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Original Article

Dentistry Section

Assessment of Gingival, Lip and Skin Pigmentation and its Association with Willingness towards Depigmentation among South Indian Female Population: A Cross-sectional Study

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ABSTRACT

Introduction: Facial appearance depends on various factors, including both intraoral and extraoral features. The association between skin pigmentation and gingival pigmentation has been previously established. Severe gingival pigmentation remains an aesthetic concern for individuals, regardless of skin colour.

Aim: To explore the relationship between lip, skin and gingival pigmentation and the willingness of South Indian women to undergo depigmentation procedures.

Materials and Methods: This cross-sectional study was conducted at the Department of Periodontology, Chettinad Dental College and Research Institute, Chennai, Tamil Nadu, India, from April 2023 to September 2023. A total of 500 South Indian women aged 21-39 years were included. Participants who provided informed consent and had not undergone any antibiotic therapy in the six months prior to participation were included. Individuals were excluded if they had previously undergone any form of aesthetic gum correction, or if they had periodontitis or any gingival pathology affecting gum colour, such as Addison's disease or malignant neoplasms like Kaposi's sarcoma. Clinical examinations were conducted to determine lip, skin and gingival colour based on established criteria and validated classifications. Gingival pigmentation and lip pigmentation was classified. Information on area of residence, income, skin type, lip pigmentation, gingival pigmentation type and willingness to undergo depigmentation procedures was also recorded after explaining the available treatment options. Statistical analysis was performed using IBM Statistical Package for the Social Sciences (SPSS) Statistics for Windows, Version 21.0 (IBM Corp., Armonk, NY, 2012).

Results: The mean age of the study population was 27.23±4.39 years. Moderate gingival pigmentation was most prevalent among the participants 295 (59%). Regarding skin colour, 323 (64.6%) had brown skin, 143 (28.6%) had fair skin and 1 (0.2%) had dark skin pigmentation. The association between skin colour and gingival pigmentation was statistically significant ($p<0.001$). Most participants exhibited mild gingival pigmentation (LC2). LC5 and LC6 were not observed in any subjects. The association between lip colour and gingival pigmentation was also statistically significant ($p<0.001$). Gingival pigmentation showed a very weak positive correlation with willingness to undergo treatment ($r=0.017$, not significant). Lip pigmentation demonstrated a very weak negative correlation with willingness ($r=-0.089$, $p=0.046$), while skin pigmentation showed a very weak positive correlation with willingness ($r=0.106$, $p=0.018$).

Conclusion: The study results demonstrated a significant association between gingival pigmentation and skin colour, as well as between gingival pigmentation and lip colour.

Keywords: Aesthetics, Gingiva, Melanin, Melanocytes, Plastic surgery

INTRODUCTION

Smile is perceived as the harmony between gums and teeth. The health and appearance of the gingiva and teeth are major components of an aesthetic smile. The colour of the gingiva can vary from pale pink to bluish-red, depending on the level of pigmentation present. Severe gingival pigmentation does not correspond to any serious disease entity, but it can cause psychosocial issues in individuals, leading to low self-esteem, especially in patients with a gummy smile [1]. Ethnicity plays a role in the prevalence of gingival melanin pigmentation, with individuals of African, Asian, or Middle Eastern descent more commonly exhibiting this feature [2].

Common causes of gingival pigmentation include melanin deposition, smoking or tobacco use, systemic conditions such as Addison's disease, dental restorations, hormonal changes and malignant neoplasms such as melanoma and Kaposi's sarcoma [3]. Treatment options may include topical agents, laser therapy, cryosurgery, radiosurgery, electrosurgery, or surgical procedures such as the conventional scalpel method and bur abrasion technique [4]. It is important to note that any changes in gingival pigmentation should be evaluated by a dental professional to determine the most appropriate course of action based on the individual's specific situation. Various depigmentation procedures have been developed and are currently used in clinical practice to reduce or eliminate pigmented melanotic areas in the gingiva [5].

The present study investigates the relationship between skin and lip pigmentation and the intensity of gingival pigmentation, while also exploring the influence of individual income on the likelihood of seeking aesthetic procedures. This provides new insights into the socioeconomic factors that may impact decisions related to gingival aesthetics, as most previous studies [1,6-8] have focused on genetic, racial and environmental determinants of gingival pigmentation, largely overlooking socioeconomic factors such as income, education and accessibility to aesthetic treatments.

Melanocytes are a heterogeneous group of unicellular cells that primarily reside in the basal cell layer of the epidermis and oral epithelium [9]. The process of pigmentation consists of three phases: activation of melanocytes, synthesis of melanin and expression of melanin.

The present study aimed to determine the association among gingival, skin and lip pigmentation with willingness to undergo depigmentation procedures among South Indian women. Through the present study, an assessment of treatment needs to improve gingival aesthetics can be made in the future.

MATERIALS AND METHODS

The present cross-sectional study was conducted at the Department of Periodontology, Chettinad Dental College and Research Institute, Chennai, Tamil Nadu, India, from April 2023 to September 2023. Ethical approval for this study was obtained from the Institutional Human Ethics Committee (Proposal ID: IHEC-II/0319/23).

Sample size: The study included 500 participants aged 21-39 years, selected using convenient sampling from patients visiting the dental outpatient department for routine dental check-ups and oral prophylaxis. Participants were included after explaining the objectives of the study and obtaining informed consent.

The age, area of residence (urban/rural), income and willingness to undergo depigmentation procedures were recorded after explaining the available treatment options.

Inclusion criteria: Participants were included if they had not undergone any antibiotic therapy in the six months prior to participation.

Exclusion criteria: Exclusion criteria included previous aesthetic correction of the gums, as such procedures could alter natural pigmentation. Individuals with periodontitis or gingival pathologies affecting gingival colour due to systemic diseases such as Addison's disease or malignant neoplasms like Kaposi's sarcoma were also excluded. Participants with pigmentation changes caused by drugs or chemical exposure were additionally excluded to ensure the accuracy and reliability of the findings.

Study Procedure

Gingival pigmentation: Dummett CO and Gupta OP introduced the Oral Pigmentation Index, known as the DOPI, in 1964. The DOPI index is widely used due to its simplicity and ease of application [10,11]. The scores are as follows:

Score 0: No clinical pigmentation (pink-coloured gingiva) [Table/Fig-1a]

Score 1: Mild clinical pigmentation (light brownish colour) [Table/Fig-1b]

Score 2: Moderate clinical pigmentation (medium brown or mixed pink and brown colour) [Table/Fig-1c]

Score 3: Heavy clinical pigmentation (deep brown or bluish-black colour) [Table/Fig-1d]

The DOPI assigns a composite numerical value to the overall melanin pigmentation observed in the oral cavity during clinical examination. For the gingiva, the assessment is conducted separately for each arch. It is determined by averaging the pigmentation estimates assigned to the lingual and buccal unit spaces, divided by the total number of unit spaces in the arch. Each maxillary and mandibular gingiva is divided into 32 unit spaces on the lingual side and 16 on the buccal/labial side. Each unit space corresponds to the area of the marginal gingiva, extending from the gingival crest to the attached gingiva. Each of these unit spaces is assigned a numerical pigmentation estimate [11].

$$\text{DOPI assessment} = \frac{\text{Sum of assigned estimates of components}}{\text{32 unit spaces}}$$

The following is the DOPI assessment values [Table/Fig-2] according to the pigmentation levels [11].

[Table/Fig-1]: Gingival pigmentation (DOPI Index).
{a) Score 0- No clinical pigmentation; b) Score 1 - Mild clinical pigmentation; c) Score 2 - Moderate clinical pigmentation; d) Score 3 - Heavy clinical pigmentation}.

Score	Description
0	No clinical pigmentation of the gingiva
0.031-0.97	Mild gingival pigmentation
1.0-1.9	Medium gingival pigmentation
2.0-3.0	Heavy gingival pigmentation

[Table/Fig-2]: DOPI assessment.

Lip colour: Lip colour was categorised according to the lip tone classification by Iyer VH and Farista S [12]:

LC1: Pink lips (no islands of melanocytes)

LC2: Light brown (few light brown islands of melanocytes)

LC3: Brown (mild dark-hued islands of melanocytes)

LC4: Dark brown (moderate dark-hued islands of melanocytes)

LC5: Chocolate brown (dark-hued islands of melanocytes)

LC6: Blackish brown (severe dark-hued islands of melanocytes)

Skin colour: Stokowski RP et al., categorised skin colour into four groups: fair, whitish, brown and dark. This classification was achieved by comparing the colour of the inner aspect of the upper arm- an area less exposed to sunlight- to standardised photographs of individuals previously graded into these categories. Detailed records were made of the macroscopic distribution and colour of pigmentation across all surfaces [13].

STATISTICAL ANALYSIS

Data were entered into Microsoft Excel (Microsoft Corp., Redmond, WA). Statistical analysis was performed using IBM SPSS Statistics for Windows, Version 21.0 (IBM Corp., Armonk, NY, 2012). Quantitative data, such as age, were expressed as mean±standard deviation. Qualitative data were expressed as frequency and percentage. Fisher's-exact test was applied for categorical variables and Spearman's rank correlation was used to assess correlations among variables. A p-value<0.05 was considered statistically significant.

RESULTS

A total of 500 females participated in the study, aged 21-39 years. The mean age of the study population was 27.23±4.39 years. Among the participants, 386 (77.2%) resided in urban areas, while 114 (22.8%) resided in rural areas [Table/Fig-3] [10-13].

A total of 54 participants (10.8%) were willing to undergo treatment, whereas 446 participants (89.2%) were not willing to undergo aesthetic gum procedures. The majority of subjects had brown (64.6%, n=323) or whitish (28.6%, n=143) complexions, with only 1 participant (0.2%) having a darker complexion. Most subjects were categorised as LC2 (76.2%, n=381), indicating mild gingival pigmentation. LC5 and LC6 were not observed in any of the subjects.

Parameters		n (%)
Urban/rural	Urban	386 (77.2%)
	Rural	114 (22.8%)
Income (INR/month)	More than 40k	193 (38.6%)
	30k-40k	102 (20.4%)
	20k-30k	40 (8.0%)
	10k-20k	5 (1.0%)
	Students	81 (16.2%)
	No	79 (15.8%)
Skin type (Stokowski RP et al.,) [13]	Dark	1 (0.2%)
	Brown	323 (64.6%)
	Wheatish	143 (28.6%)
	Fair	33 (6.6%)
Gingival pigment (Dummett CO and Gupta OP) [10,11]	Mild	194 (38.8%)
	Moderate	295 (59.0%)
	Heavy	11 (2.2%)
Lip pigment (Iyer VH and Farista S) [12]	LC1	46 (9.2%)
	LC2	381 (76.2%)
	LC3	71 (14.2%)
	LC4	2 (0.4%)
Willingness	Willing	54 (10.8%)
	Not willing	446 (89.2%)

[Table/Fig-3]: Distribution of area of residence, income, skin type, lip pigmentation and gingival pigmentation type, willingness for treatment [10-13].

The association between skin type and gingival pigmentation according to the DOPI index was statistically significant (p<0.001**) [Table/Fig-4] [10,11,13].

Parameters		Gingival pigmentation (DOPI) [10,11]			p-value
		Mild	Moderate	Heavy	
Skin type (Stokowski RP et al.,) [13]	Dark	0	0	1	<0.001**
	Brown	59	254	10	
	Whitish	106	37	0	
	Fair	29	4	0	

[Table/Fig-4]: Association between skin type and gingival pigmentation [10,11,13].
*Fisher's-exact test
**p-value of <0.001- statistically significant

The association between lip colour and gingival pigmentation was statistically significant (p<0.001**), indicating that individuals with darker lips are more likely to exhibit increased gingival pigmentation. This suggests a role of melanin distribution in oral and perioral tissues [Table/Fig-5] [12]. Descriptive data for willingness to undergo treatment, in relation to income, gingival pigmentation, lip pigmentation and skin pigmentation, are shown in [Table/Fig-6] [10-13].

Parameters		Gingival pigmentation (DOPI) [11]			p-value
		Mild	Moderate	Heavy	
Lip Pigment (Iyer VH and Farista S) [12]	LC1	45	1	0	<0.001**
	LC2	146	232	3	
	LC3	3	61	7	
	LC4	0	1	1	

[Table/Fig-5]: Association between lip pigmentation and gingival pigmentation [12].
*Fisher's-exact test

Gingival pigmentation showed a very weak positive correlation with willingness to undergo treatment (r=0.017), which was not statistically significant. Lip pigmentation demonstrated a very weak negative correlation (r=-0.089, p=0.046*), while skin pigmentation revealed a very weak positive correlation (r=0.106, p=0.018*) with willingness to undergo treatment [Table/Fig-7].

Parameters		Willingness	
		Willing	Not willing
Income (INR/ month)	More than 40k	6	187
	30k-40k	10	92
	20k-30k	8	32
	10k-20k	3	2
	Students	12	69
	No	15	64
Gingival pigment (Dummett CO Gupta OP) [10,11]	Mild	32	162
	Moderate	20	275
	Heavy	2	9
Lip pigment (Iyer VH and Farista S) [12]	LC1	4	42
	LC2	33	348
	LC3	15	56
	LC4	2	0
Skin pigment (Stokowski RP et al.,) [13]	Dark	0	1
	Brown	23	300
	Wheatish	26	117
	Fair	5	28

[Table/Fig-6]: Descriptive data for income, gingival pigment, lip pigment and skin pigment and willingness for treatment [10-13].

		Gingival pigmentation	Skin pigmentation	Lip pigmentation
Willingness to pay	Correlation coefficient (r value)	0.017	0.106*	-0.089*
	Sig. (2-tailed)	0.708	0.018	0.046
	N	500	500	500

[Table/Fig-7]: Correlation of gingival, skin and lip pigmentation with willingness towards depigmentation.
*Spearman's rank correlation coefficient

DISCUSSION

Oral aesthetics is influenced by several factors, including tooth visibility, the proportions of the teeth in relation to the periodontal tissues and the health of the gingiva. A balanced and harmonious relationship between these elements contributes to an aesthetically appealing smile [14]. Excessive gingival display and hyperpigmentation of the gingiva are common concerns for patients seeking dental care. While gingival pigmentation is usually benign and does not pose significant health risks, it may be perceived as unaesthetic, particularly in individuals with a high smile line where the gingiva is prominently visible. Such concerns can affect self-esteem and motivate patients to seek aesthetic interventions, which can be rewarding [4,9].

The association between skin pigmentation and gingival pigmentation has been widely documented across various populations [6]. Steigmann S (1965) was among the first to establish a significant correlation between cutaneous and gingival pigmentation in a study of 201 Jewish Yemenite children (p<0.01) [8], a finding also noted in later studies by Ponnaiyan D et al., (2013) and Dosumu OO and Dosumu EB (2010) [1,6]. The findings of the present study are consistent with these, showing a statistically significant relationship between skin and gingival pigmentation (p=0.001).

A study by Patil H et al., (2016) provided statistical evidence (p<0.001) that skin colour is the primary determinant of gingival pigmentation, while gingival thickness also influences pigmentation levels [15]. The authors also observed that gender

does not significantly impact pigmentation severity. However, contrasting evidence from Nandanan N et al., (2016) found no significant association between facial skin pigmentation and oral pigmentation, suggesting that the relationship may be more complex or influenced by additional factors [7]. This discrepancy may be due to differences in population demographics, age range, or pigmentation assessment methods.

Interestingly, studies have also observed that the reappearance of pigmentation after depigmentation procedures is more common in individuals with darker skin tones. This may be attributed to the increased melanogenic potential in darker-skinned individuals, as reported by Kaur H et al., (2010) [16].

Koppolu P et al., (2024) reported that females (67.1%) exhibited darker gingiva compared to males (58.3%), with a significant association also found with geography and skin tone (p=0.001) [17]. In paediatric populations, Verma J et al., (2022) observed that males showed slightly more pigmentation than females (p=0.04), contrasting with adult trends and suggesting the influence of age and hormones on pigmentation expression [18].

The impact of smoking on gingival pigmentation has been explored in a study by Multani S (2013), which highlighted a significant association between lip and gingival pigmentation in smokers (p=0.001). This suggests that tobacco use may exacerbate pigmentation in both the lips and gingival tissues [19]. The study also observed that all individuals with lip pigmentation exhibited some form of gingival pigmentation. Similar results were observed in the present study (p=0.001), reinforcing the relationship between lip and gingival melanosis. This finding underscores the role of lifestyle factors in the expression of gingival pigmentation and highlights the need for clinicians to address these factors when discussing treatment options with patients.

While Prashaanthi N and Kaarthikeyan G (2020) found that males were more open to treatment than females and that younger individuals were more aesthetically conscious, socioeconomic status was not evaluated [20]. In contrast, the present study considered income levels and found that willingness to undergo depigmentation varied across income groups in a non linear pattern. Among the participants, only 54 (10.8%) expressed willingness for depigmentation, whereas the majority (446 participants, 89.2%) were not willing to undergo the procedure. The highest willingness was observed among participants with no earnings (15 participants, 18.9%), while interest declined with increasing income, dropping to just 3.1% among those earning above INR 40,000. These findings suggest that factors beyond income, such as aesthetic perception, social influence, or cultural pressures, may play a more significant role in motivating individuals to consider depigmentation treatments.

The present study is the first of its kind to assess gingival pigmentation in relation to lip and skin colour specifically among young South Indian females. Despite reports of higher pigmentation prevalence in women, our results showed minimal differences in willingness to undergo depigmentation procedures. The low willingness underscores the need for increased patient education. Dental professionals should emphasise awareness, personalise aesthetic consultations and communicate clearly about treatment safety and efficacy to enhance acceptance and patient satisfaction with aesthetic procedures.

Limitation(s)

The present study considered only individual income and did not account for broader socioeconomic status, which could have provided a more comprehensive perspective. The study focused exclusively on the female population, excluding males, whose inclusion could have offered better insights into gender-based aesthetic concerns.

CONCLUSION(S)

The findings of the present study indicate a significant association of gingival pigmentation with lip and skin colour. However, income level did not influence patient willingness to undergo depigmentation procedures. These results highlight the need for patient-centered approaches that address individual perceptions and motivations regarding aesthetic treatments.

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