

Prevalence of Gingival Pigmentation and its Association with Gingival Biotype and Skin Colour

Dr. Arjun Hari Rijal,¹ Dr. Bhageshwar Dhama,¹ Dr. Nashib Pandey,¹ Dr. Deepa Aryal¹

¹Department of Periodontics, Kantipur Dental College and Hospital
Basundhara, Kathmandu, Nepal.

ABSTRACT

Introduction: The facial appearance depends on several oral and extraoral factors including colour of facial skin and pigmentation of gingival epithelium. The colour of the gingiva varies among individuals and is thought to be associated with cutaneous pigmentation which ranges from light to dark brown or black colour.

Objective: To assess the prevalence of physiological gingival pigmentation, gingival biotype and their association with skin colour in Nepalese subjects visiting Kantipur Dental College and Hospital (KDCH).

Methods: This was an analytical cross-sectional study which was carried out from February 2020 to June 2020 in all patients of age-group 16 to 80 years visiting the Department of Periodontics at KDCH after ethical approval. Patients were recruited by convenience sampling and examined thoroughly to find out gingival biotype and extent of gingival pigmentation intraorally as well as skin colour extraorally.

Results: In this study, 210 patients were examined among which, 105 (50%) were males and 105 (50%) were females. Out of 210, 33 (15.7%) had pink tissue without pigmentation, 84 (40%) had pigmentation only in attached gingiva, 58 (27.6%) in attached gingiva and interdental papilla, 32 (15.2%) had diffuse pigmentation involving all parts of gingiva, 2 (1%) had in marginal gingiva only, and 1 (0.5%) in marginal gingiva and interdental papilla.

Conclusion: A strong association was found between gingival pigmentation and facial skin colour in present study ($P < 0.001$). Establishing the pattern of gingival pigmentation in Nepalese population will help to choose a specific depigmentation therapy that will harmonise with skin colour.

Keywords: Gingival biotype; gingival pigmentation; skin colour.

INTRODUCTION

Gingiva is the part of the oral mucosa that covers the alveolar processes of the jaws and surrounds necks of the teeth.¹ The colour of gingiva is “coral pink”; produced by vascular supply, thickness and degree of keratinisation of epithelium, and the presence of pigment-containing cells.¹ The distribution of oral pigmentation in black individuals is as follows: gingiva, 60%; hard palate, 61%; mucous membrane, 22%; and tongue, 15%.²

Facial appearance depends on several oral and extraoral factors including colour of facial skin and pigmentation of gingival epithelium.³ These factors are strongly associated

with pleasant as well as unpleasant appearance. The colour of the gingiva is various among different individuals and it is thought to be associated with cutaneous pigmentation. It varies from light to dark brown or black. The skin tone, texture and colour differ in various races and regions.³

Few studies have been done assessing the prevalence of gingival pigmentation and its relation with facial skin colour but the authors could not find any such study in the Nepalese population. Therefore, the study was designed with an aim to assess the gingival pigmentation and its relation with skin colour in Nepalese individuals visiting Kantipur Dental College and Hospital (KDCH).

METHODS

This analytical cross-sectional study was carried out at the Department of Periodontics, KDCH, from February 2020 to June 2020 after getting ethical clearance from institutional review committee (Ref. 17/2020). The privacy of the volunteers was fully maintained and informed consent was

Correspondence

Dr. Arjun Hari Rijal
Email: rajrijal27@gmail.com



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taken after explaining all the relevant details, its importance, and its implications. Those who did not give consent for any reason were excluded from the study.

A total of 210 patients (105 males and 105 females) aged between 16-80 years were included in the present study. Sample size of 210 was calculated using data from the study of Ponnaiyan et al.³ by utilising the following formula:

$$\text{Sample Size} = \frac{Z^2 \times p(1-p)}{e^2}$$

$$= 208 \sim 210$$

Where, Z = 1.96 at confidence level = 95%; p = prevalence of gingival pigmentation = 0.162 (16.2%); q = 0.838 (83.8%) with Margin of error (e) = 0.05 (5%).

The inclusion criteria included all male and female patients visiting the Department of Periodontics and willing to participate in the study signing informed consent. Exclusion criteria were: individuals with age of ≤ 15 years and ≥ 81 years who are not able to understand the purpose of the study, are not able to give written consent after giving the information sheet and being informed verbally about the study, patients with systemic diseases that cause gingival pigmentation, systemic diseases that alter skin colour like albinism, gingival diseases that affect gingival architectures. Others were chemical skin peeling, smokers, mixed racial skin, etc. which may affect the pigmentation and facial skin colour.

A data information sheet (proforma) was developed to collect information from the samples. Individuals attending the Periodontics department of KDCH was invited to participate in this study. A complete periodontal examination was done by two trained examiners. The pigmentation status of gingiva was assessed by visual examination and cross-examination was done with the help of another examiner. Inter-examiner reliability was calculated with Cohen's Kappa Statistics, value showed 0.803 (0.61-0.80 = substantial agreement).

Pigmentation status was classified according to Dummet/Gupta² and Ponnaiyan et al.³ classification of gingival pigmentation.

Dummet-Gupta Oral pigmentation Index²

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)

This index represents the assignment of a composite numerical value to the total melanin pigmentation manifested in the clinical examination of various oral tissues. The higher the number, the darker is the oral pigmentation.

Ponnaiyan et al 2013³

Class I – Pigmentation in the attached gingiva only

Class II – Pigmentation in attached gingiva and interdental papilla

Class III – Diffuse pigmentation involving all parts of the gingiva

Class IV – Pigmentation in marginal gingiva only

Class V – Pigmentation in interdental papilla only

Class VI – Pigmentation in marginal gingiva and interdental papilla

The distribution of pigmentation was assessed in anterior and posterior teeth in the entire anatomical areas of the gingiva.

The thickness of the gingiva/gingival biotype was measured with the help of a periodontal probe. Periodontal probing was done and marginal gingiva was raised slightly. Based on the visibility of the probe, it was classified as a thin (if probe was visible) and thick (if probe was not visible) gingival biotype.⁴

Colour of skin was assessed visually on the region of the zygoma of the face and in a place, which would not be exposed to the sun (such as under the arm or behind the ear). The shade was evaluated in natural daylight.

Skin colour was classified according to the Fitzpatrick scale.⁵

Type	Skin type
I	Pale white skin
II	White skin
III	Light brown skin
IV	Moderate brown skin
V	Dark brown skin
VI	Deeply pigmented dark brown to black skin

The data obtained were entered in Microsoft Excel 2019 and converted into IBM Statistical Package of Social Sciences (SPSS) Statistics for Windows, version 20 (IBM Corp., Armonk, N.Y., USA) for statistical analysis. Chi-square test was used to find out the association of skin colour and pigmentation, as well as between gingival biotype and pigmentation where, P was considered as less than 0.05.

RESULTS

In this study, 210 patients were examined among which, 105 (50%) were males and 105 (50%) were females. The mean age of participants was 38.6 ± 13.7 years. Out of 210, 148 (70.5%) were Aryans, 46 (21.9%) were Mongolians and 16 (7.6%) were mixed. Considering the religion, 195 (92.9%) were Hindus, 14 (6.6%) were Buddhists, and 1 (0.5%) was Muslim.

Thick gingival biotype (138, 65.7%) was more prevalent as compared to thin gingival biotype (72, 34.3%). In Figure 1, the extent of gingival pigmentation has been presented. Out of 210, 33 (15.7%) had pink tissue without pigmentation, 84 (40%) had pigmentation in the attached gingiva only, 58 (27.6%) in the attached gingiva and interdental papilla, 32 (15.2%) had diffuse pigmentation involving all parts of gingiva, 2 (1%) had pigmentation in marginal gingiva only, and 1 (0.5%) in marginal gingiva and interdental papilla.

In Figure 2 distribution of gingival pigmentation based on Dummett-Gupta classification has been presented in which 115 (54.8%) had mild, light brown tissue while 33 (15.7%) had no gingival pigmentation. In Table 1, skin colour distribution has been presented in which the majority of people i.e. 103 (49%) had light brown skin while only 11 (5.2%) had dark brown skin.

A Chi-square test was used to determine the association between gingival pigmentation with gingival biotype, gingival pigmentation with the gender of patients, and skin colour with gingival biotype. There was a statistically significant relation ($P = 0.002$) between gingival pigmentation and gingival biotype (Table 2), while there was no significant relationship ($P = 0.67$) between gingival pigmentation and gender of the patient (Table 3). There was a statistically significant relationship $P = 0.019$ between skin colour and gingival pigmentation (Table 4) as well as between skin colour and gingival biotype (Table 5).

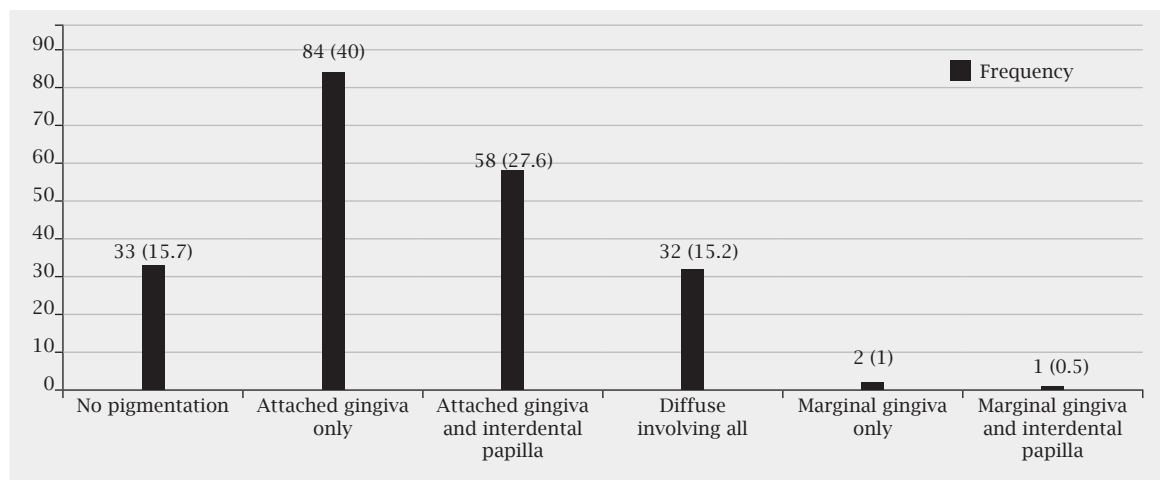


Figure 1: Extent of gingival pigmentation (Ponniyan classification, n (%)).

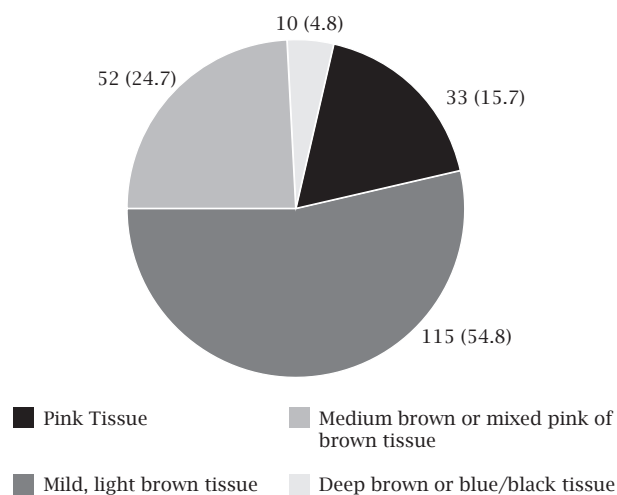


Figure 2: Distribution of gingival pigmentation based on Dummett and Gupta classification, n (%).

Table 1: Distribution of skin colour.

Skin colour	Occurrence, n (%)
White skin	55 (26.2)
Light brown skin	103 (49.0)
Moderate brown skin	41 (19.5)
Dark brown skin	11 (5.2)

Table 2: Association of gingival pigmentation with gingival biotype.

Distribution of pigmentation	Gingival biotype		Total	P value
	Thick	Thin	n (%)	
	n (%)	n (%)		
Pink tissue	19 (13.8)	14 (19.4)	33 (15.7)	0.002
Mild	66 (47.8)	49 (68.1)	115 (54.8)	
Moderate	44 (31.9)	8 (11.1)	52 (24.7)	
Heavy	9 (6.5)	1 (1.4)	10 (4.8)	
Total	138 (100)	72 (100)	210 (100)	

Table 3: Association of gingival pigmentation with the gender of the patient.

Distribution of pigmentation	Gender of patient		Total	P value
	Male	Female	n (%)	
	n (%)	n (%)		
Pink tissue	16 (15.2)	17 (16.2)	33 (15.7)	0.67
Mild	54 (51.5)	61 (58.1)	115 (54.8)	
Medium	29 (27.6)	23 (21.9)	52 (24.8)	
Heavy	6 (5.7)	4 (3.8)	10 (4.7)	
Total	105 (100)	105 (100)	210 (100)	

Table 4: Association of skin colour with gingival pigmentation (Dummet-Gupta oral pigmentation index).

Skin colour	Gingival biotype			Total	P value
	No	Mild	Moderate/ heavy	n (%)	
	n (%)	n (%)	n (%)		
White	22 (66.7)	27 (23.5)	6 (9.7)	55 (26.2)	< 0.001
Light brown	10 (30.3)	69 (60)	24 (38.7)	103 (49)	
Moderate/ dark brown	1 (3)	19 (16.5)	32 (51.6)	52 (24.8)	
Total	33 (100)	115 (100)	62 (100)	210 (100)	

Table 5: Association of skin colour with gingival biotype.

Skin colour	Gingival biotype		Total	P value
	Thick	Thin	n (%)	
	n (%)	n (%)		
White	29 (21)	26 (36.1)	55 (26.2)	0.019
Light brown	67 (48.6)	36 (50)	103 (49)	
Moderate brown	32 (23.2)	9 (12.5)	41 (19.5)	
Dark brown	10 (7.2)	1 (1.4)	11 (5.3)	
Total	138 (100)	72 (100)	210 (100)	

**Figure 3: No pigmentation.****Figure 4: Attached gingiva only.**



Figure 5: Attached gingiva and interdental papilla.



Figure 6: Diffuse involving all part of the gingiva.



Figure 7: Pigmentation in marginal gingiva only.



Figure 8: Pigmentation in interdental papilla only.



Figure 9: Pigmentation in marginal gingiva and interdental papilla.

DISCUSSION

The attached gingiva is demarcated from the adjacent alveolar mucosa on the buccal aspect by a clearly defined mucogingival line. The alveolar mucosa is red, smooth, and shiny rather than pink and stippled.¹ Melanin is a non-haemoglobin-derived brown pigment which is responsible for the normal pigmentation of the skin, gingiva, and remainder of the oral mucous membrane.¹ It is the most common pigmentation produced by melanocytes present in the basal and suprabasal layers of the epithelium. Gingival pigmentation occurs as a diffuse, deep-purplish discolouration or as irregularly shaped brown and light-brown patches. It may appear in the gingiva as early as three hours after birth, and it is often the only evidence of pigmentation.⁶

Aesthetics in dentistry means not only to get whiter teeth but to create pink gingiva, which is always a difficult task for the treating periodontist. Melanin, a pigment that occurs naturally in our body, causes pigmentation not only on the skin but also on the gingiva. This always leads to “Black Gingiva,” where aesthetics is a major concern, especially when the patient has a “Gummy Smile.” To overcome this concern, gingival depigmentation is done to remove the hyperpigmentation of the gingiva in order to improve the aesthetic quotient of the patient.

This article aimed to assess the prevalence of physiological gingival pigmentation and its association with skin colour in Nepalese subjects visiting Kantipur Dental College and Hospital.

In the present study, majority of participants (84, 40%) had pigmentation only in the attached gingiva, and 1 (0.5%) in marginal gingiva and interdental papilla. It was consistent with finding from the study done in India in 2015 by Balaji et al.⁶ where they found maximum participant had pigmentation on attached gingiva only and few participants had pigmentation on marginal gingiva and interdental papilla. Similar results were found in the study done by Rakheswar et al.⁷ in 2016.

In the similar study done by Ponniyan et al.,³ maximum participants (25.4%) had pigmentation on attached gingiva and interdental papilla whereas few participants (10.2%) had pigmentation on marginal gingiva and interdental papilla, which is similar to the present study.

The prevalence of gingival pigmentation differs from one population to another. In the present study, it was observed that mild light brown pigmentation was more prevalent in the attached gingiva. Similar results were observed by Gorsky et al. on the Jewish population⁸ whereas van Wyk observed that, it was more frequent on interdental papilla.⁹ The variation observed in distribution may be due to racial variation.

In the present study, distribution of gingival pigmentation based on Dummet and Gupta classification was found as, pink tissue (33, 15.7%), mild light brown tissue (115, 54.8%), medium brown or mixed pink or brown tissue (52, 4.8%) and deep brown or blue/black tissue (10, 4.8%).

The prevalence of facial skin colour differ from one population to another. In the present study, most of the participants had light brown skin colour 103 (49%) and a few 11 (5.2%) had dark skin colour. No study was found during literature review using Fitzpatrick Scale for the determination of facial skin colour.

Significance of gingival biotype, particularly gingival thickness is of greater importance not only in periodontal surgery but also in various other fields of dentistry like orthodontics, prosthodontics, implantology where issue of concern in aesthetic and functional outcome of the respective treatment.¹⁰ Similarly, amount of gingival thickness affects the outcome of surgical procedure like gingival depigmentation. Result of present study showed association between distribution of gingival pigmentation with gingival biotype which is statistically significant (Table 4, $P < 0.05$). This result is consistent with the study done by Radhika et al.¹⁰ in 2018, the pigmented GT (1.16 ± 0.23) was significantly higher than nonpigmented gingiva (0.99 ± 0.31)

using transgingival probing method. Similar result was found in the study done by Balaji et al.⁶ Where as in the study done by Ponnaiyan et al.,³ correlation between the gingival phenotype and the intensity of gingival pigmentation was not significant (P value = 0.125).

The association between gingival pigmentation and gender was not significant in the present study ($P = 0.67$, $P > 0.05$). This result is in consistent with the study done by Ponnaiyan et al. ($P = 0.125$) and Balaji et al.

In the present study, the association between skin colour and gingival biotype was found significant ($P = 0.019$, $P < 0.05$). No study was found during literature review showing association between gingival biotype and facial skin colour. So, meaningful comparisons are not possible.

The association between facial skin and gingival pigmentation was great area of concern for many researchers from many years and there is established relationship between gingival pigmentation and facial skin.¹¹ Researchers from different parts of the world are working on it since many decades.

According to Edwards and Duntley,¹² the colour of skin is determined by five pigments namely melanin, melanoid, oxyhaemoglobin, reduced haemoglobin, and carotene. The differences in amount and distribution of these pigments is responsible for the variations in skin colour between the sexes and different parts of the body. There is racial variation on facial skin colour. The difference in colour between various races mainly based on the production of various amounts of primary ectodermal melanin and melanoid, the amount of other pigments being the same in all races.¹²

Colour of facial skin is greater indicator of intraoral pigmentation mainly gingival pigmentation, in about 85% of cases.^{13,14} A strong association between gingival pigmentation and facial skin colour was found in the present study ($P < 0.001$). It was observed that moderate/dark brown participant showed moderate/heavy gingival pigmentation while, white skinned participants showed no pigmentation or mild pigmentation. It was consistent with the findings from the study done by Ponnaiyan et al. where, correlation was highly significant and dark-skinned subjects had heavy gingival pigmentation whereas fair skinned subjects had mild pigmentation. Steigmann et al. (1965),¹¹ Powers et al. (1977),¹⁵ Ghani et al. (2016),¹⁶ Rakheswar et al. (2016)⁷ found similar results in their study.

Evaluation of gingival pigmentation pattern, distribution and extent before any surgical procedures (E.g., gingival depigmentation) will help to choose specific depigmentation therapy that will harmonise with skin colour. The aesthetic results and the level of patient satisfaction will be enhanced by this approach. Also, will help in explaining the etiology of pigmentation (patient counselling) and prognosis of depigmentation therapy depending upon the skin colour.

CONCLUSION

Within the limitation of the present study, it was concluded that, the most prevalent gingival pigmentation was present on attached gingiva and interdental papilla. A strong association between gingival pigmentation and facial skin colour was found in the present study. It was observed that moderate/dark brown participant showed moderate/heavy

gingival pigmentation while white skinned participants showed no pigmentation or mild pigmentation. There was no gender predilection for gingival biotype. The results obtained from this study can be helpful in educating the patient as well as determining the appropriate surgical procedure for gingival depigmentation.

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