

# Correlating Skin Color with Gingival Pigmentation Patterns in South Indians – A Cross Sectional Study

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## Abstract

**Aim:** Melanin pigmentation of the gingiva occurs in all ethnicities. Excessive pigmentation is an esthetic concern that has increased awareness about depigmentation procedures. The purpose of the present study was to correlate skin color and gender with intensity and distribution of gingival melanin pigmentation in a group of South Indians.

**Methods:** 200 male and female non smoking healthy subjects were included aged 18-35 years. A clinical examination of gingiva was performed to assess the anatomic distribution of gingival pigmentation. The intensity of gingival pigmentation and phenotype of gingiva were also observed. Subsequently the skin color was visually examined and assessed as fair, wheatish, brown and dark.

**Results:** Six classes of gingival pigmentation were defined based on anatomic distribution. Gingival pigmentation was observed as highest being in the attached gingiva and interdental papilla (25.4%) and least being in the marginal gingiva and interdental papilla (10.2%). Correlation between skin color and intensity of pigmentation was statistically significant, with dark skinned subjects having heavy gingival pigmentation and fair skinned having mild pigmentation. However, no correlation was found between gender and phenotype of gingiva with intensity and distribution of pigmentation.

**Conclusion:** South Indians predominantly have pigmentation in attached gingiva and interdental papilla. It appeared that the degree of gingival pigmentation of the gingiva and skin was reciprocally related. The highest rate of gingival pigmentation was observed in the area of the incisors. Incidence of pigmentation did not differ between the sexes. Majority of subjects had thick gingival phenotype. However, to study the exact variations in the patterns of gingival pigmentation multicentre studies with a larger sample size needs to be done in future for this population.

*Key Words: Gingival color, South Indians, Gingiva, Melanin, Pigmentation, Skin Color*

## Introduction

Melanin is the fundamental pigment that colors the tissues. It appears as early as 3 hours after birth in the oral tissues and in some cases is the only sign of pigmentation on the body [1]. It is a non-hemoglobin-derived pigment formed by the cells called melanocytes, which are dendritic cells of neuroectodermal origin located in the basal and spinous layers of the gingival epithelium [2]. Melanin granules are phagocytosed and contained within other cells of the epithelium and connective tissue, called melanophages or melanophores [3]. It is generally accepted that pigmented areas are present only when melanin granules synthesized by melanocytes are transferred to keratinocytes. This close relationship between melanocytes and keratinocytes was labeled by Fitzpatrick and Breathnach as the epidermal-melanin unit [4,5].

The gingiva is the fibrous mucosa surrounding the teeth covering the coronal portion of the alveolar process [6]. The gingiva is the most frequently pigmented of the intra-oral tissues as well as the most readily seen. Dummet [7] queried the frequently used description of normal gingiva as coral pink and suggested a more accurate statement of the pattern of normal pigmentation in the following definition. The color of healthy gingiva varies from pale pink to bluish purple. Between these limits of normalcy are a large number of colors which primarily depend on the intensity of the melanogenesis, degree of epithelial cornification, depth of epithelialization and the arrangement of gingival vascularity [7].

There are two basic color zones in the oral cavities of most people which comprise the attached and marginal gingiva on one hand and the adjacent alveolar mucosa on the other hand [2]. Studying gingival

color using the Munsell color system in dentistry, Ibusuki (1975) reported that gingival color varied with the position of the papillary, marginal and attached gingiva [8]. The color of the healthy gingiva is assumed to vary from pale pink and coral pink in Caucasians [9] to brown and blue black areas in Africans or Asians [10]. Indians more than any other ethnic group have a dramatic variation in their skin color. There are all shades ranging from fair to dark which spans out over the entire country. It has been observed that there is a gradient from north to south of the sub-continent with the North Indians close to European complexions and South Indian closer to sub-Saharan Africans [11].

Melanin hyperpigmentation of gingiva usually does not present as a medical problem, but many patients may consider their black gums to be unaesthetic. This problem is aggravated in patients with a "gummy smile" or excessive gingival display while smiling [12]. Gingival depigmentation is a periodontal plastic surgical procedure whereby the gingival hyperpigmentation is removed or reduced by various techniques [13]. The foremost indication for depigmentation therapy is the demand by a person for improved esthetics. Understanding the distribution of pigmentation will help in devising better treatment strategies. However, the anatomic distribution of gingival pigmentation and its intensity have not been reported in South Indians in previous studies. Thus the objective of the present study was to assess the distribution of physiologic gingival pigmentation, establish whether correlation exists between skin color and gender with intensity of physiologic gingival pigmentation and gingival phenotype.

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## Materials and Methods

This correlation investigation study was carried out at the Department of Periodontics, SRM Dental College and Hospital, Chennai, Tamil Nadu, India, for a period of six months. A total of 200 non smoking subjects (100 males and 100 females) who fell within the age group of 18-35 years were included in the present study. An informed consent was obtained from all subjects after explaining the nature of the procedures, the objectives and possible discomforts and risks of the study to them. The study was approved by ethical committee of SRM University. The inclusion criteria were uniformly pigmented and non-mottled gingiva. The skin color should be distinctly fair, wheatish, brown and dark which is similar to the criteria adapted by Aina et al. [14]. The exclusion criteria were patients with periodontitis or any gingival pathology which might induce color changes; drug or chemical pigmentation and mottling. Others are chemical skin toning, albinism and mixed racial skin.

### Evaluation of gingival pigmentation and skin color

The method used for intensity of physiologic gingival pigmentation evaluation in this study was the Dummett-Gupta Oral pigmentation Index (DOPI) [7]. This index represents the assignment of a composite numerical value to the total melanin pigmentation manifested on clinical examination of various oral tissues. The criteria are as follows:

0=Pink tissue (no clinical pigmentation)

1=Mild, light brown tissue (mild clinical pigmentation)

2=Medium brown or mixed pink or brown tissue (moderate clinical pigmentation)

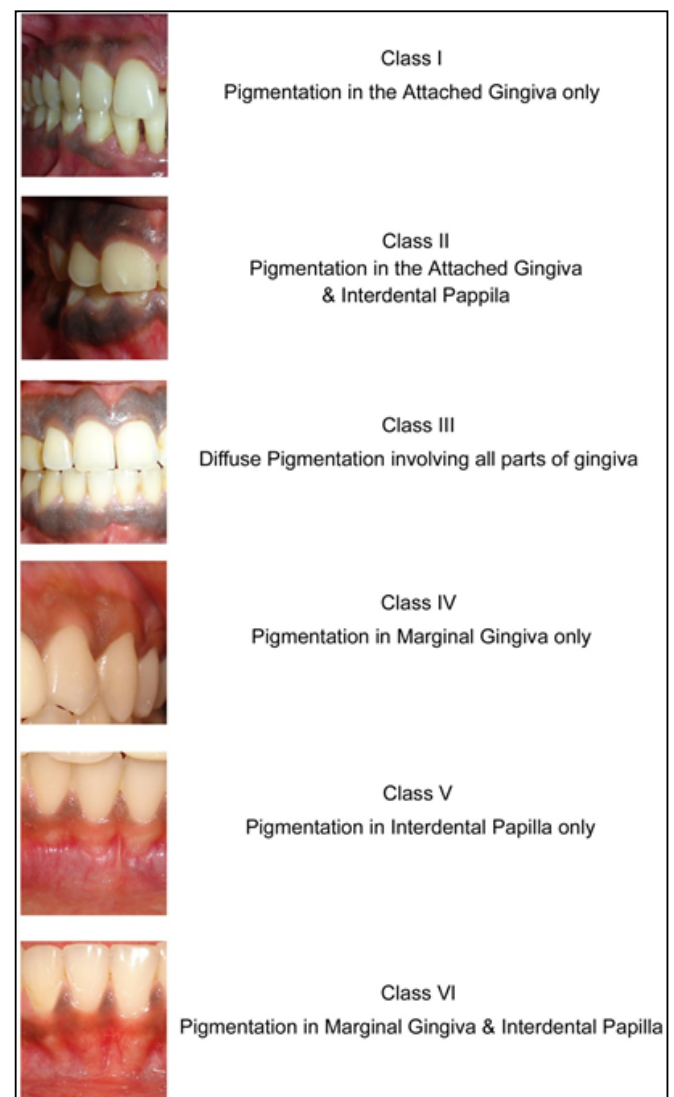
3=Deep brown or blue/black tissue (heavy clinical pigmentation)

The higher the number, the darker will be the oral pigmentation. One investigator was calibrated for the examination of the colors after been tested for normal color vision and color aptitude [15] using the line test, comparison of observers and of light sources with the use of a color rule [16]. The investigator was also seen to be adapted to daylight because higher intensity of light available from the day light sources may produce more color change. The observer views the specimen illuminated hence meeting the three conditions as highlighted by the International Commission on Illumination (CIE) [17]. Wright (1974) however stated that even after objective scientific evaluation, the eye is still the final judge of color [18]. To assess distribution patterns of pigmentation, oral photographs were obtained with a digital camera (Sony DSC- T700, Sony Electronics, San Diego, CA) with standardized settings for grey, white and black and a centimeter scale with standard lighting and backdrop conditions. The photographs were reproduced in a computer display. These reproductions exhibited sizes similar to that of the actual mouth. The distribution of pigmentation was assessed in anterior and posterior teeth in the entire anatomical areas of gingiva. The skin colors were assessed by visual examination under natural light and were divided into four groups depending on the variations in skin color found in South Indians as fair, wheatish, brown and dark [11]. Skin color was classified by comparing the color of the inner aspect of the upper arm, which is relatively unexposed to sunlight with color photographs taken of similar areas of individuals who had previously been graded as fair skinned, wheatish, brown and dark. The macroscopic distribution and color of the pigmentation of all surfaces were recorded in detail. Following this the phenotype of gingiva was assessed by inserting the periodontal probe into the sulcus and assessing the visibility on the outer surface [19]. All examination was carried out by one single examiner. The phenotype

was grouped as thick and thin. Pearson Chi Square test was applied to test the correlation of variables.

## Results

Based on the evaluation of the subjects, a classification scheme describing the patterns of anatomic distribution of gingival pigmentation was formulated. The chart is presented in *Figure 1*. Six categories were defined. All subjects were subsequently allotted one of the categories. It was observed that pigmentation was more in the attached gingiva and interdental papilla (Class II) and least being in the marginal gingiva and interdental papilla together (Class VI) (*Figure 2*). There were variations in the skin color and it was observed that majority of subjects had wheatish (68%) and fair (67%) complexions with the least being dark skin color (21%). The correlation of skin color and intensity of gingival pigmentation according to Dummett-Gupta Oral pigmentation Index (DOPI) was done and a positive correlation was observed. Skin color was in fact related to the intensity of pigmentation which was highly significant (*Table 1*). It was observed that fair skin people had mild gingival pigmentation (18.5%) whereas dark skinned people had heavy pigmentation (10.5%; *Figure 3*). There was no significant correlation between gender and distribution of gingival pigmentation (*Table 2*). The correlation between gingival phenotype and intensity of gingival pigmentation was not significant but however it was observed that 68% of subjects had thick gingival phenotype (*Table 3*).



**Figure 1.** Classification of gingival pigmentation pattern in South Indians.

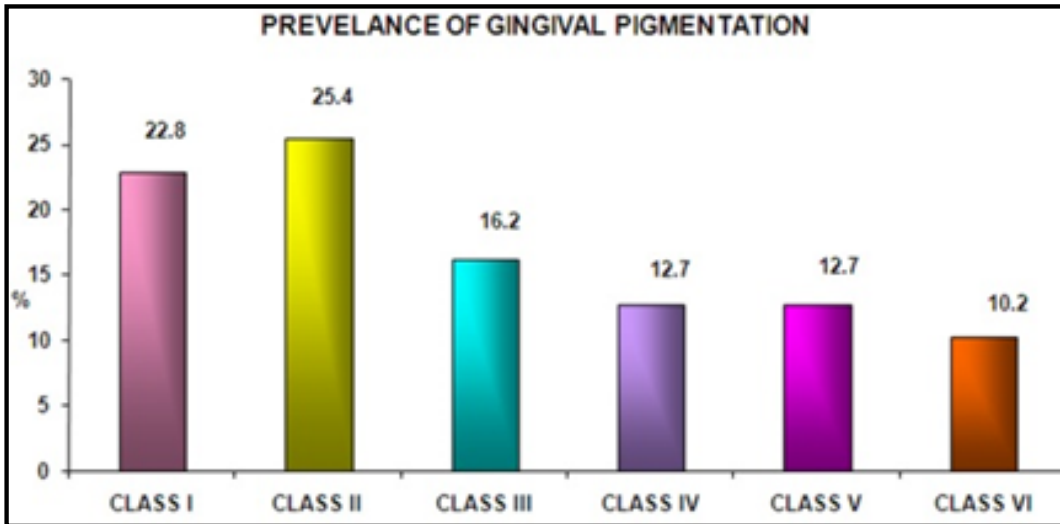


Figure 2. Prevalence of anatomic distribution of gingival pigmentation.

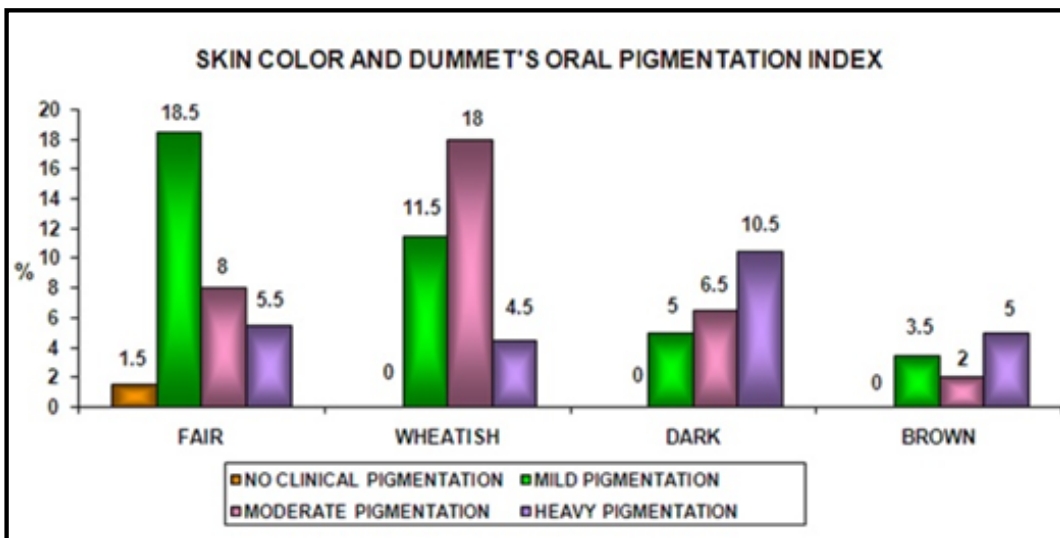


Figure 3. Correlation of skin color with intensity of gingival pigmentation.

Table 1. Correlation between skin color and intensity of gingival pigmentation.

			Dummet's Oral Pigmentation Index				Total
			No Pigmentation	Mild Pigmentation	Moderate Pigmentation	Heavy Pigmentation	
Skin	Fair	Count	3	37	16	11	67
		% of Total	1.5 %	18.5%	8.0%	5.5%	33.5%
	Wheatish	Count	0	23	36	9	68
		% of Total	0.0%	11.5%	18.0%	4.5%	34.0%
	Dark	Count	0	10	13	21	44
		% of Total	0%	5.0%	6.5%	10.5%	22.0%
	Brown	Count	0	7	4	10	21
		% of Total	0%	3.5%	2.0%	5.0%	10.5%
Total	Count	3	77	69	51	200	
	% of Total	1.5%	38.5%	34.5%	25.5%	100%	

\*Correlation between skin color and intensity of gingival pigmentation. Data are ± standard deviation. P value < 0.001 is highly significant. Observed P value 0.000. Therefore highly significant.

Table 2. Correlation between gender and distribution of gingival pigmentation.

Sex			Full Mouth					Total
			Class I	Class II	Class III	Class IV	Class V	
Male	Count	18	29	17	12	14	10	100
	% total	9.1%	14.7%	8.6%	6.1%	7.1%	3.6%	42.9%
Female	Count	27	21	15	13	11	13	100
	% total	13.7%	10.7%	7.6%	6.6%	5.6%	6.6%	50.8%
Total	Count	47	50	32	25	25	20	200
	% total	22.8%	25.4%	16.2%	12.7%	12.7%	10.7%	100.0%

\*Correlation between gender and distribution of gingival pigmentation. Patterns of gingival pigmentation, defined in classes as pigmentation in - attached gingiva (Class I), attached gingiva and interdental papilla (Class II), all parts of gingiva (Class III), marginal gingiva only (Class IV), interdental papilla only (Class V), marginal and interdental papilla (Class VI). Data are given ± SD. P < 0.001 is considered highly significant. Observed P value = 0.373. Therefore not significant.

**Table 3.** Correlation of phenotype of gingiva and intensity of pigmentation.

Gingival Phenotype		Dummet Oral Pigmentation Index				Total
		No Pigmentation	Mild Pigmentation	Moderate Pigmentation	Heavy Pigmentation	
Thick	Count	3	47	46	40	136
	% Total	1.5%	23.5%	23.0%	20.0%	68.0%
Thin	Count	0	30	23	11	64
	% Total	0.0%	15.0%	11.5%	5.5%	32.0%
Total	Count	3	77	69	51	200
	% Total	1.5%	38.5%	34.5%	25.5%	100.0%

\*Correlation between phenotype of gingiva and intensity of pigmentation. Data are mean  $\pm$  standard deviation. P value  $<0.001$  is highly significant. Observed P value 0.125. Therefore not significant.

## Discussion

Gingival hyper pigmentation is seen as a genetic trait in some populations, and is more appropriately termed physiologic or racial gingival pigmentation [20]. The prevalence of melanin pigmentation in different populations has been reported to vary between 0% to 89% with regard to genetic factors and secondary influences and perhaps environmental factors like smoking habits [21].

Among the same race the depth of color depends on density of melanin and degree of melanoblastic activity. There are three basic types or melanin, eumelanin, pheomelanin, and neuromelanin. The most common type is eumelanin, and is produced in 'black' and 'brown' subtypes. In general, people whose ancestors lived for long periods in the regions of the globe near the equator have larger quantities of eumelanin in their skins. This makes their skins brown or black [22]. The most recent scientific evidence indicates that all humans evolved in Africa [23], then populated the rest of the world through successive radiations. It seems likely that the first modern humans had relatively large numbers of eumelanin-producing melanocytes. In accordance, they had darker skin as with the indigenous people of Africa today. As some of these people migrated and settled in areas of Asia and Europe, the selective pressure for eumelanin production decreased in climates where radiation from the sun was less intense resulting in lesser skin and oral pigmentation. Thus high levels of oral melanin pigmentation are normally observed in individuals of African, East – Asian or Hispanic ethnicity [24].

In the present study an attempt has been made to assess anatomic distribution of melanin pigmentation in the gingiva and also quantify it in a South Indian Population, who have darker skin color owing to more melanin content and tend to have more oral pigmentation than their counterparts in North and Northeast India [11].

The distribution of gingival pigmentation is quite unique in South Indians. In the present study it was observed that majority had pigmentation in the attached gingiva and interdental papilla (Class II). This finding was in contrast to a Jewish population study where they found attached gingiva only to be the most common pigmented anatomic division [25] and a South African population where pigmentation was most frequently seen in the interdental papilla [26]. This establishes the fact that there is racial variation in the pigmentation of the gingiva.

Extra oral tissue color (e.g. cheeks) appears to be an indication of the color of the gingiva and mucosa in about 85% of the cases [27-29]. The color of gingiva has been correlated with facial complexion

in the present study and it was highly significant. It was observed that dark skinned subjects had heavy gingival pigmentation whereas fair skinned subjects had mild pigmentation. These findings are similar to a previous study on an Indian population where incidence of pigmentation of the gingiva increases as the complexion changes to the darker shades [30]. It has been observed that in dark complexion people after surgical depigmentation the reappearance of pigmentation is more than people with fair complexion. This could be attributed to the increased intrinsic melanogenesis in dark complexion people [31]. Thus, skin color in fact can be a predictor for mucosal and gingival pigmentation.

There was no significant correlation of distribution pattern of gingival pigmentation and gender in the present study. This finding was similar to previous studies in other races [31-34].

In the present study the phenotype of gingiva has been correlated with the intensity of gingival pigmentation which has not been done in previous studies. It was seen that there was no significant correlation, however the majority of subjects had thick phenotype. This finding was in contrast to previous studies done on Indians. This finding could be attributed to the fact that there is ethnic variation even within the same race for gingival phenotype [19,35].

## Conclusion

Gingival pigmentation has become a major esthetic concern among patients today. In view of this depigmentation procedures have emerged as a mainstay of periodontal treatment. With the findings of the present study it can be concluded that in South Indians there is correlation between oral and cutaneous pigmentation which was proved statistically beyond doubt. A relationship between the intensity of oral pigmentation and skin color was statistically established. The incidence of pigmentation did not differ between the sexes. There was a pattern of distribution of pigmentation which was observed. The highest rate of gingival pigmentation was in the area of the incisors and the rate decreased considerably in the posterior areas.

There was no correlation between phenotype of gingiva and intensity of gingival pigmentation although majority of subjects had thick phenotype. More multicentre studies with larger patient samples needs to be done in future to observe the variations in gingival pigmentation patterns and its correlation with skin color in this specific population.

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