These findings indicate that hereditary variables are highly linked to PHG. The genome-wide linkage scan in over 6,000 Latin Americans identified the first genetic locus (rs12203592 in the interferon regulatory factor 4 (IRF4) gene) related with hair greying **[20].** It was discovered that IRF4 interacts with the microphthalmia-associated gene **[21].**

In the present results, 13 was the highest GSS achieved, while 4 was the lowest, (GSS mean value = 7.37 ± 2.57). It was found that, 20/60 (33.3%) cases had a mild GSS, 34/60 (56.7%) had moderate GSS, and only 6/60 (10%) had severe GSS.

Our data revealed that Density of grey hair was greatest in the frontal area (mean score = 1.95 ± 0.79) followed by vertex (mean score = 1.82 ± 0.79), followed by right and left temporal regions (mean scores = 1.43 ± 0.59, 1.27 ± 0.48, respectively). Occipital region was least affected (mean score = 0.9 ± 0.51).

Results of **[22]** were in line with us as they demonstrated that The frontal area has the greatest proportion of grey hairs (11 percent), followed by the vertex (9 percent). The temporal area was affected to a comparable degree on average (8 percent -8.5 percent). Occipital region was impacted the least at (5.3 percent).

There was no significant difference in the prevalence of CTE and AGA between PGH patients and controls, according to the present findings ($P > 0.05$). Minority (28.3%) and (30%) of PGH patients and controls, respectively, who reported CTE. Also, about (43.3%), (46.7%) of PGH patients and controls, respectively who reported AGA.

Contrariwise these results, **[23]** who indicated that CTE, PGH, and AGA prevalence was 36.3%, 49%, and 50%, respectively, which was substantially greater than the prevalence in the control group.; CTE was 14.6 percent, PGH was 25.8 percent and AGA was 27.4 percent.

The variation between these results may be due to the differences in sample size, age or due to the associated CAD to PGH patients in Sharma,s study.

Numerous epidemiological studies have shown a correlation between coronary artery disease and adipose tissue hyperplasia (AGA), with androgen levels thought to play a central role. It is also documented that balding males had greater serum androgen, androgen receptor, and overall and free levels of testosterone **[24].**

[23] postulated that AGA and PGH patients are nearly five times more likely to develop CAD at a younger age. This is consistent with a prior research by the same authors in which they observed a strong connection between vertex baldness (grades IV–VI) and coronary artery disease (CAD) in young (45 years) male patients with CAD, with a total AGA prevalence of 37.73 percent **[25].** 50 percent of white males have some amount of baldness just before age of 50, and CTE begins as young as 12 years of age in this ethnic group **[26].**

5. Conclusion

To elucidate the clinical and epidemiological features and related variables of precocious greying of hair, there is a need for more epidemiological research on persons of many ethnic origins.

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