Comparison of craniofacial anthropometric measurements with the golden ratio in young adults

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SUMMARY

There is evidence showing the existence of the golden ratio in many fields from architecture to medicine, from art to philosophy. The aim of this study is to investigate the relationship between the measurements taken from the face area and the golden ratio (1.618) value and to present results by comparing the determined measurement parameters with the existing literature. A total of 101 university students aged between 18-25 participated in this study on a voluntary basis. In this study, data were collected by photographing method. Photographs of each individual were taken from 3 angles: the front and both sides. After the photographs were transferred to digital media, measurement was performed by means of a software program (ImageJ). In the study, data were presented as mean±standard deviation in the form of descriptive statistics. In order to compare the measurement points within the scope of the study with the golden ratio, 23 measurement indices (ratio) were determined. Proportional Index Calculation was done as follows. Head Index Ratio=Head Height/Total Cranial Head Height. A statistically significant difference was determined when the mean value of this index was compared according to sex ($p<0.05$). As a result, we think that the data we obtained in the study will be useful in the fields of science and art and may be a pioneer for the golden ratio studies to be done later.

Key words: Golden ratio – Anthropometry – Anatomy – Craniofacial measurement

INTRODUCTION

The golden ratio is a series of complex numbers connected by a very special mathematical formula (like 2, 3, 5, 8, 13, 21, 34, 55, 89). The ratio between these numbers (1.618) is an irrational, continuous and non-repeating number that goes on forever, like the number PI. The golden ratio is denoted by the symbol "Fi" (Φ) and is also called the Fi number (Φ) in the literature. Basically, the following mathematical rule is used to find the golden ratio. If a line AB is divided from any point C to give the ratio AB/AC = AC/CB, C is the golden part of AB, and the ratio AB/AC and AC/CB that creates this ratio is called the golden ratio (Markowsky, 1992; Mitchison, 1977).

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Submitted: January 26, 2024. **Accepted:** March 7, 2024

https://doi.org/10.52083/DOLL3265

In nature, there is the golden ratio as a geometric and numerical ratio relation, which is thought to be the best in terms of harmony in the shapes or structures of countless living or inanimate beings. Since ancient Greek times, the golden ratio is believed to be found in nature and human body anthropometry, although there are not many written sources on the subject. However, there is evidence showing the existence of the golden ratio in mathematics, architecture, art and many other fields (Livio, 2002; Mamarelis et al., 2022; Mitchison, 1977; Sen and Agarwal, 2008).

Considering the studies related to the golden ratio in the human body, the studies of Leonardo Da Vinci come to mind first. It is one of the important studies of Da Vinci that he applied the golden ratio in his work called The Vitruvian Man, which is thought to have been drawn at the end of the 1400s. The German artist Albrecht Durer applied the golden ratio in his works at the beginning of the sixteenth century. When evaluated in general, it is seen that artists and scientists use the golden ratio as a measure for their studies of the human body (Beyoğlu, 2016; Hastürk, 2014; İlden Yıldız and Bostancı, 2022; Livio, 2002).

There are many objective studies in the literature on the perception of attractiveness/beauty, which is a value that varies from person to person (Chatrath et al., 2007; Kürkçüoğlu et al., 2016; Pallett et al., 2010; Yalcinkaya et al., 2022). Various definitions and details have been made since the Renaissance, especially regarding facial proportions, and these have been a guide for anthropometric studies. With the introduction of anthropometry into clinical practice at the end of the nineteenth century, the number of studies covering measurements based on the face, head and neck region has also increased (Anand et al., 2015; Yalcinkaya et al., 2022).

One of the first studies on the golden ratio in facial structures was published in 1946 by Matila Ghyka in his *The Geometry of Art and Life*, in which he performed a facial analysis of tennis champion Helen Wills. In this study, it was reported that the golden ratio was found between many lengths in facial structures (Ghyka, 1977). In the literature review conducted by us, it was determined that there were studies conducted under the titles of evaluation of lower face heights, determination of nasal width and length ratios, nasolabial angle measurement, and determination of columella ratios (Abbas et al., 2015; Aki Abaci et al., 2020; Chatrath et al., 2007; Kürkçüoğlu et al., 2016; Salinas et al., 2023; Varlık et al., 2010; Zwahlen et al., 2022). However, it has been determined by us that the number of studies on the golden ratio of the face is not very high, and that it is still worthy of study in terms of contribution to the literature.

The aim of this study is to investigate the relationship between the measurements taken from the facial region and the golden ratio (1.618) value, and to present results by comparing the determined measurement parameters with the existing literatures.

MATERIALS AND METHODS

Ethics Committee permission, dated 03.12.2021 and numbered 2021/565, was obtained from Afyonkarahisar Health Sciences University (AFSU) Clinical Research Ethics Committee for the study. Within the scope of the study, a total of 101 Medical Faculty students aged between 18 and 25 years participated on a completely voluntary basis. The study was conducted in accordance with the principles of the Declaration of Helsinki.

Data were collected by photography method (photoanthropometry). A camera with at least 12 megapixels, stabilization and autofocus was used for photography (Nikon D3100, Nikon Corporation, Japan). The camera was fixed using a tripod. To ensure standardization in all photographs, these were taken from a distance of one meter without using the zoom function of the camera, providing a clear view of the face and facial features. In the anterior photographs, the plane cutting the pupils was parallel to the ground, the jaw was in the center, and the lips were closed without tension. Before lateral photographs were taken, the head was adjusted to the Frankfort plane position (i.e., individuals were positioned so that the upper part of the eye and the auricle were aligned, the jaw was in the center, and the lips were closed without tension). After all these standards were met, each individual was photographed from a total of three angles, including the front and both sides (Fig. 1).

Fig. 1.- Illustration by drawing of the photographs taken from the front (**b**) and both sides (**a**, **c**) of each individual.

Literature was used to determine reference points for the measurements (Aki Abaci et al., 2020; Khoshab et al., 2022). The reference points for anthropometric measurements in the craniofacial region were presented in Fig. 2. After the photographs were digitized, measurement was performed with ImageJ (National Institutes of Health and The Laboratory for Optical and Computational Instrumentation [LOCI], University of Wisconsin, Madison, USA) software program (Fig.

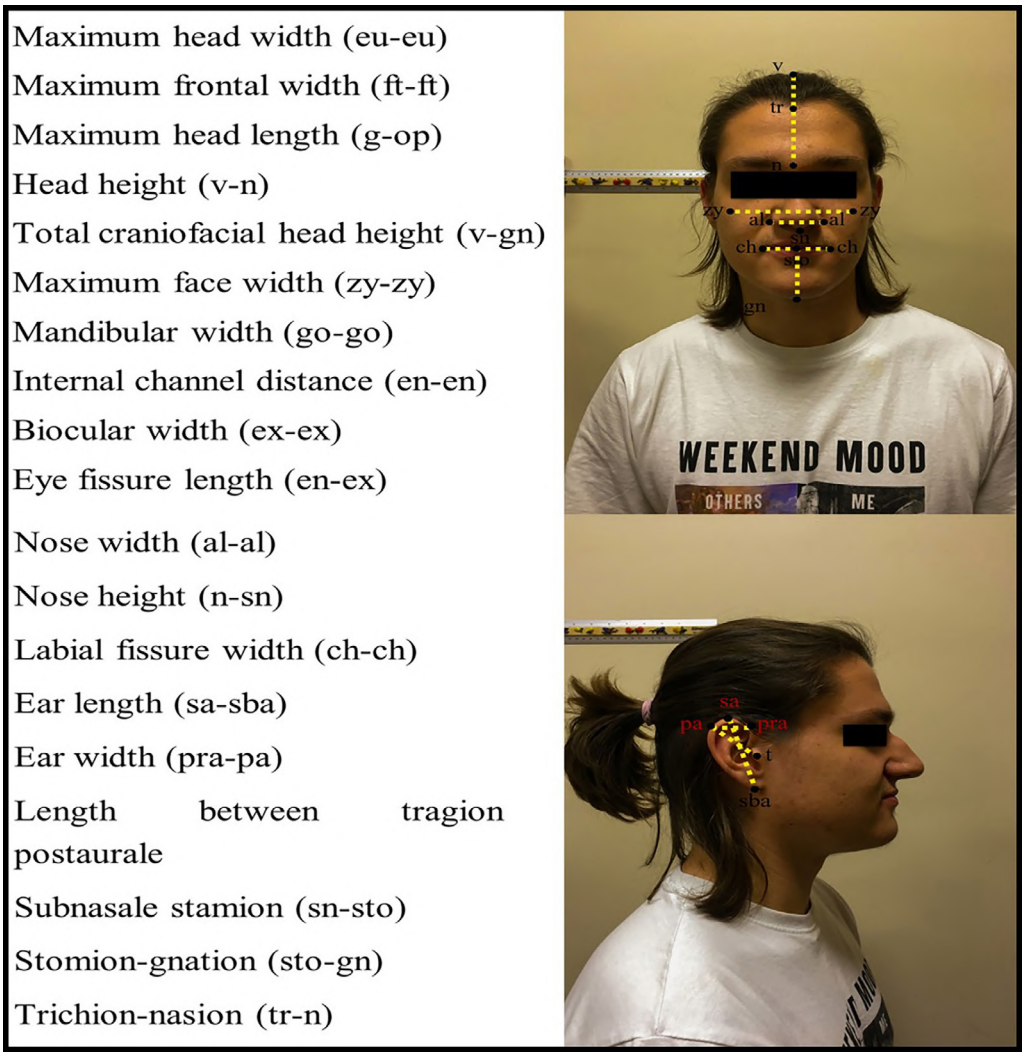

Fig. 2.- The reference points for anthropometric measurements in the craniofacial region.

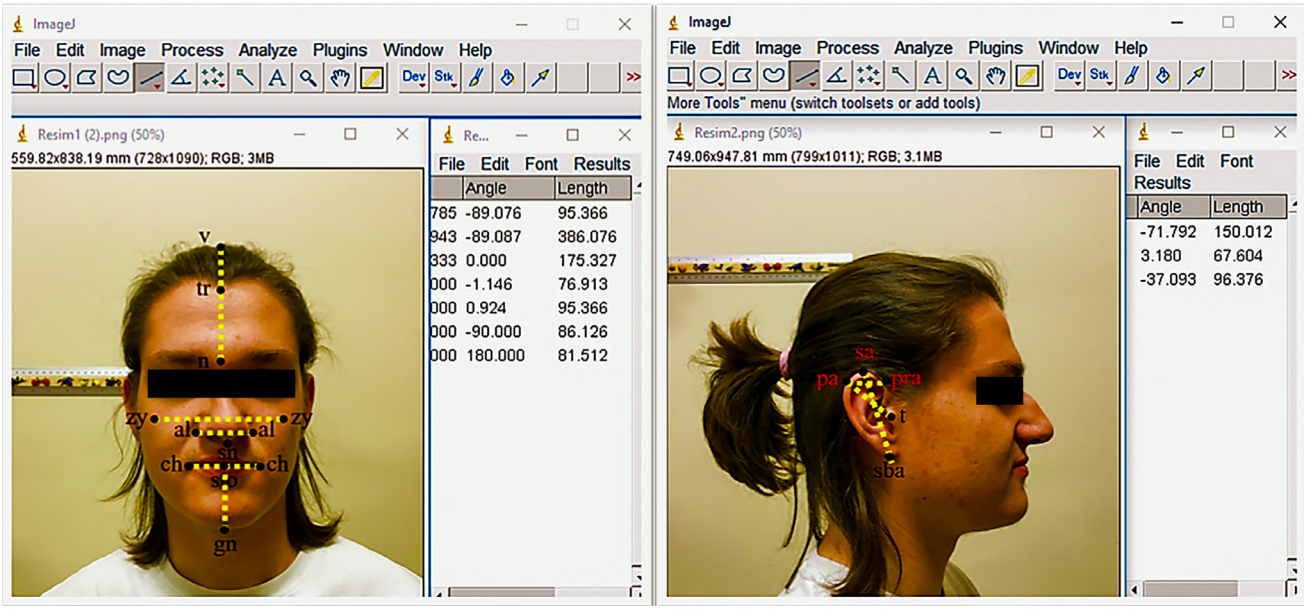

Fig. 3.- Measurements made with ImageJ software program.

3). Individuals were photographed with a ruler to ensure calibration in the measurements.

Exclusion Criteria

Individuals who did not show normal growth and development, had undergone previous orthodontic-surgical treatment, had a history of facial trauma, and/or had congenital defects were not included in the study.

Limitations of the Study

Participants were included in the study on a voluntary basis. At the same time, plans were made to include only medical faculty students in the study population. Along with all these factors, the intensity of students' theoretical and practical courses is seen as one of the important limitations in terms of include to the entire universe. However, considering the power analysis results, a sufficient number of samples was reached.

Statical Analysis

G-power 3.1.9.4 software program (Heinrich Heine Universität Düsseldorf, Düsseldorf, Germany) was used in the power analysis to determine the sample size of this study. By setting the type 1 error level to be 5%, the power to be 95%, and the effect size to be 0.9508, the sufficient sample size was determined to be minimum 47 people for each sex group. In this study, all analyses were performed using IBM Statistical Package for the Social Sciences (SPSS) 25 software program. Normality of distribution was assessed using five parameters: standard deviation/mean, skewness-kurtosis, histogram, Q–Q plots,Shapiro–Wilk Test (Batın et al., 2023). Depending on the results of the evaluation, Wilcoxon sign and Mann Whitney U tests were used for pairwise group comparisons by asymmetry and sex, respectively, while the nonparametric One Sample T-test was used for the comparison of indices with the golden ratio. Data with $p<0.05$ were considered significant. Data were shown as mean±standard deviation (M±SD) and median (minimum-maximum) (Md(Min-Max)) values.

RESULTS

A total of 101 students (47 males (46.5%) and 54 females (53.5%) from AFSU Medical Faculty participated in this study. The mean age was 21.5±2.3 years in men and 21.5±2 years in women.

All anthropometric measurements were presented in millimeters (mm). In addition, all findings obtained from men and women were compared with the golden ratio value. Measurement indices (ratios) were determined to compare the measurement points within the scope of the study with the golden ratio.

Proportional Index Calculation was done as in the example shown below:

$$\text{Head Index Ratio} = \frac{\text{Head Height}}{\text{Total Cranial Head Height}}$$

For the evaluation of facial asymmetry in the study, a bilateral comparison of the indices was made on the right and left sides. In addition, the differences between sexes for all measurement indices obtained from men and women were evaluated and compared separately by including the golden ratio value in all measurements.

Facial asymmetry was evaluated in the first phase of the study (Table 1). Depending on the results of the evaluation, a statistically significant difference was determined in the Eye Fissure Length/Biocular Width Index and Eye Fissure Length/Eye Internal Canal Length Index in the asymmetry comparison of all cases, and the right-side indices were found to be larger (p=0.003, p=0.039, respectively). However, when asymmetry differences in men and women were evaluated separately, no statistically significant difference was found (p>0.05).

In the second stage of the study, sex-related differences were evaluated (Table 2). Based on the results of the statistical evaluation, when compared according to sex, The Inner Eye Canal Length/Biocular Width, Nasal Width/Nasal Height, Nasal Width/Maximum Facial Width and Nasal Width/Labial Fissure Length indices were found to be statistically significantly greater in males than in females (p=0.004, p<0.001, p<0.001, p<0.001, p<0.001, respectively). The Head Height/Total Cranial Head Height index was found to be statistically significantly greater in females than in males (p<0.001).

In terms of closeness to the golden ratio in the face area, women and men were analyzed separately and the results are shown in Table 3. In the analysis, it was found that no index was similar to the golden ratio value of 1.618 regardless of sex or depending on sex (p<0.001).

DISCUSSION

Parts of the human body have been measured for various reasons since ancient times. While body measurements (anthropometry) were mostly used in figurative arts in ancient times, it began to be used in the naturalistic field to describe the basic morphological features of humans, especially since the seventeenth century (Albrizio, 2007; Lieberman, 1996). Craniofacial anthropometry, one of the branches of anthropometry,

Table 1. Comparison of right and left side indices of the facial region.

Index M±SD		Right		Left		p
		Md (Min-max)	M±SD	Md (Min-max)		
Female	Eye Fissur Length/Biocular Width Index	0.3±0.02	0.31 (0.26-0.33	0.3±0.02	0.3 (0.25-0.36)	0.3
	Eye Fissur Length/Eye Internal Canal Length Index	0.91±0.1	0.92 (0.71-1.12	0.89±0.11	0.89 (0.69-1.18)	0.154
	Ear Width/Ear Length Index	0.54±0.06	0.53 (0.42-0.76	0.55±0.06	0.55 (0.69-0.75)	0.326
	Ear Width/Trichion-Postaurale Length Index	0.25±0.04	0.25 (0.17-0.37	0.25±0.04	0.24 (0.69-0.4)	0.503
Male	Eye Fissur Length/Biocular Width Index	0.31±0.03	0.31 (0.27-0.48)	0.3±0.03	0.3 (0.25-0.47)	0.37
	Eye Fissur Length/Eye Internal Canal Length Index	0.89±0.09	0.88 (0.76-1.14)	0.86±0.1	0.84 (0.69-1.11)	0.126
	Ear Width/Ear Length Index	0.54±0.05	0.55 (0.44-0.65)	0.54±0.06	0.53 (0.42-0.67)	0.838
	Ear Width/Trichion-Postaurale Length Index	0.25±0.03	0.24 (0.18-0.34)	0.24±0.03	0.24 (0.2-0.33)	0.386
Total	Eye Fissur Length/Biocular Width Index	0.31±0.03	0.31 (0.26-0.48)	0.3±0.03	0.3 (0.25-0.47)	**0.003***
	Eye Fissur Length/Eye Internal Canal Length Index	0.9±0.1	0.9 (0.71-1.14)	0.87±0.1	0.86 (0.69-1.18)	**0.039***
	Ear Width/Ear Length Index	0.54±0.06	0.54 (0.42-0.76)	0.54±0.06	0.54 (0.42-0.75)	0.539
	Ear Width/Trichion-Postaurale Length Index	0.25±0.04	0.25 (0.17-0.37)	0.25±0.04	0.24 (0.18-0.4)	0.34

* Wilcoxon sign test, statistically significant difference was found.

Table 2. Comparison of sex-related index differences.

Index	Male (n=47)		Female (n=54)		Total (n=101)		p
	M±SD	Md (Min-Max)	M±SD	Md (Min-Max)	M±SD	Md (Min-Max)	
Head Height/Total Cranial Head Height Index	0.38±0.02	0.38 (0.32-0.44)	0.41±0.03	0.41 (0.33-0.47)	0.4±0.03	0.39 (0.32-0.47)	<0.001*
Maximum Frontal Width/Maximum Head Width Index	0.97±0.03	0.98 (0.89-1)	0.96±0.02	0.97 (0.9-0.99)	0.96±0.03	0.97 (0.89-1)	0.6
Maximum Face Width/Maximum Head Width Index	1.03±0.08	1.03 (0.88-1.18)	1.04±0.09	1.06 (0.88-1.18)	1.04±0.08	1.04 (0.88-1.18)	0.658
Maximum Frontal Width/Maximum Face Width Index	0.94±0.07	0.94 (0.79-1.1)	0.93±0.08	0.91 (0.82-1.09)	0.93±0.08	0.93 (0.79-1.1)	0.344
Eye Fissure Length/Biocular Width Index (Right)	0.31±0.03	0.31 (0.27-0.48)	0.3±0.02	0.31 (0.26-0.33)	0.31±0.02	0.31 (0.26-0.48)	0.387
Eye Fissure Length/Biocular Width Index (Left)	0.3±0.03	0.3 (0.25-0.47)	0.3±0.02	0.3 (0.25-0.36)	0.3±0.03	0.3 (0.25-0.47)	0.591
Maximum Head Length/Total Cranial Head Height Index	0.96±0.16	0.97 (0.12-1.23)	0.96±0.12	0.97 (0.75-1.27)	0.96±0.14	0.97 (0.12-1.27)	0.643
Mandibular Width/Maximum Face Width Index	0.74±0.06	0.73 (0.58-0.89)	0.72±0.06	0.73 (0.55-0.84)	0.73±0.06	0.73 (0.55-0.89)	0.218
Mandibular Width/Maximum Frontal Width Index	0.79±0.09	0.79 (0.56-1.06)	0.78±0.1	0.8 (0.59-0.99)	0.79±0.09	0.79 (0.56-1.06)	0.989
Eye Internal Canal Length/Biocular Width Index	0.35±0.03	0.35 (0.29-0.52)	0.34±0.02	0.33 (0.29-0.39)	0.34±0.03	0.34 (0.29-0.52)	**0.004***
Eye Fissure Length/Eye Internal Canal Length Index (Right)	0.89±0.09	0.88 (0.76-1.14)	0.91±0.1	0.92 (0.71-1.12)	0.9±0.09	0.9 (0.71-1.14)	0.079
Eye Fissure Length/Eye Internal Canal Length Index (Left)	0.86±0.1	0.84 (0.69-1.11)	0.89±0.11	0.88 (0.69-1.18)	0.87±0.1	0.86 (0.69-1.18)	0.144
Subnasale-Stamion/Stamion-Gnathion Index	0.47±0.05	0.48 (0.37-0.62)	0.47±0.05	0.46 (0.37-0.58)	0.47±0.05	0.47 (0.37-0.62)	0.728
Stamion/Gnathion Index	0.72±0.1	0.72 (0.53-1)	0.71±0.09	0.71 (0.5-0.94)	0.72±0.09	0.71 (0.5-1)	0.87
Subnasale-Stamion Length/Trichion-Nasion Length Index	0.34±0.05	0.34 (0.24-0.53)	0.33±0.04	0.33 (0.25-0.48)	0.34±0.05	0.33 (0.24-0.53)	0.591
Nose Width/Nose Height Index	0.8±0.13	0.79 (0.55-1.13)	0.71±0.14	0.68 (0.48-1.14)	0.75±0.14	0.74 (0.48-1.14)	**<0.001***
Nose Height/Total Cranial Head Height Index	0.07±0.01	0.07 (0.05-0.1)	0.07±0.01	0.07 (0.05-0.11)	0.07±0.01	0.07 (0.05-0.11)	0.728
Nose Width/Maximum Face Width Index	0.09±0.02	0.08 (0.07-0.14)	0.08±0.01	0.07 (0.06-0.12)	0.08±0.01	0.08 (0.06-0.14)	**<0.001***
Nose Height/Head Height Index	0.19±0.03	0.19 (0.14-0.25)	0.18±0.04	0.18 (0.11-0.3)	0.18±0.03	0.19 (0.11-0.3)	0.093
Labial Fissure Length/Mandibular Width Index	0.15±0.04	0.14 (0.08-0.27)	0.15±0.02	0.14 (0.11-0.25)	0.15±0.03	0.14 (0.08-0.27)	0.957
Nose Width/Labial Fissure Length Index	0.79±0.13	0.78 (0.49-1.38)	0.72±0.07	0.71 (0.58-0.89)	0.75±0.11	0.75 (0.49-1.38)	<0.001*
Ear Width/Ear Length Index (Right)	0.54±0.05	0.55 (0.44-0.65)	0.54±0.06	0.53 (0.42-0.76)	0.54±0.06	0.54 (0.42-0.76)	0.822
Ear Width/Ear Length Index (Left)	0.54±0.06	0.53 (0.42-0.67)	0.55±0.06	0.54 (0.42-0.75)	0.54±0.06	0.54 (0.42-0.75)	0.41
Ear Width/Trichion-Postaurale Length Index (Right)	0.25±0.03	0.24 (0.18-0.34)	0.25±0.04	0.25 (0.17-0.37)	0.25±0.04	0.25 (0.17-0.37)	0.759
Ear Width/Trichion-Postaurale Length Index (Left)	0.24±0.03	0.24 (0.2-0.33)	0.25±0.04	0.24 (0.18-0.4)	0.25±0.04	0.24 (0.18-0.4)	0.454

* Mann Whitney U test, statistically significant difference was found.

Table 3. Analysis results of length measurements taken from the facial region compared with golden ratio (1.618) for the whole sex.

Index	p*		
	Male (n=47)	Female (n=54)	Total (n=101)
Head Height/Total Cranial Head Height Index	<0.001	<0.001	<0.001
Maximum Frontal Width/Maximum Head Width Index	<0.001	<0.001	<0.001
Maximum Face Width/Maximum Head Width Index	<0.001	<0.001	<0.001
Maximum Frontal Width/Maximum Face Width Index	<0.001	<0.001	<0.001
Eye Fissure Length/Biocular Width Index (Right)	<0.001	<0.001	<0.001
Eye Fissure Length/Biocular Width Index (Left)	<0.001	<0.001	<0.001
Maximum Head Length/Total Cranial Head Height Index	<0.001	<0.001	<0.001
Mandibular Width/Maximum Face Width Index	<0.001	<0.001	<0.001
Mandibular Width/Maximum Frontal Width Index	<0.001	<0.001	<0.001
Eye Internal Canal Length/Biocular Width Index	<0.001	<0.001	<0.001
Eye Fissure Length/Eye Internal Canal Length Index (Right)	<0.001	<0.001	<0.001
Eye Fissure Length/Eye Internal Canal Length Index (Left)	<0.001	<0.001	<0.001
Subnasale-Stamion/Stamion-Gnathion Index	<0.001	<0.001	<0.001
Stamion/Gnathion Index	<0.001	<0.001	<0.001
Subnasale-Stamion Length/Trichion-Nasion Length Index	<0.001	<0.001	<0.001
Nose Width/Nose Height Index	<0.001	<0.001	<0.001
Nose Height/Total Cranial Head Height Index	<0.001	<0.001	<0.001
Nose Width/Maximum Face Width Index	<0.001	<0.001	<0.001
Nose Height/Head Height Index	<0.001	<0.001	<0.001
Labial Fissure Length/Mandibular Width Index	<0.001	<0.001	<0.001
Nose Width/Labial Fissure Length Index	<0.001	<0.001	<0.001
Ear Width/Ear Length Index (Right)	<0.001	<0.001	<0.001
Ear Width/Ear Length Index (Left)	<0.001	<0.001	<0.001
Ear Width/Trichion-Postaurale Length Index (Right)	<0.001	<0.001	<0.001
Ear Width/Trichion-Postaurale Length Index (Left)	<0.001	<0.001	<0.001

* One Sample T test was used for the comparison of indices with the golden ratio.

includes head and face measurements on living, cadaveric and radiological samples (Bahşi et al., 2021; Golalipour, 2006; Güler et al., 2023; Güler et al., 2023; Umar et al., 2006). The appearance of the face, which is the most variable part of the human body, is affected by factors such as age, sex, race and ethnicity. In this context, studies based on facial area (craniofacial) measurements have an important place in attractiveness. In addition, craniofacial measurements are used in symmetry and asymmetry research, orthodontics, plastic and reconstructive surgery, anthropology and many other scientific fields, and they also have an important place in people's perception of beauty (Choe et al., 2004; Farkas et al., 2005; Porter and Olson, 2001).

It is seen that there are some ratios, canons and ideal angles in the literature on concepts such as facial beauty and ideal proportions for the face. However, these ratios and values are based on faces perceived as beautiful or the preferences of the authors. These ratios and values, which are associated with attractive faces regardless of factors such as age, sex and ethnicity, lead away from an objective perspective. From a clinical point of view, orthodontists, oral and maxillofacial surgeons, and plastic surgeons accept reference points based on final treatment results in both sexes and races as ideal impression ratios. This is because the perception of facial attractiveness varies according to race and ethnicity, and they do not think it is correct to apply some traditional

rules for ideal facial attractiveness (Kiekens et al., 2008; Malkoc and Fidancioglu, 2016; Rhee, 2018). With all this literature information, there are still debates about which ratios and angles are valid: golden and/or divine ratios are important according to some researchers and not so important according to others. Based on all these ideas, our study was planned and we investigated whether parameters such as ideal reference points and proportions, which were previously mentioned in the literature, affect the aesthetic evaluation of Turkish adolescents and young people. Considering the literature information, craniofacial measurements were compared with the golden ratio in our study. We think that the results of the study will be useful for branches of science such as anatomy, surgical medicine and anthropometry.

In our literature review, it was determined that there is a relationship between the golden ratio and various parts of the human body such as limbs, facial features, heart and teeth (Abbas et al., 2015; Aki Abaci et al., 2020; Henein et al., 2011; Zwahlen et al., 2022). In the study conducted by Seçkin and Bülbül (2020), morphometric measurements of anatomical regions (hand, face, head, omos, belly areas) in 16 individuals, 8 men and 8 women, were examined for compliance with the golden ratio. In the measurements made, it was observed that the subjects had different measurements, and the golden ratio was approached in some regions while more distant results were obtained in other regions. In particular, the ratio of the middle finger measurement of the hand to the whole hand was found to be similar in all subjects. It was stated that the closest results to the golden ratio value belong to the measurements taken from this region. As a result, it was stated in the study that all living and non-living beings in nature naturally have a ratio due to creation. In addition, the importance of interdisciplinary work was emphasized, and they expressed their belief that the results of the study would shed light on new research (Seçkin and Bülbül, 2020). Although, according to our study results, there is no similarity between the indices obtained as a result of the measurements made in the face area and the golden ratio, we believe that there is a certain order and ratio between the body parts. Our analysis reveals that there was no index close to the golden ratio value of 1.618, neither sex-dependent nor sex-independent. We think that the data we have revealed can be a source for other studies.

In their 2016 study, Malkoç and Fidancioglu made various aesthetic evaluations in photographs of adolescents' facial regions and examined the role of ideal angles and proportions. As a result of the study, according to the angles and proportions measured in the photographs, it was observed that the clinician eye (orthodontists) noticed the sagittal position of the lower jaw, the distance between the eyes and the length of the face, while laymen noticed only the distance between the eyes and the length of the face. However, no statistically significant relationship was found between any of the various ratios (such as divine ratio, golden ratio) and facial aesthetics (Malkoc and Fidancioglu, 2016).

In our study, various indices of the facial region were extracted and compared with the golden ratio. However, no significant relationship was found in the statistical analysis. However, it was found that there were statistical differences in the comparison of these indices according to sex. These results are similar to those reported in the study by Malkoc and Fidancioglu (2016). It is accepted that there are certain proportions in the human body. However, it is not always possible for these ratios to be similar to concepts such as the golden ratio or the divine ratio. This is because the presence of factors such as age, sex and race, which vary from individual to individual, as well as the presence of relative factors such as beauty and perceptions of beauty, affect the results of the study. Based on our study results, it is seen that there are differences in the measurements made between the reference points accepted by the literature and the indices created between them according to both sex and right-left distinction (right and left side of the face). We think that these results will contribute more to the literature, both because they are obtained from more objective reference points and because they can be used more in the clinic (for fields such as anthropometry, head and neck facial surgery, facial aesthetic applications).

Khoshab et al. (2022) systematically reviewed the literature in their study on the applicability of the golden ratio for anthropometric facial assessment. In their literature review, they conducted a systematic analysis of a total of 27 articles. They stated that the mean values of Canon 2 (tr-n and sn-menton), Canon 6 (en-en and ex-en) and Canon 8 (zy-zy and al-al) showed significant differences between ethnic groups in men, while Canon 5 (en-en and al-al) and Canon 8 (zy-zy and al-al) showed significant differences between ethnic groups in women. They also analyzed whether there was significant inter-ethnic variability in measurements made in the face and ear region. In the analysis of various golden ratio indices (indices such as Phi 1; en-en/sa-sba, Phi 2; al-al/sa-sba, Phi 5; en-en/ch-ch, Phi 8; en-en/ex-en, Phi 10; ex-en/al-al), they reported that no ethnic/sex group indices consistently approached the "ideal/golden ratio" (Khoshab et al., 2022).

In our study, the results in Table 2 show the analysis of various index values by sex. According to Table 2, it is stated that Head Height/Total Cranial Head Height Index, Eye Internal Canal Length/Biocular Width Index, Nose Width/Nose Height Index, Nose Width/Maximum Face Width Index and Nose Width/Labial Fissure Length Index values differ according to sex ($p<0.05$). We think that these results according to sex are due to the differences in the anatomical structure of men and women. However, according to the results of the analysis in Table 3, where the length measurements taken from the facial region were compared with the golden ratio (1.618) for all sexes, it was found that none of the indices were similar/close to the golden ratio value of 1.618. Based on the results in the meta-analysis study of Khoshab et al. (2022), we can say that our study results are similar to the literature.

In conclusion, when our study is evaluated as a whole, we think that it is at a level that will contribute to the literature in different aspects in terms of its results. In today's conditions, with the increasing demand for plastic surgery worldwide at the point of beauty perception, it is very important to study ideal anthropometric measurements in a systematic way and to make new contributions to the literature. At the point of designing our study, it was aimed to reveal the existence of the relationship between the young population's perception of beauty and the golden ratio.

As we have stated before, beauty perception is a relative concept and it is important to understand the complexities of this concept objectively. We think that there will be no change in the perception of beauty even when the values that exist and accepted in nature such as "ideal/golden ratio" do not fit human body parts. In addition to all these, we believe that in planning scientific research based on anthropometric measurements, it would be correct to act by taking into account that many ethnic groups have different facial features and that each individual can be beautiful without adopting a single aesthetic.

ACKNOWLEDGEMENTS

This study was planned within the scope of the Project Implementation Study course in the course curriculum of AFSU Faculty of Medicine. This study was presented as an Oral Presentation by our students who carried out the study in the end-of-term program of the Project Implementation Study course (https://afsu.edu.tr/afsu-lu-tip-fakultesi-ogrencilerinin-bilimsel-sunumlari-odullendirildi/). We declare that none of us have any financial or personal relationships with other people or organizations that can inappropriately influence our work, there was no professional or other personal interest in our work.

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