





Original Article: Anthropometric Study of the Facial Index in the Population of Medical Students in Tehran University of Medical Sciences



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ABSTRACT

Background: Facial anthropometry is useful in individual identification and reconstructive surgery. In the present study, we aimed to determine the facial characteristic of the Iranian population through anthropometric study.

Materials and Methods: In a cross sectional study, 200 (100 male and 100 female) volunteer medical students (aged 20-25 years) of Tehran University of Medical Sciences were selected. The facial variables including Total Facial Height (TFH), Upper Facial Height (UFH) and Facial Width (FW) were measured and accordingly the Total Facial Index (TFI) and Upper Facial Index (UFI) were calculated. The data were analyzed using Statistical Software (SPSS).

Results: The mean age of subjects was 22.97±1.12. the mean TFH, UFH, FW, TFI and UFI was 11.155 cm, 7.05 cm, 11.68 cm, 95.75, and 60.55, respectively. The most common types of face were hyperleptoprosopic (54%) and hyperleptene (54%) based on TFI and UFI, respectively. There were significant differences in the facial characteristic including TFH (P<0.0001), UFH (P<0.0001), FW (P=0.02), TFI (P<0.0001), and UFI (P<0.0001) of males and female subjects.

Conclusion: According to the results, the most frequent face type was hyperleptoprosopic based on TFI and hyperleptene based on UFI in Iranian population, which showed the differences in the various populations. Additionally, the values of facial characteristics were higher in males than females. So, sexual dimorphism was recorded according to the facial measurements of Iranian population which can be considered in the reconstructive surgeries.

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Introduction

A

nthropometric studies are scientific methods and techniques for displaying different measurement and observation on the human being as well as skeleton [1]. It is known as an applicable branch of scientific studies which deals with these type of measurements [2]. This is performed

in two forms of direct measurements and indirect via radiography, Magnetic Resonance Imaging (MRI), computed tomography (CT), ultrasonic methods [3, 4]. Anthropometry is crucial to determine anthropometric measurements for each specific population due to the genetic and environmental influences [4-6]. Numerous studies have introduced several acceptable usages of the anthropometry in medical and forensic sciences [7, 8].

Craniofacial anthropometry is a subgroup of anthropometry, which is associated with the anatomical measurements of the face and head [9, 10]. Facial anthropometry has an important role in cosmetic surgeries, orthogenetic surgeries and forensic medicine to identify the sex and age [11]. These characteristics have been introduced as predictive values in Obstructive Sleep Apnea (OSA) [12, 13]. Additionally, the craniofacial characteristics have been determined in different patient groups such as patients with thalassemia, Down syndrome, etc. [14-16].

To use facial anthropometry in cosmetic surgery or forensic medicine, anthropometric data for each populations needs to be determined; because of anatomical differences which existed between the different populations and sex groups [17]. Several studies have reported the population differences in anthropometric measurements [18, 19]. Besides, our previous studies have confirmed the population differences in Iran [17, 20, 21].

Knowledge on facial measurements can help scientists in different aspects, including individual identification of decomposed body, appropriate and symmetric design of face reconstructive surgery and improving the result of rhinoplasty [11]. To compare and distinguish the face shapes, different anthropometrical indices have been introduced, such as Total Facial Index (TFI), Upper Facial Index (UFI), Nasal index and Orbital index [22]. TFI and UFI are the two most common and reliable indices which are used in the facial anthropometric studies [23, 24].

According to the TFI, the shape of the face is divided into 5 types; Hypereuryprosopic (TFI: ≤ 79.9), Euryprosopic (TFI: 80.0-84.9), Mesoprosopic (FI: 85.0-89.9), Leptoprosopic (TFI: 90.0-94.9) and Hyperleptoprosopic (TFI: ≥ 95.0) [22]. Also, according to the UFI, the skull shape is divided into 5 types; Hypereuryene (UFI: ≤ 49.9), Euryene (UFI: 45-49.9), Mesene (UFI: 50-54.9), Leptene (UFI: 55-59.9) and Hyperleptene (UFI: ≥ 60.0) [22].

Considering the importance of the subject there is little information available on the facial anthropometry measurement of Iranian population. The aim of this study was to indicate the facial and upper facial indices among medical students of Tehran University of medical sciences. Also, the distribution of different face types of the target population was determined.

Materials and Methods

In a cross sectional study, 200 subjects from Tehran University of Medical Sciences (age range of 20-25 years old) were randomly selected from the volunteer students. This study was approved by the ethical committee of Tehran university of Medical Sciences (IR.TUMS.MEDICINE.REC.1396.3659).

All medical students with the age of 20 to 25 years studying at Tehran University of Medical Sciences in 2018 with normal craniofacial configuration were included, and all subjects with any craniofacial abnormalities such as trauma, congenital malformation, as well as subjects with facial plastic surgery were excluded. Each subject was asked to sign an informed consent form.

To calculate Total Facial Index (TFI) and Upper Facial Index (UFI), we firstly measured the Total Facial Height (TFH; distance between Nasion and Gnathion), Upper Facial Height (UFH; distance between Nasion and Prosthion) and Facial Width (FW; distance between two Zygions) using a standard spreading caliper according to the facial landmark points was listed as follows (Table 1):

Nasion: the midpoint of the nasofrontal suture; Gnathion: Midpoint on the lower border of the mandible; Zygion: Most lateral point of the zygomatic arch; Prosthion: most anterior point in the midline of the alveolar process. FI was calculated by dividing the facial height by the facial width multiplied by 100 [17]. UFI was calculated by dividing the upper facial height by the facial width multiplied by 100 [22]. Finally, the distribution of

Table 1. Face classification based on total facial index and upper facial index

| Variables | Face Classification | |
|--------------------|---------------------|---------|
| Facial index | Hypereuryprosopic | ≤79.9 |
| | Euryprosopic | 80-84.9 |
| | Mesoprosopic | 85-89.9 |
| | Leptoprosopic | 90-95.9 |
| | Hyperleptoprosopic | ≥95 |
| Upper facial index | Hypereuryene | ≤44.9 |
| | Euryene | 45-49.9 |
| | Mesene | 50-54.9 |
| | Leptene | 55-59.9 |
| | Hyperleptene | ≥60 |



different face and skull types among the target population in both sexes were demonstrated.

Statistical analysis

The statistical analysis was done by using Statistical Package for Social Sciences (Version 22) software (SPSS-22.0). The differences between men and women were carried out by using independent t test. P<0.05 was considered significant level.

Results

In this study, 200 volunteer medical students (100 males and 100 females) from Tehran University of Medical Sciences were selected. The mean age of subjects was 22.37±3.06 (ranged from 20-25 years). The results consisting of the statistical analysis with respect to the measurement of facial variables such as TFH, UFH, FW, TFI and UFI were summarized in Table 2. Mean age was compared between males and females and no significant difference was observed in the mean age of sex groups (P=0.012, Table 3)

Moreover, the data of facial variables were compared between males and females in Table 3. According to the results, significant differences were observed in the facial measurements including TFH (P<0.0001), UFH (P<0.0001), FW (P=0.02), TFI (P<0.0001) and UFI (P<0.0001)) bases on sex groups as was shown in Table 3.

The face classifications were described in all subjects according to the total facial index as follow (Table 4): nine hypereuryprosopic (4.5%), 13 euryprosopic (6.5%), 29 mesoprosopic (14.5%), 41 leptoprosopic (20.5%), and 108 hyperleptoprosopic (54%) types. The distribution of face calcification based on the total facial index in males and females were demonstrated in Table 4. The most frequent face type was related to hyperleptoprosopic type in male group and equally mesoprosopic and leptoprosopic in female group (Table 4).

Furthermore, the face classifications were described according to the upper facial index as follow (Table 5): five euryene (2.5%), 30 mesene (15%), 57 leptene (28.5%), and 108 hyperleptene (54%) types. The distribution of face calcification based on the total facial index in males and females were demonstrated in Table 5. The most frequent face type was related to hyperleptene type in both sexes (Table 5).

In this study, the correlations between quantitative data were also examined. There were significant correlations between facial measurements in which a strong correlation was found between TFH and UFH (r=0.743 & p<0.0001, Table 6), as well as TFI UFI (r=0.76 & p<0.0001, Table 6). Additionally, a strong correlation was found between TFI and UFI (r=0.786 & p<0.0001, Table 6).

Table 2. Basic descriptive statistic of facial anthropometric characteristics among the medical students of Tehran University of Medical Sciences

| Variables | All Subjects | | | |
|------------|--------------|-------|-------|--------|
| | Mean | SD | Min | Max |
| Age (Year) | 22.97 | 1.12 | 20 | 25 |
| TFH (cm) | 11.155 | 0.982 | 8.850 | 13.100 |
| UFH (cm) | 7.05 | 0.55 | 5.54 | 8.81 |
| FW (cm) | 11.68 | 0.71 | 8.31 | 13.93 |
| TFI | 95.75 | 8.80 | 77.29 | 123.35 |
| UFI | 60.55 | 5.58 | 46.79 | 82.07 |



SD: Standard Deviation; Min: Minimum; Max: Maximum; TFH: Total Facial Height; UFH: Upper Facial Height; FW: Facial Width; TFI: Total Facial Index; UFI: Upper Facial Index

Discussion

In the present study, the facial anthropometric features of 200 medical students from Iranian population were evaluated. Anthropometry is known as the human individual measurements [25] which is essential in reconstructive surgery and forensic identification [26]. Human facial contour has always been an attractive topic for artists, anthropologists, anatomists, and plastic surgeons [27]. Face is developed from different bony structures, in which its final characteristics depend mainly on the changes in the proportion and position of these facial components [28]. It has been confirmed that the development and growth of humans are affected by different fac-

tors such as sex, race, age geography, and geology [29, 30]. Each population has special anthropometric features for example in their facial dimensions which are important for identification of an individual and as well in the operational planning for patients with facial defects due to tumor, trauma, or congenital malformations [28].

Based on our findings, the mean TFH, UFH, FW, TFI and UFI of medical students was 11.155 cm, 7.05 cm, 11.68 cm, 95.75, and 60.55, respectively. Additionally, the most frequent face class was hyperleptoprosopic type based on TFI and hyperleptene based on UFI in this population. Recently, Jaberi et al. stated that the mean FH, FW and FI of the Iranian population (Students of

Table 3. Comparison the facial anthropometric measurements of males and females among students of Tehran University of Medical Sciences

| Variables | Sex Groups | | | | | | | | P |
|------------|------------|-------|-------|--------|--------|------|-------|--------|---------|
| | Male | | | | Female | | | | |
| | Mean | SD | Min | Max | Mean | SD | Min | Max | |
| Age (Year) | 22.97 | 1.12 | 20.00 | 25.00 | 22.77 | 1.76 | 20.00 | 25.00 | 0.12 |
| TFH (cm) | 11.918 | 0.583 | 9.850 | 13.100 | 10.392 | .650 | 8.850 | 11.620 | <0.0001 |
| UFH (cm) | 7.33 | 0.38 | 6.34 | 8.30 | 6.77 | 0.56 | 5.24 | 8.81 | <0.0001 |
| FW (cm) | 11.79 | 0.62 | 10.30 | 13.37 | 11.56 | 0.78 | 8.31 | 13.93 | 0.02 |
| TFI | 101.26 | 6.05 | 81.15 | 115.83 | 90.24 | 7.60 | 77.29 | 123.35 | <0.0001 |
| UFI | 62.31 | 4.25 | 52.36 | 71.96 | 58.80 | 6.20 | 46.79 | 82.07 | <0.0001 |



SD: standard Deviation/Min: Minimum/ Max: Maximum/ TFH: Total Facial Height/UFH: Upper facial height/ FW: Facial Width/TFI: Total Facial Index/UFI: Upper Facial Index

Table 4. Distribution of facial classifications based on total facial index in all subjects, male and female medical students

| Face Classification | All Subjects | | Sex | | | | P |
|---------------------|--------------|------|------|----|--------|----|--------|
| | | | Male | | Female | | |
| | N | % | N | % | N | % | |
| Hypereuryprosopic | 9 | 4.5 | 0 | 0 | 9 | 9 | 0.0001 |
| Euryprosopic | 13 | 6.5 | 1 | 1 | 12 | 12 | |
| Mesoprosopic | 29 | 14.5 | 0 | 0 | 29 | 29 | |
| Leptoprosopic | 41 | 20.5 | 13 | 13 | 28 | 28 | |
| Hyperleptoprosopic | 108 | 54 | 86 | 86 | 22 | 22 | |



Table 5. Distribution of facial classifications based on Upper facial index in all subjects, male and female medical students

| Face Classification | All subjects | | Sex | | | | P |
|---------------------|--------------|------|------|----|--------|----|---------|
| | | | Male | | Female | | |
| | N | % | N | % | N | % | |
| Euryene | 5 | 2.5 | 0 | 0 | 5 | 5 | <0.0001 |
| Mesene | 30 | 15 | 5 | 5 | 25 | 25 | |
| Leptene | 57 | 28.5 | 24 | 24 | 33 | 33 | |
| Hyperleptene | 108 | 54 | 71 | 71 | 37 | 37 | |



Shiraz University of Medical Sciences) was 11.3 cm, 12.2 cm and 92, respectively [17]. They showed that the most frequent face class was hyperleptoprosopic. Their findings confirmed the findings of present study, which

performed on the Iranian population. In a similar study by Heidari et al., the most frequent type of face was the leptoprosopic type in the Iranian population (Sistani and Baluch groups) [31]. Yasmin et al. conducted a study to

Table 6. The correlation between facial measurements obtained from medical students

| Variables | | TFH (cm) | UFH (cm) | FW (cm) | TFI | UFI |
|-----------|---|----------|----------|---------|---------|---------|
| TFH (cm) | r | 1 | 0.743 | 0.292 | 0.76 | 0.432 |
| | P | | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| UFH (cm) | r | .743 | 1 | 0.160 | 0.604 | 0.738 |
| | P | <0.0001 | | 0.024 | <0.0001 | <0.0001 |
| FW (cm) | r | - | - | 1 | -0.393 | -0.541 |
| | P | - | - | - | <0.0001 | <0.0001 |
| TFI | r | - | - | - | 1 | - |
| | P | - | - | - | - | <0.0001 |
| UFI | r | - | - | - | - | 1 |
| | P | - | - | - | - | - |



SD: Standard Deviation; Min: Minimum; Max: Maximum; TFH: Total Facial Height; UFH: Upper Facial Height; FW: Facial Width; TFI: Total Facial Index; UFI: Upper Facial Index

estimate the FI among the Malay population. They reported that the mean FH and FW were 111.9 and 127.3 mm, respectively [26]. They found that the most frequent class of face was mesoprosopic among their population. This findings also confirmed that the differences exists among various populations.

According to our findings, the values related to the fiscal characteristics were significantly higher in males than females. These findings confirmed the existence of sexual dimorphism in facial characteristics of medical students in the Iranian population. In a study, the facial nasofacial characteristics of males and females were compared with that of Shiraz University of Medical Sciences students (Iranian population) by Jaber et al. and they found almost similar results [17]. Furthermore, Yasmin et al. and Din et al. in their studies on the Malay population demonstrated that facial values in males were higher than females [26, 32]. The study of Omotoso et al. showed significant differences in the mean FL based on the gender [18]. Their findings are comparable to the present study.

Moreover, the most frequent face class of male subjects was hyperleptoprosopic (86%) and hyperleptene (71%) based on TFI and UFI, respectively. However, the most frequent face classes of female subjects were mesoprosopic (29%) and leptoprosopic (28%) based on TFI and hyperleptene (37%) based on UFI. In an Indian population, Kumari et al. reported that the most common face type in males was mesoprosopic and in females was euryprosopic [33]. Yasmin et al. showed that the most frequent face type was equally mesoprosopic among Malaysian males and females [26]. In a similar study among Chinese ethnic population of Indonesia, Kurnia et al. demonstrated that the common face classification was leptoprosopic type in male and mesoprosopic in female [30]. These findings from various populations showed that environment affect their facial characteristics. A strong correlation was recorded between TFH and UFH as well as TFI. Additionally, UFH and UFI correlated strongly. The strongest correlation was between TFI and UFI.

Conclusion

Based on the results of present study, the most common type of face among the Iranian population was related to hyperleptoprosopic (38%). Additionally, there was also sexual dimorphism in the facial characteristics of the Iranian population and the values of males were higher than females.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the ethical committee of Tehran University of Medical Sciences (IR.TUMS.MEDICINE.REC.1396.3659). Informed consent was obtained from all participant included in this study.

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Authors' contributions

All authors contributed toward data analysis, drafting and revising the paper and agreed to be responsible for all the aspects of this work.

Conflict of interest

The authors declared no conflict of interest.

References

- [1] Mohammed I, Mokhtari T, Ijaz S, Ngaski AA, Milanifard M, Hassanzadeh G. Anthropometric study of nasal index in Hausa ethnic population of northwestern Nigeria. *J. Contemp. Med. Sci.* 2018;4(1). URL: <http://www.jocms.org/index.php/jcms/article/view/327> [DOI:10.22317/jcms.03201806]
- [2] Bayat M, Shariati M, Rajaeirad F, Yekaninejad MS, Momen-heravi F, Davoudmanesh Z. Facial anthropometric norms of the young Iranian population. *J. Maxillofac. Oral. Surg.* 2018;17(2):150-157. [DOI:10.1007/s12663-016-0897-3] [PMID] [PMCID]
- [3] Azizi M, Hassanzadeh G, Barbarestani M, et al. Comparative Anthropometric Analysis of Facial Dimensions and Types in Qazvin, Iran and DeraGhazi Khan, Pakistan. *Anat. Sci. J.* 2014;11(3):119-126. URL: <http://anatomyjournal.ir/article-1-35-en.html>
- [4] Abu A, Ngo CG, Abu-Hassan NIA, Othman SA. Automated craniofacial landmarks detection on 3D image using geometry characteristics information. *BMC Bioinformatics.* 2019;19(13):548. [DOI:10.1186/s12859-018-2548-9] [PMID]
- [5] Moshkdanian G, Mahaki Zadeh S, Moghani Ghoroghi F, Mokhtari T, Hassanzadeh G. Estimation of Stature from the Anthropometric Measurement of Lower Limb in Iranian Adults. *Anatomic. Sci. J* 2014;11(3):149-154. URL: <http://anatomyjournal.ir/article-1-98-en.html>
- [6] Ojaimi E, Morgan IG, Robaei D, et al. Effect of stature and other anthropometric parameters on eye size and refraction in a popula-

- tion-based study of Australian children. *Invest Ophthalmol Vis Sci.* 2005;46(12):4424-4429. [DOI:10.1167/iov.05-0077] [PMID]
- [7] Halberstein R. The application of anthropometric indices in forensic photography: three case studies. *J. Forensic. Sci.* 2001;46(6):1438-1441. [DOI:10.1520/JFS15168J]
- [8] Akhlaghi M, Sheikhzadi A, Khosravi N, Pourmia Y, Anary SHS. The value of the anthropometric parameters of the tibia in the forensic identification of the Iranian population over the age of 20. *J. Forensic. Leg. Med.* 2011;18(6):257-263. [DOI:10.1016/j.jflm.2011.05.001] [PMID]
- [9] Ngeow W, Aljunid S. Craniofacial anthropometric norms of Malaysian Indians. *Indian J. Dent. Res.* 2009;20(3):313. [DOI:10.4103/0970-9290.57372] [PMID]
- [10] Hassanzadeh G, Sadr M, Alaghbandha N, Dehbashipour A, Abbas MA, Heydar Zeidi O. Anthropometric characteristics of craniums in residents of Qazvin, Iran and Dera Ghazi Khan, Pakistan: A comparative study. *Anat. Sci. J.* 2013;10(1):43-49.
- [11] Navaei F, Ghaffari N, Mojaverrostami S, Dodongeh M, Nemati M, Hassanzadeh G. Stature estimation from facial measurements in medical students of Tehran university of Medical Sciences: an Iranian population. *Iraq. Med. J.* 2018;2(3):68-71.
- [12] Remya KJ, Mathangi K, Mathangi DC, et al. Predictive value of craniofacial and anthropometric measures in obstructive sleep apnea (OSA). *Cranio.* 2017;35(3):162-167. [DOI:10.1080/08869634.2016.1206701] [PMID]
- [13] Perri RA, Kairaitis K, Wheatley JR, Amis TC. Anthropometric and craniofacial sexual dimorphism in obstructive sleep apnea patients: is there male-female phenotypical convergence? *J. Sleep Res.* 2015;24(1):82-91. [DOI:10.1111/jsr.12205] [PMID]
- [14] Karakas S, Tellioglu AM, Bilgin M, Omurlu IK, Caliskan S, Coskun S. Craniofacial Characteristics of Thalassemia Major Patients. *Eurasian. J. Med.* 2016;48(3):204-208. [DOI:10.5152/eurasianjmed.2016.150013] [PMID] [PMCID]
- [15] Asha KR, Lakshmi Prabha S, Nanjaiah CM, Prashanth SN. Craniofacial anthropometric analysis in Down syndrome. *Indian. J. Pediatr.* 2011;78(9):1091-1095. [DOI:10.1007/s12098-011-0377-1] [PMID]
- [16] Bagic I, Verzak Z. Craniofacial anthropometric analysis in Down's syndrome patients. *Coll. Antropol.* 2003;27 Suppl 2:23-30.
- [17] Jaber KR, Kavakebian F, Mojaverrostami S, et al. Nasofacial Anthropometric Study Among Students of Shiraz University of Medical Sciences, Iran: A Population Based Study. *Indian J. Otolaryngol. Head. Neck. Surg.* 2019;1-6. [DOI:10.1007/s12070-018-01578-7]
- [18] Omotoso D, Oludiran O, Sakpa C. Nasofacial anthropometry of adult Bini tribe in Nigeria. *Afr. J. Biomed. Res.* 2011;14(3):219-221. URL: <https://www.ajol.info/index.php/ajbr/article/view/95264>
- [19] Husein OF, Sepehr A, Garg R, et al. Anthropometric and aesthetic analysis of the Indian American woman's face. *J. Plast. Reconstr. Aesthet. Surg.* 2010;63(11):1825-1831. [DOI:10.1016/j.bjps.2009.10.032] [PMID]
- [20] Poorhassan M, Mokhtari T, Navid S, et al. Stature estimation from forearm length: an anthropological study in Iranian medical students. *J. Contemp. Med. Sci.* 2017;3(11):270-272. URL: <http://www.jocms.org/index.php/jcms/article/view/223> [DOI:10.22317/jcms.09201705]
- [21] Mojaverrostami S, Mokhtari T, Malekzadeh M, Noori L, Kazemzadeh Sh IS. Stature Estimation Based on Fingers Anthropometry in Iranian Population. *Anat. Sci.* 2017;14(4):163-168. URL: <http://anatomyjournal.ir/article-1-208-en.html>
- [22] Novita M. Facial, upper facial, and orbital index in Batak, Klaten, and Flores students of Jember University. *Dent. J.* 2006;39(3): 116-119. [DOI:10.20473/j.djmk.v39.i3.p116-119]
- [23] Gallardo CAC, Galdames ICS, López MGC, et al. Relationship between pterygopalatine fossa volume and cephalic and upper facial indexes. *Int. J. Morphol.* 2008;26:393-396. [DOI:10.4067/S0717-95022008000200023]
- [24] Trivedi H, Azam A, Tandon R, Chandra P, Kulshrestha R, Gupta A. Correlation between morphological facial index and canine relationship in adults- An anthropometric study. *J Orofac. Sci.* 2017;9(1):16. [DOI:10.4103/jofs.jofs_50_16]
- [25] Navid S, Mokhtari T, Alizamir T, Arabkheradmand A, Hassanzadeh G. Determination of Stature from Upper Arm Length in Medical Students. *Anat. Sci. J.* 2014;11(3):135-140. URL: <http://anatomyjournal.ir/article-1-95-en.html>
- [26] Yesmin T, Thwin SS, Afrin Urmi S, Wai MM, Zaini P, Azwan K. A study of facial index among Malay population. *J. Anthropol.* 2014;2014. [DOI:10.1155/2014/726974]
- [27] Doni RPK, Vijayaraghavan V. A study on measurement and correlation of cephalic and facial indices in males of South Indian population. *Int. J. Med Res. Health Sci.* 2013;2(3):439-446. [DOI:10.5958/j.2319-5886.2.3.076]
- [28] Moore KL, Persaud T. *Essentials of Embryology and Birth Defects*, St. George's University, Grenada; 1999.
- [29] Jahanshahi M, Golalipour M, Heidari K. The effect of ethnicity on facial anthropometry in Northern Iran. *Singapore. Med J.* 2008;49(11):940-943.
- [30] Kurnia C, Susiana S, Husin W. Facial indices in Chinese ethnic students aged 20-22. *J. Dent. Indones.* 2013;19(1):1-4. [DOI:10.14693/jdi.v19i1.121]
- [31] Heidari Z, Mahmoudzadeh-Sagheb H, Khammar T, Khammar M. Anthropometric measurements of the external nose in 18-25-year-old Siستاني and Baluch aborigine women in the southeast of Iran. *Folia. Morphol.* 2009;68(2):88-92.
- [32] Din TNDT, Rajion ZA, Luddin N. Nasofacial morphometric analysis for nasal reconstruction. *J. Teknol.* 2015;76(7):81-85. [DOI:10.11113/jt.v76.5719]
- [33] Kumari KL, Babu PV, Kumari PK, Nagamani M. A study of cephalic index and facial index in Visakhapatnam, Andhra Pradesh, India. *Int J Res Med Sci.* 2015; 3(3): 656-658. [DOI:10.5455/2320-6012.ijrms20150324]