ETHNIC VARIATION IN THE MOST COMMON SHADE OF ANTERIOR TEETH AMONG MALAYSIAN STUDENTS: A CROSS-SECTIONAL STUDY

Variación del tono más común de los dientes anteriores entre estudiantes malasios de diferentes etnias: un estudio transversal

Ravi Gupta,[1] Ishani Saluja.[1]

1. Department of Conservative Dentistry and Endodontics, Manipal College of Dental Sciences, Mangalore, Manipal Academy of Higher Education, Karnataka, India.

ABSTRACT

Aim: Determination of the most common shade of anterior teeth in Malaysian students of different ethnicities.

Materials and Methods: A total of 120 subjects, 40 each from different ethnicities (Malay, Chinese, and Indian) aged 18-22 years were evaluated for tooth shade using the VITA Classical shade guide. The subject was asked to sit in an up-right position with teeth at the clinician's eye level and the subject was instructed to remove makeup or tinted eyewear which may affect the result. The procedure was done in natural daylight. The shade tabs were positioned adjacent to the maxillary central incisor and the middle 1/3rd of the facial surface was assessed by experts to determine the correct tooth shade. The data was statistically analysed.

Results: The differences in tooth shade were seen among the subjects of different ethnicities. The Malay ethnicity has B1 (37%) as the most common tooth shade whereas Chinese has C1 (27%) and Indian C1 (40%).

Conclusions: Under the limitation of the study, it was found that there is a relationship between tooth color and ethnic background. Malay students tend to have brighter teeth as compared to Chinese and Indian students.

Keywords: *Tooth; Incisor; Color; Colorimetry; Ethnicity; Malaysia.*

RESUMEN

Objetivo: Determinar el tono más común de los dientes anteriores en estudiantes malasios de diferentes etnias.

Materiales y Métodos: Se evaluó el color de los dientes de un total de 120 sujetos, 40 de diferentes etnias (malayos, chinos e indios) de edades comprendidas entre 18 y 22 años, utilizando la guía de colores VITA Classical. Se pidió al sujeto que se sentara en posición vertical con los dientes al nivel de los ojos del médico y se le indicó que se quitara el maquillaje o las gafas teñidas, lo que podría afectar el resultado. El procedimiento se realizó con luz natural. Las pestañas de color se colocaron adyacentes al incisivo central superior y expertos evaluaron el tercio medio de la superficie facial para determinar el tono correcto del diente. Los datos fueron analizados estadísticamente.

Resultados: Se observaron diferencias en el color de los dientes entre los sujetos de diferentes etnias. La etnia malaya tiene el B1 (37%) como el color de dientes más común, mientras que los chinos tienen el C1 (27%) y los indios C1 (40%).

Conclusión: Bajo las limitaciones del estudio, se encontró que existe una relación entre el color de los dientes y el origen étnico. Los estudiantes malayos tienden a tener dientes más brillantes en comparación con los estudiantes chinos e indios.

Palabras Clave: *Diente; Incisivo; Color; Colorimetría; Etnicidad; Malasia*

CORRESPONDING AUTHOR: Ishani Saluja. Department of Conservative Dentistry and Endodontics, Manipal College of Dental Sciences, Manipal Academy of Higher Education, Mangalore. Lighthouse Hill Road, Mangalore, Karnataka, India. **E-mail:** ishani.saluja@manipal.edu

INTRODUCTION

Shade selection in dentistry is an important step in achieving aesthetically pleasing and harmonious restorations. The ability to accurately match the color of dental restorations with natural teeth is a technical skill and an art, as it requires an in-depth understanding of color perception, lighting conditions, and the complex interplay between shades and tooth structure. The choice of the most appropriate shade significantly impacts the overall appe-arance and patient satisfaction. Various me-thods are used for shade selection such as shade guides or digital devices such as intraoral spectrophotometers and scanners.[1,2]

The shade selection using these digital devices provides better results than conventional visual methods.[1,2] The process of shade selection using shade guides is influenced by many operator factors such as age, health, and visual acuity. Also affected by external light conditions and the optical properties of the teeth.[1,2]

Therefore, care should be taken while using the visual method of shade determination, and experienced experts should be involved in the study.[5] Hence, the conventional visual shade matching method continues to be preferred, despite its susceptibility to inaccuracies, because it is not reliant on specialized devices and remains a cost-effective option.[6]

Lights and colors are not the only factors that can affect a shade selection. There are a few key optical properties of teeth that need to be kept in mind before selecting a color for restoration.[7] There are many factors that are required to be kept in mind for shade selection in a patient.

Numerous studies in the past have sought to investigate the relationship between tooth shade and skin color. This study aims to understand shade selection by investigating the common shades of anterior teeth in Malaysian students of different ethnicities.

MATERIALS AND METHODS

Participant selection

The research was carried out on Malaysian students of diverse ethnic backgrounds, including Malay, Chinese, and Indian, following approval from the Institutional Ethical Committee of Manipal University, India (IEC 171/2017).

The targeted sample size is 120 (40 from each ethnicity). The study was conducted by using the VITA Classical shade guide to determine the shade of maxillary anterior teeth under controlled conditions of bright daylight to ensure consistent lighting across all observations. Bright daylight was chosen to replicate the most encountered lighting situation in natural settings, as it can influence the perception of tooth shade.

Subjects with discolored upper anterior due to intrinsic, extrinsic staining were excluded. Oral prophylaxis was done, and teeth were polished using polishing paste and rubber cups prior to shade selection.

Color blindness test

The experts were selected based on their extensive experience in restorative dentistry and shade matching.

Three independent female experts, each possessing over five years of clinical experience, underwent a color blindness assessment con-ducted by an ophthalmologist. This step was taken to ensure the accuracy of shade matching, as discrepancies in color vision can impact the process.[8-10]

Color deficiency screening took place in a controlled, consistently lit room using the Ishihara color blind test, where clinicians had to identify numbers within coloured circles with a provided answer key. Conditions like room lighting were maintained constant, and participants with normal vision correctly identified all numbers in the test.[8,9]

Grouping

A total of 120 participants, 40 each from different ethnicities (Malay, Chinese, and Indian) aged 18-22 years were evaluated for tooth shade using the VITA Classical shade guide (Figure 1). Each of the three experts independently evaluated the tooth shade of all 120 students in the study. To ensure consistency, the experts used a standardized shade guide for assessment. Following the evaluation, each expert reported the final tooth shade using the Vita Classical shade guide. The Vita shade guide was selected due to its widespread use and established standardization in dental practice.

Shade selection

The shade of teeth on subjects is determined as follows:

Subjects sat upright at the operator's eye level, holding the VITA Classical shade guide at arm's length. Shade assessment focused on the middle one-third of the facial surface of the maxillary central incisor due to color variation reasons.

Shade tabs were placed at a 45-degree angle to the light source to replicate clinical

Table 1. Data Collection.

Shade	Malaysian (n=40)	Chinese (n=40)	Indian (n=40)
A1	5	0	4
A2	2	6	2
A3	1	4	3
A4	1	1	0
B1	15	2	4
B2	9	2	4
B3	1	0	2
B4	0	1	0
C1	2	11	16
C2	3	4	1
C3	0	2	1
C4	0	0	0
D1	0	0	0
D2	0	2	3
D3	1	0	0
D4	0	0	0

conditions, with all three observers following this angle. The tooth and tabs were kept moist during the process.

The following precautions were taken such as makeup/ tinted eyeglasses being removed. Operatory walls were kept neutral. Shade comparisons were made quickly to avoid eye fatigue and tooth shade was evaluated under natural daylight in a time frame of 5-10 seconds.[12,13]

Statistical analysis

Collected data were organized and analysed using dedicated software (IBM SPSS V 17.0). Descriptive data were presented in tabular form.

The chi-square test was employed to assess correlations among qualitative data, with statistical significance set at a *p*-value <0.05.

Figure 1. Group Distribution.
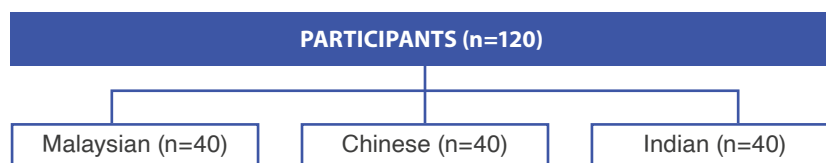
Figure 2. Bar graph showing Determination of most common shade of anterior teeth in Malaysians students of different ethnicity.
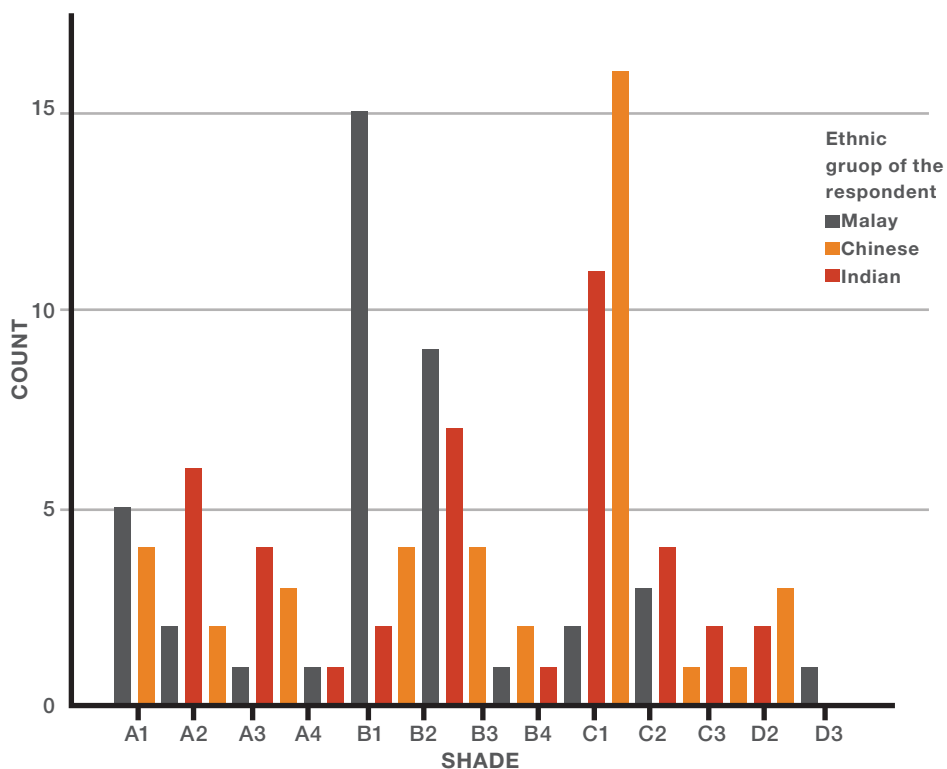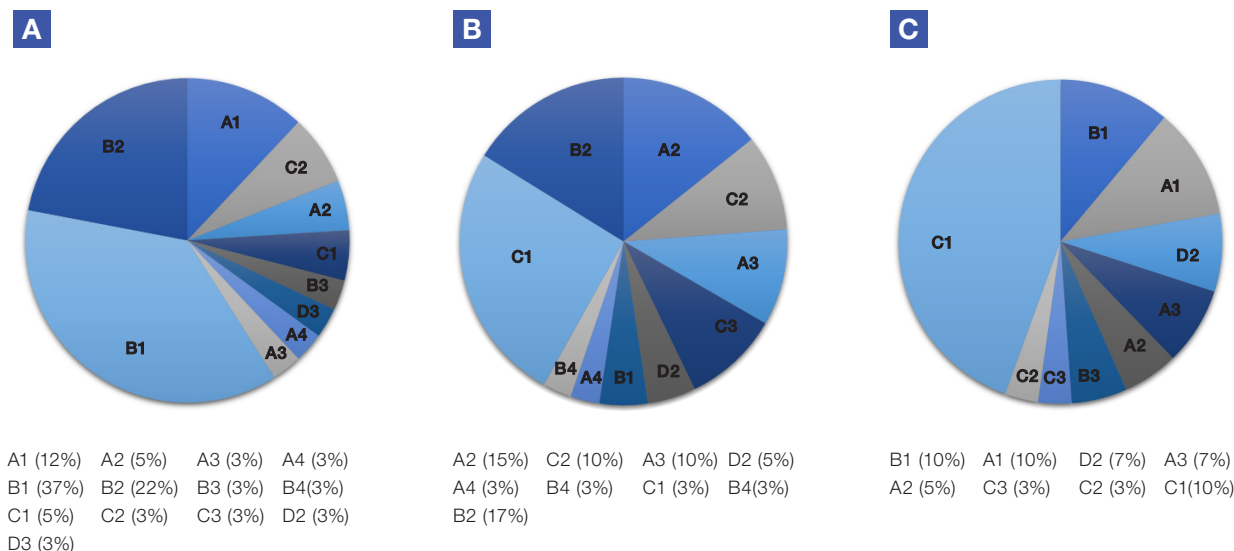
Figure 3. Tooth shade in percentage (%)

A

A1 (12%) A2 (5%) A3 (3%) A4 (3%)
B1 (37%) B2 (22%) B3 (3%) B4(3%)
C1 (5%) C2 (3%) C3 (3%) D2 (3%)
D3 (3%)

B

A2 (15%) C2 (10%) A3 (10%) D2 (5%)
A4 (3%) B4 (3%) C1 (3%) B4(3%)
B2 (17%)

C

B1 (10%) A1 (10%) D2 (7%) A3 (7%)
A2 (5%) C3 (3%) C2 (3%) C1(10%)

RESULTS

A total of 120 participants, 40 each from different ethnicities (Malay, Chinese, and Indian) aged 18-22 years were evaluated for tooth shade using the VITA Classical shade guide. The most common shading for Malay par-ticipants is B1, which is 37.5% within the Malay group. The most common shading for Chinese participants is C1, which is 27.5% of the Chinese participants. For India, the most common shading is C1, which is 40% within the Indian participants (Table 1).

None of the Chinese participants have shade A1 and shade B3. The only group that has shade B4 is the Chinese participants (Figure 2 and Figure 3). There is a significant association between ethnic groups and shade guides ($p=$ 0.002).

DISCUSSION

Teeth color is influenced by the interaction of the light with the tooth structure.[14-16] The important factor affecting aesthetics is tooth shade or color. The determination of tooth color is quite complex, as it involves both subjective and objective components.[17]

There is limited data available on the relationship between tooth shade and ethnic background, hence the present study was conducted to determine the most common shade in ante-rior teeth in Malaysian students of different ethnicities and to evaluate its association with ethnic background.
The human eye is very accurate in determining variations in the texture or color of various surfaces. The human eye possesses a remarkable ability to perceive visual details, it is essential to consider various factors that

influence the accuracy of color perception. Factors such as lighting conditions, individual variations in perception, and inherent limitations in human vision can impact the perceived accuracy of color matching. Furthermore, quantifying the level of accuracy can be challenging without a comparative framework to other objective methods of color assessment. Thus, while the human eye is capable of nuanced color perception, the context in which it operates must be carefully considered to understand its limitations and strengths.

Visual shade determination is widely used by dentists across the globe. Various devices such as handheld spectrophotometers, colorimeters, and optical color scanners are used for shade detection in dentistry. Visual tooth shade se-lection by shade guide is a more widely used method and much more cost-effective.[6] The tooth shade guide was arranged based on value components into 4 categories as per the previous study.[18]

In the present study, the most prevalent shade among Malay was B1 (highest value) and the least was B4 (low value), followed by C3, C4, D1, D2, and D4. The most prevalent shade among Chinese was C1(high value) and the least was A1(highest value), followed by B3, C4, D1, D3, and D4. The most prevalent shade among Indians was C1(high value) and the least was A4 (low value), followed by B4, C4, D1, D3, and D4.

In our study, the results were in agreement with the study done by Jahangiri *et al*.[19] This study shows that there is a significant

relationship between ethnic background and tooth shade. However, there is no literature available regarding the comparison of tooth color in different populations.

The middle one-third of the tooth was used to assess tooth shade because the incisal part if often translucent while the cervical one-third is affected by light scattered from the gingiva.[20]

In our current study, clinicians who exhibited normal visual acuity and were confirmed to have no color vision deficiency through the Ishihara pseudoisochromatic plate test were recruited. Recognizing the potential for retinal cell fatigue when focusing on an object for extended periods, clinicians were encouraged to alleviate eye strain by taking intermittent breaks and looking at a neutral gray background that was provided for this purpose. This approach aimed to maintain the visual acuity and accuracy of the clinicians throughout the process.[10-13] Female clinicians were chosen for shade mat-ching, primarily due to the potential advantage of tetrachromacy in women. This genetic trait, stemming from differences in cone pigment genes on the X chromosome, could enhance their ability in the shade-matching process.[21] Another factor that can influence the accuracy of visual shade matching is the clinical experience of the dental personnel.[22] The color-matching accuracy is assumed to improve and be reliable as clinical experience increases.

Individuals aged over 30 were intentionally excluded from the study. This is because there

is a progressive yellow discoloration of their teeth due to continuous secondary dentin deposition and thinning of enamel. Hasegawa *et al.*,[23] observed that the cervical area of the tooth is much more yellow, and it increases with the advancement of age. Similar findings were reported by Jahangiri *et al.*,[17] in their study.

Limitations and future research

While this descriptive study employed a traditional approach to shade assessment, we acknowledge the potential benefits of digital shade analysis for enhancing accuracy and facilitating comparison with previous research. Future investigations could explore the integration of digital methods to build upon our findings and offer additional insights into shade selection within diverse populations.

Subsequent research endeavors with larger sample sizes are imperative to attain more precise results in the future. These outcomes could prove to be immensely valuable in advancing the frontiers of modern dentistry, offering significant contributions to the field. Other contributing factors such as genetics and dietary habits, should be considered.

CONCLUSION

Under the limitation of the study, it was found out that there is a relationship between tooth color and ethnic background. Malay students tend to have brighter teeth as compared to Chinese and Indian students.

CONFLICT OF INTERESTS

There are no conflicts of interest.

ETHICS APPROVAL

Institutional ethical committee clearance obtained (Ref. No. IEC 171/2017)

AUTHORS' CONTRIBUTIONS

Ravi Gupta: Concepts; Design; Definition of intellectual content; Literature search; Manuscript preparation; Experimental studies; Data acquisition; Data analysis; Statistical analysis Manuscript editing; Manuscript review; Guarantor

Ishani Saluja: Concepts; Design; Definition of intellectual content; Literature search; Manuscript preparation; Manuscript editing; Manuscript review; Guarantor

ORCID

Ravi Gupta

0000-0002-1735-7247

Ishani Saluja

0000-0002-3188-3112

PUBLISHER'S NOTE

All statements expressed in this article are those of the authors alone and do not necessarily represent those of the publisher, editors, and reviewers.

PEER REVIEW

This manuscript was evaluated by the editors of the journal and reviewed by at least two peers in a double-blind process.

PLAGIARISM SOFTWARE

This manuscript was analyzed by Turnitin's Ouriginal plagiarism detector software. Analysis report of document (be7c81d80dec7bacb3 b14d7470a650d7ee562276)

REFERENCES.

1. Igiel C, Lehmann KM, Ghinea R, et al. Reliability of visual and instrumental color matching. J Esthet Restor Dent. 2017;29: 303–308.

2. Tabatabaian F, Beyabanaki E, Alirezaei P, Epakchi S. Visual and digital tooth shade selection methods, related effective factors and conditions, and their accuracy and precision: A literature review. J Esthet Restor Dent. 2021;33:1084–1104.

3. Kielbassa AM, Beheim-Schwarzbach NJ, Neumann K, Nat R, Zantner C. In vitro comparison of visual and computer-aided pre- and post-tooth shade determination using various home bleaching procedures. J Prosthet Dent. 2009;101:92–100.

4. Derdilopoulou FV, Zantner C, Neumann K, Kielbassa AM. Evaluation of visual and spectrophotometric shade analyses: a clinical comparison of 3758 teeth. Int J Prosthodont. 2007;20:414–416.

5. Ebeid K, Sabet A, Della Bona A. Accuracy and repeatability of different intraoral scanners on shade determination. J Esthet Restor Dent. 2021;33:844–848.

6. Aswini KK, Ramanarayanan V, Rejithan A, Sajeev R, Suresh R. The effect of gender and clinical experience on shade perception. J Esthet Restor Dent 2019;31:608–612.

7. Dagg H, O'Connell B, Claffey N, Byrne D, Gorman C. The influence of some different factors on the accuracy of shade selection. J Oral Rehabil. 2004;22:900- 04.

8. Birch J. Worldwide prevalence of redgreen color deficiency. J Opt Soc Am A Opt Image Sci Vis. 2012;29:313–320.

9. Khosla A, Maini AP, Wangoo A, Singh S, Mehar DK. Prevalence of colour vision anomalies amongst dental professionals and its effect on shade matching of teeth. J Clin Diagn Res. 2017;11:33–36.

10. Veeraganta SK, Savadi RC, Baroudi K, Nassani MZ. Differences in tooth shade value according to age, gender and skin color: A pilot study. J Indian Prosthodont Soc. 2015;15(2):138.

11. Dental product spotlight. Dental shade guide. J Am Dent Assoc. 2002;133:366-7.

12. Yilmaz B, Karaagaclioglu L. In vitro evaluation of color replication of metal ceramic specimens using visual and instrumental color determinations. J Prosthet Dent. 2011;105:21–27.

13. Yilmaz B, Karaagaclioglu L. In vitro evaluation of color replication of metal ceramic specimens using visual and instrumental color determinations. J Prosthet Dent. 2011;105:21–27.

14. Sen Bosch JJ, Coops JC. Tooth colour and reflectance as related to light scattering and enamel hardness. J Dent Res. 1995;74(1):374–80.

15. Hasegawa A, Ikeda I, Kawaguchi S. Colour and translucency of in vivo natural central incisors. J Prosthet Dent. 2000;83(4):418–23

16. Giesel M, Gegenfurtner KR. Colour appearance of real objects varying in material, hue, and shape. J Vis. 2010;10(9):10.

17. Sharma V, Punia V, Khandelwal M, Punia S, Lakshmana RB. A study of relationship between skin colour and tooth shade value in population of Udaipur. Rajasthan Internat J Dental Clinics. 2010:2(4):26-29

18. Paravina RD, Powers JM, Fay RM. Dental color standards: Shade tab arrangement. J Esthet Restor Dent. 2001;13:254-63.

19. Jahangiri L, Reinhardt SB, Mehra RV, Matheson PB. Relationship between tooth shade value and skin color: An observational study. J Prosthet Dent 2002;87:149-52.

20. Schwabacher WB, Goodkind RJ, Lua MJ. Interdependence of the hue, value, and chroma in themiddle site of anterior human teeth. J Prosthodont. 1994;3:188-92.

21. Neitz J, Neitz M, Jacobs GH. More than three different cone pigments among people with normal color vision. Vision Res. 1993;33:117–122.

22. Barrett AA, Grimaudo NJ, Anusavice KJ, Yang MC. Influence of tab and disk design on shade matching of dental porcelain. J Prosthet Dent 2002;88:591-7.

23. Hasegawa A, Ikeda I, Kawaguchi S. Color and translucency of in vivo natural central incisors. The J Prosthetic Dent. 2000;83(4):418-23.