

Original Article

Evaluation of the intensity of gingival melanin pigmentation at different age groups in the Indian population: An observational study

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ABSTRACT

Background: The brownish-black pigmentation of the gingiva has been reported in several countries. However, the available literature pertaining to the Asian population suggests that this pigmentation is more predominant in individuals with dark complexion. Although there is available literature on the intensity of gingival pigmentation with different age groups in Japanese and Israel population, no such literature pertaining to age and intensity of melanin pigmentation is available in the Indian population.

Aim: This study aims to observe the intensity of melanin pigmentation in different age groups in the Indian population. **Methods and Materials:** Intensity of melanin pigmentation was observed by the gingival melanin pigmentation index as given by Ponnaian et al. in 250 individuals who were grouped under the age group of 0–5 years, 6–9 years, 10–12 years, 13–15 years, and 16–20 years. Each group comprised 25 individuals.

Results and Conclusion: The results were subjected to statistical analysis so as to observe the intensity of melanin pigmentation at different age groups in the Indian population. It was concluded that with age, the intensity of gingival melanin pigmentation, as well as its distribution to the posterior gingiva was increased. As age increased, gingival pigmentation was more in the attached and interdental papilla, while in the younger age groups, it was confined either only to the interdental, marginal or attached gingival, or both depending on the skin color.

KEYWORDS: Adult, child, puberty, gingiva, melanin pigmentation

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appears as early as 3 h after birth in the oral tissues.^[2] It is accepted that these pigmented areas are present only when melanin granules synthesized by melanocytes are transferred to keratinocytes.^[3] relationship between melanocytes and keratinocytes is labeled as the epidermal-melanin-unit as suggested by Goldzieher *et al* (1951).^[4] Usually, the color of the healthy gingiva varies from pale pink to bluish purple and between these limits of normalcy are large number of colors which depend on the intensity of melanogenesis, degree of epithelial cornification, depth of epithelialization, and the gingival vascularity. Thus, the color of the healthy gingiva is assumed to vary from pale pink to coral pink in the Caucasians^[5] and brownish to blackish in

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Introduction

Melanin is a nonhemoglobin-derived pigment formed by the melanocytes which are dendritic cells of neuroectodermal origin and located in the basal and spinous layers of the gingival epithelium.^[1] It is a fundamental pigment that colors the tissue and

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the Africans and Asians.^[6] However, Indians have a variation in their skin color with shades ranging from fair to dark which span out over the entire country, and it has been observed that there is a gradient from North to the South of the subcontinent with the North Indians close to European complexions and South Indians closer to Sub-Saharan Africans.^[7] Whether this skin pigmentation is evident in the oral cavity in South Indians^[8] has been investigated in the adults above 18 years of age, but the same has not been investigated in the age groups below 18 years of age. Although the literature does suggest that the intensity of melanin pigmentation is frequently altered by physical, chemical, and hormonal factors,^[9] no literature so far suggests that the intensity of melanin pigmentation increases with age. Thus, this study is first of its kind which observes the anatomic distribution of the physiologic gingival melanin pigmentation along with the evaluation of the intensity of melanin pigmentation in different age groups from 1 to 20 years of age.

Materials and Methods

This cross-sectional, observational study was conducted in the Department of Periodontics, SDM college of dental sciences and hospital, Dharwad, and Sattur Montessori School, Sattur, Dharwad, from November 14, 2016 to December 15, 2016. A total of 250 participants were randomly selected and were grouped under the age group of 0–5 years, 6–9 years, 10–12 years, 13–15 years, and 16–20 years. Each group comprised 25 individuals. Informed consent was obtained from all the participants/parents after explaining the study design to them. The inclusion criteria comprised participants with healthy gingiva and those with skin color as fair, wheatish, brown, and dark (criteria adapted by Aina *et al.*^[10]). The exclusion criteria comprised participants with gingivitis and periodontitis which might induce color changes, participants with drug or chemical pigmentation on the gingiva, those with systemic diseases like Type 1 diabetes mellitus which can produce gingival color changes, participants with syndromes, pigmentation disorders, chemical skin peeling and albinism, patients who had undergone any dental treatment in the past 6 months to 1 year, and participants with history of smoking or tobacco chewing.

Evaluation of skin color and gingival melanin pigmentation

Skin color was classified by comparing the color of the inner aspect of the upper arm which is relatively unexposed to sunlight and was graded as fair skinned, wheatish, brown, and dark. This color confirmation was done by interexaminer calibration, where both the examiners agreed with the specific skin color of the participant. Both the examiners were adapted to see the daylight outside the classroom because the higher intensity of light sources may produce more color change. This method of assessing the

skin color is called as color test.^[8] Although there are different techniques^[10] to evaluate skin color such as comparison with standard color guides, use of spectrophotometry, reflectometry, and visual examination, the skin color examination under natural light with eyes is considered to assess the final judge of color as suggested by Wright.^[11] Thus, this method of skin color examination was employed in this study. Moreover, Lee^[12] noted that objects appeared darker when viewed at a distance than when observed from a closer point and thus, to overcome this problem, it was recommended to examine the participants in bright diffuse daylight through visual examination. Thus, in this study, skin colors were assessed visually and accordingly, the intensity and distribution of gingival melanin pigmentation was assessed in the anterior and posterior teeth in the anatomic areas of the gingiva and were classified as mentioned by Ponnaiyan *et al.* 2013^[8] which is as follows: Class 1 – Pigmentation in the attached gingiva only, Class 2 – Pigmentation in the attached and interdental papilla, Class 3 – Diffuse pigmentation involving all parts of the gingiva, Class 4 – Pigmentation in marginal gingival only, Class 5 – Pigmentation in interdental papilla only, and Class 6 – Pigmentation in marginal and interdental gingiva.

Since this classification was used in the South Indians in India, the same classification was used in this study as well. The gingival pigmentation scores were evaluated in all the above-mentioned age groups by a single examiner. The results were subjected to statistical analysis so as to evaluate the intensity of physiologic gingival pigmentation at different age groups in the Indian population.

Statistical analysis

The data were subjected to statistical analysis and Chi-Square test was performed so as to evaluate the intensity of gingival melanin pigmentation at different age groups in the Indian population.

Results

In the present study, all the participants were subsequently categorized into different age groups according to the variations in the skin color, which were further correlated to the anatomic distribution as well as the intensity of gingival melanin pigmentation according to the classification given by Ponnaiyan *et al.* The skin color was well related to the intensity of pigmentation in all age groups which was highly significant ($P < 0.5$). It was observed that in all the age groups, the fair-skinned individuals had a mild gingival pigmentation while the dark-skinned individuals had a heavy pigmentation [Table 1].

It was also observed that with the age, the intensity of gingival melanin pigmentation as well as its distribution to the posterior gingiva increased. As

Table 1: Intensity of gingival melanin pigmentation in different skin complexions

	Fair complexion	Wheatish complexion	Brown complexion	Dark complexion	χ^2	P
Class 0					110.577	0.001**
Count	8	7	1	0		
Percentage within class	50.0	43.8	6.2	0.0		
Percentage within complexion	44.4	9.7	1.1	0.0		
Percentage of total	3.9	3.4	0.5	0.0		
Class 1						
Count	6	34	29	2		
Percentage within class	8.5	47.9	40.8	2.8		
Percentage within complexion	33.3	47.2	32.6	7.1		
Percentage of total	2.9	16.4	14.0	1.0		
Class 2						
Count	0	3	31	21		
Percentage within class	0.0	5.5	56.4	38.2		
Percentage within complexion	0.0	4.2	34.8	75.0		
Percentage of total	0.0	1.4	15.0	10.1		
Class 3						
Count	0	0	1	1		
Percentage within class	0.0	0.0	50.0	50.0		
Percentage within complexion	0.0	0.0	1.1	3.6		
Percentage of total	0.0	0.0	0.5	0.5		
Class 4						
Count	0	3	3	0		
Percentage within class	0.0	50.0	50.0	0.0		
Percentage within complexion	0.0	4.2	3.4	0.0		
Percentage of total	0.0	1.4	1.4	0.0		
Class 5						
Count	4	20	12	1		
Percentage within class	10.8	54.1	32.4	2.7		
Percentage within complexion	22.2	27.8	13.5	3.6		
Percentage of total	1.9	9.7	5.8	0.5		
Class 6						
Count	0	5	12	3		
Percentage within class	0.0	25.0	60.0	15.0		
Percentage within complexion	0.0	6.9	13.5	10.7		
Percentage of total	0.0	2.4	5.8	1.4		

** Statistical Significance with *p*-value <0.05

the age increased, gingival pigmentation was more in the attached and interdental papilla, while in the younger age groups, it was confined either only to the interdental, marginal, or attached gingiva depending on the skin color. The anatomic distribution of the gingival melanin pigmentation to the posterior gingiva did increase after 6 years of age in all the different skin colors, except for 1 individual with pigmentation on attached and interdental papilla in the age group of 0–5 years with a brown complexion. Thus, age was significantly correlated with the intensity of gingival melanin pigmentation [Table 2].

Discussion

Gingival pigmentation is seen as a genetic trait in some populations and is more appropriately termed physiologic or racial gingival pigmentation.^[13]

In the present study, an attempt was made to assess the intensity and anatomic distribution of gingival melanin pigmentation in the South Indian population who have darker skin color and tend to have more gingival melanin pigmentation than their counterparts in North and Northeast India which could be attributed to their genetic traits. Usually, Indians have a dramatic variation in their skin color with all shades ranging from fair to dark which span out over the entire country with North Indians close to European complexions and South Indians closer to the Sub-Saharan Africans.^[7] Whether this skin pigmentation was also evident in the gingiva of South Indian children and adults was a need of investigation.

The present study also made an attempt to evaluate the intensity of gingival melanin pigmentation in different age groups from 1 to 20 years of age, and it was observed that with the age, the intensity of gingival melanin pigmentation, as well as its distribution to

Table 2: Intensity of gingival melanin pigmentation in different age groups

	0-5 years	6-9 years	10-15 years	16-20 years	χ^2	P		
Class 0					59.95	<0.001**		
Count	11	0	1	4				
Percentage within class	68.8	0.0	6.2	25.0				
Percentage within age	29.7	0.0	1.1	14.3				
Percentage of total	5.3	0.0	0.5	1.9				
Class 1								
Count	14	18	30	10				
Percentage within class	19.4	25.0	41.7	13.9				
Percentage within age	37.8	36.0	32.3	35.7				
Percentage of total	6.7	8.7	14.4	4.8				
Class 2								
Count	3	13	32	7				
Percentage within class	5.5	23.6	58.2	12.7				
Percentage within age	8.1	26.0	34.4	25.0				
Percentage of total	1.4	6.2	15.4	3.4				
Class 3								
Count	0	0	2	0				
Percentage within class	0.0	0.0	100.0	0.0				
Percentage within age	0.0	0.0	2.2	0.0				
Percentage of total	0.0	0.0	1.0	0.0				
Class 4								
Count	1	2	2	1				
Percentage within class	16.7	33.3	33.3	16.7				
Percentage within age	2.7	4.0	2.2	3.6				
Percentage of total	0.5	1.0	1.0	0.5				
Class 5								
Count	8	6	17	6				
Percentage within class	21.6	16.2	45.9	16.2				
Percentage within age	21.6	12.0	18.3	21.4				
Percentage of total	3.8	2.9	8.2	2.9				
Class 6								
Count	0	11	9	0				
Percentage within class	0.0	55.0	45.0	0.0				
Percentage within age	0.0	22.0	9.7	0.0				
Percentage of total	0.0	5.3	4.3	0.0				
Pigmentation	Age			Complexion				
Correlation coefficient	0.048			0.259**				
Significant (two-tailed)	0.490			<0.001				
n	207			207				

** Statistical Significance with p-value <0.05

the posterior gingiva did increase. It was observed that as age increased, gingival pigmentation was more in the attached and interdental papilla, while in the younger age groups, it was confined either only to the interdental, marginal or attached gingiva, or both depending on the skin color. This decreased intensity of gingival melanin pigmentation in the young individuals in the age groups of 0-5 years and 6-9 years could be attributed to the immature skin morphology in children when compared to the adults. Although Dummet^[2] did suggest that melanin appears as early as 3 h after birth, studies by Stamatas *et al.*^[14] suggest that melanin content in children is less when compared to the adults and the reason being the smaller corneocytes and the keratinocytes,

thinner epidermis, and stratum corneum containing more water content. This increased water content in the stratum corneum enables an increased enzymatic activities for lipid processing, corneo-desmolysis, and production of components of natural moisturizing factor (NMF) which helps to maintain epithelial permeability. NMF is also known to bind to the water molecules thus maintaining increased hydration and further decreasing the scattering of the ultraviolet light thus masking the need of the melanin granules to be transferred to the keratinocytes to produce melanin pigments.^[15] Another reason for decreased melanin pigmentation could be attributed to the close relationship between melanocytes and keratinocytes forming and epidermal-melanin unit.^[3,4] But since the

keratinocytes being smaller in size in children, there could be decreased melanin content and its synthesis in the keratinocytes leading to decreased expression of the melanin pigmentation. Since the features of gingiva are similar to skin, there could be decreased gingival melanin pigmentation in children. So far, there is no substantiating literature that specifies the age where melanin appears on the gingiva, its increase in anatomic distribution with age or intensity. Thus, an attempt was made to evaluate all these findings and results showed that there was no gingival melanin pigmentation in the posterior gingiva below 12 years of age in all the skin complexions. This could be attributed to decreased melanogenesis in the mixed dentition.

In the present study, the color of the gingiva was correlated with the skin complexion which was highly significant. It was observed that in all the age groups, the brown and dark-skinned participants had more gingival melanin pigmentation (Class 1 and Class 2) with distribution to the posterior gingiva while the fair and wheatish-skinned participants had pigmentation of Class 1, Class 4, or Class 5 pigmentation. This could be attributed to the genetic traits in a study conducted in the Jewish population, where melanin was found to be more on the attached gingiva while in the South African population, it is more frequently seen in the interdental papilla.^[16] We observed that pigmentation in dark and wheatish complexion was more intense and diffused along with its distribution in the posterior gingiva, while that in the fair and wheatish complexion, it was more localized. This could be attributed to the increased melanogenesis in dark complexion people.^[17] Melanin is a nonhemoglobin-derived pigment formed by the cells called melanocytes, which are dendritic cells of neuroectodermal origin in basal and spinous layers of gingival epithelium. These melanin pigmented areas are present only when melanin granules are synthesized to melanocytes and transferred to the keratinocytes, on exposure to friction or ultraviolet light.^[1]

The results of this study in the age group of 16–20 years can be correlated to the study by Ponnaiyan *et al.*^[8] in the South Indian population which attributed to the ethnic variations; however, the observations made in the younger age group in this study remain the novelty.

Conclusion

With age, the intensity of gingival melanin pigmentation as well as its distribution to the posterior gingiva increases. As age increased, gingival pigmentation was more in the attached and interdental papilla, while in the younger age groups, it was confined either only to the interdental, marginal or attached gingival, or both depending on the skin color.

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Conflicts of interest

There are no conflicts of interest.

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