

**Original Article**

**Facial golden ratio and facial appearance among medical students of Jouf University**

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**Abstract:**

**Background:** All human faces are unique and contribute to individual identity. The face is one of the most fundamental parts of the body for self-recognition. Objectives: To measure the facial golden ratio (FGR) and facial appearance (FA) of medical students of Jouf University, Saudi Arabia. **Methodology:** This is a cross sectional study, facial height (FH) and facial width (FW) of each participant were measured by digital verniercalliper. All measurements were done by two researchers, if the measurements are equal or nearby, then mean value are considered and assessment of facial awareness are done by a validated structured questionnaire. Data analysis was carried out using the Statistical Package for Social Sciences version 23 (SPSS Inc., Chicago, IL, USA). **Results:** Mean FGR value of the males and females are 1.64 and 1.55 respectively. This study revealed highly significant disparities among genders. The male participant has close resembles with FGR in comparison to females. There was no significant difference between upper FH (57.74), Middle FH (55.16) and Lower FH (56.65) among Saudi, Jordan and Syrian participant. The females were significantly more satisfied with their eyelids and eyes than males, and their significant different was  $p=0.014$  and  $0.002$ , respectively. **Conclusions:** Majority population, both male and female having a normal face and satisfied with their face's variables. The male participant has close resembles with the FGR.

**Keywords:** Facial golden ratio; Facial awareness; Facial appearance; Saudi.

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**Introduction:**

Facial type and morphology assessment is indispensable for the planning and recognition of anthropometric measurement of the face.<sup>1</sup> The FGR is a mathematical ratio found by dividing the line into two parts so that the longer part divided by, the

smaller part. FGR is 1: 1.6.<sup>2</sup> The FGR is expressed throughout the physical human body in innumerable ways, including our bone structure. Hence, our research concern is the FGR of the face. The length of the face is measured from the trigon to the mental tubercle. The width of the face is measured from

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the zygomatic to zygomatic prominence. The facial index (FI) is calculated from the two of them as  $\text{Length} / \text{Width} \times 100$ .<sup>2</sup> The FI classifies the face as euryprosopic (Broad face), mesoprosopic (Round face) and leptoprosopic (Long Face).<sup>3</sup>

In 2012 a study with facial indices measurement were done and found that North American Caucasians had a wider lower face than local North American.<sup>4</sup> Facial morphology has utmost importance to help early detection, diagnose and treatment of various disorders associated with short and long face based on FGR.<sup>5</sup> Another study revealed south Indians FH was wider as compared to that of north Indians in both sexes.<sup>6</sup>

A study was applied to the North Maharashtra population to evaluate the relationship between facial esthetics and the FGR revealed that the measurement of the anterior FH showed proportionality with the total FH in comparison with the golden proportion.<sup>7</sup> Soft tissue cephalometric analysis for Bangladeshi adult showed that the face tends to be straighter in Bangladeshi female compared to Bangladeshi male. The changes in Hold way measurements in Bangladeshi adult showed similarities except for the convexity and soft tissue facial angle.<sup>8</sup>

Awareness of FA, Indian-subcontinent are satisfied with their FA than Japanese.<sup>9</sup> Furthermore, in 2014, awareness and satisfaction of personal FA among Thai laypersons showed that female laypersons tend to be more dissatisfied about their overall FA than male. Nevertheless, for each facial part, Thai male laypersons tend to be more dissatisfied than female. Both groups show no significant differences in awareness for the overall impression and each facial element.<sup>10</sup> Bangladeshi population showed that lip morphology is precise for the ethnic group, but these values should not be interpreted as treatment aim.<sup>11</sup> These soft tissue evaluations will enable the clinician to achieve good facial aesthetics for the patients.<sup>12</sup> Assessing the influence of chin prominence on perceived attractiveness in the orthognathic patient showed that the greater the retrusion or prominence of the chin, the less the rating of the perceived attractiveness and the greater the desire for surgical correction.<sup>13</sup>

Erbay 2002, revealed soft tissue analyses of esthetic lines, to evaluate perceptions of Anatolian Turkish adults' beauty, the material consisted of lateral cephalometric radiographs and facial-profile results

showed that persons having a high mandibular plane angle, a small nose, protrusive lips, and a retrusive profile were viewed as attractive or beautiful.<sup>14</sup>

We did not find any research data among the Saudi population in relation with the FGR. Hence, this study used to determine the normal anthropometrical measurements of facial length, FW and FI and to determine the association of facial proportion among the participants in relation with golden scale, and to identify and classify the samples into different facial shapes based on FA. Also, to determine the existence of significant differences in facial measurements and indices between genders. Furthermore, to assesses participant's evaluation of their own FA by a validated structured questionnaire

### Materials and Methods:

All participants provide their written informed consent. In total 249 participants, 1st to 5th-year medical students from the College of Medicine of Jouf University. Participants attending Jouf University, originate from different parts of Saudi Arabia and hence considered true representation of the whole Saudi population. Craniofacial deformity and subject with a history of facial surgery were excluded from the study.

The anthropometrical landmarks involved were palpated and located on the face of the participants and a total of 5 measurements were taken including total FH (trichion-mental), upper FH (trichion - glabella), middle FH (glabella - subnasalle) and lower FH (subnasalle - mental) as well as FW (zygion-zygion). All facial parameters such as FH and FW measured by digital vernier caliper (Boley Dental, USA). Direct measuring technique, considered to be more accurate than indirect measuring technique. Assessment of FA done by a validated structured questionnaire.

Facial Index (FI): The ratio of bi zygomatic width (FW) to the total FH of each participant was calculated and recorded as the subject's FI. Participants were classified into different facial shapes based on the relationship of their facial indices to the FGR (1.6–1.699 = Normal, < 1.6 = Short, > 1.699 = Long).<sup>15, 16</sup>

Assessment of FA by validated structured questionnaire, Participants were also asked to fill up a questionnaire to assess their perception towards beauty and evaluation of their own FA. In this section, the subjects were asked to choose from 5-degree

of satisfaction (1: satisfied, 2: somewhat satisfied, 3: neither satisfied nor dissatisfied, 4: somewhat dissatisfied, and 5: dissatisfied). There were 9 questions about the participants' overall impression of the face. 9 questions about the satisfaction towards their own facial parts such as eyelids, eyes, nose, cheeks, lips, chin, angle of the jaw, the shape of the face, and relation to the chin. The mean of the responses to these nine questions is recorded as the satisfaction score for facial parts.

**Statistical analysis**

The data were analyzed statistically using SPSS version 23 (SPSS Inc., Chicago, IL, USA). The statistical significance of inter-gender differences in mean values of the measured parameters and satisfaction scores from the questionnaire was examined using Independent t-test while One-Way ANOVA was done to investigate the existence of statistical significance between Saudi and mixed races. Graphical representation of the participants with different facial shapes and the relation of the chin profile was obtained from Microsoft excel 2010.

**Ethical clearance:** This study was approved by the Local committee of Bio-Ethics of Jouf University (approval no. 3-25-7/40).

**Results:**

*Gender disparities*

Table 1 shows mean facial measurement among

**Table 1. Gender disparities in relation to Facial heights and Facial golden ratio.**

Variable	Gender	Mean	SD	SE	95% CI		p value
					Lower	Upper	
Total Facial Height	Male	172.48	13.16	1.17	2.57	8.88	0.000***
	Female	166.76	12.11	1.09			
Upper facial height	Male	58.10	5.05	0.45	-0.83	2.24	0.365
	Female	57.40	7.08	0.64			
Middle facial height	Male	56.77	5.33	0.48	1.77	4.31	0.000***
	Female	53.73	4.79	0.43			
Lower facial height	Male	57.84	4.06	0.36	0.75	3.64	0.003**
	Female	55.64	7.12	0.64			
Bi-zygomatic width	Male	119.28	88.97	7.93	-4.63	27.06	0.165
	Female	108.07	6.81	0.61			
Facial golden ratio	Male	1.64	0.12	0.01	0.06	0.12	0.000**
	Female	1.55	0.12	0.01			

SD: Standard Deviation, SE: Standard Error Mean, CI: Confidence Interval; p<0.05 = Considered significant. Independent t test used.

gender. Total mean FH among males (172.48), females (166.76) shows disparities and highly significant difference (p=<0.001).

Furthermore, Mean middle FH among males (56.77), females (53.73), also shows disparities and highly significant (p=<0.000).

Mean lower FH among males (57.84) and females (55.64), shows the disparities were highly significant (p=<0.003).

There was no significant dissimilarity between males and females upper FH and FW.

Mean FGR value of the males and females are 1.64 and 1.55 respectively. This study revealed highly significant disparities among genders. The male participant has close resembles with FGR in comparison to females.

Table 2 shows the ratio of FH and FGR among Saudi vs mixed (here mixed means Saudi father and mother from Jordan or Syrian).

There is no significant difference between upper FH (57.74), Middle FH (55.16), Lower FH (56.65) among Saudi, Jordan and Syrian participant.

According to FGR, among Saudi and mixed participants showed 1.59, which is proportional to the FGR.

**Facial shapes based on the GR**

Figure 1 shows total males participate 126, among

**Table 2. Saudi vs Mixed [Father = Saudi and Mother = Syrian/Jordan], disparities in relation to Facial heights and Facial golden ratio.**

Variable	Race	Mean	SD	SE	95% CI		p value
					Lower	Upper	
Total Facial Height	Saudi	169.56	13.36	0.95	-4.50	3.52	0.809
	Mixed	170.05	11.30	1.58			
Upper facial height	Saudi	57.74	6.32	0.45	-1.97	1.83	0.942
	Mixed	57.81	5.44	0.76			
Middle facial height	Saudi	55.16	5.42	0.39	-2.15	1.13	0.539
	Mixed	55.67	4.75	0.66			
Lower facial height	Saudi	56.65	6.24	0.44	-2.33	1.31	0.581
	Mixed	57.16	4.17	0.58			
Bi-zygomatic width	Saudi	109.36	9.63	0.68	-40.94	-1.89	0.032
	Mixed	130.77	139.01	19.47			
Facial golden ratio	Saudi	1.59	0.13	0.01	-0.04	0.04	0.884
	Mixed	1.59	0.12	0.02			

SD: Standard Deviation, SE: Standard Error Mean, CI: Confidence Interval; p<0.05 = Considered significant. Independent t test used.

**Table 3. Gender disparities in relation to facial awareness.**

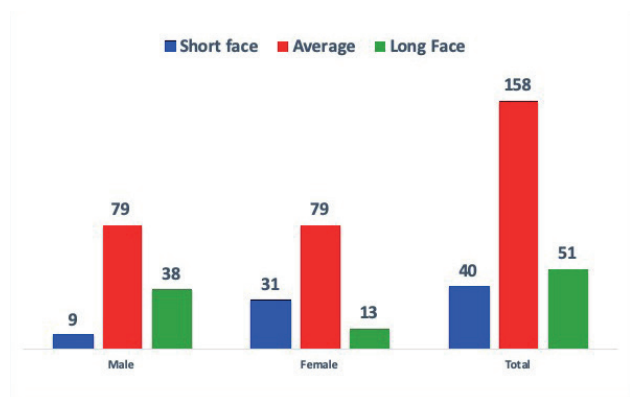
Variable	Gender	Mean	SD	SE	95% CI		p value
					Lower	Upper	
Eyelids	Male	1.75	0.95	0.09	0.06	0.51	0.014*
	Female	1.46	0.84	0.08			
Eyes	Male	1.83	0.97	0.09	0.14	0.59	0.002**
	Female	1.47	0.84	0.08			
Nose	Male	2.03	1.14	0.10	-0.42	0.16	0.373
	Female	2.16	1.18	0.11			
Cheeks	Male	1.94	1.05	0.09	-0.16	0.39	0.408
	Female	1.83	1.13	0.10			
Lips	Male	1.85	0.95	0.08	-0.14	0.36	0.382
	Female	1.74	1.02	0.09			
Chin	Male	1.90	1.04	0.09	-0.04	0.48	0.094
	Female	1.67	1.04	0.09			
Angle of Jaw	Male	1.75	0.90	0.08	-0.31	0.18	0.623
	Female	1.81	1.05	0.10			

SD: Standard Deviation, SE: Standard Error Mean, CI: Confidence Interval; p<0.05 = Considered significant. Mann Whitney U test used

them 79 participate are within the range of FGR (1.6-1.699), 38 participants have a long face (>1.699), and only 9 participants have a short face (<1.6).

Total females participate 123, among them 79 participate within the range of FGR (1.6 – 1.699), 13 participants have a long face (>1.699), only 31 participants have a short face (<1.6).

Average face percentage was significantly higher ( $\chi^2 < 0.001$ ) concerning long and short face in both male





**Table 4. Saudi vs Mixed [Father = Saudi and Mother = Syrian/Jordan], disparities in relation to facial awareness.**

Variable	Gender	Mean	SD	SE	95% CI		p value
					Lower	Upper	
Eyelids	Saudi	1.57	0.90	0.06	-0.46	0.11	0.223
	Mixed	1.75	0.96	0.13			
Eyes	Saudi	1.62	0.88	0.06	-0.47	0.10	0.197
	Mixed	1.80	1.08	0.15			
Nose	Saudi	2.08	1.14	0.08	-0.43	0.28	0.676
	Mixed	2.16	1.24	0.17			
Cheeks	Saudi	1.90	1.10	0.08	-0.28	0.39	0.747
	Mixed	1.84	1.07	0.15			
Lips	Saudi	1.80	1.01	0.07	-0.27	0.34	0.805
	Mixed	1.76	0.89	0.12			
Chin	Saudi	1.81	1.05	0.07	-0.20	0.45	0.443
	Mixed	1.69	1.03	0.14			
Angle of Jaw	Saudi	1.78	0.96	0.07	-0.31	0.30	0.987
	Mixed	1.78	1.03	0.14			

SD: Standard Deviation, SE: Standard Error Mean, CI: Confidence Interval; p<0.05 = Considered significant. Mann Whitney U test used.

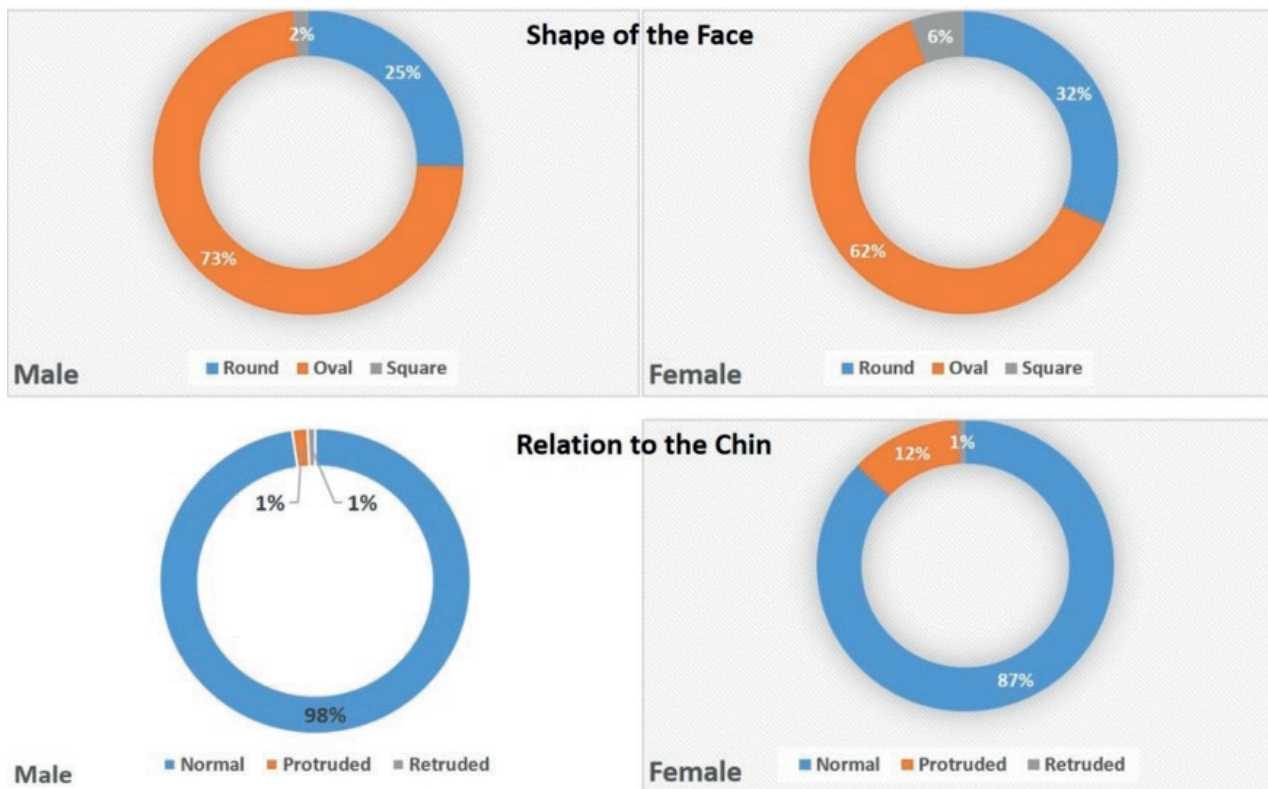


Figure 2. Shape of the face and relation to the chin.

and female participants which match with FGR 1.6.

Figure 1. Facial golden ratio in Male and Female. Chi square test used to see the association.

**FA score among Saudi**

Table 3. shows gender disparities concerning FA.

Male and female are satisfied concerning all 9 parameters. Among 9 variables, 2 variables showed significant disparities. The females were significantly more satisfied with their eyelids and eyes than males, and their significant different was p=0.014 and 0.002, respectively.

### FA score among Saudi and mixed group

Saudi vs Mixed [Father = Saudi and Mother = Syrian/Jordan], disparities concerning FA are shown in Table 4.

Both groups showed satisfaction among all 9 variables. No significant disparities have been observed. The satisfaction scores regarding the eyelids, eyes, nose, cheeks are better in Saudi group, whereas, nose and cheeks score is better in a mixed group. Satisfaction score of the angle of the jaw was equal in both participants.

### Facial shapes appearance concerning chin

Figure 2 shows the shape of the face and relation to the chin among males and females. We found 73% of males and 62% of females having an oval shape. Only 25% and 32% of males and females having a round shape. Least percentage was found in relation to a square shape, and it was 2% for male and 6% for females. In the relationship to the chin, there are normal, protruded and retruded chin. We found 98% of males and 82% of females having a normal chin. 12% of the female has protruded chin, whereas the male has only 1%.

### Discussion

The present study showed that male subjects had higher values for TFH and FW compared to female subjects, which are reliable with values of other populations across the world reported by Rajiet al.<sup>17</sup>, Ngeow et al.<sup>18,19</sup>, Omaret al.<sup>20</sup> and Erika et al.<sup>21</sup>

TFH of Saudi males (172.48 mm) showed almost similar values with that of Saudi mixed origin males (170.05 mm), which could be explained by similar ancestral origin. A similar value of TFH was also shown by Egyptian male subjects (176 mm).<sup>22</sup> TFH measurements of Saudi female (166.76 mm) also coincide with the values of Indian American (169.45 mm) and Hungarian (169.4 mm) females.<sup>23,20</sup>

FW measurements of Saudi female (108.07 mm) was shown to be close to the value of Malaysian Indian females (107.8 mm).<sup>24</sup> Craniofacial parameters from our anthropometric studies on Saudi populations can be used to provide crucial data for anatomical and anthropological research as well as research in forensic medicine. In clinical practice, these data can serve as important guidelines and references among

reconstructive and plastic surgeons, maxillofacial surgeons, orthodontists and prosthodontists, particularly in the analysis of treatment outcome.<sup>25-28</sup> For evaluation of variations in craniofacial morphology and also to detect potential pathological abnormalities, standards of anthropometric measurements should be established for the Saudi population. Here, the study showed a mean FGR value of the males and females are 1.64 and 1.55 respectively. This study revealed highly significant disparities among genders. The male participant has close resembles with FGR in comparison to females. According to FGR, among Saudi and mixed showed 1.59 which is proportional to the FGR.

Inter-racial differences of facial measurements showed no significant difference between Saudi and Mixed verity for TFH in both sexes.

In our study, facial shapes according to FGR, showed maximum number of participants had an ideal face (within the range of FGR; (1.6-1.699) and minimum number of participants had long and short face. However, in contrast to the studies done by Packiriswamy et al.<sup>15</sup>, Saraswathi et al.<sup>16</sup>, and Alam et al.<sup>24</sup> which reported the highest number of subjects had short face and the least number of subjects in the long face. It was interesting to note that very few Chinese females recorded have a long face which is similar to our study.<sup>24</sup>

Regarding satisfaction for facial awareness, Saudi females were significantly more satisfied with their eyelids and eyes than Saudi males, which shows significant  $p=0.014$  and  $0.002$  respectively and which was also similar to the findings of Malaysian Indian females by Alam et al.<sup>24</sup>

In this study, shape of the face both male and female showed oval shape, and the least percentage were found square shape. Regarding the shape of the face and relation to the chin, the Japanese population who found that a straight profile was ranked the most attractive while mandibular retrognathic and pragmatic profiles had poor rankings.<sup>29</sup> Nainiet al.<sup>30</sup> showed that the greater the retrusion or prominence of the chin, the lower the rating of the perceived attractiveness. Similar to a study by Maganzini et al.<sup>31</sup> our study indicated either a retrognathic or a prognathic mandible were found to be the least appealing by both male and female Saudi subjects. In another study, Caucasian males also preferred

mandibular protrusion more than retrusion.<sup>32</sup>Such discrepancies might be due to cross-cultural differences between different populations.<sup>33</sup>

In Summary, we found, the Saudi population has a total FH value of 172.48mm male, 166.76mm female and FW of 119.28 mm male, 108.07 female. Mean FGR value of the males and females are 1.64 and 1.55, respectively. This study revealed highly significant disparities among genders. The male participant has close resembles with FGR in comparison to females. Majority of Saudi facial proportion conformed to the FGR, with a minority of the population having a long face and least having a short face. According to FGR, there were no significant differences among Saudi and mixed showed 1.59, which is proportional to the FGR. Other Saudi and mixed Saudi races are generally satisfied with their FA.

#### **Limitation of the study:**

It is possible that by increasing the parameters of analysed samples in this study, we may arrive at even more certain conclusions. Hence, the importance of future similar studies done in other parts of Saudi Arabia cannot be overstated.

#### **Conclusion:**

This first-in-human study in Saudi population revealed the results of facial anthropometric measurements, FGR, facial awareness score. Significant disparities among genders for facial measurements and the FGR was found. The male participant has close resembles with FGR. The FGR was used to identify subjects with a normal, short and long face, in our study, we found the majority population both male and female having a normal face. According to facial satisfaction and awareness score, we found, the majority of the population are satisfied with their face's variables.

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**Conflict of Interest:** There are no conflicts of Interest.

#### **Authors' contribution**

RB, ANS, SAA, WSB, WMA, ABA, NAA and MKA contributed in data gathering and idea owner of this study. Study designed by RB, ABA, NAA and MKA. Writing and submitting manuscript contributed by RB, ANS, SAA, WSB, WMA, ABA, NAA and MKA. Editing and approval of final draft done by RB, ANS, SAA, WSB, WMA, ABA, NAA and MKA.

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