The European Research Journal 2023;9(4):717-724 Original Article

DOI: 10.18621/eurj.1192005 *Anatomy*

Associating craniofacial morphometry determined by photo analysis with somatotype in healthy young individuals

Yusuf Seçgin[1], Şeyma Toy[1], Deniz Şenol[2], Zülal Öner[3]

[1]Department of Anatomy, Karabük University, Faculty of Medicine, Karabük, Turkey; [2]Department of Anatomy, Düzce University, Faculty of Medicine, Düzce, Turkey; [3]Department of Anatomy, İzmir Bakırçay University, Faculty of Medicine, İzmir, Turkey

ABSTRACT

Objectives: Evaluation of the relationship between craniofacial parameters and somatotype provides important contributions to specialist physicians and anatomists in determining diseases and obtaining objective results of anthropometric measurements. The study was designed in line with this hypothesis and the aim was to find out how this relationship changed in healthy individuals.

Methods: The study was conducted by examining 191 healthy individuals between the ages of 18 and 30. The individuals' faces were photographed from a distance of 1 meter and craniofacial parameters were measured in Image J program. Somatotype analysis was conducted by using Heath-Carter somatotype method.

Results: As a result of our study, the individuals were found to be grouped in four classes according to Heath-Carter somatotype method: (1) mesomorph endomorph, (2) endomorph ectomorph, (3) endomorph mesomorph and (4) central. Significant correlation was found between the second and first somatotype groups in terms of total nasal length, while significant correlation was found between second and first/second and third/fourth and third/first and third somatotype groups in terms of body mass index (BMI) parameter ($p < 0.05$). Craniofacial parameters were also evaluated and a very high correlation was found between total facial height and mandibular height, while there was a high correlation between total facial height and the other 16 parameters.

Conclusions: As a result of our study, a relationship was found between somatotype groups and craniofacial parameters, within craniofacial parameters, and between somatotype and BMI. We believe that this relationship will guide morphological studies in basic medical sciences and surgical interventions in clinical sciences.

Keywords: Heath-Carter somatotype analysis, craniofacial parameters, photo analysis

Anthropometry is a universal, inexpensive and reliable method evaluating morphological characteristics of human beings. Body structure, age, gender, body proportion and body mass index (BMI) are critically important in correct evaluation of anthropometric parameters. Knowing the aforementioned information about the human body is important in terms of both the reliability of anthropometric parameters and also fully showing factors such as individuals' health and nutritional habits [1-4].

Anatomic measurements vary according to age, gender, height, weight, race, physiological and patho-

Received: **October 20, 2022;** *Accepted:* **January 4, 2023;** *Published Online:* **March 20, 2023**

e-ISSN: 2149-3189

How to cite this article: *Seçgin Y, Toy Ş, Şenol D, Öner Z. Associating craniofacial morphometry determined by photo analysis with somatotype in healthy young individuals. Eur Res J 2023;9(4):717-724. DOI: 10.18621/eurj.1192005*

Address for correspondence: *Şeyma Toy, MD., Associate Professor, Karabük University, Faculty of Medicine, Department of Anatomy, Karabük, Turkey. E-mail: seymatoy@karabuk.edu.tr, Phone: +90 370 418 94 46, Fax: +90 370 418 92 99*

logical factors. Therefore, determination of somatotype with advanced anthropometric methods is critically important in the objective evaluation and interpretation of anatomical measurements [5]. For this reason, knowing about craniofacial anthropometry is important for both basic medical sciences and clinical sciences. Craniofacial anthropometry is clinically important in Down syndrome, nasal septum deviation, facial asymmetry, dentofacial disorders, facial and orthofacial surgery [5-10]. Different face types have been formed with the data obtained as a result of craniofacial anthropometry. Some of these are Bruges facial index, Vitruvian facial index and the ratio of lower facial height to total facial height [8].

Somatotype is a method based on anthropometric measurements that allow to determine body composition [11, 12]. Somatotype method was introduced by Sheldon in 1940. In this method, classification was made from 1 to 7 based on shape of the body. According to Sheldon, these classes occur due to genetic differences and they do not change throughout life. However, many researchers rejected this hypothesis in the following years. In 1967, Heath and Carter modified the Sheldon somatotype method and introduced the Heath-Carter somatotype method [12-14]. This somatotype method is a method in which body types are determined with anthropometric measurements, which are widely used in health and sport sciences [15-18]. Skin thickness from four points, two circumference, two width, weight and height measurements are required to calculate this method. Body types are grouped in three main categories as endomorphy, mesomorphy and ectomorphy with the measurements obtained [17, 19]. Roughly, endomorphy is defined as obesity, mesomorphy is defined as muscularity and ectomorphy is defined as being thin [20]. Endomorphy occurs with the increase in physical fat mass of the body due to the increase in the energy stores of the individual. Mesomorphy occurs due to the development of the body's musculoskeletal system. Ectomorphy occurs with the decrease in height-weight ratio [13].

This study was conducted to reveal the relationship between somatotype and craniofacial parameters and to guide this relationship to morphological (anatomical, radioanatomical), surgical (fascial, dentofascial, orthofascial intervention) studies in the field of health.

METHODS

The study was initiated with the 2022/798 decision of non-interventional local ethics committee and the study was funded by Karabük University Scientific Research Projects Unit (Project Number: KBÜBAP-22-DS-008). This study was carried out within the framework of ethical rules in accordance with the Declaration of Helsinki. 191 healthy individuals between the ages of 18 and 30 who had no pathologies (septum deviation, nose, face and chin anomaly, strabismus) or no surgical intervention in craniofacial parameters were included in the study population.

Study Protocol

A fixed board was placed next to the individuals and a guiding paper with a space of 1 mm was placed on the board. A professional camera was placed at a

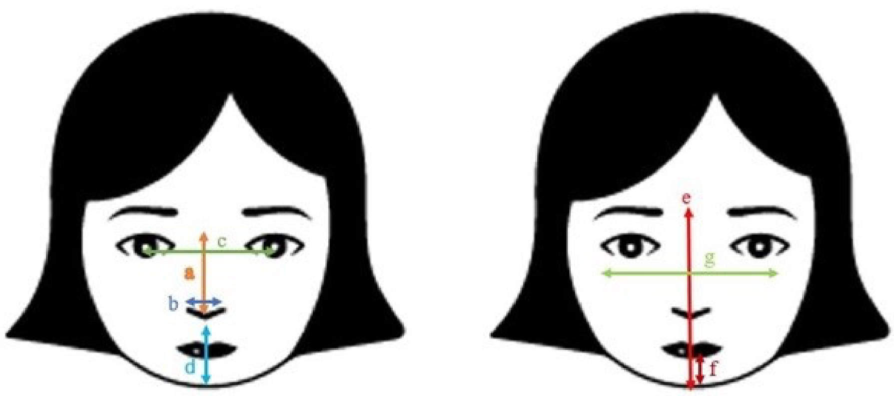

Fig. 1. **Craniofacial parameters. (a) Total nasal length, (b) Nose width, (c) Pupillary distance, (d) Lower facial height, (e) Total face height, (f) Mandibular height and (g) Face width.**

distance of 100 cm from the individuals with a tripod. Facial photos of each individual were taken and saved to computer in jpeg format. These saved photos were transferred to Image J (Version 1.53e) program and craniofacial measurements were made.

The following craniofacial measurements were made (Fig. 1):

- (a) Total nasal length: Nasion-subnasal
- (b) Nose width: Distance between alae ancillary
- (c) Pupillary distance: Pupillary distance
- (d) Lower facial height: Subnasal-gnathion
- (e) Total face height: Supraorbitale-gnathion
- (f) Mandibular height: Stomion-gnathion
- (g) Face width: Distance between zygomatic bones

Facial indices suitable for these craniofacial parameters were included in the study. Face indices were: Bruges face index, The ratio of lower facial height to total face height and Vitruvian index.
The following formulas were used:

Bruges face index:

$$\frac{\textit{Total face height}}{\textit{Pupillary distance}}$$

The ratio of lower facial height to total face height:

$$\frac{\textit{Lower facial height}}{\textit{Total face height}}$$

Vitruvian index:

$$\frac{\textit{Mandibular height}}{\textit{Lower facial height}}$$

Following the photo shooting, the individuals' heights were measured with a tape measure, while their weights were measured with a digital calliper and saved in excel format with their BMI. Next, in order to determine the somatotypes of individuals, their triceps, subscapular, suprailiac and calf skinfold thicknesses were measured and recorded with a skinfold calliper. In addition, contracted arm and calf circumference were measured and recorded by using tape measure and elbow and knee widths were measured and recorded with digital calliper.

Statistical Analysis

Heath-Carter somatotype method and Somatotype (Version 1.2.5) were used in somatotype analysis of the individuals. Height, weight, triceps, subscapular, suprailiac, calf skin thickness and contracted arm and calf circumference widths were used in somatotype analysis. Median, minimum and maximum values were included in descriptive statistics. Normality distribution of the data was tested with Kruskal Wallis H test. The correlation between somatotype groups and the parameters was analysed with Kruskal Wallis H test. Significant correlation was determined between which groups by Pairwise Comparisons test. In addition, the relationship between parameters was tested

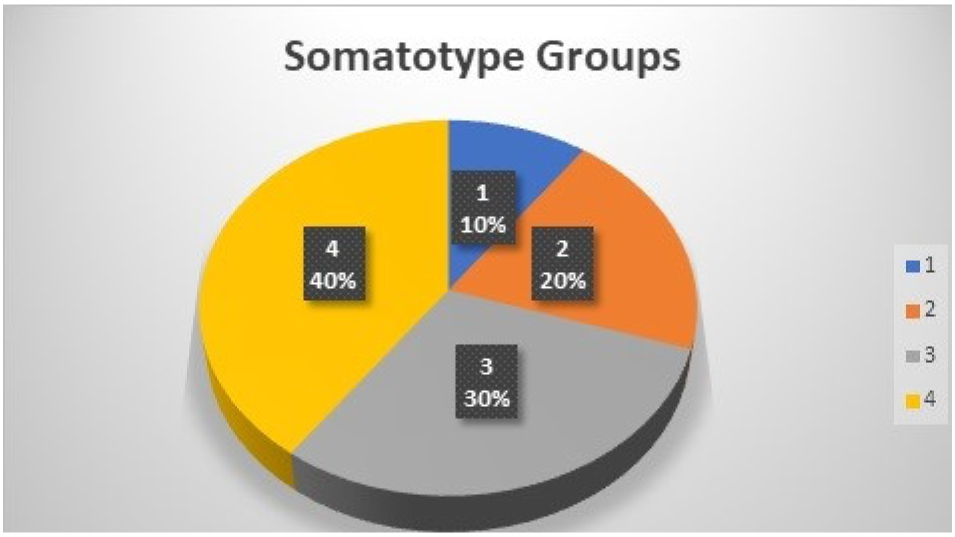

Fig. 2. Somatotype groups. (1) Mesomorph endomorph, (2) Endomorph ectomorph, (3) Endomorph mesomorph and (4) Central.

with Spearman rho test in our study. $P < 0.05$ value was considered as statistically significant in analyses. Minitab 17 and SPSS (Version 21) programs were used for statistical analysis in the study.

RESULTS

It was found that the individuals in the study were distributed in four different groups in terms of somatotype. It was found that there were 111 individuals in the first group (mesomorph endomorph), 33 individuals in the second group (endomorph ectomorph), 32 individuals in the third group (endomorph mesomorph) and 15 individuals in the fourth group (central) (Fig. 2). As a result of the study, it was found that 40% of the individuals had mesomorph endomorph body type, 30% had endomorph ectomorph body type, 20% had endomorph mesomorph body type and 10% had central body type.

Table 1 shows descriptive statistics of age, BMI and craniofacial parameters used in the study in terms of somatotype groups. Table 2 shows the descriptive statistics of face index parameters. Table 3 shows the descriptive statistics of Heath-Carter somatotype method.

With Kruskal Wallis H test, a significant correlation was found between total nose length and BMI according to somatotype groups ($p < 0.05$). Pairwise Comparisons test were found between 1 vs 3 groups in total nasal length and between 2 vs 1/2 vs 3/4 vs 3/1 vs 3 groups in terms of BMI ($p < 0.05$) (Tables 4 and 5).

The correlation between Spearman rho test and craniofacial parameters were examined and a very high correlation was found between total face height and mandibular height. A high correlation was also found between 16 parameters. High correlation was found between total nasal length and nose width, pupillary distance, total face height and face width; between nose width and pupillary distance, lower facial height, total face height, mandibular height and face width; between pupillary distance and total face height and face width; between lower facial height and

Table 1. Descriptive statistics of age, BMI and craniofacial parameters in terms of somatotype

Parameters	Mesomorph endomorph	Endomorph ectomorph	Endomorph mesomorph	Central
Age (year)	20.00 (18.00-27.00)	20.00 (18.00-28.00)	20.50 (19.00-30.00)	20.00 (18.00-23.00)
BMI (kg/m^2)	23.18 (17.91-36.01)	19.05 (17.26-23.05)	25.62 (18.98-32.39)	20.98 (19.03-23.24)
Total nasal length (cm)	5.25 (3.39-7.24)	5.69 (4.09-8.02)	5.88 (3.90-6.99)	5.25 (4.10-6.33)
Nose width (cm)	3.41 (2.19-5.99)	3.47 (2.57-5.18)	3.65 (2.19-4.65)	3.37 (2.59-4.55)
Pupillary distance (cm)	5.42 (4.04-7.43)	5.49 (4.45-7.86)	5.97 (4.23-7.00)	5.33 (4.55-6.66)
Lower facial height (cm)	5.95 (4.53-8.69)	6.20 (5.02-9.32)	6.17 (4.89-9.55)	6.20 (5.53-8.22)
Total face height (cm)	12.50 (9.51-17.51)	12.20 (10.13-17.41)	13.08 (9.92-17.569	12.32 (10.75-14.93)
Mandibular height (cm)	4.36 (3.07-6.15)	4.36 (3.66-6.48)	4.68 (3.45-7.45)	4.67 (3.44-5.91)
Face width (cm)	10.72 (7.25-14.40)	10.47 (8.66-14.81)	11.02 (7.25-14.41)	10.97 (9.18-14.03)

Table 2. Descriptive statistics of face index parameters in terms of somatotype

Parameters	Mesomorph endomorph	Endomorph ectomorph	Endomorph mesomorph	Central
Bruges face index	2.27 (1.83-2.70)	2.32 (1.76-3.13)	2.27 (1.76-2.70)	2.36 (1.75-3.14)
The ratio of lower facial height to total face height	0.50 (0.40-0.65)	0.49 (0.41-0.77)	0.50 0.42-0.58)	0.52 (0.41-0.73)
Vitruvian index	0.72 (0.59-0.85)	0.70 (0.62-0.79)	0.73 (0.56-0.92)	0.71 (0.42-0.96)

Table 3. Descriptive statistics of Heath-Carter somatotype method in terms of somatotype

Parameters	Mesomorph endomorph	Endomorph ectomorph	Endomorph mesomorph	Central
Triceps skin thickness (mm)	13.00 (5.00-27.00)	11.00 (7.00-27.00)	13.00 (7.00-25.00)	13.00 (5.00-23.00)
Subscapular skin thickness (mm)	15.00 (5.00-29.00)	15.00 (7.00-25.00)	13.50 (7.00-27.00)	15.00 (8.00-27.00)
Suprailiac skin thickness (mm)	12.00 (4.00-29.00)	11.00 (3.00-21.00)	11.00 (3.00-22.00)	11.00 (5.00-19.00)
Calf skin thickness (mm)	17.00 (5.00-33.00)	17.00 (9.00-27.00)	15.00 (6.00-29.00)	17.00 (7.00-37.00)
Contracted arm circumference (cm)	28.00 (21.00-35.00)	28.00 (21.00-38.00)	28.25 (21.00-35.00)	29.00 (24.00-42.00)
Calf circumference (cm)	34.00 (29.00-41.00)	35.00 (29.00-43.00)	34.00 (27.00-41.50)	34.00 (29.00-40.70)
Elbow width (mm)	61.19 (49.62-83.09)	60.66 (51.68-76.10)	62.52 (50.51-71.58)	61.48 (54.78-87.08)
Knee width (mm)	91.79 (77.53-108.26)	91.99 (80.18-129.40)	91.75 (82.34-103.34)	91.91 (85.66-115.73)

total face height and face width; between total face height and mandibular height and face width and between mandibular height and face width (Table 6).

DISCUSSION

The present study was conducted to find out the relationship between somatotype and craniofacial parameters. As a result of the study, it was found that 40% of the individuals had mesomorph endomorph body type, 30% had endomorph ectomorph body type, 20% had endomorph mesomorph body type and 10% had central body type. Significant correlation was found between total nasal length and BMI parameters in different somatotypes ($p < 0.05$). In addition, very high correlation was found between total face height and mandibular height ($p < 0.05$).

The relationship between somatotype and BMI has been examined in many studies in which different diseases and parameters have been used and significant correlations have been found between these two

Table 4. Pairwise comparisons test results for total nasal length parameter

Parameters	Somatotype Groups	*p* value
Total nasal length	1 vs 2	0.21
	1 vs 3	**0.08**
	1 vs 4	0.85
	2 vs 3	0.77
	2 vs 4	0.19
	3 vs 4	0.13

Table 5. Pairwise comparisons test results for BMI

Parameters	Somatotype Groups	*p* value
BMI	1 vs 2	**0.00**
	1 vs 3	**0.00**
	1 vs 4	**0.01**
	2 vs 3	**0.00**
	2 vs 4	0.06
	3 vs 4	**0.00**

parameters. In a study in which they examined the correlation between Q angle and Stork balance stand and somatotype, Şenol *et al*. [3] found a significant correlation between somatotypes and BMI. As a result of the cohort study they conducted on somatotype and pituitary adenocarcinoma, Cote *et al*. [21] found a significant correlation between somatotype and BMI. In our study, significant correlation was found between BMI and 2 vs 1/2 vs 3/4 vs 3/1 vs 3 somatotype groups ($p < 0.05$). These results support the literature.

The relationship between somatotype and diseases has been the subject of many articles and a correlation has been found between many diseases and somatotype. In a study in which they examined the relationship between COPD phenotypes and somatotype, Divo *et al*. [22] found correlations between smoking-related COPD and somatotype. In a study they conducted on the relationship between sarcopenia and somatotype, Yasuda *et al*. [23] found correlation between presarcopenia and somatotypes of young female individuals. Mantarkov *et al*. [24] found significant correlations among schizophrenia and somatotype. The literature shows that somatotyping, which is a detailed body composition analysis, has started to gain

Table 6. Correlation analysis of craniofacial parameters

Parameters		Total nasal length	Nose width	Pupillary distance	Lower facial height	Total face height	Mandibular height
Nose width	r	0.623[c]					
	p	**0.000**					
Pupillary distance	r	0.711[c]	0.794[c]				
	p	**0.000**	**0.000**				
Lower facial height	r	0.306[a]	0.613[c]	0.566[b]			
	p	**0.000**	**0.000**	**0.000**			
Total face height	r	0.654[c]	0.776[c]	0.751[c]	0.757[c]		
	p	**0.000**	**0.000**	**0.000**	**0.000**		
Mandibular height	r	0.391[a]	0.624[c]	0.513[b]	0.800[d]	0.769[c]	
	p	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	
Face width	r	0.642[c]	0.770[c]	0.766[c]	0.640[c]	0.748[c]	0.660[c]
	p	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**

[a] weak correlation, [b] moderate correlation, [c] high correlation, [d] very high correlation

popularity in studies conducted in the field of health. However, it is noteworthy that no studies were found in literature examining the effects of somatotype on craniofacial measurements of healthy young individuals.

There are complex relationships between craniofacial parameters and the relationships are sometimes not fully recognized by visual examination. These complex relationships can be the indicator of many diseases in clinic [5, 6]. In a study they examined the craniofacial parameters of schizophrenic individuals, Demir *et al*. [25] reported relationship between schizophrenia and craniofacial parameters. In a study they examined craniofacial parameters and nasal septum deviation, Arpacı *et al*. [4] reported correlation between these two. In a study they conducted on 180 individuals, Lee *et al*. [26] found a correlation between obstructive sleep apnoea and craniofacial parameters. Our study was based on the hypothesis that somatotype could affect craniofacial parameters in healthy individuals and a very high correlation was found between total face height and mandibular height, while high correlation was found between 16 parameters. We believe that knowing about these characteristics of healthy individuals will guide clinical studies.

In a study conducted on 76 females and 76 males individuals between the ages of 17 and 25, Kosif [27] found lower facial height as 77.54 ± 8.16 mm in women and as 86.70 ± 9.87 mm in men; total nasal length as 52.34 ± 8.05 mm in women and as 56.49 ± 5.86 mm in men; nose width as 41.65 ± 2.24 in women and as 44.62 ± 4.59 mm in men. In this study, we found lower facial height media value as 5.95 cm in the first group, as 6.20 cm in the second group, as 6.17 cm in the third group and as 6.20 cm in the fourth group; total nasal length median value as 5.25 cm in the first group, as 5.69 cm in the second group, as 5.88 cm in the third group and as 5.25 cm in the fourth group; nose width median value as 3.41 cm in the first group, as 3.47 cm in the second group, as 3.65 cm in the third group and as 3.37 cm in the fourth group. In a study they conducted on face types of Anatolian men, Özdemir *et al*. [8] examined 300 individuals between the ages of 20 and 40 and found Bruges face index as 193.85 ± 16.48 mm, the ratio of lower facial height to total face height as 30.92 ± 2.37 mm. In the present study, we found Bruges face index median value as 2.27 cm in the first group, as 2.32 cm in the second group, as 2.27 cm in the third group and as 2.36 cm in the fourth group; we found the median value of the ratio of lower facial height to total face height as 0.50 cm in the first group, as 0.49 cm in the second group, as 0.50 cm in the third group and as 0.52 cm in the fourth group. These results support the results we found. We believe that the partial highness in the ratio of lower facial height to total face height is due to regional differences.

Limitations

Limitations of the study;
- Low number of individuals,
- It is the narrowness of the age range.

CONCLUSION

We believe that the results of this study, which examines the relationship between craniofacial parameters and somatotype, will contribute greatly to clinical (fascial surgery, maxillofacial surgery, nasal septum deviation) and morphological (anthropological, radioanatomical, anatomical) studies.

Authors' Contribution

Study Conception: ŞT, YS; Study Design: ŞT, YS; Supervision: ŞT; Funding: N/A; Materials: ŞT, YS, ZÖ, DŞ; Data Collection and/or Processing: YS; Statistical Analysis and/or Data Interpretation: YS; Literature Review: ŞT; Manuscript Preparation: ŞT, YS and Critical Review: ŞT.

Conflict of interest

The authors disclosed no conflict of interest during the preparation or publication of this manuscript.

Financing

This study was funded by Karabük University Scientific Research Project Coordinatorship. Project Number: KBÜBAP-22-DS-008.

Acknowledgement

We would like to thank Karabük University Scientific Research Project Coordinator.

REFERENCES

1. De Onis M, Habicht J-P. Anthropometric reference data for international use: recommendations from a World Health Organization Expert Committee. Am J Clin Nutr 1996;64:650-8.
2. Özkoçak V, Koç F, Demir E, Yavuz Y. Antropometrik Ölçümlerin Tanimlanması. In: Demir E, Özkoçak V, eds., İstatistiksel Uygulamalarla Sağlık, Spor Ve Adli Bilimlerde Antropometrik Ölçümlere Dayalı Araştırma Tasarımları. Ankara: Nobel Tıp Kitapevi, 2019: pp.1-4.
3. Şenol D, Altinoğlu M, Şeyma T, Kisaoğlu A, Özbağ D. Investigation of the relationship of Q Angle and stork balance stand test with somatotype in healthy young individuals. Medical Records 2019;1:60-6.
4. Arpacı MF, Özbağ D, Aydın Ş, Şenol D, Baykara RA, Çiçek İB. Evaluation of the relationship between nasal septal deviation and development of facial asymmetry with anthropometric measurements depending on age. Int J Pediatr Otorhinolaryngol 2022:111207.
5. Dmitrienko S, Domenyuk D, Melekhov S, Domenyuk S, Weisheim L. Analytical approach within cephalometric studies assessment in people with various somatotypes. Archiv EuroMedica 2019;9:103-11.
6. Farkas LG, Katic MJ, Forrest CR, Litsas L. Surface anatomy of the face in Down's syndrome: linear and angular measurements in the craniofacial regions. J Craniofac Surg 2001;12:373-9.
7. Gulsen A, Okay C, Aslan BI, Uner O, Yavuzer R. The relationship between craniofacial structures and the nose in Anatolian Turkish adults: a cephalometric evaluation. Am J Orthod Dentofacial Orthop 2006;130:131. e15-25.
8. Özdemir F, Özkoçak V. [Nose, face types and their rates to each other in Anatolian men and their age-related changes]. J Int Lingual Soc Educ Sci 2017;3:135-42. [Article in Turkish]
9. Mommaerts M, Moerenhout B. Ideal proportions in full face front view, contemporary versus antique. J Craniomaxillofac Sur 2011;39:107-10.
10. Gökaslan ÇÖ. [The relationship of nasal septum deviation with facial asymmetry]. Kocatepe Med J 2019;20:157-61. [Article in Turkish]
11. Toy Ş, Çiftçi R, Şenol D, Kizilay F, Ermiş H. Comparison of the effects of the somatotype on the physical activity, kinesiophobia, and fatigue levels of obstructive sleep apnea syndrome patients and healthy individuals. Iran J Public Health 2021;50:919-26.
12. Çiftçi R, Kizilay F, Şeyma T, Şenol D, Akyol B, Ersoy Y, et al. [Evaluation of the relationship between nutritional status and somatotype profiles in children with physical sisability]. Muğla Sıtkı Koçman Üniversitesi Tıp Dergisi 2021;8:127-31. [Article in Turkish]
13. Turnagöl HH, Demirel H, T. [Somatotype profile and relationship of some anthropometric variables with performance of Turkish national weightlifters]. Spor Bilimleri Dergisi 1992;3:11-8. [Article in Turkish]
14. Kizilay F, Şeyma T. [Somatotype character analysis in elderly population - short review]. Medical Records 2019;1:37-40. [Article in Turkish]
15. Pastuszak A, Gajewski J, Buśko K. The impact of skinfolds measurement on somatotype determination in Heath-Carter method. PLoS One 2019;14:e0222100.
16. Carter J. Part 1: The Heath-Carter anthropometric somatotype-instruction manual. TeP and Rosscraft: Surrey, BA, Canada. 2002.
17. Slankamenac J, Bjelica D, Jaksic D, Trivic T, Drapsin M, Vujkov S, et al. Somatotype profiles of Montenegrin Karatekas: an observational study. Int J Environ Res Public Health. 2021;18:12914.
18. Şenol D, Altınoğlu M, Kısaoğlu A, Toy Ş, Duz S, Ozbağ D. Comparison of visual and auditory reaction times in athletes and sedentary individuals with different somatotypes: a neuroperformance study. Int J Sports Stud Health 2020;3:1-6.
19. Campa F, Bongiovanni T, Matias CN, Genovesi F, Trecroci A, Rossi A, et al. A new strategy to integrate Heath-Carter somatotype assessment with bioelectrical impedance analysis in elite soccer players. Sports (Basel) 2020;8:142.
20. Alvero-Cruz JR, Parent Mathias V, García-Romero JC. Somatotype components as useful predictors of disordered eating attitudes in young female ballet dance students. J Clin Med 2020;9:2024.
21. Cote DJ, Smith TR, Kaiser UB, Laws Jr ER, Stampfer MJ. Body habitus across the lifespan and risk of pituitary adenoma. J Clin Endocrinol Metab 2021;106:1591-602.
22. Divo MJ, Oto MM, Macario CC, Lopez CC, de-Torres JP, Trigo JMM, et al. Somatotypes trajectories during adulthood and their association with COPD phenotypes. ERJ Open Res 2020;6:00122-2020.
23. Yasuda T. Anthropometric, body composition, and somatotype characteristics of Japanese young women: Implications for normal-weight obesity syndrome and sarcopenia diagnosis criteria. Interv Med Appl Sci 2019;11:117-21.
24. Mantarkov MY, Ahmed-Popova FM. Minor physical anomalies, palmar dermatoglyphics and somatotype: composite anthropometric biomarker predictors in schizophrenia. Project. ResearcGate. 2017.
25. Demir M, Emre A, Tümer MK, Çiçek M, Ahmet G, Altindağ A, et al. [Craniofacial morphometry of schizophrenia patients]. İnönü Üniversitesi Sağlık Biliimleri Dergisi 2017;6:10-8. [Article in Turkish]
26. Lee RW, Petocz P, Prvan T, Chan AS, Grunstein RR, Cistulli PA. Prediction of obstructive sleep apnea with craniofacial photographic analysis. Sleep 2009;32:46-52.
27. Kosif R. [Study on the relationship between personal properties and facial anatomy]. Kocatepe Med J 2019;20:137-41. [Article in Turkish]