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# Study On Association Of Skin Colour With Gingival Pigmentation Using Skin Phototype Scale, Melanin And Gingival - Melanin Pigmentation Index

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***Abstract***
***Background:*** *The physiological phenomena of gingival melanin pigmentation are seen across a wide range of ethnic groups. On the other hand, noticeable pigmentation frequently causes cosmetic issues, which increases the need for depigmentation procedures.*
***Aim:*** *The aim of this study was to examine and compare the association between skin color and gingival melanin pigmentation among participants in Chengalpattu district, aged 18–35 years.*
***Materials and methods:*** *A total of 150 participants, aged 18–35 years, were included. Participants' skin color was assessed in broad daylight and was graded using the Skin Phototype scale (Fitzpatrick scale). The assessment of gingival pigmentation was carried out using the Melanin Pigmentation Index (Hedin Index, 1997) and the Gingival-Melanin Pigmentation and Pigmented Lesions Index (Peeran et al., 2014). The scoring covered each arch segment, starting from the incisors and extending to the second premolars and correlated with skin color.*
***Results:*** *Of the 150 individuals, the majority, around 66.7%, had beige skin tone, and this shows that there is a substantial positive link between skin tone and gingival pigmentation; i.e., the darker the skin tone, the darker the gingival pigmentation.*
***Conclusion:*** *In this study, the gingival pigmentation and facial skin color were found to be strongly correlated ($P \leq 0.001$) in the South Indian population.*
***Keywords:*** *gingival melanin pigmentation, depigmentation, skin color, melanin*

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## I. Introduction

Human skin color ranges from the darkest brown to the lightest shades, primarily due to variations in

pigmentation, which result from a combination of genetics, sun exposure or both. Melanin is the major component that determines the skin color [(1)]. The main factor influencing skin tone in people with darker skin tones is melanin, which is produced by melanocytes. The most commonly pigmented area of intraoral tissues is the gingiva, the fibrous mucosa that surrounds the teeth. Gingival pigmentation is the process of pigment deposition that causes the gingiva to become colored or discolored [(1)].

Over the past decades, insight about gingival pigmentation and its causes has grown enormously. Though racial or physiologic pigmentation is not a medical concern, it may at times pose as an aesthetic issue. Light brown to black pigmentation is common and considered normal in individuals with darker skin tones, whereas similar pigmentation in Caucasians may be indicative of an abnormality [(1)].

The development of pigmentation is primarily influenced by an individual's genetic makeup, though its intensity can be modified by physical, chemical and hormonal factors [(2, 3)]. The ideal color of gingiva is coral pink in adults and reddish pink in children when seen in healthy individuals. Changes in gingival color are common and are believed to be related to cutaneous pigmentation [(1)].

Gingival color can vary from mild to dark brown or black. Skin tone, texture and color vary across different races and regions. The gingival color is primarily controlled by factors such as the number and size of blood vessels, epithelial thickness, degree of keratinization and the presence of pigments inside the gingival epithelium [(1)]. The key pigments associated with gingival color are melanin, carotene, reduced hemoglobin and oxyhemoglobin, with melanin being the most prevalent [(4)].

Megaloblastic activity is the primary determinant of melanin pigmentation severity, which varies from person to person. The Indian population has different shades of color, ranging from fair-skinned to dark-skinned. Various types of melanin pigmentation can be recognized among the Indian population. Confounding factors may include amalgam restorations near the gingiva, melanoma, long-term use of antimalarial medications, minocycline and hereditary influences [(5)].

Till date, various studies have been conducted by different authors on the association between skin color and gingival pigmentation, utilizing various indices and no other authors have done studies comparing the Skin Phototype Scale with the Melanin Pigmentation Index and the Gingival Melanin Pigmentation Index. Thus, the aim of this study was to assess and correlate these indices among participants from both male and female groups.

## II. Materials And Methods

This analytical cross-sectional study was carried out after getting ethical clearance from the Institutional Ethical Committee of Tagore Dental College and Hospital (Ref: IEC/TDCH/92/2024). A total of 150 patients aged between 18 and 35 years were selected from the outpatient Department of Periodontics & Implantology, Tagore Dental College and Hospital. The participants of the study were selected using the census method and also fulfilling inclusion criteria. Participants aged between 18 and 35 years with healthy gingiva who give their consent will be included in this study.

Participants presenting with systemic diseases that cause gingival pigmentation, altered skin color like albinism, gingival diseases that affect gingival architecture, active gingival and periodontal conditions, smokers and mixed-racial skin were excluded from the study.

Participants undergoing any periodontal/gingival treatment or therapy and also skin treatment procedures like chemical skin peeling were also excluded from the study.

Before the start of the study, informed consent was obtained from the participants after explaining all the relevant details, their importance, and their implications. The confidentiality of the volunteers was completely upheld. Then, the participant's demographic details, i.e., age, gender and address, were recorded. A data information sheet (proforma) was developed to collect information from the samples. The assessment of skin color was examined visually by recording the color of the inner aspect of the upper arm (unexposed area to sunlight) `used as a reference **figure 1(a-b),** and the shade was evaluated in broad daylight and graded using the Fitzpatrick **scale** [(5)]. In **figure 2,** a detailed description of methodology has been presented.

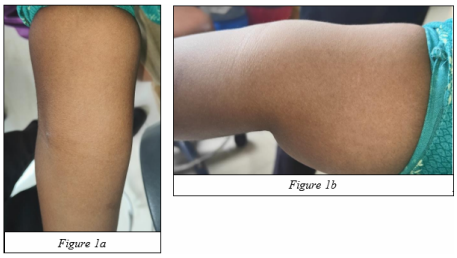



***Figure 1(a - b) – Inner aspect of the upper arm (unexposed area to sunlight)***

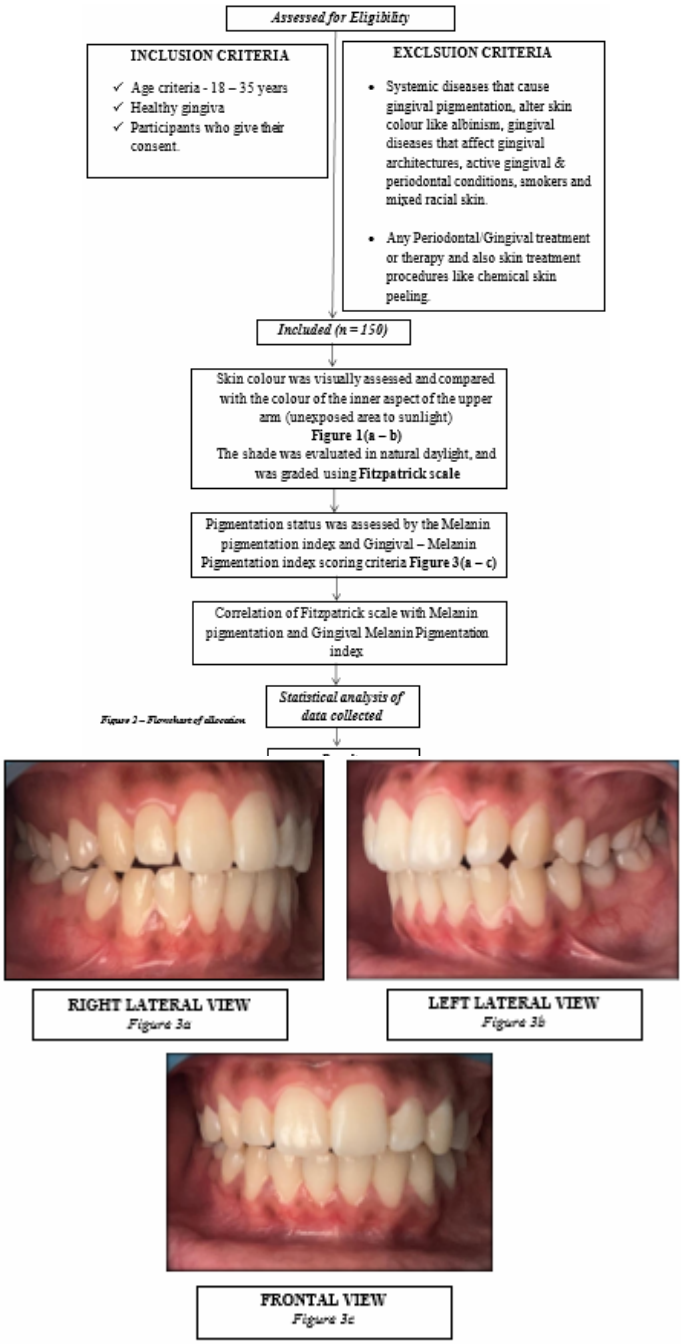



*Figure 3(a - c) – Gingival pigmentation of the Anterior and Posterior Gingiva*

**Skin Phototype Scale – (Fitzpatrick Scale)**[21]
**SCORE 1** - Pale white skin **SCORE 2** - White skin **SCORE 3** - Light brown skin
**SCORE 4** - Moderate brown skin
**SCORE 5** - Dark brown skin
**SCORE 6** - Deeply pigmented dark brown to black skin

Assessment of gingival melanin pigmentation was evaluated by doing a complete periodontal examination and was done by two trained examiners (double-examiner calibration). Then, the pigmentation status of the gingiva was evaluated by the Melanin pigmentation index and Gingival–Melanin Pigmentation index scoring criteria as mentioned below and the distribution of pigmentation was assessed in anterior and posterior teeth (incisors to second premolars of both arches) in the entire anatomical areas of the gingiva.

**Melanin Pigmentation Index - (Hedin Index-1997)**[21]
**SCORE 0 -** No pigmentation
**SCORE 1 -** One or two solitary unit(s) of pigmentation in papillary gingiva without the formation of a continuous ribbon between solitary units
**SCORE 2 -** More than three units of pigmentation in papillary gingiva without the formation of a continuous ribbon
**SCORE 3 -** One or more short continuous ribbons of pigmentation
**SCORE 4 -** One continuous ribbon including the entire area between canines

**Gingival – Melanin Pigmentation And Pigmented Lesions Index - (Peeran Et Al – 2014)**[21]
**SCORE 0**: Coral pink - coloured gingiva, no gingival pigmentation, and/or pigmented lesions.
**SCORE 1**: Mild, solitary/diffuse, gingival melanin pigmentation involving anterior gingiva, with or without the involvement of posterior gingiva.
**SCORE 2**: Moderate to severe, solitary or diffuse, gingival melanin pigmentation involving anterior gingiva with or without the involvement of posterior gingiva.
**SCORE 3**: Gingival melanin pigmentation only in posterior gingiva.
**SCORE 4**: Tobacco-associated pigmentation: Smoker's melanosis, chewing tobacco.
**SCORE 5**: Gingival pigmentation due to exogenous pigments: amalgam tattoos, arsenic, bismuth, chewing betel nut, cultural gingival tattooing, drinks, food colours, lead-burtonian line, mercury, silver, topical medications, idiopathic, etc.
**SCORE 6**: Gingival pigmentation due to other endogenous pigments: bilirubin, blood breakdown products, ecchymosis, hemochromatosis, hemosiderin, petechiae, etc.
**SCORE 7**: Drug-associated gingival pigmentation: antimalarial drugs, minocycline, oral contraceptives, etc.
**Score 8**: Gingival pigmentation associated with other causes: Addison's disease, Albright's syndrome, basilar melanosis with incontinence, hereditary hemorrhagic telangiectasia, HIV patients, lichen planus, neurofibromatosis, Peutz-Jeghers syndrome, pyogenic granuloma/granulomatous epulis, etc.
**SCORE 9**: Pigmented benign lesions: hemangioma, melanocytic nevus, pigmented macule.
**SCORE 10**: Pigmented malignant lesions: angiosarcoma, Kaposi's sarcoma, malignant melanoma.

**Statistical Analysis**

Data were analyzed using the statistical software RStudio for Windows (Ver 2024.09.1+394). Descriptive statistics were used in the analysis. A value of $P \leq 0.001$ was regarded as a statistically significant value. Chi-square test was used to determine the association between gingival pigmentation and skin color.

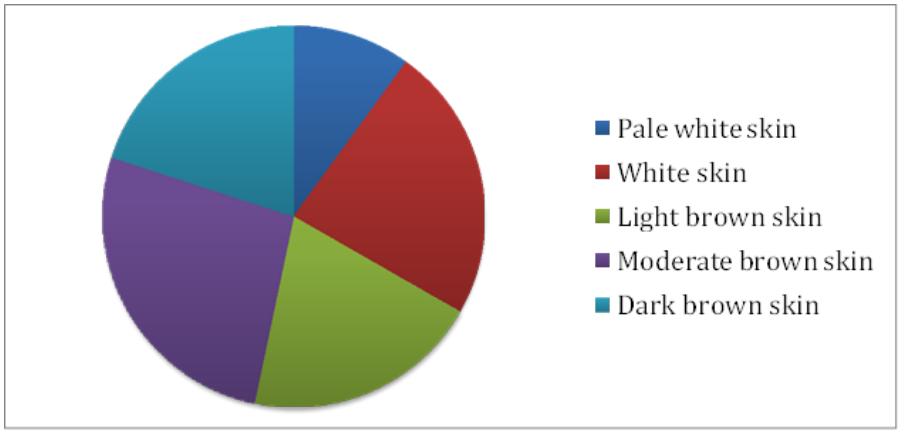
## III. Results

The study involved the examination of 150 individuals, out of which 75 (50%) were males and 75 (50%) were females.

Table 1 and Figure 1 illustrate the distribution of skin color in which, out of the total subjects, 10.0% were pale white skin color, 23.0% were white skin color, 20.0% were light brown skin color, 26.7% were moderate brown skin, 20.0% were dark brown skin, and deeply pigmented dark brown to black skin was found to be 0%.

| Skin color | Frequency | Percent |
|---|---|---|
| Pale white skin | 15 | 10.0 |
| White skin | 35 | 23.3 |
| Light brown skin | 30 | 20 |
| Moderate brown skin | 40 | 26.7 |
| Dark brown skin | 30 | 20 |
| Deeply pigmented dark brown to black skin | 0 | 0 |
| Total | 150 | 100 |

***Table 1 and Figure 3 – Distribution of Skin color***




Tables 2A and 2B illustrate the recordings of gingival pigmentation using the Melanin Pigmentation - HEDIN Index, in which each sextant has been assessed and given a score (0–4) based on the correlation of gingival pigmentation with the Hedin index in the upper and lower quadrants, respectively.

| Tooth no wise | Score 0 | Score 1 | Score 2 | Score 3 | Score 4 |
|---|---|---|---|---|---|
| **15** | 30 (20.0%) | 51 (34.0%) | 1 (0.7%) | 0 (0%) | 68 (45.3%) |
| **14** | 30 (20.0%) | 62 (41.3%) | 1 (0.7%) | 0 (0%) | 57 (38.0%) |
| **13** | 29 (19.3%) | 40 (26.7%) | 1 (0.7%) | 4 (2.7%) | 76 (50.7%) |
| **12** | 23 (15.3%) | 47 (31.3%) | 0 (0%) | 4 (2.7%) | 76 (50.7%) |
| **11** | 20 (13.3%) | 52 (34.7%) | 0 (0%) | 4 (2.7%) | 74 (49.3%) |
| **21** | 32 (21.3%) | 22 (14.7%) | 22 (14.7%) | 0 (0%) | 74 (49.3%) |
| **22** | 29 (19.3%) | 17 (11.3%) | 29 (19.3%) | 0 (0%) | 75 (50.0%) |
| **23** | 35 (23.3%) | 10 (6.7%) | 30 (20.0%) | 0 (0%) | 75 (50.0%) |
| **24** | 35 (23.3%) | 17 (11.3%) | 23 (15.3%) | 0 (0%) | 75 (50.0%) |
| **25** | 35 (23.3%) | 17 (11.3%) | 23 (15.3%) | 0 (0%) | 75 (50.0%) |

***Table 2A Gingival pigmentation using Melanin Pigmentation – HEDIN Index in the (Upper quadrant)***

| Tooth no wise | Score 0 | Score 1 | Score 2 | Score 3 | Score 4 |
|---|---|---|---|---|---|
| **45** | 28 (18.7%) | 38 (25.3%) | 24 (16.0%) | 0 (0.0%) | 60 (40.0%) |
| **44** | 27 (18.0%) | 39 (26.0%) | 24 (16.0%) | 0 (0.0%) | 60 (40.0%) |
| **43** | 21 (14.0%) | 21 (14.0%) | 36 (24.0%) | 4 (2.7%) | 68 (45.3%) |
| **42** | 8 (5.3%) | 35 (23.3%) | 27 (18.0%) | 4 (2.7%) | 76 (50.7%) |
| **41** | 12 (8.0%) | 39 (26.0%) | 21 (14.0%) | 4 (2.7%) | 74 (49.3%) |
| **31** | 21 (14.0%) | 22 (14.7%) | 28 (18.7%) | 10 (6.7%) | 69 (46.0%) |
| **32** | 21 (14.0%) | 21 (14.0%) | 28 (18.7%) | 10 (6.7%) | 70 (46.7%) |
| **33** | 7 (11.3%) | 21 (14.0%) | 28 (18.7%) | 14 (9.3%) | 70 (46.7%) |
| **34** | 27 (18.0%) | 12 (8.0%) | 28 (18.7%) | 13 (8.7%) | 70 (46.7%) |
| **35** | 28 (18.7%) | 13 (7.2%) | 28 (18.7%) | 13 (8.7%) | 70 (46.7%) |

***Table 2B Gingival pigmentation using Melanin Pigmentation – HEDIN Index (Lower quadrant)***

Tables 3A and 3B illustrate the recordings of gingival pigmentation using the Gingival Melanin Pigmentation and Pigmented Lesions Index - PEERAN ET AL., in which each sextant has been assessed and given a score of (0–4) based on the correlation of gingival pigmentation with the Peeran et al. index in the upper and lower quadrants, respectively.

| Tooth no wise | Score 0 | Score 1 | Score 2 |
|---|---|---|---|
| | 21 (14.0%) | 77 (51.3%) | 52 (34.7%) |

| | | | |
|---|---|---|---|
| **15** | | | |
| **14** | 21 (14.0%) | 77 (51.3%) | 52 (34.7%) |
| **13** | 20 (13.3%) | 66 (44.0%) | 64 (42.7%) |
| **12** | 9 (6.0%) | 70 (46.7%) | 71 (47.3%) |
| **11** | 14 (9.3%) | 68 (45.3%) | 68 (45.3%) |
| **21** | 15 (10.0%) | 60 (40.0%) | 75 (50.7%) |
| **22** | 9 (6.0%) | 70 (46.7%) | 71 (47.3%) |
| **23** | 23 (15.3%) | 55 (36.7%) | 72 (48.0%) |
| **24** | 28 (18.7%) | 51 (34.0%) | 71 (47.3%) |
| **25** | 28 (18.7%) | 51 (34.0%) | 71 (47.3%) |

***Table 3A Gingival pigmentation using Melanin Pigmentation – PEERAN ET AL Index (Upper quadrant)***

| **Tooth no wise** | **Score 0** | **Score 1** | **Score 2** |
|---|---|---|---|
| **45** | 28 (18.7 %) | 46 (30.7%) | 76 (50.7%) |
| **44** | 23 (15.3%) | 50 (33.3%) | 77 (51.3%) |
| **43** | 21 (14.0%) | 33 (22.0%) | 96 (64.0%) |
| **42** | 8 (5.3%) | 45 (30.0%) | 97 (64.7%) |
| **41** | 8 (5.3%) | 53 (35.3%) | 89 (59.3%) |
| **31** | 8 (5.3%) | 53 (35.3%) | 89 (59.3%) |
| **32** | 12 (8.0%) | 47 (31.3%) | 91 (60.7%) |
| **33** | 8 (5.3%) | 40 (26.7%) | 102 (68.0%) |
| **34** | 14 (9.3%) | 41 (27.3%) | 95 (63.3%) |
| **35** | 19 (12.7%) | 35 (24.0%) | 95 (63.3%) |

***Table 3B Gingival pigmentation using Melanin Pigmentation – PEERAN ET AL Index (Lower quadrant)***

Table 4A illustrates the recordings of the correlation between skin color and gingival pigmentation using the **Melanin Pigmentation – HEDIN Index** in the upper right lateral incisor **(22 region)**. Individuals with pale white skin color are higher in Score 0 (no pigmentation) of about 60.0%; individuals with white skin color are relatively higher in Score 1 (mild pigmentation) of about 42.9%; individuals with light brown skin, moderate brown skin, and dark brown skin show a higher score in Score 3 (moderate to severe pigmentation) of about 70.0%, 72.5%, and 80.0%, respectively, when compared to other scores, with statistically significant differences of P value (≤ 0.001).

| | **22 – MPH** | | | | |
|---|---|---|---|---|---|
| **SKIN COLOUR** | **SCORE 0** | **SCORE 1** | **SCORE 2** | **SCORE 3** | **P value** |
| **Pale white skin** | 9 (60.0%) | 0 (0.0%) | 6 (40.0%) | 0 (0.0%) | |
| **White skin** | 11 (31.4%) | 15 (42.9%) | 8 (22.9%) | 1 (2.9%) | |
| **Light brown skin** | 8 (26.7%) | 0 (0.0%) | 1 (3.3%) | 21 (70.0%) | |
| **Moderate brown skin** | 1 (2.5%) | 2 (5.0%) | 8 (20.0%) | 29 (72.5%) | |
| **Dark brown skin** | 0 (0.0%) | 0 (0.0%) | 6 (20.0%) | 24 (80.0%) | **0.001** |

| | | | | | |
|---|---|---|---|---|---|
| **TOTAL** | 29 (19.3%) | 17 (11.3%) | 29 (19.3%) | 75 (50.0%) | |

***Table 4A Correlation between Skin colour and Gingival Pigmentation using Melanin Pigmentation – HEDIN Index***

Table 4B illustrates the recordings of the correlation between skin color and gingival pigmentation using the Gingival Melanin Pigmentation and Pigmented Lesions Index - PEERAN ET AL. in the lower left second premolar (45 region). Individuals with pale white skin color are higher in Score 1 (mild pigmentation) of about 100.0%; individuals with white skin color are relatively higher at a score of 0 (no pigmentation) of about 60.0%; individuals with light brown skin, moderate brown skin, and dark brown skin show a higher score in Score 3 (moderate to severe pigmentation) of about 66.7%, 97.5%, and 53.3%, respectively, with statistically significant differences of P value (≤ 0.001).

| **SKIN COLOUR** | **45 – GMPP** | | | **P Value** |
|---|---|---|---|---|
| | **SCORE 0** | **SCORE 1** | **SCORE 2** | |
| **Pale white skin** | 0 (0.0%) | 15 (100.0%) | 0 (0.0%) | **0.001** |
| **White skin** | 21 (60.0%) | 13 (37.1%) | 1 (2.9%) | |
| **Light brown skin** | 1 (3.3%) | 9 (30.0%) | 20 (66.7%) | |
| **Moderate brown skin** | 0 (0.0%) | 1 (2.5%) | 39 (97.5%) | |
| **Dark brown skin** | 6 (20.0%) | 8 (26.7%) | 16 (53.3%) | |
| **Total** | 28 (18.7%) | 46 (30.7%) | 76 (50.7%) | |

***Table 4B Correlation between Skin colour and Gingival Pigmentation using Gingival Melanin Pigmentation and Pigmented lesions – PEERAN ET AL – Index***

## IV. Discussion

The normal pigmentation of the skin, gingiva and remaining oral mucous membrane is caused by melanin, a brown pigment that is not generated from hemoglobin. Melanocytes found in the basal and suprabasal layers of the epithelium create this most prevalent pigmentation[6].Melanoid, oxyhemoglobin, decreased hemoglobin, melanin and carotene are the five pigments that influence skin color, according to Edwards and Duntley [4]. The color disparities between the sexes and other body parts are caused by variations in the quantity and distribution of these pigments. The skin tone of the face varies by race. While the proportion of other pigments is the same in all races, the principal ectodermal melanin and melanoid synthesis vary in different amounts,which accounts for the majority of the color differences between races [4].

Gingival pigmentation manifests as irregularly shaped brown and light brown patches or as a diffuse, deep-purplish discoloration. It is frequently the only sign of pigmentation and can show up in the gingiva as early as three hours after birth [7].

In dentistry, aesthetics refers to both whiter teeth and pink gingiva, which is never easy for the Periodontist doing the treatment. Our bodies naturally contain a pigment called melanin, which gives our skin and gingiva their color

[12]. This always results in "Black Gingiva," where the patient's appearance is a top priority, particularly if they have a "Gummy Smile." In order to address this issue and raise the patient's aesthetic quotient, gingival depigmentation is performed to eliminate the gingiva's hyperpigmentation[12].

Assessing the prevalence of physiological gingival pigmentation and its correlation with skin color in the South Indian population was the goal of this work.

The demographic information of the participants in this study, such as age, gender and address, was noted and assessed in the natural light to determine their skin tone. The color of the inner part of the upper arm, which is comparatively sheltered from sunlight, has been used as a reference to grade the skin tone. According to Wright, the examiner's eyes were used to record the children's skin color in natural light [5]. Using a skin color shade guide, skin colors were categorized as pale white, white, light brown, moderate brown, dark brown, and deeply pigmented.

Participants in the current study were categorized based on the skin color shade guidance given above, which was used to record facial complexion. This study demonstrates a relationship between skin tone and gingival melanin pigmentation. The majority of the fair-skinned individuals in this study had mild gingival melanin pigmentation, whereas the majority of the brown and dark patients had medium gingival pigmentation. Since the histological nature of the skin and the gingiva are found to be similar, gingival pigmentation is always linked to skin pigmentation [1]. This could be the likely cause of excessive pigmentation in those with dark complexions.

Previous research has shown that the melanocytes in these patients are typically hypoactive or inactive [9]. Dosumu et al.'s [10] 2010 study revealed a statistically significant relationship between the pigmentation of gingival tissue and facial skin color. Conversely, research conducted by Dummett et al.,Kamat et al., and Patel et al.[1] has not demonstrated a relationship between gingival pigmentation and the complexion of the skin of the

face. The findings of our investigation contrast with those of a study by Dummett et al. [(11)] (1980), which found no connection between gingival pigmentation and facial skin colour.

In order to determine if skin tone and gingival melanin pigmentation are related, Patel et al. [(9)] studied maxillary anteriors. Skin tone and gingival melanin pigmentation did not correlate, according to this investigation as well

[(13)]. According to our current investigation, the results showed that skin tone and gingival melanin pigmentation were shown to be significantly positively correlated. The gingival pigmentation was darker in those with darker skin tones.

Although there is a known link between gingival pigmentation and facial skin color, the interaction between these two has long been a source of concern for numerous academics [(8)]. For many decades, researchers from all over the world have been working on it.

## V. Conclusion

In this study, the gingival pigmentation and facial skin color were found to be strongly correlated ($P \leq 0.001$) in the South Indian population among both genders. On the whole, this study also aids individuals in selecting a depigmentation treatment that matches their skin tone, aesthetic goals, the underlying causes of pigmentation, and the likelihood of treatment success based on skin characteristics. Moreover, results concluded that gingival depigmentation isn't suitable for all cases, and monitoring for recurrence is necessary.

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