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The Most Prevalent Shade of Anterior Teeth Among Egyptians Attending the MIU Dental Clinic. A Cross-Sectional Study

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ABSTRACT

Background: Shade selection in the appearance zone is a challenge for laboratory technicians and clinician. Knowing the prevalence of tooth shade among a specific population can help in proper tooth selection in fixed Prosthodontics. **Objective:** This study was designed to identify the most prevalent shade among sample of Egyptian participants who receive their treatment in Misr International University dental clinic analyzing different age and gender. **Material and methods:** A convenience sample of 180 subjects was recruited at MIU dental clinic and divided into three equal groups according to age (n=60): young group (18-30 years old), middle-aged group (31-59 years old) and elderly group (over 60 years old). Each group was further subdivided into two equal subgroups according to gender (male /female) (n=30). shade recording was carried using a spectrophotometer (3D master Easyshade Compact; Vita Zahnfabrik). Chi-square and spearman's correlation coefficient were used to determine the significant correlations ($p< 0.05$). **Results:** The most prevalent shade of anterior teeth was 2M2 (20.6%) followed by 3M3 (13.0%) then 2M3 (11.2%). Age and gender had significant effect on shade ($x^2 = 47.340$, $P <0.001$ and $x^2 = 9.127$, $P= 0.028$ respectively). Young group showed higher prevalence of shade 2M2. middle-aged group showed higher prevalence of shade 2M3. Elderly group showed higher prevalence of shade 3M3. Males showed higher prevalence of shade 3M3 while females showed higher prevalence of shades 2M2 and 2M3. **Conclusions:** The most prevalent shade among sample of Egyptian participants of anterior teeth was 2M2.Tooth shade is both age- and gender-dependent.

***Keywords*:** Age, Easy shade, gender, Spectrophotometry, tooth shade.

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INTRODUCTION

Nowadays patients all over the world including Egypt are seeking dental restorations with a natural appearance. Proper planning for the dental restoration are essential to reach such goal, including shape; contour; texture; tooth proportional; gingival balance, periodontal health, smile line and tooth shade.[1] Although the shade is not the only important factor to create an esthetic restoration, it is still considered as one of the parameters with the greatest weight. A correct selection and a proper communication of tooth shade allow the clinicians and dental technicians to fabricate a natural looking dental restoration to satisfy the increased esthetic expectations of patients.[2]

Color vision is the ability to distinguish between objects based on the wavelength of the light they emit, reflect or transmit. A person perception of colors is subjective processes where the brain reacts to stimuli that arise when light react with several types of cone cell in the eye.[3,4] Given the three types of color receptors in the eye, it is the most common to specify the color an observer would detect with three-color parameters. Although other color order systems described the color as being three-dimensional,[5,6] Munsell was the first to separate into perceptually uniform and independent dimensions of hue, value, and chroma, and was the first to illustrate the colors systematically in three-dimensional space.

Visual tooth shade assessment, are considered the oldest and frequently used method of shade selection,[7-9] was regarded by several authors as subjective,[9,10] susceptible to error,[11] can be affected by many environmental factors include observer ability, light and surrounding structure.[12-15] Also, the available dental shade guide may not be able to represent all the natural tooth shade.[16,17] The brand of the shade guide also different from each other and even among batches[18,19] and even varies between batches,[20] also aging of the shade guide may affect the shade itself. To overcome all these drawbacks, the shade measurement devices that allow objective choice of shade values are preferred now. These devices represented by tristimulus colorimeters, spectrophotometers, spectroradiometers and digital cameras.[17]

In several studies, spectrophotometers have been used as a reference due to their accuracy, reproducibility, and sensitivity.[21-23] Spectrophotometers, as well as colorimeters, can provide readings from CIE (Commission Internationale de l'Eclairage) L*, a*, b* color space, where L* indicate lightness (amount of white and black within a color), a* measure of greenness (negative a*) or redness (positive a*) and b* represents the position on the

blue (negative b*) yellow (positive b*) axis.[2.7.9]

Several previous studies[20, 22,24-29] have been conducted and focused on the effect of age and gender determinants on the natural tooth shade s in various population and tried to establish a relation between them. They collaborated and found that there was a definite relation between age and natural tooth shade. They concluded that the shade of natural teeth becomes darker over time. While, gender on the other hand was a subject of controversy regarding its influence on tooth shade. Some studies[20,22,27,29] found no significant relation between them while others[24,26,28] concluded that men have darker teeth compared to women of the same age group.

Knowing the distribution of natural tooth shades according to age group and gender can help in the selection of tooth shade, especially for inexperienced operators. However, limited scientific information about the frequency of natural tooth shade according to the shades tabs of 3D Master Systems are available in Egypt. Therefore, the present study was designed to identify the most prevalent tooth shade among a sample of Egyptian participants who receive their treatment in Misr International University outpatient clinic using the clinical spectrum- photometer (Easyshade Compact - Vita-Zahnfabrik) and analyzing different age and gender groups, according to 3D Master System. The hypothesis of this study is that age and gender will affect the tooth shade among sample of Egyptians attending MIU outpatient clinic.

MATERIAL AND METHODS

Sample size calculation:

Sample size calculation was calculated based upon the average number of patients attending MIU Dental Clinics per year which was found to be 75050 patients/year according to the records of the academic years 2012/2013 to 2014/2015 and using alpha level = 0.05, β level = 0.20 (Power = 80%), the estimated minimum sample size is 164 patients. Sample size calculation was performed using StatCalc formulas of Epi Info 7.1.1.14 software.

Human subject approval was obtained by the Misr International University Review Board (Protocol # 00010118 dated May 2016) to carry out this research. A convenience sample of 180 subjects was recruited at Misr International University outpatient dental clinic and divided into three equal groups according to age: young group (18-30 years old) (n=60), middle age group (31-59 years old) (n=60) and elderly group (over 60 years old) (n=60). Each group was further subdivided into two equal subgroups according to gender (male /female) (n=30 each).

Inclusion criteria:

Participant-related criteria:

1. Egyptians between 16 and 89 years old both gender.

2. Participants with all upper anterior teeth present.

Tooth-related criteria:

1. Free from any restorative procedure in the anterior teeth.

2. Did not undergo bleaching of teeth before.

3. Free from any periodontal disease and tooth mobility in upper anterior areas.

Exclusion criteria:

Participant -related criteria:

1. Medically compromised patients.

2. Smoker.

3. Psychiatric, cognitive, or social (for example, alcoholism or drug abuse) conditions that would interfere with giving consent and cooperation.

Tooth-related criteria:

1. Non-vital teeth.

2. Intrinsic staining on maxillary anterior teeth-for example, tetracycline stains, or fluorosis.

3. Severe attrition resulting in incisal enamel wear.

After selection of the participants, they were asked to read and sign an informed consent form for participation in the study, then they were referred to the department of periodontology in Misr International University outpatient dental clinic to undergo a scaling and polishing visit and instructed for a good oral hygiene before shade measurement. The shade of the participant's clothes was neutralized with a gray cloth to prevent any miss-shade measurement. Shade recording was carried out by only one examiner using the same spectrophotometer (Easyshade Compact; Vita Zahnfabrik) with a standardized protocol for shade evaluation. The examiner was instructed to practice the use of Easyshade compact over two days before starting the measurements. Hygienic protectors were placed over the probe tip for each patient to prevent any cross infection. Before recording, the lamp was calibrated according to the manufacturer's instructions. The Easyshade was placed on the calibration block holder (Easyshade Compact; Vita Zahnfabrik) followed by depressing the calibration block until a green LED was lit in the center of the illuminated base and two short beeps was heard. Calibration was done before each recording for every patient. The easy shade instrument was placed perpendicular to the labial tooth surface in the middle third (single tooth mode). For every patient, shade recording was carried out several time until the first repeated measurements). To ensure standardization, all measurements were taken in the same room and under the same lightening conditions. All data were entered and saved electronically, patient files were stored in numerical order and stored in secured file.

Data were encrypted using a password.

Statistical analysis

Qualitative data were presented as frequencies (n) and percentages while numerical data were presented as mean and standard deviation (SD) values. Chi-square and spearman's correlation coefficient were used to determine the significant correlations. Multinomial logistic regression model was constructed to study the effect of age and gender on tooth shade. The significance level was set at $p< 0.05$. Statistical analysis was performed with IBM SPSS Statistics Version 20 for Windows.

RESULTS

Demographic data

The present study was conducted on 180 subjects; 90 males (50%) and 90 females (50%). The mean ± standard deviation values for age were 43.2 ± 16.4 years with a minimum of 18 and a maximum of 71 years old.

Overall prevalence

Shade selection was performed for upper anterior teeth of each participant, hence giving a total of 1080 teeth. Results are presented in Table 1 and Figure 1. The most prevalent shade of all teeth was 2M2 (20.6%) followed by 3M3 (13.0%) and 2M3 (11.2%). The least prevalent shade was 3R3.5 (0.1%) followed by 3R1.5 (0.2%) and 4L2.5 (0.3%).

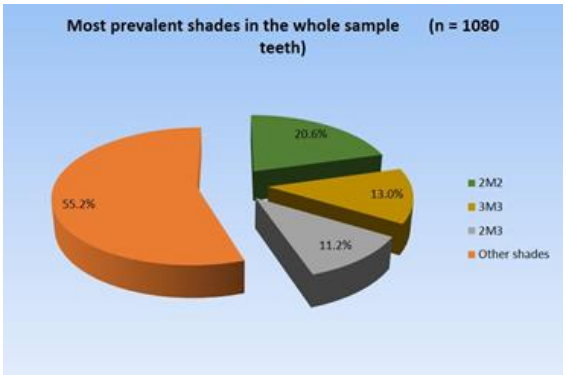

Figure (1): Pie chart representing the percentages (%) for overall prevalence of different shades (n = 1080 teeth).

Regarding the upper canine (n = 360); the most prevalent shade was 3M3 (23.1%) followed by 2M3 (14.7%) then 3M2 (11.7%). The least prevalent shades were 2R1.5, 3R1.5, 3R3.5 and 4L2.5with a prevalence of (0.3%) for each shade. Shades 1M1, 1M2, 2L1.5 and 2L2.5 were not found.

While for upper lateral incisor teeth (n = 360); the most prevalent shade was 2M2 (28.9%) followed by 2M3 (8.9%) then 3M2 (8.1%). The least prevalent shades were 2R1.5, 3R1.5, 3R3.5 and 4L2.5with a prevalence of (0.3%) for each shade. Shades 1M1, 1M2, 2L1.5 and 2L2.5 were not found.

As regard the upper central incisor teeth (n = 360); the most prevalent shade was 2M2 (30.0%) followed by 2M3 (10.0%) then 3M3 (8.3%). The least prevalent shades were 3M1, 3R1.5 and 5M1 with a prevalence of (0.3%) for each shade. Shades 3R3.5, 4L2.5, 4R1.5, 5M2 and 5M3 were not found.

Table (I): Frequencies (n) and percentages (%) for overall prevalence of different shades.

Shade	All teeth (n=1080)		Upper canine (n=360)		Upper lateral incisor (n=360)		Upper central incisor (n=360)	
	n	%	n	%	n	%	n	%
1M1	9	0.8	0	0	3	0.8	6	1.7
1M2	33	3.1	0	0	10	2.8	23	6.4
2L1.5	35	3.2	0	0	14	3.9	21	5.8
2L2.5	34	3.1	0	0	12	3.3	22	6.1
2M1	33	3.1	3	0.8	12	3.3	18	5.0
2M2	222	20.6	10	2.8	104	28.9	108	30.0
2M3	121	11.2	53	14.7	32	8.9	36	10.0
2R1.5	33	3.1	1	0.3	22	6.1	10	2.8
2R2.5	47	4.4	5	1.4	23	6.4	19	5.3
3L1.5	32	3.0	7	1.9	12	3.3	13	3.6
3L2.5	18	1.7	7	1.9	7	1.9	4	1.1
3M1	7	0.6	2	0.6	4	1.1	1	0.3
3M2	85	7.9	42	11.7	29	8.1	14	3.9
3M3	140	13.0	83	23.1	27	7.5	30	8.3
3R1.5	2	0.2	1	0.3	0	0	1	0.3
3R2.5	17	1.6	7	1.9	7	1.9	3	0.8
3R3.5	1	0.1	1	0.3	0	0	0	0
4L1.5	33	3.1	18	5.0	7	1.9	8	2.2
4L2.5	3	0.3	1	0.3	2	0.6	0	0
4M1	17	1.6	9	2.5	6	1.7	2	0.6
4M2	49	4.5	35	9.7	5	1.4	9	0.8
4M3	49	4.5	33	9.2	7	1.9	9	0.8
4R1.5	8	0.7	6	1.7	2	0.6	0	0
4R2.5	25	2.3	15	4.2	8	2.2	2	0.6
5M1	10	0.9	7	1.9	2	0.6	1	0.3
5M2	7	0.6	5	1.4	2	0.6	0	0
5M3	10	0.9	9	0.8	1	0.3	0	0

Prevalence in males and females

Ninety males were included in the study giving a total of 540 teeth. Results are presented in figure 2. The most prevalent shade of all teeth was 2M2 (17.8%) followed by 3M3 (14.1%) then 2M3 (9.8%). The least prevalent shade was 4L2.5 (0.2%) followed by shades 3M1 and 4R1.5 (0.6% for each shade). Shade 3R3.5 was not found. Regarding the upper canine (n = 180); the most prevalent shade was 3M3 (23.3%) followed by 2M3 (16.1%) then 4M3 (11.7%). The least prevalent shades were 2M1, 4R1.5 with a prevalence of (0.6%) for each shade followed by 3L1.5 and 3R2.5 with a prevalence of (1.1%) for each shade. Shades 1M1, 1M2, 2L1.5, 2L2.5, 2R1.5, 3M1, 3R1.5, 3R3.5 and 4L2.5 were not found. While for upper lateral incisor teeth (n = 180); the most prevalent shade was 2M2 (21.1%) followed by 2M3 (9.4%) then 3M2 and 3M3 (7.2%

for each shade). The least prevalent shades were 4L2.5, 5M1 and 5M3 with a prevalence of (0.6%) for each shade.

Shades 3R1.5 and 3R3.5 were not found. Regarding the upper central incisor teeth (n = 180); the most prevalent shade was 2M2 (29.4%) followed by 3M3 (11.7%) then 1M2 (9.4%). The least prevalent shades were 3M1, 3R1.5, 3R2.5 and 5M1 with a prevalence of (0.6%) for each shade. Shades 3R3.5, 4L2.5, 4R1.5, 5M2 and 5M3 were not found.

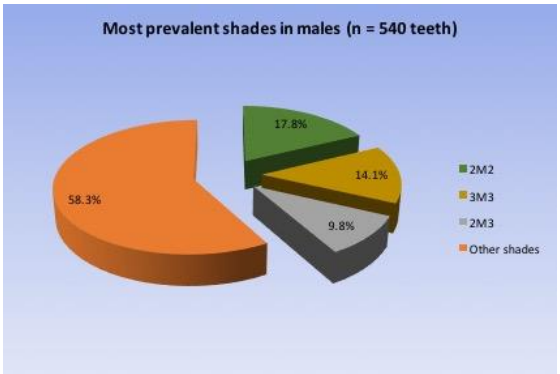

Figure (2): Pie chart represents the percentages (%) for the most prevalence shades in males (n=540 teeth)

Ninety females were included in the study giving a total of 540 teeth. Results are presented **figure 3**. The most prevalent shade of all teeth was 2M2 (23.3%) followed by 2M3 (12.6%) then 3M3 (11.9%). The least prevalent shades were 3R1.5, 3R3.5 and 5M3 (0.2% for each shade). Regarding the upper canine (n = 180); the most prevalent shade was 3M3 (22.2%) followed by 3M2 (15.6%) then 2M3(13.3%). The least prevalent shades were 2R1.5, 2R2.5, 3R1.5, 3R3.5, 4L2.5 and 5M3 with a prevalence of (0.6%) for each shade. Shades 1M1, 1M2, 2L1.5 and 2L2.5 were not found. While for upper lateral incisor teeth (n = 180); the most prevalent shade was 2M2 (36.7%) followed by 3M2 (8.9%) then 2M3 and 3M3 (8.3% for each shade). The least prevalent shades were 1M1, 2M1, 3L2.5, 4L2.5 and 5M1 with a prevalence of (0.6%) for each shade. Shades 3R1.5, 3R3.5, 4M2, 4R1.5, 5M2 and 5M3 were not found. Regarding the upper central incisor teeth (n = 180); the most prevalent shade was 2M2 (30.6%) followed by 2M3 (16.1%) then 2L1.5 (8.9%). The least prevalent shades were 3L2.5, 3R2.5 and 4L1.5 with a prevalence of (1.1%) for each shade. Shades 3M1, 3R1.5, 3R3.5, 4L2.5, 4M1, 4R1.5, 4R2.5, 5 M1, 5M2 and 5M3 were not found.

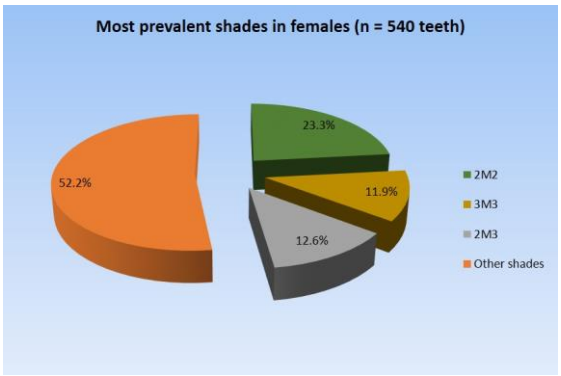

Figure (3): Pie chart represents the percentages (%) for the most prevalence shades in females (n=540 teeth)

Prevalence in different age groups

Sixty subjects aged 18 – 30 years old participated in the study giving a total of 360 teeth. Results are presented in **figure 4**.

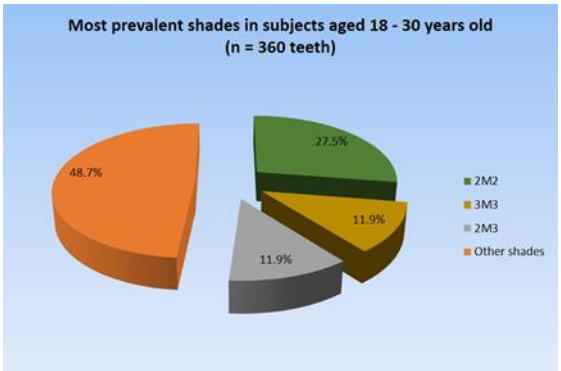

Figure (4): Pie chart represents the percentages (%) for the most prevalence shades in subjects aged 18-30 years old (n=360 teeth)

The most prevalent shade of all teeth was 2M2 (27.5%) followed by 2M3 and 3M3 (11.9% for each shade). The least prevalent shades were 4L1.5, 4M1, 5M2 and 5M3 (0.3% for each shade). Shades 3M1, 3R1.5, 3R3.5, 4L2.5, 4R1.5 and 5M1 were not found. Regarding the upper canine (n = 120); the most prevalent shade was 3M3 (28.3%) followed by 2M3 (22.5%) then 3M2 (15.8%). The least prevalent shades were 2M1, 3L2.5, 4L1.5, 5M2 and 5M3 with a prevalence of (0.8%) for each shade. Shades 1M1, 1M2, 2L1.5, 2L2.5, 2R1.5, 3M1, 3R1.5, 3R3.5, 4L2.5, 4M1, 4R1.5 and 5M1 were not found. While for upper lateral incisor teeth (n = 120); the most prevalent shade was 2M2 (37.5%) followed by 2R2.5 (13.3%) then 2M3 (10.0%). The least prevalent shades were 3L1.5, 3L2.5 and 4M1 with a prevalence of (0.8%) for each shade. Shades 1M1, 3M1, 3R1.5, 3R3.5, 4L1.5, 4L2.5, 4M2, 4R1.5, 4R2.5, 5M1, 5M2 and 5M3 were not found. Regarding the upper central incisor teeth (n = 120); the most prevalent shade was 2M2 (39.2%) followed by 1M2 (14.2%) then 2L1.5 (8.3%). The least prevalent shades were 3L1.5, 3M2 and 4M2 with a prevalence of (1.7%) for each shade. Shades 3L2.5, 3M1, 3R1.5, 3R2.5, 3R3.5, 4L1.5, 4L2.5, 4M1, 4R1.5, 4R2.5, 5M1, 5M2 and 5M3 were not found.

Sixty subjects aged 31 – 59 years old participated in the study giving a total of 360 teeth. Results are presented in figure 5.

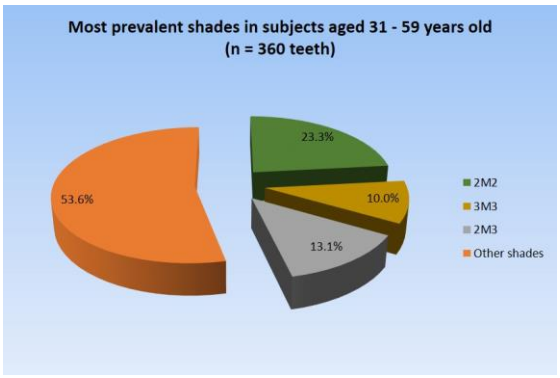

Figure (5): Pie chart represents the percentages (%) for the most prevalence shades in subjects aged 31-59 years old (n=360 teeth)

The most prevalent shade of all teeth was 2M2 (23.3%) followed by 2M3 (13.1%) then 3M3 (10.0%). The least prevalent shades were 3R1.5, 3R3.5 and 5M1 (0.3% for each shade). Shades 4L2.5 and 5M2 were not found. Regarding the upper canine (n = 120); the most prevalent shade was 3M3 (22.5%) followed by 2M3 (18.3%) then 3M2 (15.0%). The least prevalent shades were 3L1.5, 3L2.5, 3M1, 3R3.5 and 5M1 with a prevalence of (0.8%) for each shade. Shades 1M1, 1M2, 2L1.5, 2L2.5, 2M1, 2R1.5, 4L2.5 and 5M2 were

not found. While for upper lateral incisor teeth (n = 120); the most prevalent shade was 2M2 (35.0%) followed by 2M3 (11.7%) then 3M2 (9.2%). The least prevalent shades were 3M1, 4M3 and 5M3 with a prevalence of (0.8%) for each shade. Shades 3R1.5, 3R3.5, 4L2.5, 4M1, 4R1.5, 5M1 and 5M2 were not found. Regarding the upper central incisor teeth (n = 120); the most prevalent shade was 2M2 (33.3%) followed by 2R2.5 (10.0%) then 2M3 (9.2%). The least prevalent shades were 1M1, 3R2.5, 4M2 and 4R2.5 with a prevalence of (0.8%) for each shade. Shades 3L2.5, 3M1, 3R1.5, 3R3.5, 4L2.5, 4R1.5, 5M1, 5M2 and 5M3 were not found.

Sixty subjects aged 60 – 89 years old participated in the study giving a total of 360 teeth. Results are presented in **figure 6**.

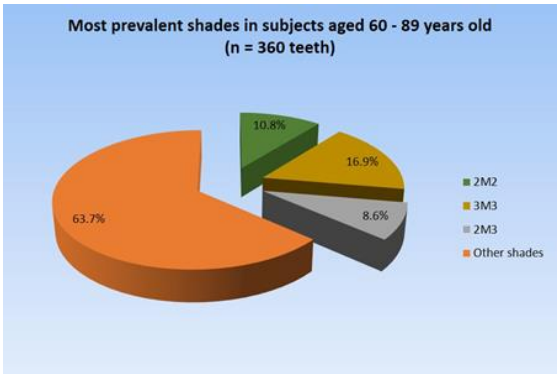

Figure (6): Pie chart represents the percentages (%) for the most prevalence shades in subjects aged 60-89 years old (n=360 teeth)

The most prevalent shade of all teeth was 3M3 (16.9%) followed by 2M2 (10.8%) then 2M3 (8.6%). The least prevalent shades were 1M1 and 3R1.5 (0.3% for each shade) followed by 4L2.5 (0.8%). Shades 1M2 and 3R3.5 were not found. regarding the upper canine (n = 120); the most prevalent shade was 3M3 (17.5%) followed by 4M3 (15.8%) then 4L1.5 (12.5%). The least prevalent shades were 2M2, 2R1.5, 3M1 and 4L2.5 with a prevalence of (0.8%) for each shade. Shades 1M1, 1M2, 2L1.5, 2L2.5, 2R2.5, 3R1.5 and 3R3.5 were not found. While for upper lateral incisor teeth (n = 120); the most prevalent shade was 3M3 (16.7%) followed by 2M2 (14.2%) then 3M2 (8.3%). The least prevalent shades were 1M1 and 3R2.5 with a prevalence of (0.8%) for each shade followed by shades 4L2.5, 4R1.5, 5M1 and 5M2 with a prevalence of (1.7%) for each shade. Shades 1M2, 3R1.5, 3R3.5 and 5M3 were not found. Regard the upper central incisor teeth (n = 120); the most prevalent shades were 2M2 and 2M3 (17.5% for each shade) followed by 3M3 (16.7%). The least prevalent shades were 2L1.5, 2R2.5, 3M1, 3R1.5, 4R2.5 and 5M1 with a prevalence of (0.8%) for each shade. Shades 1M1, 1M2, 2R1.5, 3R3.5, 4L2.5, 4M1, 4R1.5, 5M2 and 5M3 were not found.

Effect of gender and age on tooth shade

Multinomial logistic regression model was constructed to study the effect of age and gender on tooth shade. Tooth shade was the dependent variable and included 4 categories (Shade 2M2, Shade 2M3, Shade

3M3 and Other shades). The independent variables were age and gender. Model fit was tested using Chi-square test (x^2 = 18.025, *P*-value = 0.624), Cox and Snell, Nagelkerke as well as McFadden pseudo R-Square tests were also performed to check model fit and their results were (0.393, 0.419 and 0.180, respectively). These results indicate that the model was fit to describe the relation between the variables.

The results showed that age has a statistically significant effect on shade (x^2 = 47.340, *P*-value <0.001). Subjects aged 18 – 30 years old showed higher prevalence of shade 2M2 than other age categories. Subjects aged 31 – 59 years old showed higher prevalence of shade 2M3 than other age categories. Subjects aged 60 – 89 years old showed higher prevalence of shade 3M3 in addition to higher prevalence of other shades than other age categories.

Also, gender has a statistically significant effect on shade (x^2 = 9.127, *P*-value = 0.028). Males showed higher prevalence of shade 3M3 than females while females showed higher prevalence of shades 2M2 and 2M3 than males.

DISCUSSION

The present study was designed to identify the most common tooth shade among a sample of Egyptian participants who received their treatment at Misr International University outpatient dental clinic using the clinical spectrum-photometer, (Easyshade Compact - Vita-Zahnfabrik) and analyzing different age and gender groups, according to 3D Master System. The hypothesis of the current study was accepted as both age and gender groups significantly affect the natural tooth shade.

The shade of the natural tooth is affected by intrinsic and extrinsic staining which have a great impact on altering tooth shade selection. Some of the intrinsic factors are congenital defects of enamel or dentin such as amelogenesis and dentinogenesis imperfecta, environmental factors such as tetracycline staining, traumatic injury, dental caries, and aging. Extrinsic factors include diet, smoking, xerostomia, restorations and absorption of materials (e.g., tea, coffee, the side effects of medicaments) into the surface of the enamel.[30,31] So, all patients were recruited in the present study based on the inclusion/exclusion criteria and underwent a full mouth scaling and oral hygiene measure to exclude the effect of extrinsic staining on final shade of anterior teeth.[30,31]

The use of clinical spectrophotometer (Easy shade) which was selected rather than the conventional visual measurements to omit the human variation error and use a more standardized and reproducible method.[32,33] Some studies[4,5,8] suggested that spectrophotometric shade selection and analysis were more accurate and reproducible compared to visual shade

assessment.

For tooth shade determination, the middle site of the tooth was selected. The middle site of the teeth is the best representative, as the incisal site is the most often translucent and is affected by its background while the cervical shade is modified by scattered light from the gingiva.[34]

In the present study, Chi-square test found that patient age-groups selected had a significant effect on tooth shade (x^2 = 47.340, *P*-value <0.001). Young age group (18-30 years old), showed higher prevalence of shade 2M2, middle age group (31-59 years old) showed higher prevalence of shade 2M3and and elderly group (over 60 years old) showed higher prevalence of shade 3M3. The results showed that both groups (young and middle aged) had the same value and hue but the teeth became more saturated in the middle-aged group (Chroma). While, for elderly group, the teeth become darker. These findings are attributed to the fact that tooth shade depends on the dentin thickness, dentin shade, and volume of the pulp chamber and by aging there is increase in the dentin layer and the volume of the pulp chamber is also reduced due to continuous secondary dentin deposition,[25] Hasegawa et al.[15] observed that the natural tooth shade showed a significant decrease in lightness at the center to cervical site and increase in yellowness with advancing age. Similar correlation was reported by Goodkind et al.[25] and other researchers.[26-29, 35] Most of literature reported that the age had a significant effect on darkness of natural teeth The findings of this study were in agreement with the results of the above-mentioned studies.

In addition, gender is another factor which significantly had a great impact on tooth shade in this study (x^2 = 9.127, *P*-value = 0.028). Esan et al.[26] reported that gender is significantly associated with tooth shade values. Men had darker tooth shade values compared to women within the same age group,[26] In the present study, for all groups, males showed higher prevalence of shade 3M3 (high value) than females while, females showed higher prevalence of shades 2M2 and 2M3 (low value) than males which is consistent with the previous results. On the other hand, our findings are not consistent with those reported by Veeraganta et al.[29] who concluded that gender had no significant relation to tooth shade value. The difference may be due to the imbalance in the ratio of male to female subjects in the sample of their study. Also, our findings are not consistent with previous studies[27,29] using guide tabs for shade measurement. While, in the studies[22,24,25,28] using digital shade measurement, there were significant differences between gender and tooth

shade. The reason of this outcome in studies using guide tabs for shade measurement may be due to the difference in teeth shade between men and women are less, and the inability of the human eye to perceive this slight difference.[35]

Aside from the limitations on instrumentation and measurements in the present study, the selected sample does not represent a random sample of the Egyptian population. Therefore, future studies should include measuring the tooth shade among different areas of Egypt are needed to confirm the findings of this work.

CONCLUSIONS

Within the limitations of the present study, the following conclusions were drawn:

1. The most prevalent tooth shade among a sample of Egyptian participants of all anterior teeth was 2M2.

2. Tooth shade is both age- and gender-dependent.

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