Age estimation using level of eyebrow and eyelash whitening

Authors' Contribution:
Study Design A
Data Collection B
Statistical Analysis C
Data Interpretation D
Manuscript Preparation E
Literature Search F
Funds Collection G

ABCDEF 1 **Feride Aylin Kantarcı**
ACEF 2 **Muhammed Nabi Kantarcı**
ABEF 3 **Sefer Bilgi**

1 Department of Ophthalmology, Sultangazi Lütfiye Nuri Burat State Hospital, Istanbul, Turkey
2 Department of Forensic Medicine, Ministry of Justice, Forensic Science Institute, Istanbul, Turkey
3 Department of Forensic Medicine, Marmara University, Pendik Training and Research Hospital, Istanbul, Turkey

Corresponding Author: Feride Aylin Kantarcı, e-mail: ferideaylin@gmail.com
Source of support: Departmental sources

Background: The aim of this study was to determine whether eyebrow and eyelash whitening is an effective parameter in age estimation.

Material/Methods: We evaluated 1545 patients. Age groups were 1–10, 11–20, 21–30, 31–40, 41–50, 51–60, 61–70, 71–80, and 81–90 years. Level of whitening was categorized as level 0: no whitening, level 1: 1–3 strands, level 2: 3–10 strands, level 3: 10 strands–2/3 whitening, level 4: >3/4 whitening.

Results: Mean age was 42.39±20.01. While there was no eyebrow whitening in 87% of the subjects, level 4 whitening of eyebrows was observed in 0,8% of the subjects. There was no eyelash whitening in 97,7% of the subjects and no level 4 eyelash whitening was detected in any subject. Men had significantly more level 1, 2, 3, and 4 eyebrow whitening compared with women. There was no gender difference in terms of eyelash whitening level. There was no eyebrow and eyelash whitening in subjects age 1–40 years; whitening began in the 41–50 years age group and increased with age in other groups. Mean age was 39.59±19.63 years in subjects with no eyebrow whitening; 59 years in level 1, 61 years in level 2, 63 years in level 3, and 69 years in level 4 eyebrow whitening. Mean age was 41.85±19.87 in subjects with no eyelash whitening; and 63.57±10.75 in those with whitening.

Conclusions: Particularly after 41–50 years of age, level of eyebrow and eyelash whitening may be among a useful age estimation parameter.

MeSH Keywords: **Eyelashes • Age Factors • Waardenburg Syndrome • Eyebrows**

Full-text PDF: http://www.medscimonit.com/download/index/idArt/889946

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Background

Hair is developed by invagination of the epidermal epithelia. Hair color may vary with race, age, and location. Hair enters a resting period after growth, but the period is not simultaneous in all body regions or within a single region. Sexual, adrenal, and thyroid hormones are among the hormones that affect hair growth [1].

Hair color depends on melanocyte activity. Melanocytes are located between epithelial cells and papilla of the hair follicle. Melanocytes form the pigment present in medullar and cortical cells of hair follicle [1,2]. Eyebrow and eyelash whitening occur due to decreased hair pigmentation. Change of hair follicle color depends on melanin pigment [3]. With older age, increased melanocyte death due to oxidative stress and apoptosis are detected in white hair follicles [4].

Pathological localized whitening of eyebrow and eyelash whitening is termed poliosis [5]. Poliosis may be due to inflammatory ophthalmic conditions such as chronic blepharitis, Herpes zoster infection, Vogt-Koyanagi-Harada syndrome sarcoidosis, vitiligo, tuberous sclerosis, sympathic ophthalmia, post-irradiation, or halo nevus [6]. Besides, poliosis can be an adverse effect of topical prostaglandin F (2alpha) analogs in glaucoma treatment [7], cetuximab in cancer treatment [8], acitretin in psoriasis treatment [9], chloroquine [10], and topical chloramphenicol [11].

Eyelashes and eyebrows provide protection from dirt and sweat [12]. In our study, apart from all these functions, we investigated the utility of whitening in age estimation. Since epiphyseal lines of the long bones are closed after the second decade of life, age estimation becomes more difficult. In that case, calcification level of sternum and ribs becomes more important [13,14]. Other bones (e.g. vertebra) can be used [15] and bulging of dorsal superficial veins of the hands is also important [16]. However, it is not possible to make an accurate age estimation based on these and similar findings.

Estimation of biological age is important in determining identity, and for retirement, licensing, and other social activities and benefits that depend on age [17].

A previous study investigated the use of pubic hair whitening in age estimation [18]. Our aim was to investigate whether eyebrow and eyelash whitening are useful in estimating age in individuals living at Istanbul.

Material/Methods

The study was conducted in 1545 patients who applied to Sultangazi Lütfiye Nuri Burat State Hospital ophthalmology outpatient clinic between 2011 and 2012 after informed consent was obtained. Subjects with any pathological condition leading to premature hair whitening, systemic disorders, or substance abuse were excluded from the study [6–11]. Local ethics review board approval was obtained for the study. We included 792 males and 753 females between 1 and 90 years of age.

Eyebrow and eyelash whitening were rated according to number of whitened strands.

For eyebrows;
Level 0: no whitening,
Level 1: 1–3 strands,
Level 2: 3–10 strands,
Level 3: 11 strands–2/3 whitening,
level 4: >3/4 whitening.

For eyelashes;
Level 0: no whitening,
Level 1: 1–3 strands,
Level 2: 3–10 strands,
Level 3: 11 strands–2/3 whitening,
level 4: >3/4 whitening.

Age was grouped into 1–10, 11–20, 21–30, 31–40, 41–50, 51–60, 61–70, 71–80, and 81–90 years of age. Separate statistical analysis was conducted for men and women, and eyelashes and eyebrows.

Statistical analysis

NCSS (Number Cruncher Statistical System) 2007 and PASS (Power Analysis and Sample Size) 2008 statistical software (Utah, USA) programs were used for statistical analysis. Along with descriptive statistical methods (mean, standard deviation, frequency, and rate), one-way ANOVA test and post hoc Tukey HSD test were used to evaluate age and Student's t test was used to compare the 2 groups. Pearson chi-square test was used to compare qualitative data and Fisher's exact test and Yates continuity correction test were used to detect differences between groups. Significance was evaluated at $p < 0.01$ and $p < 0.05$ levels.

Results

The study included 1545 patients between July 2011 and July 2012. Ages of patients were between 1 and 90 years, with a mean of 42.39±20.01; 48,7% of the subjects were female (n=753) and 51,3% were male (n=792).

There were no differences in age distribution in terms of gender when eyebrow and eyelash whitening were taken as a whole (p>0.05). When the age distribution of all subjects was

Table 1. Age distribution regarding gender.

		Age		p
		Mean	SD	
Subjects with eyebrow and eyelash whitening (n=201)	Women (n=41)	62.46	10.51	0.338
	Men (n=160)	60.88	9.16	
All subjects	Women (n=753)	41.05	19.33	0.010*
	Men (n=792)	43.66	20.56	

Student t test * p<0.05.

Table 2. Right and left eyelash whitening levels regarding gender.

		Gender				p
		Women (n=753)		Men (n=792)		
		n (%)		n (%)		
Level of right eyelash whitening	0	741	(98.4)	768	(97.0)	[b]0.089
	1	10	(1.3)	18	(2.3)	[b]0.230
	2	1	(0.1)	3	(0.4)	[c]0.625
	3	1	(0.1)	3	(0.4)	[c]0.625
Level of left eyelash whitening	0	742	(98.5)	770	(97.2)	[b]0.107
	1	8	(1.1)	17	(2.1)	[b]0.137
	2	2	(0.3)	2	(0.3)	[c]1.000
	3	1	(0.1)	3	(0.4)	[c]0.625

[a] Pearson Chi-Square; [b] Yates Continuity Correction; [c] Fisher's Exact Test.

investigated, mean age was significantly lower in females when compared with males (p<0.05) (Table 1).

There was no whitening in the right eyebrow in 87.2% (n=1347) and left eyebrow in 87.6% (n=1354) of the subjects. When whitening in the right eyebrow was evaluated, 4.4% (n=68) had level 1, 5.3% (n=82) had level 2, 2.3% (n=35) had level 3, and 0.8% (n=13) had level 4 whitening. For the left eyebrow, 4% (n=62) had level 1, 5.2% (n=81) had level 2, 2.3% (n=35) had level 3, and 0.8% (n=13) had level 4 whitening (Table 1).

While there was no whitening in the right eyelash in 97.7% (n=1509) and left eyelash in 97.9% (n=1512) of the subjects, the most common whitening was level 1 (1.8%, n=28) and there was no level 4 whitening in any subject in right or left eyelashes. Of those with right eyelash whitening, 1.8% (n=28) had level 1, 0.3% (n=4) had level 2, and 0.3% had level 3 (n=4) whitening. For the left eyelash, 1.6% (n=25) had level 1, 0.3% (n=4) had level 2, and 0.3% had level 3 (n=4) whitening (Table 2).

When the relationship between gender and whitening was evaluated, absence of whitening in either right or left eyelashes

was significantly more common in females (p<0.01). Rate of level 1, 2, 3, and 4 right or left eyebrow whitening was significantly higher in males compared to women (p<0.01) (Table 3).

There were no differences in terms of gender for levels of right and left eyelash whitening (p>0.05) (Table 2).

When the association between age and whitening was investigated, there was no right or left eyebrow whitening in 1–10, 11–20, 21–30, or 31–40 age groups; whitening began in the 41–50 age group and showed an increase in frequency in each subsequent age group. When means of age were evaluated, mean age was 39.59±19.63 in subjects with no right eyebrow whitening, 59.04±8.61 years in level 1, 61.20±9.22 years in level 2, 63.49±9.87 years in level 3, and 69.77±6.37 years in level 4 whitening (Table 4).

In the left eyebrow, mean age was 39.70±19.65 in subjects with no whitening, 59.19±8.76 years in level 1, 60.94±9.14 years in level 2, 63.49±9.87 years in level 3, and 69.77±6.37 years in level 4 whitening. Age distribution was significantly different in terms of left *vs.* right eyebrow whitening levels

Table 3. Right and left eyebrow whitening levels regarding gender.

		Age				p
		Women (n=753)		Men (n=792)		
		n (%)		n (%)		
Level of right eyebrow whitening	0	715	(95.0)	632	(79.8)	[a]0.001**
	1	13	(1.7)	55	(6.9)	[b]0.001**
	2	18	(2.4)	64	(8.1)	[b]0.001**
	3	7	(0.9)	28	(3.5)	[b]0.001**
	4	0	(0.0)	13	(1.6)	[b]0.001**
Level of left eyebrow whitening	0	718	(95.4)	636	(80.3)	[a]0.001**
	1	11	(1.5)	51	(6.4)	[b]0.001**
	2	17	(2.3)	64	(8.1)	[b]0.001**
	3	7	(0.9)	28	(3.5)	[b]0.001**
	4	0	(0.0)	13	(1.6)	[b]0.001**

[a] Pearson Chi-Square; [b] Yates Continuity Correction; ** $p < 0.01$.

Table 4. Distribution of right and left eyebrow whitening levels in the age groups.

		Age groups									Age	p; Post Hoc test
		1–10 (n=153)	11–20 (n=153)	21–30 (n=111)	31–40 (n=155)	41–50 (n=391)	51–60 (n=301)	61–70 (n=192)	71–80 (n=75)	81–90 (n=14)		
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	Mean ±SD	
Level of right eyebrow whitening	0	153 (100)	153 (100)	111 (100)	155 (100)	363 (92.8)	235 (78.1)	123 (64.1)	43 (57.3)	11 (78.6)	39.59±19.63	0.001**; TukeyHSD; None<1** None<2** None<3** None<4**
	1	0	0	0	0	12 (3.1)	29 (9.6)	18 (9.4)	8 (10.7)	1 (7.1)	59.04±8.61	
	2	0	0	0	0	11 (2.8)	30 (10.0)	27 (14.1)	13 (17.3)	1 (7.1)	62.20±9.21	
	3	0	0	0	0	5 (1.3)	6 (2.0)	17 (8.9)	6 (8.0)	1 (7.1)	63.49±9.87	
	4	0	0	0	0	0	1 (0.2)	7 (3.6)	5 (6.7)	0 (0.0)	69.77±6.38	
Level of left eyebrow whitening	0	153 (100)	153 (100)	111 (100)	155 (100)	364 (93.1)	238 (79.1)	125 (65.1)	44 (58.7)	11 (78.6)	39.70±19.65	0.001**; TukeyHSD; None<1** None<2** None<3** None<4**
	1	0	0	0	0	11 (2.8)	25 (8.3)	17 (8.9)	8 (10.6)	1 (7.1)	59.19±8.78	
	2	0	0	0	0	11 (2.8)	31 (10.3)	26 (13.5)	12 (16.0)	1 (7.1)	60.94±9.14	
	3	0	0	0	0	5 (1.3)	6 (2.0)	17 (8.9)	6 (8.0)	1 (7.1)	63.49±9.87	
	4	0	0	0	0	0	1 (0.3)	7 (3.6)	5 (4.7)	0 (0.0)	69.77±6.37	

Oneway Anova Test; Post Hoc Tukey HSD test ** $p < 0.01$.

($p < 0.01$); further analysis showed that the group with no whitening was significantly younger than the groups with level 1, 2, 3 and 4 whitening ($p < 0.01$). There were no age differences between subjects with right or left level 1, 2, 3, and 4 eyebrow whitening ($p > 0.05$) (Table 4).

There was no whitening in right or left eyelashes in 1–10, 11–20, 21–30, and 31–40 years age groups; whitening began in the 41–50 years age group and showed an increase in frequency in each subsequent age group. Mean age of subjects without any right eyelash whitening was 41.85±19.87 years and 63.57±10.75 years in those with whitening. Mean age of subjects without any left eyelash whitening was 41.91±19.87 years and 63.64±10.34 years in those with whitening. There was a significant difference in age distribution in terms of right or left eyelash whitening ($p < 0.01$) (Table 5).

Table 5. Distribution of right and left eyelash whitening levels in the age groups.

		Age groups									Age	p
		1–10 (n=153)	11–20 (n=153)	21–30 (n=111)	31–40 (n=155)	41–50 (n=391)	51–60 (n=301)	61–70 (n=192)	71–80 (n=75)	81–90 (n=14)		
		n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	Mean ±SD	
Level of right eyelash whitening	0	153 (100)	153 (100)	111 (100)	155 (100)	387 (99.0)	295 (98.0)	178 (92.7)	64 (85.3)	13 (92.9)	41.85±19.87	0.001**
	1	0	0	0	0	4 (1.0)	5 (1.7)	12 (6.3)	6 (8.0)	1 (7.1)	63.57±10.75	
	2	0	0	0	0	0	0	2 (1.0)	2 (2.7)	0	68.00±3.83	
	3	0	0	0	0	0	1 (0.3)	0	3 (4.0)	0	72.75±9.50	
Level of left eyelash whitening	0	153 (100)	153 (100)	111 (100)	155 (100)	387 (99.0)	295 (98.0)	180 (93.8)	65 (86.7)	13 (92.9)	41.91±19.89	0.001**
	1	0	0	0	0	3 (0.8)	5 (1.7)	11 (5.7)	5 (6.7)	1 (7.1)	63.64±10.34	
	2	0	0	0	0	1 (0.2)	0 (0.0)	1 (0.5)	2 (2.7)	0	61.75±13.69	
	3	0	0	0	0	0	1 (0.3)	0	3 (4.0)	0	72.75±9.50	

Since there are 4 subjects with level "2" and "3" whitening, the figures are reported in the table but were not included in the statistical analysis Student t test ** p<0.01.

Discussion

Hair development is one of the parameters used for age estimation. Hair color, size, and location may change with race, age, and body region [2]. Rate of whitening is slower in eyelashes and eyebrows when compared with hair in humans because of different amounts of outer sheath melanocytes, enzymes, and stem cells in different hair follicles [19–21]. Onset and progression of whitening of hair follicles depends on chronological age and occurs to various degrees independent of gender and race. Age of onset is under genetic control and hereditary. Onset of whitening of hair follicles is around the mid-30s in whites, the mid-40s in Africans, and in the 30s in Asians [3,22–24]. In our study, mean age was 62, 46 years in females and 60,88 years in males with whitening. When the association of age with whitening was investigated, there was no eyelash or eyebrow whitening between 0 and 40 years of age; whitening started in the 41-50 years group and frequency of whitening increased in each subsequent age group. Mean age for level 1 eyebrow whitening was 59 years and 63 years for level 1 eyelash whitening. Levels of eyelash and eyebrow whitening were not significantly different in terms of age distribution.

In our study, level 0 eyebrow whitening was detected in 87% of male and female subjects and level 0 eyelash whitening was evident in 97% of the subjects. Level 1 eyebrow whitening was detected in 4%, level 2 in 5%, level 3 in 2% and level 4 in 0,8% of the subjects. Level 1 eyelash whitening was detected in 1,8%, level 2 in 0.3%, and level 3 in 0.3% of the subjects.

No level 4 whitening was detected among our subjects. In our study, level 3 whitening was 0.3% in subjects ages 51–60 and 4% among those 71–80 years of age. Thibaut et al performed eyelid biopsy on a total of 17 subjects (16 men and 1 woman) ages 68 to 87 and reported highly pigmented eyelashes [2]. This result is consistent with our findings.

We found a lower level of eyebrow whitening in women when compared with men. There was no gender difference regarding eyelash whitening. When the mean age of women (62.46±10.51 years) and men (60.88±9.16 years) with eyelash or eyebrow whitening was compared, no significant difference was detected. We did not find any previous study that investigated the utility of eyelash and eyebrow whitening for age estimation in the literature. On the other hand, a study from Japan compared whitening of pubic hairs of men and women. Haga et al reported that onset of pubic hair whitening was at age 30 among men and age 36 among women [18].

In conclusion, men had a significantly increased rate of level 1, 2, 3, and 4 bilateral eyebrow whitening when compared with women (p<0.01). Therefore, particularly after 51–60 years of age (in which every level of whitening can be observed), men's eyebrows can be important for age estimation.

We determined that degrees of whitening of eyebrows and eyelashes are in line with the other parameters routinely used for estimation of age.

Conclusions

In our study, age distribution was significantly different for right or left eyebrow level of whitening ($p<0.01$). This was also true for right and left eyelash whitening ($p<0.01$). Therefore, particularly after 41–50 years of age, level of eyebrow and eyelash whitening may be a useful age estimation parameter. Particularly during middle- and old-age, when age estimation is more difficult due to closure of epiphysis in long bones, the importance of eyelash and eyebrow whitening increases and may useful along with other parameters.

Statement

The authors received no financial support for the research and/or authorship of this article. The authors declare that they have no conflict of interest in the publication of this article.

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