Soft-Tissue Anthropometric Norms of Iranians with Proper Occlusion and Inter-Ethnic Norm Comparisons

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Abstract

Background Photographic soft-tissue norms of Iranian race are not reported previously, nor are they compared with other ethnicities. Besides, sex dimorphism is assessed in only very few studies on soft-tissue profile. The aim of this study was to assess the soft-tissue measurements of Iranians with good occlusion and the existing sex dimorphism and to compare the Iranian norms with other ethnicities.

Materials and Methods Twelve anthropometric variables were measured by a dentist in 100 Iranian subjects with good occlusions. The subjects included 50 males and 50 females. The differences between the two genders, as well as the differences between Iranian norms and the norms in all other ethnicities available in the literature were statistically analyzed using a *t* test ($\alpha = 0.05$).

Results There were significant differences between males and females regarding frontonasal angle ($P = 0.0000$), mentolabial sulcus ($P = 0.0000$), vertical height ratio ($P = 0.0000$), vertical lip–chin ratio ($P = 0.0013$), nasolabial angle ($P = 0.0019$), lower vertical height–depth ratio ($P = 0.0029$), maxillary prognathism ($P = 0.0045$), and mandibular prognathism ($P = 0.0118$). The difference in

facial convexity was marginally significant ($P = 0.0543$). Protrusions of both lips and horizontal distance between the lips were not significantly different between sexes ($P > 0.2$).

Conclusions Unlike Americans and Brazilians but similar to Koreans, there was considerable sex dimorphism in Iranians. Compared to Iranian men, women might have more convex profiles, more advanced mandibles (unlike all other races studied), more protruded maxillae, lips closer to the middle of nose–chin vertical distance, deeper mentolabial sulci, less protruded noses with higher nose tips, and smaller lower faces.

Keywords Anthropometry · Ethnic groups · Orthodontic photography · Sex dimorphism

Introduction

One of the major components of orthodontic diagnosis and treatment planning is the evaluation of patient profile and detecting departures from the defined norm [1–5]. Knowledge of the normal dentofacial pattern allows the clinician to make correct decisions and enhances treatment success in establishing optimal facial harmony [6, 7]. Of great concern to dentists, orthodontists, maxillofacial/plastic surgeons, and anthropologists is the study of facial profile [4, 7]. It has implications in terms of esthetic evaluation as well as understanding the changes induced by the growth, or by orthodontic/surgical treatments [2, 4, 6–8]. Overlooking the esthetics may lead to dissatisfaction of orthodontist and patient [9], who might refuse to pay for the treatment, sue the responsible clinician, or even try to inflict physical harm to the orthodontist

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[5, 9–11]. These indicate a strong need to establish the orthodontic norms in various ethnic groups [2, 4–6, 8].

Most classical norms were derived from populations with European/American ancestries [3, 6, 12]. These standards may not be necessarily applicable to the diagnosis and treatment planning of patients from other racial backgrounds [3–6]. Orthodontists should then aim for standards only with considering each race separately and while bearing in mind the opinions of patients [3, 4, 6]. Since, no ethnical study might be generalized to other races [1, 3, 4, 8, 13–18], studying different populations is of significant value, and attempts have been made to explore various ethnicities [3, 6]. The findings indicate a considerable difference between populations [1, 3, 5, 6, 8, 12, 13, 15, 19–23].

Many of earlier studies [1, 8, 12, 13, 15, 19–23] are performed on cephalographs, which are not strongly associated with soft-tissue profile and hence with appearance [4, 24, 25]. Thus, the measurements of soft-tissue profile have played a small part in the literature [3, 5]. Analysis of the soft-tissue profile has the benefit of assessing the external appearance and therefore is more relevant to the treatment outcome perceived by an observer, compared to cephalometry analyses [6]. Besides, X-ray exposure merely for research purposes can raise ethical concerns [4, 26–28]. Another drawback in some previous studies was their rather small samples, as they had samples as large as 41 [6], 62 [13], or 60 subjects [3].

Furthermore, comparison of a population with several other ethnicities can be of clinical and anthropological value [3, 4]. Nevertheless, very few researches have done this and none of those few ones has evaluated more than two ethnicities per study [1, 3, 22, 23]. Due to the mentioned issues and the lack of any studies on soft-tissue norms of Iranians, we aimed to determine these factors from a large sample of well-balanced faced Iranians and to compare our results with all other ethnicities available in the literature. The last but not the least, sex dimorphism is reported by very few authors [3, 7]. Thus, its investigation is of interest. Due to mentioned gaps, this study was conducted to establish 12 anthropometric variables among Iranians, investigate gender dimorphism, and assess the differences between the population at hand and the other ethnicities available through English literature.

Materials and Methods

The sample of this cross-sectional study comprised 100 profile photographs borrowed from our previous study's first phase [4], in which 50 male and 50 female subjects had been sequentially qualified after evaluation of more than 1000 randomly selected dental students [4]. The

inclusion criteria comprised subjects' willingness to participate, being aged 18–28 years old (mean age 21.8), Iranian nationality of both of the subject's parents, having a full set of dentition (excluding third molars), and being dentally class I (both canine and molar) with normal overbite and overjet [4]. The exclusion criteria were posterior/anterior crossbite, crowding and spacing > 2 mm, any histories of orthodontic treatments or maxillofacial/plastic surgeries, or any pathologic conditions [4]. The internal review board of the university approved the protocol ethics, and written consents were taken from the participants [4].

Photometric Analysis

The participants sat on a chair, with no makeups and facial expressions, and with their lips in mild contact. Subjects' heads were in natural head position (NHP) by looking at their pupils in a mirror in standard situation. A hanged chain was used to exclude potential camera positioning errors and calibrate the image frame with horizontal and vertical planes (**HP** and **VP**). Grayscale photographs were taken using a high-resolution digital camera (8.1 megapixels, Exilim, Casio, Japan) from a distance of 139 cm, at standardized zoom and light, and with a white background. Vertical position of the camera was aligned with the subject's eyebrow (Fig. 1) [4].

The analyses were based on the following landmarks: cervical point (**C**), soft-tissue menton (**Me'**), glabella (**G**), soft-tissue pogonion (**Pg'**), soft-tissue B point (**Si [B']**), the highest point on the lower lip (**STMi**), the lowest point on the upper lip ([stomion superius **STMs**]), lower lip anterior (**Li**), upper lip anterior (**Ls**), subnasale (**Sn**), the most anterior point of the columella (**Cm**), pronasale (**Pn**), and soft-tissue nasion (**N'**, Fig. 2). All photographs were analyzed by a dentist on printed images [4]. The Sn-Si distance was measured on the face and on its printed photograph to calculate the magnification factor. This coefficient was used to calculate actual-size distances.

Linear measurements (mm) were maxillary prognathism [**G-Sn(HP)**], mandibular prognathism [**G-Pg'(HP)**], upper lip protrusion [**Ls to (Sn-Pg')**], lower lip protrusion [**Li to (Sn-Pg')**], and mentolabial sulcus [**B' to (Li-Pg')**]. Angular measurements (in degrees) comprised facial convexity angle [**G-Sn-Pg'**], frontonasal or nasofrontal angle [**G-N'-Pn**], and nasolabial angle [**Cm-Sn-Ls**]. Relative measurements comprised vertical height ratio [**G-Sn/Sn-Me'(VP)**], lower vertical height–depth ratio [**Sn-Gn'/C-Gn'**], vertical lip–chin ratio [**Sn-Stms/Stmi-Me'(VP)**], and protrusion of the upper lip relative to the lower lip's position [horizontal position of the lips, **Ls-Li(HP)** in mm] [4].

Fig. 1 Illustrations of three random females (a–c) and three random males (d–f)

Statistical Analysis

Measurements of the genders were compared using an independent-samples *t* test at a 0.05 level of significance. Iranian norm was compared with all other races available in the literature [1, 7, 12, 22, 23] using a Welch's *t* test.

Results

The difference between the mean ages of males and females was not significant ($P = 0.5$), according to the *t* test.

Descriptive statistics are presented in Tables 1, 2, 3. There were significant differences between males and females in terms of frontonasal angle ($P = 0.0000$), nasolabial angle ($P = 0.0019$), maxillary prognathism ($P = 0.0045$), mandibular prognathism ($P = 0.0118$), mentolabial sulcus ($P = 0.0000$), vertical height ratio ($P = 0.0000$), lower vertical height–depth ratio

($P = 0.0029$), vertical lip–chin ratio ($P = 0.0013$). Sex dimorphism in terms of facial convexity angle was marginally significant ($P = 0.0543$). Protrusion of either the upper lips ($P = 0.898$) or the lower lips ($P = 0.486$) and also horizontal position of the lips ($P = 0.250$) were not significantly different between the genders (Figs. 3, 4, 5).

The comparison between Iranian norms (both genders together) with other races pointed to some similarities between Iranians with Caucasian norm, but not with Chinese (Table 4). Comparing Iranian males with males from other races showed that most similarities existed between Iranian and Yemeni males, while there were considerable differences when comparing Iranian men with other races (Table 5). Iranian females, however, showed most similarities with American females, but not with Turk or Brazilian females (Table 6).

Fig. 2 Landmarks used in this study

Discussion

Sex Dimorphism

Compared to males, Iranian females had smaller noses, more obtuse frontonasal and nasolabial angles, more convex profiles, more protruded maxillae and mandibles, deeper mentolabial sulci, the lips closer to the middle of the nose–chin vertical distance, and smaller lower faces. In contrast, Americans showed much less sex dimorphism, as

they had a difference only in the forehead area [3]. In Americans, the forehead angle was larger and the frontonasal angle was smaller in men, indicating a more prominent male forehead [3]. Unlike Americans and Brazilians but similar to Koreans [3, 7], there was considerable gender dimorphism among Iranians. Few studies had statistically evaluated differences between the genders [7]. For another study in which genders were not compared [1], we compared statistically the genders and computed the *P* values from the information available in that study [1]. It was found that the pattern of differences was similar to our study, with an exception that in Turkish population, the number and extent of gender dimorphism were smaller [1]. For instance, in their population, males were similar to females in terms of maxillary prognathism, lower lip protrusion, vertical height ratio, lower vertical height–depth ratio, and vertical lip–chin ratio [1]. However, unlike Iranians, Turk men had the upper lips more protruded than that in women ($P = 0.005$) [1]. Mentolabial sulcus was significantly deeper in Iranian males compared to females, similar to the findings in Turkish and white Americans [1]. A noteworthy finding in contrast to reports on other available populations (such as Americans and Turks) [1] was the advanced position of the mandible in Iranian females, compared to males [4].

These differences varied in pattern among white Americans, showing no gender-dependent dissimilarity in terms of facial convexity and nasolabial angle, position of the lips, and vertical position of the lips between the nose and chin. Instead, American males had more protruded maxillae and mandibles ($P < 0.002$ computed by us) and had bigger chins (indicated by the relative measurements [$P < 0.01$]) [1].

Table 1 Measurements of the sample ($n = 100$)

Measurements	Mean	SD	Min	Q1	Med	Q3	Max	95% CI	
G–Sn(HP) (mm)	5.76	2.78	– 3	4	6	7	13	5.21	6.31
G–Pg'(HP) (mm)	– 1.95	3.08	– 13	– 3	– 1	0	3	– 2.56	– 1.34
Ls to (Sn–Pg') (mm)	2.82	1.55	– 2	2	3	4	7	2.51	3.13
Li to (Sn–Pg') (mm)	2.01	1.86	– 3	1	2	3	7	1.64	2.38
B' to (Li–Pg') (mm)	5.17	1.41	3	4	5	6	9	4.89	5.45
Ls–Li(HP) (mm)	0.81	1.30	– 3	0	1	1.25	4	0.55	1.07
G–Sn–Pg' (°)	164.62	4.79	153	161	165	168	175	163.67	165.57
G–N'–Pn (°)	133.32	9.52	91	129.75	135	139.25	150	131.43	135.21
Cm–Sn–Ls (°)	100.63	9.77	72	95	101	107	125	98.69	102.57
G–Sn/Sn–Me'(VP)	0.92	0.08	0.73	0.86	0.925	0.98	1.2	0.9	0.93
Sn–Gn'/C–Gn'	1.42	0.22	0.96	1.2775	1.4	1.5425	1.97	1.38	1.47
Sn–Stms/Stmi–Me'(VP)	0.44	0.04	0.34	0.42	0.445	0.47	0.55	0.44	0.45

SD standard deviation; Min minimum; Q1 25th percentile; Med median; Q3 75th percentile; Max maximum; CI confidence interval; HP horizontal plane; VP vertical plane

Table 2 Measurements in male subjects ($n = 50$)

Measurements	Mean	SD	Min	Q1	Med	Q3	Max	95% CI	
G-Sn(HP) (mm)	4.98	2.89	− 3	4	5	7	10	4.16	5.8
G-Pg'(HP) (mm)	− 2.72	3.40	− 13	− 5	− 1	0	1	− 3.69	− 1.75
Ls to (Sn-Pg') (mm)	2.84	1.57	0	2	3	4	7	2.39	3.29
Li to (Sn-Pg') (mm)	1.88	1.86	− 2	0.25	2	3	6	1.35	2.41
B' to (Li-Pg') (mm)	5.90	1.43	3	5	6	7	9	5.49	6.31
Ls-Li(HP) (mm)	0.96	1.32	− 2	0	1	2	4	0.58	1.34
G-Sn-Pg' (°)	165.54	4.85	153	163	166	169.75	175	164.16	166.92
G-N'-Pn (°)	129.52	10.35	91	126	131	136.75	145	126.58	132.46
Cm-Sn-Ls (°)	97.64	11.02	72	89.25	99	107	118	94.51	100.77
G-Sn/Sn-Me'(VP)	0.88	0.07	0.73	0.83	0.88	0.92	1.01	0.86	0.9
Sn-Gn'/C-Gn'	1.49	0.24	0.96	1.3225	1.485	1.635	1.97	1.42	1.56
Sn-Stms/Stmi-Me'(VP)	0.43	0.05	0.34	0.4	0.43	0.4575	0.51	0.42	0.44

SD standard deviation; Min minimum; Q1 25th percentile; Med median; Q3 75th percentile; Max maximum; CI confidence interval; HP horizontal plane; VP vertical plane

Table 3 Measurements in females ($n = 50$)

Measurements	Mean	SD	Min	Q1	Med	Q3	Max	95% CI	
G-Sn(HP) (mm)	6.54	2.46	0	5	7	8	13	5.84	7.24
G-Pg'(HP) (mm)	− 1.18	2.53	− 10	− 1	− 0.5	0	3	− 1.9	− 0.46
Ls to (Sn-Pg') (mm)	2.80	1.55	− 2	2	3	4	6	2.36	3.24
Li to (Sn-Pg') (mm)	2.14	1.86	− 3	1	2	3	7	1.61	2.67
B' to (Li-Pg') (mm)	4.44	0.95	3	4	4	5	7	4.17	4.71
Ls-Li(HP) (mm)	0.66	1.27	− 3	0	1	1	3	0.3	1.02
G-Sn-Pg' (°)	163.70	4.59	153	161	163.5	166	175	162.4	165.01
G-N'-Pn (°)	137.12	6.83	113	133	138	141	150	135.18	139.06
Cm-Sn-Ls (°)	103.62	7.30	91	100	102	107	125	101.55	105.69
G-Sn/Sn-Me'(VP)	0.95	0.07	0.79	0.93	0.97	1	1.2	0.93	0.97
Sn-Gn'/C-Gn'	1.36	0.18	1	1.255	1.33	1.4375	1.92	1.31	1.41
Sn-Stms/Stmi-Me'(VP)	0.46	0.04	0.38	0.44	0.46	0.48	0.55	0.45	0.47

SD standard deviation; Min minimum; Q1 25th percentile; Med median; Q3 75th percentile; Max maximum; CI confidence interval; HP horizontal plane; VP vertical plane

Fig. 3 Linear measurements, highlighted in the case of significant sex dimorphism **Fig. 4** Angular measurements, marked according to significant gender dimorphism

Fig. 5 Ratios established between linear measurements, all significantly different between males and females

Interracial Differences

Iranian men had several similarities with Yemeni men, but not with Brazilian and Turk men [1, 4, 7, 22]. Iranian males had profiles more convex than Americans and Turks did, but were similar to Brazilians and more straight than Yemenis [1, 4, 7, 22]. The nose tip was more sloping in Iranian men compared with all other ethnicities studied [1, 7, 22]. The maxilla and mandible were more retrognathic in Iranian males than in Turks and Americans [1, 4]. The lip position had more variations among the populations. The lips in Iranian males were similar or more protruded compared with American and Yemeni men, but more retruded than Turk men [1, 4, 22]. While men in all other available ethnic groups had equal middle and lower faces, in Iranian males, the middle third was smaller (or the chin was bigger) [1, 4, 7, 22]. Also, in Iranian men, the lips

Table 4 Comparison between Iranian norm ($n = 100$) with available measurements from white norm ($n = 40$) and Chinese attractive measurements ($n = 72$), regardless of gender, using the t test

Measurements	Iranian norm	White norm		Chinese norm	
		Mean	<i>P</i>	Mean	<i>P</i>
G-Sn(HP) (maxillary prognathism)	5.76	6	0.6639	2.5	0.0000
G-Pg'(HP) (mandibular prognathism)	− 1.95	0	0.0075	−	−
Ls to (Sn-Pg') (upper lip protrusion)	2.82	3	0.4180	7	0.0000
Li to (Sn-Pg') (lower lip protrusion)	2.01	2	0.9674	−	−
B' to (Li-Pg') (mentolabial sulcus)	5.17	4	0.0013	3.5	0.0000
G-Sn-Pg' (facial convexity angle)	164.62	168	0.0000	169.5	0.0000
Cm-Sn-Ls (nasolabial angle)	100.63	102	0.3937	95	0.0000
G-Sn/Sn-Me'(VP) (vertical height ratio)	0.92	1	−	1	0.0000
Sn-Gn'/C-Gn' (lower vertical height-depth ratio)	1.42	1.2	−	1.1	0.0000

− *P* value not computable due to the lack of sufficient data in the compared studies

Table 5 Comparison between Iranian male norm ($n = 50$) with available measurements from male norms in Americans ($n = 52$), Turks ($n = 52$), Yemenis ($n = 34$), and Brazilians ($n = 23$), using the t test

Measurements	Iranian males	American males		Turk males		Yemeni males		Brazilian males	
		Mean	<i>P</i>	Mean	<i>P</i>	Mean	<i>P</i>	Mean	<i>P</i>
G-Sn(HP) (maxillary prognathism)	4.98	8.4	0.0000	6.1	0.1616	6.9	0.0219	−	−
G-Pg'(HP) (mandibular prognathism)	− 2.72	3.5	0.5501	− 1.4	0.3035	− 4.9	0.0871	−	−
Ls to (Sn-Pg') (upper lip protrusion)	2.84	2.6	0.3603	4	0.0011	2.6	0.4303	−	−
Li to (Sn-Pg') (lower lip protrusion)	1.88	1.5	0.0000	3	0.0080	2.2	0.4617	−	−
B' to (Li-Pg') (mentolabial sulcus)	5.90	− 6.2	0.0000	− 7	0.0000	5	0.0017	−	−
G-Sn-Pg' (facial convexity angle)	165.54	169.6	0.0000	167.9	0.0279	163.1	0.0337	166.28	0.4963
Cm-Sn-Ls (nasolabial angle)	97.64	112.6	0.0000	102.9	0.0154	106.4	0.0003	105.52	0.0228
G-Sn/Sn-Me'(VP) (vertical height ratio)	0.88	1	0.0428	1	0.0000	1	0.4897	1.01	0.0001
Sn-Gn'/C-Gn' (lower vertical height-depth ratio)	1.49	1.4	0.0000	1.8	0.2240	1.4	0.0659	1.29	0.0001
Sn-Stms/Stmi-Me'(VP) (vertical lip-chin ratio)	0.43	53.2	0.0000	51.1	0.0000	0.4	0.1130	0.47	0.0028

− *P* value not computable due to the lack of sufficient data in the compared studies

Table 6 Comparison between Iranian female norm ($n = 50$) with available measurements from female norms in Americans ($n = 64$), Turks ($n = 65$), and Brazilians ($n = 35$), using the t test

Measurements	Iranian females	American females		Turk females		Brazilian females	
		Mean	P	Mean	P	Mean	P
G-Sn(HP) (maxillary prognathism)	6.54	5.2	0.0766	5.1	0.0155	–	–
G-Pg'(HP) (mandibular prognathism)	– 1.18	– 1.1	0.9395	– 4.7	0.0005	–	–
Ls to (Sn-Pg') (upper lip protrusion)	2.80	2.7	0.7576	3	0.5240	–	–
Li to (Sn-Pg') (lower lip protrusion)	2.14	1.9	0.4694	2.5	0.3216	–	–
B' to (Li-Pg') (mentolabial sulcus)	4.44	– 5.2	0.0000	– 5.7	0.0000	–	–
G-Sn-Pg' (facial convexity angle)	163.70	169.4	0.0000	165.8	0.0200	167.37	0.0004
Cm-Sn-Ls (nasolabial angle)	103.62	111.1	0.0000	107.7	0.0070	107.87	0.0252
G-Sn/Sn-Me'(VP) (vertical height ratio)	0.95	1.1	0.0000	1	0.0021	1.06	0.0000
Sn-Gn'/C-Gn' (lower vertical height-depth ratio)	1.36	1.3	0.0955	1.3	0.0942	1.14	0.0001
Sn-Stms/Stmi-Me'(VP) (vertical lip-chin ratio)	0.46	51.6	0.0000	50.3	0.0000	0.46	1

– P value not computable due to the lack of sufficient data in the compared studies

were closer to the nose, in comparison with males from American, Turk, or Brazilian races, but not Yemeni men which were similar to Iranians in this matter [1, 4, 7, 22].

It seems that attractive Iranian males share more resemblance with American and Turk males [1, 4], while usual Iranian males might be much less similar to males from Turk and American whites. This was not, however, applicable to females or to the sample of both genders combined. Not only attractive Iranian women but also usual Iranian women shared the same similarities with American women and with white norm (except for mandibular prognathism) [1, 4, 12].

The results of this study confirmed other reports stating that gender and race affect lip prominence [1, 4, 14, 17, 22]. Previous investigations have shown that position of the lips is much more protruded in Chinese people, and after that, slightly more protruded in Turks compared to Americans, Yemenis, and Iranians [1, 4, 12, 14, 22, 23]. The protrusion of each of the upper or lower lips is defined in Legan–Burstone analysis as independent variables. Their relative position has been assessed and defined in the context of various lines such as H, S1, S2, E, or B [1, 4, 12, 13, 21, 29]. However, horizontal distance between the Ls and Li is not studied before (except in our previous study on attractive Iranians) [4] nor it is included in soft-tissue analyses (although inter-labial gap defined as Stms–Stmi is defined in Legan–Burstone analysis). Our previous findings showed that this variable can have an impact on the beauty [4]. Thus, its inclusion in further analysis might be of value. In general, the lips seem to be vertically closer to the nose than to the chin in Iranians and Yemenis. However, they are equidistant from the nose and chin in European whites, Turkish people, and

Chinese [1, 4, 12, 22, 23]. Also, Iranian females had more feminine chins compared with American and Turk females [1].

Facial profile of Iranians was more convex than Chinese attractive people [23], European-American ancestry, Brazilian females [1, 7, 12, 22], and Turkish class I individuals [1]. Besides, Iranian males had convexity angles nearly close to Yemeni and Brazilian men's convexities [7, 22]. Similar to those populations [1, 12, 23], facial profile was a little more convex in women. The maxilla and mandible were more retruded in Iranians in comparison with what was seen in white norm [1, 12], but were prognathic compared to Chinese and Turk individuals [1, 23].

Iranians and Iranian attractive people seem to have bigger and more sloping noses than do white Americans, Turks, and Brazilians [1, 4, 7]. However, attractive Chinese and Class-I Korean people had noses much more sloping than did Iranian Class-I and attractive individuals [3, 4, 23]. The nose tip was lower in Iranian and Turk males, compared to their counterpart females; however, this was not the case in Americans and Koreans [1, 3, 4].

Limitations

Intermixture of different ethnicities disallows drawing distinct lines. As well, Iran has different races and it is less likely that a group selected from one city can reflect all the ethnicities living in Iran. This seems a limitation of almost every other similar research so far. However, Tehran dwells to a mixture of different ethnicities from all over the country, which might compensate partly for this issue. Moreover, when the methods of other studies are not

exactly known or followed, the inter-ethnic comparisons might be less reliable. Nonetheless, it should be noted that other studies as well followed the same standardized definitions and that our results were compared with them only when they had reported the same measurements. Furthermore, the statistical test used could improve reliability. In particular, when the sample distributions in other investigations were not known, and their raw data were not available, a proper solution is to use a Welch's *t* test, which ignores the assumption of variance similarity. Another limitation was the method of measurement. It was better to estimate the distances and angles directly on digital images. This might allow using several features of digital image processors (such as zoom and brightness adjustments), which could favor the accuracy and speed of the procedure [30, 31]. In this study, the sample was sequentially collected from a random pool of dental students. This sample could not be the best representative of Iranian population. Future studies should improve their generalizability by random sampling from various points of a city or better than that multiple cities. Finally, the age range of the assessed subjects was not generalizable to the whole population, but only to young adults and young people. Future studies should assess broader age ranges and should distinguish their findings in different age ranges.

Conclusions

Within the limitations of the present study, it was concluded that Iranian women might have more convex profiles, more protruded maxillae, and more advanced mandibles (unlike all other ethnicities compared). In women, the lips were closer to the middle of the nose-chin vertical distance. They had deeper mentolabial sulci, less protruded noses with higher nose tips, and smaller lower faces. Some similarities were observed between Iranians and different races, but no similarities were seen with Mongoloids.

Authors' Contribution BK mentored the thesis on photographic factors associated with beauty (published earlier). ER selected and photographed subjects and conceived the use of data pertaining to the first phase of thesis (not published as thesis or article) to compare male/female norms. VR conceived the use of first phase data for male/female and inter-ethnic comparisons, searched the literature, collected published norms of other countries, statistically compared the measurements between males and females and between Iranians with other countries, prepared the figures and tables, and drafted/revised the article. FKO participated in literature search and article revision.

Compliance with Ethical Standards

Conflict of interest All authors declare that they have no conflict of interest.

Ethical Approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed Consent Informed consent was obtained from all individual participants included in the study.

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