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RESEARCH

Association between somatotype and auricular anthropometric measurements in healthy young adults

Sağlıklı genç yetişkinlerde somatotip ve auriküler antropometrik ölçümler arasındaki ilişki

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Abstract

Purpose: The aim of the study is to correlate somatotype with parameters obtained from the auricula of healthy young individuals.
Materials and Methods: The study was conducted on 256 healthy volunteery individuals between the ages of 18-30. Body types of individuals were determined by the Heath-Carter somatotype method. Then, the auricula of the individuals were photographed and transferred to the Image J program, and the determined parameters were measured.
Results: Using the Heath-Carter somatotype method, eight different body types were identified among the participants. The Mann-Whitney U test evaluated the relationship between auricular morphometry and body type by gender. Significant findings included the Inint-Sba distance in mesomorphic endomorphs and the Pa-Crura Antihelix distance in endomorphic ectomorphs. Spearman's rho test revealed gender-specific differences: in males, key correlations involved T-Sba, Inint-Sba, Superaurale-Sba, and Otobasion Superior-Pa distances, while in females, a very high correlation was found between T-Sba and Inint-Sba parameters..
Conclusion: Significant relationships were found between body types and auricle morphometry, and in the evaluation of auricula morphometry according to gender.
Keywords:. Somatotype, auricula, morphometry, photo analysis

Öz

Amaç: Çalışmanın amacı sağlıklı genç bireylerin auriculasından elde edilen parametreler ile somatotipin ilişkilendirilmesidir.
Gereç ve Yöntem: Çalışma 18-30 yaş aralığındaki 256 gönüllü sağlıklı birey üzerinde gerçekleştirildi. Bireylerin vücut tipleri Heath-Carter somatotip yöntemiyle belirlendi. Daha sonra bireylerin auricula'sı fotoğraflandırılarak Image J programına aktarılıp belirlenen parametreler ölçüldü.
Bulgular: Heath-Carter somatotip yöntemine göre katılımcılarda sekiz farklı vücut tipi belirlendi. Mann-Whitney U testi ile aurikula morfometrisi ile vücut tipi arasındaki ilişki cinsiyete göre değerlendirildi. Mesomorfik endomorf bireylerde Inint-Sba mesafesi, endomorfik ektomorf bireylerde ise Pa-Crura Antihelix mesafesi anlamlı bulundu. Spearman rho testi, cinsiyete özgü farklılıklar gösterdi: Erkeklerde T-Sba, Inint-Sba, Superaurale-Sba ve Otobasion Superior-Pa mesafeleri arasında önemli korelasyonlar bulunurken, kadınlarda T-Sba ve Inint-Sba parametreleri arasında çok yüksek bir korelasyon saptandı.
Sonuç: Çalışmamız sonucunda vücut tipleri ile auricula morfometrisi arasında ve auricula morfometrisinin cinsiyete göre değerlendirilmesinde anlamlı ilişkiler bulundu.

Anahtar kelimeler: Somatotip, auricula, morfometri, foto analiz.

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INTRODUCTION

Somatotype is the morphological examination of body structure. This method dates back to the Hippocratic period. Today, the most common method for determining somatotype is the Heath-Carter somatotype method. In this method, body types are divided into 3 main classes, 4 main groups and 13 subclasses. Endomorphy (fatness), mesomorphy (muscularity) and ectomorphy (thinness) constitute the 3 main classes. Heath-Carter somatotype method is divided into 3 types in terms of application: anthropometric method, photocopic method and the method using both. This somatotype method is frequently preferred in health sciences and sports sciences[1-4].

Anthropometry is a method that describes the objective characteristics of the human body and the measurable properties of the body and its parts. Craniofacial anthropometry is a method that allows the examination of the morphology and position of the structures that make up the human face and skull. Among the craniofacial structures, the auricula is often preferred in craniofacial anthropometry. The main reason for this is that its holistic shape, structure and appearance do not change with facial expressions and mimics[4-8].

Auricula morphology has an important place in craniofacial surgery, forensic sciences and genetic sciences. In genetic sciences, auricula morphology has a critical importance in the identification of congenital anomalies and genetic disorders. For example, planar differences, deformities and deformations in the auricula may indicate important genetic diseases. The auricula is of great importance in craniofacial surgery and aesthetic surgery. Anthropometry and morphology of the auricula in healthy individuals are important for aesthetic aesthetics of the auricula[8-10].

The auricula is an important component of the face and reflects cultural differences and facial aesthetics to a significant degree. Deformities in the auricula, ear size, position of the ear, microtia, anoti, slope of the ear directly affect facial aesthetics. Therefore, race-related measurements of the auricula in healthy individuals are of great importance. These measurements allow us to obtain important clues about facial aesthetics, acquired disorders, hereditary diseases and anomalies[11-12].

The study was conducted with the hypothesis that auricular morphometry of individuals with different somatotypes may differ from each other. It was conducted to investigate the relationship between somatotype and anthropometric measurements obtained from the auricle of healthy young individuals.

MATERIALS AND METHODS

Sample

The study was carried out between January-2022 and June-2022 on students studying at Karabuk University Faculty of Medicine, Faculty of Dentistry and Faculty of Health Sciences Nursing and Midwifery departments. The study sample consisted of 256 students aged between 18-30 years, 141 of whom were female and 115 of whom were male. Of the 355 students screened within the scope of the study, 99 were excluded from the sample because they did not meet the inclusion criteria. While forming the research sample, healthy and voluntary individuals between the ages of 18-30, who had not undergone any craniofacial surgery (especially auricular surgery), were included and the voluntary consent form was read.

Procedure

The study was initiated with the approval of Karabük University Non-Interventional Clinical Research Ethics Committee with the number 2022/788.

Anthropometric assessment

Photographs of the auricula were taken in front of a fixed board with defined standards and divided into squares (a grid paper with a 1 mm gap). The subjects were asked to stand in front of the board with their shoulders touching the board. The photographs were then recorded using a professional camera and a tripod. The photographs were converted to jpeg format and displayed on a computer and the distances between the 9 anthropometric points determined on the auricula were measured using Image J (version 1.53e) software.

The anthropometric points measured;

1. Otobasion superius (upper point where the ear adheres to the cheek, Obs)
2. Otobasion inferius (lower point where the ear attaches to the cheek, Obi)
3. Superaurale (highest point of the ear, Sa)

4. Tragus (T)
5. Subaurale (lowest point of the ear, Sba)
6. Postaurale (posterior most point of the ear, Pa)
7. Postearlobe (posterior most point of the earlobe, Pl)
8. Helix (H)
9. Antihelix (Ah)
10. Most medial of the crura antihelix
11. Incisura intertragica (Inint)

These reference points include; the distance from the superaurale to the subaurale (Sa-Sba), the distance from the postaurale to the autobasion superius (Pa-Obs), the length from the postaurale to the most medial crura antihelix, the length of the tragus, the length from the tragus to the helix (T-H), Length between tragus and antihelix (T-Ah), length between tragus and subaurale (T-Sba), length between incisura intertragica and subaurale (Inint-Sba), length between postearlobe and autobasion inferius (Pl-Obi) were measured (Figure 1).

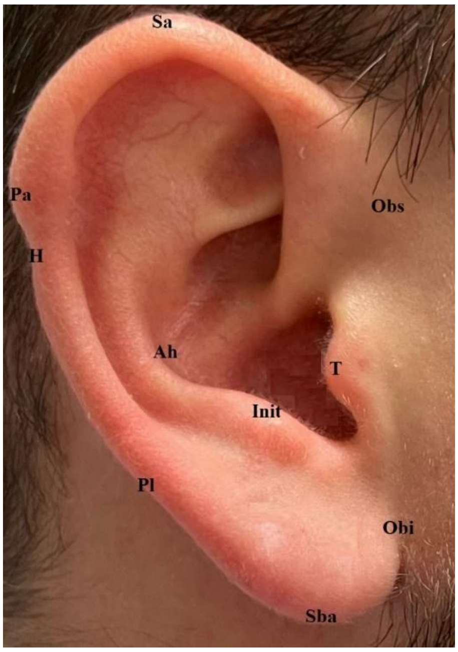

Figure 1. Measurement points

Somatotype assessment

Somatotypes of the individuals were determined by Heath-Carter somatotype method. The measurements were performed by a single measurer using appropriate measuring instruments for each parameter. For the application of the technique, 10 different anthropometric measurements were performed. These were; height, weight, arm circumference, calf circumference, knee width, elbow width, triceps skin thickness, subscapular skin thickness, supraspinal skin thickness, calf skin thickness. All measurements described above were performed by the same anatomist.

Statistical Analysis

Median, minimum and maximum values were included in the descriptive statistics of the data. Mann Whitney-U test was used to compare the parameters of somatotype groups in terms of gender. The relationship between somatotype groups was evaluated using Kruskal Wallis H test. Pairwise comparison test was used to determine the exact relationship between the groups. The relationship and the degree of relationship between the auricula parameters were determined by Spearman Rho correlation test. SPSS (Version 21) package programme was used for statistical analyses and $p<0.05$ was considered statistically significant. The study sample was identified using G Power analysis. The analysis was determined with the G*Power (Version 3.1.9.4) program using 95% power and an error rate of 0.05, and the minimum number of individuals was determined as 93.

RESULTS

In this study, which was carried out to correlate ear morphometry with body somatotype in 141 female and 115 male individuals aged 18-30 years, it was seen that the individuals were distributed into 8 different groups in terms of somatotype. In the first group, 41 male and 23 female individuals were mesomorphic endomorph, in the second group 33 male and 17 female individuals were endomorphic mesomorph, in the third group 34 male and 20 female individuals were balanced ectomorph, in the fourth group 56 male and 29 female individuals were mesomorphic endomorph, In the fifth group, 22 males and 16 females were endomorphic ectomorph, in the sixth group 24 males and 9 females were central, in the seventh group 26 males and 14 females were ectomorphic endomorph and in the eighth group 20 males and 13 females were balanced endomorph. There is no sıgnıficant difference was found in age terms in both sex groups.

Auricula morphometry parameters of male individuals are shown in Table 1 according to somatotype groups. Auricula morphometry parameters of female individuals are shown in Table 2 according to somatotype groups. Auricular morphometry parameters were evaluated by Mann Whitney-U test in terms of gender according to somatotype groups and a statistically significant relationship was found in 1 parameter in the third group, 1 parameter in the fourth group and 1 parameter in the fifth group (p<0.005), (Table 3)

Auricula morphometry parameters of male and female individuals were compared with Spearman Rho correlation test and statistically significant correlation was found between all parameters (p<0.05), (Tables 4, 5). A very high correlation was found between T-Sba parameter and Inint-Sba and Sa-Sba parameters in males and between Obs-Pa parameter and T-Ah parameter (Table 4). A very high correlation was found between T-Sba parameter and Inint-Sba parameter in females (Table 5).

Table 1. Morphometry of auricula in male subjects according to somatotype groups

Parameters	Mesomorph Endomorph	Endomorphic Mesomorph	Balanced Ectomorphy (n=34)	Mesomorphic Endomorph (n=56)	Endomorphic Ectomorph (n=22)	Central (n=24)	Ectomorphic Endomorph	Balanced Endomorphy (n=20)
T (cm)	0.9 (0.8-1.1)	1.0 (0.8-1.8)	1.1 (0.7-1.4)	1.0 (0.7-1.5)	1.0 (0.8-1.3)	1.1 (0.7-1.2)	1.0 (0.7-1.3)	1.0 (0.7-1.3)
T-Sba (cm)	2.4 (1.5-3.2)	2.4 (1.4-3.1)	2.5 (1.5-3.5)	2.4 (1.4-3.3)	2.3 (1.8-3.0)	2.2 (1.6-3.0)	2.2 (1.8-2.9)	2.4 (1.9-2.9)
Inint-Sba (cm)	1.5 (0.9-2.2)	1.5 (0.9-2.2)	1.7 (0.9-2.6)	1.6 (0.9-2.1)	1.4 (1.0-1.7)	1.4 (0.9-2.3)	1.4 (1.0-1.7)	1.6 (1.3-1.9)
Obs-Pa (cm)	2.96 (2.2-4.1)	3.2 (2.1-4.8)	3.4 (2.6-4.0)	3.1 (2.0-3.8)	3.3 (2.5-4.4)	3.0 (1.8-3.9)	2.7 (1.8-3.7)	2.8 (1.1-4.3)
Obi-Pl (cm)	1.8 (0.8-2.6)	1.9 (1.2-2.9)	1.7 (1.1-2.6)	1.7 (0.9-2.4)	1.8 (1.6-2.0)	1.8 (1.0-2.7)	1.7 (1.2-3.0)	1.5 (1.4-2.6)
T-H (cm)	1.7 (1.1-2.2)	1.8 (1.1-2.5)	1.7 (1.2-2.5)	1.6 (1.2-2.2)	1.8 (1.3-2.2)	1.6 (1.1-2.1)	1.6 (1.0-3.4)	1.4 (1.0-2.3)
T-Ah (cm)	2,6 (1.8-3.5)	2.5 (1.4-4.2)	2.7 (2.0-3.8)	2.6 (1.8-3.5)	2.9 (2.1-3.4)	2.5 (1.6-3.3)	2.4 (1.5-3.4)	2.3 (2.0-4.1)
Sa-Sba (cm)	5.2 (4.1-7.1)	5.6 (4.1-7.8)	5.5 (4.7-6.9)	5.5 (4.6-7.0)	5.1 (4.6-6.9)	4.9 (4.0-6.6)	4.9 (4.3-6.8)	5.5 (4.6-6.6)
Pa-Crura Most Medial of Antihelix	1.3 (0.7-2.1)	1.5 (0.9-3.1)	1.4 (0.9-1.9)	1.5 (0.8-2.0)	1.7 (1.1-2.6)	1.3 (0.7-2.0)	1.4 (0.9-2.3)	1.6 (0.9-2.2)

*T: Tragus, Sba: Subaurale, Inint: Incisura Intertragica, Obs: Otobasion Superior, Pa : Postaurale, Obi : Otobasion Inferior, Pl : Postearlobe, H : Helices, Ah : Antihelix, Sa : Superaurale.

Table 2. Morphometry of auricula in female subjects according to somatotype groups

Parameters	Mesomorph Endomorph (n=23)	Endomorphic Mesomorph (n=17)	Balanced Ectomorphy (n=20)	Mesomorphic Endomorph (n=29)	Endomorphic Ectomorph (n=16)	Central (n=9)	Ectomorphic Endomorph (n=14)	Balanced Endomorphy (n=13)
T (cm)	20 (19-30)	20 (18-28)	20 (19-25)	20 (18-25)	20 (19-28)	19 (18-22)	20,5 (19-27)	20 (19-24)
T-Sba (cm)	24.3 (17.9-36)	23.3 (18.6-32.3)	18.5 (16.1-20.5)	24.3 (21.4-34.3)	19.3 (17.6-23)	20.5 (19-22.4)	20.9 (18.5-27)	21.7 (19.4-27.1)
Inint-Sba (cm)	15 (9-19)	17 (9-23)	14.5 (6-25)	15 (7-24)	9.5 (7-27)	15 (13-21)	16 (7-25)	12 (7-21)
Obs-Pa (cm)	14 (7-25)	16 (9-27)	15 (10-23)	15 (7-27)	15 (7-21)	13 (11-19)	15 (7-23)	17 (7-21)
Obi-Pl (cm)	9 (5-17)	13 (1-29)	11.5 (4-21)	11 (4-23)	10 (3-21)	9 (7-21)	11.5 (5-23)	13 (5-17)
T-H (cm)	17 (11-21)	19 (11-29)	17 (11-19)	19 (9-29)	16.5 (11-27)	19 (11-23)	19 (13-23)	17 (9-21)
T-Ah (cm)	25 (21-33)	26.5 (21-36)	27 (24-32)	27 (21-34)	26.2 (21-33)	25 (22-32)	27.5 (21-32)	25 (22-29)
Sa-Sba (cm)	32.5 (27-38)	33 (29-47)	33.5 (29.8-39)	33 (30-39)	32.2 (29-38)	33 (27-39)	32 (29-40)	34 (29-40)
Pa-Crura Most Medial of Antihelix	57.2 (49.7-64.6)	56.2 (50.5-67.4)	58.2 (51.3-71)	57.1 (49.6-67.8)	56 (51.6-66.9)	61.1 (51-65.2)	58.2 (53.6-65.3)	56.1 (54.1-63)

*T: Tragus, Sba: Subaurale, Inint: Incisura Intertragica, Obs: Otobasion Superior, Pa: Postaurale, Obi: Otobasion Inferior, Pl: Postearlobe, H: Helices, Ah: Antihelix, Sa: Superaurale.

Table 3. Comparison of auricula parameters according to gender groups

Parameters	Mesomorph Endomorph (n=23)	Endomorphic Mesomorph (n=17)	Balanced Ectomorphy (n=20)	Mesomorphic Endomorph (n=29)	Endomorphic Ectomorph (n=16)	Central (n=9)	Ectomorphic Endomorph (n=14)	Balanced Endomorphy (n=13)
T (cm)	0.599	0.382	0.131	0.823	0.376	0.355	0.165	0.817
T-Sba (cm)	0.299	0.929	0.350	0.129	0.302	0.881	0.237	0.351
Inint-Sba (cm)	0.590	0.958	0.825	0.009	0.606	0.929	0.181	0.311
Obs-Pa (cm)	0.793	0.179	0.371	0.341	0.197	0.743	0.504	0.536
Obi-Pl (cm)	0.773	0.845	0.094	0.904	0.883	0.531	0.354	0.536
T-H (cm)	0.999	0.345	0.417	0.796	0.825	0.355	0.837	0.699
T-Ah (cm)	0.895	0.260	0.456	0.592	0.439	0.655	0.355	0.536
Sa-Sba (cm)	0.259	0.217	0.216	0.769	0.210	0.456	0.504	0.351
Pa-Crura Most Medial of Antihelix	0.753	0.179	0.140	0.959	0.033	0.743	0.355	0.311

*a: low association, b: moderate association, c: high association, d: very high association
** T: Tragus, Sba: Subaurale, Inint: Incisura Intertragica, Obs: Otobasion Superior, Pa: Postaurale, Obi: Otobasion Inferior, Pl: Postearlobe, H: Heliks, Ah: Antiheliks, Sa: Superaurale.

Table 4. Correlation analysis of auricular morphometry parameters of male individuals.

	T (cm)	T-Sba (cm)	Inint-Sba (cm)	Obs-Pa (cm)	Obi-Pl (cm)	T-H (cm)	T-Ah (cm)	Sa-Sba (cm)
T-Sba (cm)	0.563[b] **0.000**							
Inint-Sba (cm)	0.473[b] **0.000**	0.830[d] **0.000**						
Obs-Pa (cm)	0.536[b] **0.000**	0.561[b] **0.000**	0.558[b] **0.000**					
Obi-Pl (cm)	0.446[b] **0.000**	0.478[b] **0.000**	0.517[b] **0.000**	0.480[b] **0.000**				
T-H (cm)	0.565[b] **0.000**	0.565[b] **0.000**	0.493[b] **0.000**	0.732[c] **0.000**	0.568[b] **0.000**			
T-Ah (cm)	0.578[b] **0.000**	0.550[b] **0.000**	0.514[b] **0.000**	0.833[d] **0.000**	0.486[b] **0.000**	0.797[c] **0.000**		
Sa-Sba (cm)	0.601c 0.000	0.806d 0.000	0.704c 0.000	0.674c 0.000	0.532b 0.000	0.683c 0.000	0.659c 0.000	
Pa-Crura Most Medial of Antihelix	0.535b 0.000	0.315a 0.001	0.348a 0.000	0.573b 0.000	0.413b 0.000	0.511c 0.000	0.649c 0.000	0.502b 0.000

Table 5. Correlation analysis of auricular morphometry parameters of female individuals

	T (cm)	T-Sba (cm)	Inint-Sba (cm)	Obs-Pa (cm)	Obi-Pl (cm)	T-H (cm)	T-Ah (cm)	Sa-Sba (cm)
T-Sba (cm)	0.342a 0.000							
Inint-Sba (cm)	0.231a 0.006	0.886d 0.000						
Obs-Pa (cm)	0.371a 0.000	0.517b 0.000	0.470b 0.000					
Obi-Pl (cm)	0.376a 0.000	0.611c 0.000	0.560b 0.000	0.552b 0.000				
T-H (cm)	0.295a 0.000	0.506b 0.000	0.382a 0.000	0.551b 0.000	0.456b 0.000			
T-Ah (cm)	0.500b 0.000	0.499b 0.000	0.410b 0.000	0.697c 0.000	0.551b 0.000	0.739c 0.000		
Sa-Sba (cm)	0.398a 0.000	0.757c 0.000	0.696c 0.000	0.591b 0.000	0.530b 0.000	0.490b 0.000	0.511b 0.000	
Pa-Crura Most Medial of Antihelix	0.512b 0.000	0.276a 0.001	0.221a 0.009	0.531b 0.000	0.385a 0.000	0.296a 0.000	0.506b 0.000	0.308a 0.000

*a: low association, b: moderate association, c: high association, d: very high association
** T: Tragus, Sba: Subaurale, Inint: Incisura Intertragica, Obs: Otobasion Superior, Pa: Postaurale, Obi: Otobasion Inferior, Pl: Postearlobe, H: Heliks, Ah: Antiheliks, Sa: Superaurale.

DISCUSSION

This study was conducted to determine the relationship between auricula morphometry and somatotype. As a result of the study, 16.01% mesomorph-endomorph, 12.8% endomorphic-mesomorph, 13.2% balanced ectomorph, 21.8% mesomorphic-endomorph, 8.5% endomorph-ectomorph, 9.3% central, 10.1% ectomorphic-endomorph, 7.8% balanced endomorph. The relationship between auricula morphometry and body type was evaluated according to gender and a significant relationship was found in the mesamorphic endomorphic body type in the distance parameter between Incisura Intertragica (Inint) and Subaurale (Sba), and in the endomorphic ectomorphic body type in the distance parameter between Postaurale (Pa) and Crura Antihelix en medial ($p<0.05$). Auricula morphometry was evaluated according to gender and a very high correlation was found between the distance parameter between Tragus (T)-Sba and Inint-Sba and Superaurale -Sba and between Otobasion Superior -Pa and T- Antihelix in male individuals, and between T-Sba and Inint-Sba in female individuals ($p<0.05$).

The anatomical structure of the outer ear has been studied by many researchers for different purposes. The characteristic features of the auricula, which are inherited, have led to its frequent use in craniofacial anthropometry[8-10].

Somatotyping was described by Sheldon et al. as a prioritised technique for measuring human physique, and it was suggested that BMI could be an alternative strategy by Maddan et al[13,14]. Liu et al. In a study conducted to evaluate somatotype and obesity in 1690 male and 1748 female individuals over the age of 20 living in the Xinjiang Uygur Autonomous Region of China, it was concluded that the somatotype of overweight or obese people was mainly related to endomorphic mesomorph, mesomorph-endomorph and mesomorphic endomorph[15]. In a study conducted with 334 male participants aged between 18 and 60 years, Das et al. found a strong relationship between somatotype and BMI[16]. In parallel, Longkumer reported a statistically significant relationship between BMI and somatotype in a study with 790 individuals aged 8-18 years[17]. Unlike the mentioned studies, in the study published by Genovese, he stated that BMI is an insufficient parameter for somatotype[18]. In our study, it was concluded that there was a statistically significant relationship between certain somatotype groups and BMI ($p<0.05$).

Anomalies or deformities in the auricula are of great importance in terms of facial beauty. In addition, the auricula is the first structure of the auditory system and plays an important role in collecting external sound. Because of these features, auricula morphometry has been a subject of curiosity in the literature. Race-related, age-related and gender-related changes of auricula morphometry have been frequently studied[12,19]. The difference of this study from the studies in the literature is that it was also examined in terms of somototype.

In Açar's study on 136 female and 110 male students studying at Meram Medical Faculty, the mean Sa-Sba was 6.30 cm, Obs-Pa was 3.43 cm, T-Ah was 2.01 cm, and T-H was 3.04 cm[8]. In a study of 313 individuals aged between 18-75 years from the Indian population, all ear sizes were found to be larger than females, Sa-Sba was 6.2 cm in males and 5.8 cm in females, Obs-Pa was 3.1 cm in males and 2.9 cm in females [20]. In a study conducted on 177 healthy young medical students aged 17-25 years, Sa-Sba 6.03 cm, Obs-Pa 3.06 cm and Inint-Sba 1.69 cm were measured in males and 5.77 cm, 2.87 cm and 1.68 cm in females, respectively. It was reported that auricula measurements of males were higher than those of females [21]. The results of anthropometric auricula measurements performed on a total of 200 individuals, 80 females and 120 males aged 18-25 years, belonging to the Egyptian population were as follows; the average left ear Sa-Sba length in males was 6.57 cm and in females 6. 21 cm, left ear Obs-Pa length in male 3.84 cm in female 3.74 cm, left ear T length in male 1.34 cm in female 1.33 cm, left ear Inint-Sba length in male 2.11 cm in female 1.95 cm, left lobule width in male 2.07 cm in female 2.04 cm [22]. Karakaş et al. reported that the Sa-Sba length of female individuals was shorter than the Sa-Sba length of male individuals in their study conducted in 7-11 age group students [23]. In a study the distance between Sa-Sba was 5.22 cm in female individuals and 5.33 cm in male individuals, the distance between Inint-Sba was 3.20 cm in female individuals and 3.24 cm in male individuals, and the distance between Pl-Obi was measured as 2.00 cm in female individuals and 2.03 cm in male individuals [24]. In our study, the auricula parameters measured from male individuals were as follows; T length 1.01 cm, length between T-Sba 2.35 cm, length between Inint-Sba 1.51 cm, length between Obs-Pa 3.05 cm, length between Obi-Pl 1.73 cm, length between T-H 1.75 cm, length between T-Ah 2.56 cm, length between Sa-Sba 5.27 cm, length between Pa-Crura antihelix most medial 1.46 cm. The mean auricula parameters measured from female individuals were as follows; T length 0.95 cm, length between T-Sba 2.17 cm, length between Inint-Sba 1.43 cm, length between Obs-Pa 2.71 cm, length between Obi-Pl 1.75 cm, length between T-H 1.68 cm, length between T-Ah 2.62 cm, length between Sa-Sba 5.01 cm, length between Pa-Crura antihelix most medial 1.35 cm. The distance between Sa and Sba, Obs and Pa was measured higher in males than females. The limitation of the study was not being able to reach a larger sample number from each somatotype group.

In conclusion significant relationships were found between BMI and body types, between body types and auricula morphometry, and in the evaluation of auricula morphometry according to gender. In this respect, we believe that our study will guide morphological and morphometric studies and interventions.

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REFERENCES

1. Carter J, Ackland T, Kerr D, Stapff A. Somatotype and size of elite female basketball players. J Sports Sci. 2005;23:1057-63.
2. Carter JEL. The Heath-Carter Anthropometric Somatotype: Instruction Manual. San Diego, San Diego State University, 2002.
3. Özer MK. Kinantropometri: Sporda Morfolojik Planlama. İstanbul, Nobel. 2009.
4. Seçgin Y, Toy Ş, Şenol D, Öner Z. Associating craniofacial morphometry determined by photo analysis with somatotype in healthy young individuals. European Research Journal. 2023;9:717-24.
5. Bisati SN, Bhan NB. Anthropometric measurements of kashmiri pandit infants (0–18 Months). Anthropologist. 2005;7:149-51.
6. Farkas LG, Hreczko T, Katic MJ. Craniofacial norms in North American caucasians from birth to adulthood. In Anthropometry of the Head and Face (Ed LG Farkas):241-333. New York, Raven Press, 1994.
7. Jayaratne YS, Zwahlen RA. Application of digital anthropometry for craniofacial assessment. Craniomaxillofac Trauma Reconstr. 2014;7:101-7.
8. Açar G. Sağlıklı genç gönüllülerde dış kulak morfometrisinin foto analizi ile boy, cinsiyet ve vüçut kitle indeksi arasındaki korelasyonun incelenmesi. Dünya Sağlık ve Tabiat Bilimleri Dergisi. 2021;4:12-22.
9. Motulsky AG, Vogel F. Human Genetics: Problems and Approaches. Cham, Springer, 1997.
10. Purkait R, Singh P. Anthropometry of the normal human auricle: a study of adult Indian men. Aesthetic Plast Surg. 2007;31:372-9.
11. Tang L, Xie WJ, Zhou YH, Wang HB. The ideal proportion of the auricle exposure via a morphometric analysis in Asian women. Aesthetic Plast Surg. 2024;48:2611-7.
12. Lin Y, Dobbe JG, Lachkar N, Ronde EM, Smit TH, Breugem CC et al. A three-dimensional algorithm for precise measurement of human auricle parameters. Sci Rep. 2024;14:10760.
13. Maddan S, Walker JT, Miller JM. Does size really matter?: a reexamination of sheldon's somatotypes and criminal behavior. Soc Sci. 2008;45:330-44.
14. Sheldon W, Stevens S, Tucker W. The Varieties of Human Physique: An Introduction to Constitutional Psychology'. New York, Harper and Brothers, 1940.
15. Liu X, Li W, Wen Y, Xu G, Zhou G, Qu Q et al. Obesity and heath-carter somatotyping of 3438 adults in the Xinjiang Uygur autonomous region of China by multivariate analysis. Diabetes Metab Syndr Obes. 2021;14:659-70.
16. Das K, Mukherjee K, Ganguli S, Pal S, Bagchi SS. The association between somatotype and nutritional status: a cross-sectional study among the adult sabar males of Purulia, West Bengal, India. Int J Anthropol Ethnol. 2021;5:5.
17. Longkumer T. Age and sex differences in human body physique and its association with nutrition: A cross-sectional study among the Ao children from Nagaland, North-East India. Indian J Nutr Diet. 2016;3:132.
18. Genovese JE. Can body mass index (BMI) be used as a proxy for somatotype? Soc Sci. 2009;46:390-93.
19. Ese A, Daniel AO, Sopuluchukwu UP, Godswill OO, Ogheneriobórue ID. Anthropometric study of the external ear among delta state üniversity students in abraka, nigeria. Nigerian Journal of Basic and Clinical Sciences. 2024;21:43-7.
20. Asadujjaman M, Rashid MHO, Rana S. Anthropometric measurement of external ear and correlation with age in north regional people of bangladesh. Bangladesh Journal of Medical Science. 2019;18:206-10.
21. Deopa D, Thakkar H, Prakash C, Niranjan R, Barua M. Anthropometric measurements of external ear of medical students in Uttarakhand Region. J Anat Soc India. 2013;62:79-83.
22. Abdelaleem S, Fouad Abdelbaky F. Estimation of stature in Upper Egypt population from external ear morphometry. Int J Forensic Sci Pathol. 2016;4:276-84.
23. Karakaş S, Kavaklı A, Uzun A, Cihan ÖF. Malatya merkez ilkokul öğrencilerinin yüz ve kulak ile ilgili antropometrik ölçümlerinin incelenmesi. Journal of Turgut Ozal Medical Center. 1999;6:24-7.
24. Farhan SS, Al-Jewari WM, Al-Maathidy AQA, Al-Qtaitat A. Morphological assessment of Ear auricle in a group of Iraqi subjects and its possible role in personal identification. Ital J Anat Embryol. 2019;124:432-42