

Vita Tooth Shade Selection in relation to Age, Gender, and Fitzpatrick Skin Tone in Mosul City

Rawaa Y. Al-Rawee, Dina Wadullah Azeez.

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Abstract**Background:**

Selecting a proper tooth shade is essential for achieving esthetic harmony in restorative and prosthetic dentistry. Factors such as age, gender, and skin tone significantly influence natural tooth color, yet limited data exist for the Iraqi population.

Objective:

This study aimed to evaluate the relationship between Vita 3D-Master tooth shade, age, gender, and Fitzpatrick skin tone among individuals in Mosul City.

Methods:

A descriptive cross-sectional study was conducted on 1,000 participants (18–60 years) attending Al-Salam Teaching Hospital, Nineveh Health Directorate, from September to October 2025. Tooth shade was determined using the VITA 3D-Master Shade Guide, and skin tone was assessed using the Fitzpatrick Skin Phototype Scale. Data were analyzed using descriptive statistics and Chi-square tests to assess associations between categorical variables, with $p < 0.05$ considered statistically significant.

Results:

The predominant tooth shade was 2M (38.9%), followed by 2L (17.8%) and 2R (16.0%). A significant association was observed between tooth shade and age ($p < 0.00001$), with lighter shades (1M) more common among younger individuals and darker shades (3L–4R) prevalent in older groups. Gender showed a significant effect ($p = 0.001$), as females exhibited lighter shades than males. Skin tone was also significantly correlated with tooth shade ($p = 0.0001$); lighter skin types (I–II) tended to have lighter tooth shades, while darker skin types (V–VI) corresponded with darker shades.

Conclusion:

Age, gender, and skin tone significantly influence tooth shade distribution in the Mosul population. The 2M shade represented the most frequent natural tooth color across all groups. These findings emphasize

Keywords: Tooth shade, Vita 3D-Master, age, gender, Fitzpatrick skin tone, esthetic dentistry, Mosul.

Introduction:

Selecting an appropriate tooth shade is a critical step in achieving natural and aesthetically pleasing outcomes in restorative and prosthetic dentistry. While external factors such as staining influence dental color, more fundamental determinants include enamel translucency, dentin thickness, as well as patient-specific variables like age, sex, and skin pigmentation (1,2).

Advancing age is commonly associated with a progressive darkening of teeth. This change is largely attributed to structural modifications such as secondary dentin deposition and enamel thinning, both of which alter light transmission and, consequently, the perception of color (3).

Previous studies suggest that tooth shade may vary by gender, with women often showing comparatively lighter shades than men. This difference has been linked to variations in enamel thickness and dentin pigmentation between the sexes (4).

Skin tone also plays an important role in guiding the selection of prosthetic tooth color to ensure harmony with facial features. The Fitzpatrick Skin Phototype Scale, although originally developed for dermatology, has become a valuable tool in dental research for categorizing skin color and correlating it with tooth shade selection (5, 6).

Evidence from previous investigations demonstrates a tendency for individuals with fairer complexions to present with lighter tooth shades, whereas those with darker skin types are more of-

ten associated with deeper tooth colors (2, 7).

Despite the growing focus on esthetic dentistry, there is a lack of consensus concerning the relationship between tooth shade (as determined by the Vita shade guide), age, gender, and Fitzpatrick skin tone across various populations. An enhanced comprehension of these linkages may enhance therapeutic outcomes in restorative dentistry by informing personalized shade selection and minimizing aesthetic discrepancies (7).

This study seeks to assess the relationship between Vita 3D tooth shade, age, gender, and Fitzpatrick skin tone within a cross-sectional population sample.

Methodology

Study Design

This study was designed as a descriptive cross-sectional study conducted to evaluate the correlation between 3D master tooth shade, age, gender, and Fitzpatrick skin tone in a population sample.

Study Setting and Duration

The study was carried out at the Al-Salam Teaching Hospital / Nineveh Health Directorate over a period in one month from 1 / September - 1 / October / 2025.

Study Population

A total of 1000 participants were recruited from patients and volunteers attending the dental clinics. Both males and females aged 18–60 years were included. Participants were divided into different

age groups (18–26, 27-32, 33-40, > 40 years).

Inclusion Criteria: includes individuals with natural maxillary central incisors without restorations, bleaching, or prostheses, participants with healthy periodontal and oral soft tissues and age range 18–60 years. As well as consent to participate in the study.

Exclusion Criteria: Discolored teeth are excluded whatever the cause .History of tooth bleaching or placement of anterior restorations also not rolled in the study . Smokers or patients with systemic conditions affecting tooth color also omitted. Participants with visible skin diseases or tanning are excluded too.

Data Collection Procedure

Tooth Shade Selection: Tooth Shade Assessment determined using the VITA 3D-Master Shade Guide (VITA Zahnfabrik, Germany). The shade tab was held adjacent to the middle third of the maxillary right central incisor under standardized natural daylight conditions (10:00 a.m.–2:00 p.m.), with participants wearing no makeup or lipstick. Shades were classified using the VITA 3D-Master system (Fig. 1). This guide organizes tooth color based on three main parameters:

- Brightness (value): ranked from 1 (the lightest) to 5 (the darkest).
- Color intensity (chroma): defined within each brightness group, ranging from low to high saturation.
- Color tone (hue): categorized as yellowish, reddish, or neutral variations.



Figure 1: VITA 3D-Master Shade Guide (VITA Zahnfabrik, Germany)(8)

Skin Tone Evaluation: Skin tone was determined using the Fitzpatrick Skin Phototype Scale (Types I –VI) (Fig. 2). Assessment combined both observed skin color and participants’ responses to a structured questionnaire about their reaction to sun exposure. Each answer was assigned a numerical score, and the total indicated the category:

- **Type I:** Very fair skin, always burns and never tans (0–6 points).
- **Type II:** Fair skin, burns easily and tans minimally (7–13 points).
- **Type III:** Light brown or beige, may burn slightly and gradually tans (14–20 points).
- **Type IV:** Olive or moderate brown skin, rarely burns and tans well (21–27 points).
- **Type V:** Dark brown skin, almost never burns and tans deeply (28–34 points).
- **Type VI:** Deeply pigmented skin, resistant to burning with very strong tanning response (35+ points).

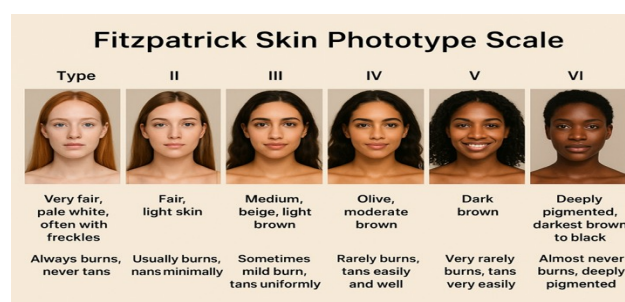


Figure 2: Fitzpatrick Skin Phototype Scale (9)

Demographic Data: Age, gender, and relevant medical/dental history were recorded using a structured questionnaire (9). rarely observed, while shade 5M was not found in any participant (Table 1).

Ethical Considerations: Ethical approval was obtained from the Institutional Ethics Committee (Approval No:271 / 2025181 in 3 / 9/ 2025). Written informed consent was obtained from all participants prior to data collection. The study was conducted in accordance with the Declaration of Helsinki (2013 revision).

Statistical Analysis: Data were entered and analyzed using Microsoft Excel . Descriptive statistics (frequency, percentage) were used to summarize data. Chi-square test was applied to evaluate associations between categorical variables (tooth shade, gender, skin type). Pearson or Spearman correlation coefficient was applied to assess the correlation between Vita tooth shade and Fitzpatrick skin tone. A *p*-value < 0.05 was considered statistically significant.

Result

A total of 1000 participants were included in this study. The majority were aged more than 40 years (33.3%), followed by 34–40 years (29.4%), while the youngest group (18–26 years) constituted 24.3% of the sample. Females represented a larger proportion (59.2%) compared to males (40.8%).

With regard to skin color, the most common categories were type III (40.2%) and type IV (32.5%), whereas types II (4.0%) and VI (4.2%) were the least frequent.

The predominant tooth shade was 2M (38.9%), followed by 2L (17.8%) and 2R (16.0%). Very dark shades such as 4R (2.2%) and 4M (2.7%) were

Variables		No. of Patients	%
Age	18-26	243	24%
	27-33	130	13%
	34-40	294	29%
	More than 40	333	33%
Gender	Male	408	41%
	Female	592	59%
Skin Color and Type	I	57	6%
	II	40	4%
	III	402	40%
	IV	325	33%
	V	134	13%
	VI	42	4%
Tooth Color Shade	1M	97	10%
	2L	178	18%
	2M	389	39%
	2R	160	16%
	3L	51	5%
	3M	27	3%
	3R	27	3%
	4L	22	2%
	4M	27	3%
	4R	22	2%
	5M	0	0J%

Table 1: Descriptive details of the Study Sample (1000 participant)

Color Shade relation with Age:

The 2M shade was most frequent across all age groups, particularly in participants aged 33–40 years (49.7% within age group). The lighter shade 1M was more common among younger individuals (18–26 years; 60.8% within shade), whereas darker shades (3L, 3M, 4L, 4M, 4R) were predominantly seen in individuals older than 40 years (Table 2).

Figure 3 show the distribution of age group in relation to tooth shade type. Table 3 show a statistical-

ly significant association was observed between tooth shade and age ($\chi^2 = 1024.63$, $df = 27$, $p < 0.00001$).

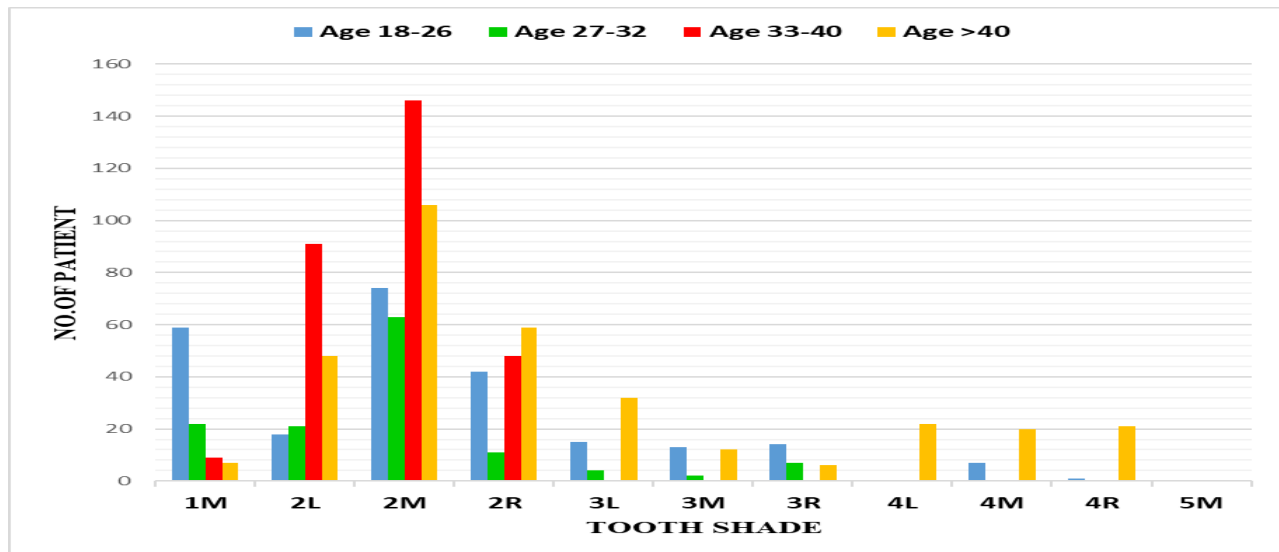


Figure 3; Distribution of Tooth Shade among Age Groups

Table 3: Pearson Chi-Square for analysis

Tooth Shade		Age				Total
		18-26	27-32	33-40	>41	
1M	No. of participant	59	22	9	7	97
	within Tooth Shade	60.8%	22.7%	9.3%	7.2%	100.0%
	Within Age	24.3%	16.9%	3.1%	2.1%	9.7%
2L	No. of participant	18	21	91	48	178
	within Tooth Shade	10.1%	11.8%	51.1%	27.0%	100.0%
	Within Age	7.4%	16.2%	31.0%	14.4%	17.8%
2M	No. of participant	74	63	146	106	389
	within Tooth Shade	19.0%	16.2%	37.5%	27.2%	100.0%
	Within Age	30.5%	48.5%	49.7%	31.8%	38.9%
2R	No. of participant	42	11	48	59	160
	within Tooth Shade	26.3%	6.9%	30.0%	36.9%	100.0%
	Within Age	17.3%	8.5%	16.3%	17.7%	16.0%
3L	No. of participant	15	4	0	32	51
	within Tooth Shade	29.4%	7.8%	0.0%	62.7%	100.0%
	Within Age	6.2%	3.1%	0.0%	9.6%	5.1%
3M	No. of participant	13	2	0	12	27
	within Tooth Shade	48.1%	7.4%	0.0%	44.4%	100.0%
	Within Age	5.3%	1.5%	0.0%	3.6%	2.7%
3R	No. of participant	14	7	0	6	27
	within Tooth Shade	51.9%	25.9%	0.0%	22.2%	100.0%
	Within Age	5.8%	5.4%	0.0%	1.8%	2.7%
4L	No. of participant	0	0	0	22	22
	within Tooth Shade	0.0%	0.0%	0.0%	100.0%	100.0%
	Within Age	0.0%	0.0%	0.0%	6.6%	2.2%
4M	No. of participant	7	0	0	20	27
	within Tooth Shade	25.9%	0.0%	0.0%	74.1%	100.0%
	Within Age	2.9%	0.0%	0.0%	2.0%	2.7%
4R	No. of participant	1	0	0	21	22
	within Tooth Shade	4.5%	0.0%	0.0%	95.5%	100.0%
	Within Age	0.4%	0.0%	0.0%	6.3%	2.2%
5M	No. of participant	0	0	0	0	0
	within Tooth Shade	0.0%	0.0%	0.0%	0.0%	0.0%
	Within Age	0.0%	0.0%	0.0%	0.0%	0.0%
Total	No. of participant	243	130	294	333	1000
	within Tooth Shade	276.1%	98.7%	127.9%	497.2%	100.0%
	Within Age	100.0%	100.0%	100.0%	100.0%	100.0%

Tooth Shade with Age						
Pearson Chi-Square	Value	df	p-value	1024.63	27	0.0001
	likelihood Ratio	375	27			
linear by linear association	45.36	1	0.0001			

p-value < 0.05 was considered statistically significant

Color Shade relation with Gender:

The 2M shade was the most common in both males (38.5%) and females (39.2%) (Figure 4). Lighter shades, particularly 1M, were more frequent in females (11.5%) compared to males (7.1%). Conversely, darker shades such as 3L, 3M, and 4R were more common among males (Table 4). Tooth shade distribution differed significantly by gender ($\chi^2 = 72.19$, df = 9, p = 0.001) (Table 5).

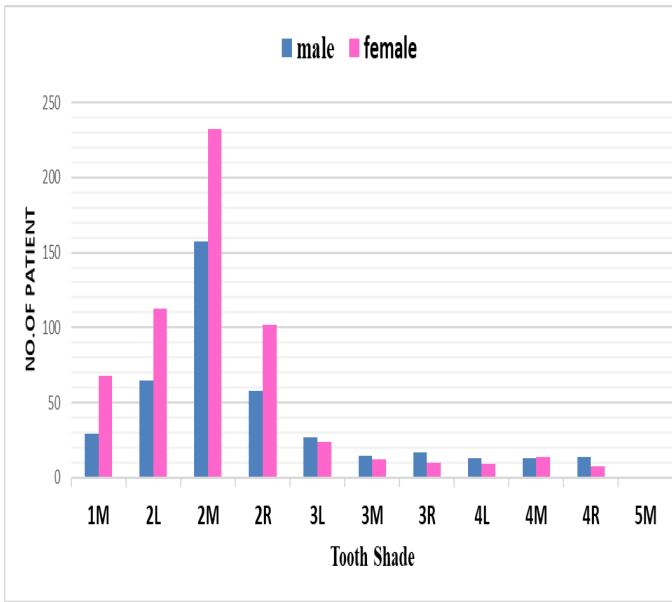


Figure 4: Distribution of Tooth Shade among Gender

Tooth Shade		Gender		Total
		Male	Female	
1M	No. participant	29	68	97
	within Tooth Shade	29.9%	70.1%	100.0%
	within Gender	7.1%	11.5%	18.6%
2L	No. participant	65	113	178
	within Tooth Shade	36.5%	63.5%	100.0%
	within Gender	15.9%	19.1%	35.0%
2M	No. participant	157	232	389
	within Tooth Shade	40.4%	59.6%	100.0%
	within Gender	38.5%	39.2%	77.7%
2R	No. participant	58	102	160
	within Tooth Shade	36.3%	63.8%	100.0%
	within Gender	14.2%	17.2%	31.4%
3L	No. participant	27	24	51
	within Tooth Shade	52.9%	47.1%	100.0%
	within Gender	6.6%	4.1%	10.7%
3M	No. participant	15	12	27
	within Tooth Shade	55.6%	44.4%	100.0%
	within Gender	3.7%	2.0%	5.7%
3R	No. participant	17	10	27
	within Tooth Shade	63.0%	37.0%	100.0%
	within Gender	4.2%	1.7%	5.9%
4L	No. participant	13	9	22
	within Tooth Shade	59.1%	40.9%	100.0%
	within Gender	3.2%	1.5%	4.7%
4M	No. participant	13	14	27
	within Tooth Shade	48.1%	51.9%	100.0%
	within Gender	3.2%	2.4%	5.6%
4R	No. participant	14	8	22
	within Tooth Shade	63.6%	36.4%	100.0%
	within Gender	3.4%	1.4%	4.8%
5M	No. participant	0	0	0
	within Tooth Shade	0.0%	0.0%	0.0%
	within Gender	0.0%	0.0%	0.0%
Total	No. participant	408	592	1000
	within Tooth Shade	0.408	0.592	1
	within Gender	1	1	1

Table 4: Relation between Tooth Shade and Gender in the Participant Sample

Tooth Shade with Gender						
Pearson Chi-Square	value	df	p-value			
	72.19	9	0.001	likelihood Ratio	26.87	9
linear by linear association	19.64	1	0.0001			

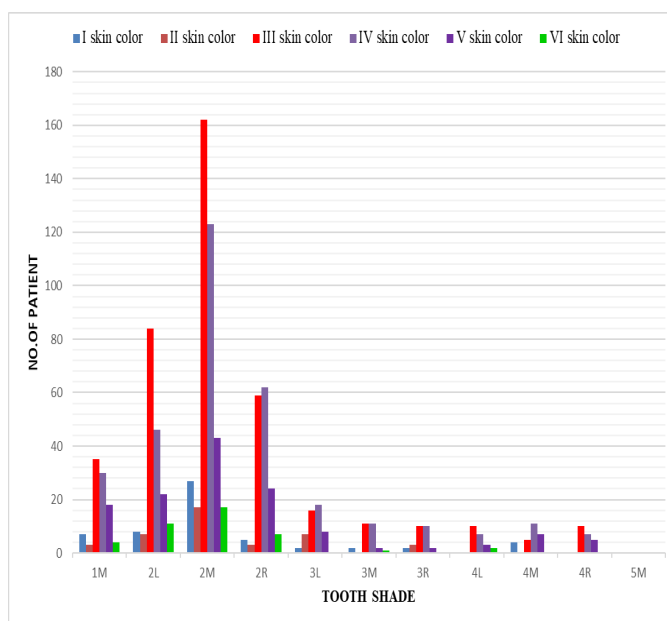
p-value < 0.05 was considered statistically significant

Table 5: Pearson Chi-Square for analysis

Color Shade relation with Skin Color

Shade 2M was consistently the most frequent across all skin types, with the highest occurrence in Figure 5: Distribution of Tooth Shade among Skin type III (41.6%) and type IV (31.6%) (Figure 5). Color

Lighter shades such as 1M were more common among individuals with lighter skin tones (types I and II), whereas darker shades (3L, 3M, and 4R) were more often observed in individuals with darker skin tones (types V and VI) (Table 6). Shade 5M was absent in all skin categories. There was a significant association between tooth shade and skin color ($\chi^2 = 175.32$, $df = 45$, $p = 0.0001$) (Table 7).



Shade		skin color						total
		I	II	III	IV	V	VI	
1M	No. of participants	7	3	35	30	18	4	97
	within Tooth Shade	7.2%	3.1%	36.1%	30.9%	18.6%	4.1%	100.0%
	within Skin Color	12.3%	7.5%	8.7%	9.2%	13.4%	9.5%	9.7%
2L	No. of participants	8	7	84	46	22	11	178
	within Tooth Shade	4.5%	3.9%	47.2%	25.8%	12.4%	6.2%	100.0%
	within Skin Color	14.0%	17.5%	20.9%	14.2%	0.1%	26.2%	17.8%
2M	No. of participants	27	17	162	123	43	17	389
	within Tooth Shade	6.9%	4.4%	41.6%	31.6%	11.1%	4.4%	100.0%
	within Skin Color	47.4%	42.5%	40.3%	37.8%	32.1%	40.5%	38.9%
2R	No. of participants	5	3	59	62	24	7	160
	within Tooth Shade	3.1%	1.9%	36.9%	38.8%	15.0%	4.4%	100.0%
	within Skin Color	8.8%	7.5%	14.7%	19.1%	17.9%	16.7%	16.0%
3L	No. of participants	2	7	16	18	8	0	51
	within Tooth Shade	3.9%	13.7%	31.4%	35.3%	15.7%	0.0%	100.0%
	within Skin Color	3.5%	17.5%	4.0%	5.5%	6.0%	0.0%	5.1%
3M	No. of participants	2	0	11	11	2	1	27
	within Tooth Shade	7.4%	0.0%	40.7%	40.7%	7.4%	3.7%	100.0%
	within Skin Color	3.5%	0.0%	2.7%	3.4%	1.5%	2.4%	2.7%
3R	No. of participants	2	3	10	10	2	0	27
	within Tooth Shade	7.4%	11.1%	37.0%	37.0%	7.4%	0.0%	100.0%
	within Skin Color	3.5%	7.5%	2.5%	3.1%	1.5%	0.0%	2.7%

4L	No. of participants	0	0	10	7	3	2	22
	within Tooth Shade	0.0%	0.0%	45.5%	31.8%	13.6%	9.1%	100.0%
	within Skin Color	0.0%	0.0%	2.5%	2.2%	2.2%	4.8%	2.2%
4M	No. of participants	4	0	5	11	7	0	27
	within Tooth Shade	14.8%	0.0%	18.5%	40.7%	25.9%	0.0%	100.0%
	within Skin Color	7.0%	0.0%	1.2%	3.4%	5.2%	0.0%	2.7%
4R	No. of participants	0	0	10	7	5	0	22
	within Tooth Shade	0.0%	0.0%	45.5%	31.8%	22.7%	0.0%	100.0%
	within Skin Color	0.0%	0.0%	2.5%	2.2%	3.7%	0.0%	2.2%
5M	No. of participants	0	0	0	0	0	0	0
	within Tooth Shade	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
	within Skin Color	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
total	No. of participants	57	40	402	325	134	42	1000
	within Tooth Shade	55.3%	38.1%	380.4%	344.6%	149.8%	31.8%	100.0%
	within Skin Color	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 6: Relation between the Tooth Shade and Skin Color in the Participant Sample

Tooth Shade with Skin Color						
Pearson Chi-Square	value	df	p-value	175	4	0.
				.32	5	0
						0
	likelihood Ratio	199	4			1
		.34	5			
linear by linear association	0.388	1	0.533			

p-value < 0.05 was considered statistically significant

Table 7: Pearson Chi-Square for analysis

Discussion

This study investigated the relationship between tooth shade, age, gender, and skin color in a large sample of 1000 participants. The findings demonstrated significant associations across these variables, providing valuable insights into natural variations in tooth shade distribution (10).

The overall distribution of tooth shade showed that

2M was the most predominant shade (38.9%), consistent across all demographic groups. This supports previous studies reporting that middle-range shades are the most common in the general population, likely reflecting the balance between enamel translucency and dentin color that becomes more prominent with age. In contrast, very dark shades such as 4M, 4R, and 5M were rare or absent, confirming that extreme shades are uncommon in natural dentition (11).

A significant association was found between tooth shade and age ($p < 0.00001$). Younger participants (18–26 years) more frequently exhibited lighter shades (particularly 1M), whereas older individuals (>40 years) showed a predominance of darker shades (3L, 4L, 4R). This aligns with the biological understanding that enamel undergoes gradual thinning and dentin becomes more sclerotic with aging, leading to darker tooth appearance (12). These results agree with previous literature highlighting tooth darkening as an indicator of aging and a challenge for aesthetic restorative dentistry (2).

Gender also showed a significant association with tooth shade ($p = 0.001$). Females demonstrated a

higher frequency of lighter shades (1M, 2L), dominant in older participants. In Al-Dosari et al. (11) also reported a tendency toward darker tooth shades with increasing age in the Iraqi population, whereas males were more likely to present with darker shades such as 3L and 4R. This finding corresponds with earlier reports suggesting that females generally place greater emphasis on tooth aesthetics and may adopt better oral hygiene practices, potentially contributing to lighter tooth coloration. Biological factors such as enamel thickness differences between sexes may also play a role (13, 14, 15). These results are consistent with this study findings, reinforcing the biological basis of age-related tooth color changes in Iraq as elsewhere.

Skin color was another important determinant, with a statistically significant correlation between skin type and tooth shade ($p = 0.0001$). Individuals with lighter skin (types I and II) had a higher prevalence of lighter shades (1M, 2L), while darker skin tones (types V and VI) were more often associated with darker shades (3L, 4R). These findings are in agreement with previous cross-sectional studies, which demonstrated that tooth shade tends to harmonize with surrounding facial complexion, supporting the concept of aesthetic balance in natural dentition. The predominance of 2M across all skin types, however, suggests that this shade may represent a universal baseline in tooth color distribution (16, 17).

These results contribute to the growing body of literature emphasizing the influence of age, gender, and skin color on tooth shade. Future research should expand to include genetic, dietary, and environmental factors to provide a more comprehensive understanding of tooth color determinants (18).

Comparison with Other Studies in Iraq

Age and Tooth Shade: This study found a significant association between age and tooth shade, with lighter shades (1M) more common among younger individuals and darker shades (3L, 4L, 4R) pre-

Gender and Tooth Shade: Females had lighter shades (1M, 2L) more frequently, while males showed darker shades (3L, 4R). In Al-Saleem (20) reported a similar pattern, with females exhibiting lighter shades, possibly due to greater attention to oral hygiene and cosmetic care. As well as Al-Daami & Al-Huwaizi (21) also noted that darker shades were more prevalent in males, supporting the idea that gender differences are both biological and behavioral. This study findings align closely with these Iraqi studies, confirming that gender-related differences in tooth shade are consistent across regions in Iraq.

Skin Color and Tooth Shade: Statistically significant correlation shown in this article; lighter skin (types I–II) associated with lighter tooth shades (1M, 2L), and darker skin (types V–VI) with darker shades (3L, 4R). Al-Dosari et al. (11) was among the earliest to show a link between skin tone and tooth shade in Iraqi adults. In addition Al-Naqshbandi (22) confirmed this relationship, noting that individuals with darker complexions tended to have higher shade values. Accordingly these studies support our findings, suggesting that tooth and skin shade correlation is strong in the Iraqi population and should be considered in prosthetic dentistry.

Predominant Tooth Shade (2M): In this study; 2M was the most frequent shade across all groups (38.9%), while very dark shades (4M, 4R, 5M) were rare. Al-Saadi (23) found 2M to be the most common shade in a sample of central incisors, supporting your result. Also Al-Qurainy (24) also reported that shades from the "2" category were most prevalent, with very dark shades rarely observed. This confirms that 2M is a dominant baseline shade in the Iraqi population, similar to international findings.

Why this study is Novel:

This research represents one of the few studies in Iraq—and particularly the first comprehensive one in Mosul City, to explore the relationship between Vita 3D-Master tooth shade, age, gender, and Fitzpatrick skin tone using a large sample size (n = 1000). Its novelty lies in establishing local baseline data for natural tooth shade distribution among different demographic and phenotypic groups, which had not been systematically analyzed before in the region. Moreover, by integrating the Fitzpatrick Skin Phototype Scale; commonly used in dermatology; into dental shade selection, this study introduces an interdisciplinary approach that enhances accuracy and aesthetic predictability in restorative dentistry. The findings provide an essential reference for clinicians and dental technicians in Iraq when selecting prosthetic shades tailored to individual patient characteristics.

Limitations:

Despite the valuable findings, this study has certain limitations. First, it was conducted as a single-center cross-sectional study within Mosul City; therefore, the results may not be fully generalizable to other Iraqi regions or ethnic groups with different genetic and environmental characteristics. Sec-

ond, tooth shade assessment relied on visual comparison using the VITA 3D-Master Shade Guide, which, although standardized, is subject to observer variability and lighting conditions.

Suggestion:

The use of instrumental color measurement devices (such as spectrophotometers) could have improved precision and minimized subjective bias. Additionally, external factors such as diet, oral hygiene habits, and socioeconomic status which may influence tooth color were not controlled in this study. Finally, the study's cross-sectional design limited the ability to infer causality between age, gender, skin tone, and tooth shade variation.

Conflict of Interest: Authors declare no COI

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Authors Contribution:

Dr. Rawaa Y. Al-Rawee responsible for concept, design, definition of intellectual content, literature search, clinical studies, data acquisition, manuscript preparation,

Dr. Dina manuscript editing and manuscript review.

Approval Statement: The manuscript has been read and approved by all the authors

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