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Does Different Somatotype Affect Face and Nasal Morphometry in Women?

¿Afecta el Somatotipo la Morfometría Facial y Nasal en Mujeres?

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SUMMARY: The aim of this study is to investigate whether there is a relationship between somatotype character and facial-nose morphometry in female individuals. In this analysis 158 female participants were included in the study. Participants' age, Body Mass Index (BMI), nasal length, nostril length, nasal height, facial height, morphological nasal width, anatomical nasal width, nasal root width, nostril width, bizygomatic width, and nasal depth were recorded. Height, weight, skinfold thickness (triceps/subscapular/suprailiac/medial calf), diameter measurements (humerus/femur), and circumference measurements (arm/calf) were also taken for somatotype analysis. Somatotype assessment was performed using the Heath-Carter method. Five different somatotypes were identified. Accordingly, when age, height, weight, and BMI were examined, a statistically significant difference was found between the groups in terms of weight and BMI ($p<0.05$). When body measurements used in somatotype calculation were evaluated, significant differences were found between the somatotypes in all measurements ($p<0.05$). When facial morphology measurements were examined, facial height, nostril width, and bizygomatic width values showed significant differences between the somatotype groups ($p<0.05$). Pairwise comparisons revealed that the most significant somatotype in these differences was the balanced ectomorph. This study shows that there may be significant relationships between the somatotype character and the nose and facial morphometric features in women aged 18-39. Especially in individuals with balanced ectomorph somatotype, significant differences in facial height, nostril width and bizygomatic width measurements were observed. These findings suggest that craniofacial structures may be associated not only with genetic and environmental factors, but also with body composition. In this direction, non-surgical solutions can also be evaluated for women who experience dissatisfaction with the aesthetic appearance. Thus, the need for aesthetic surgery can be reduced and unhealthy applications can be avoided. In the future, it is recommended to investigate this relationship in more detail with more extensive studies to be carried out in both sexes, in different age groups.

KEY WORDS: Somatotype; Female; Nose; Morphometry.

INTRODUCTION

The method of evaluating and comparing various parts of the human body is called anthropometry. Anthropometry is an important field of study in anatomy (Hınçal & Gültekin, 2018). Somatotype analysis, on the other hand, is a morphological quantitative data analysis that evaluates individuals' body shape and composition. Somatotype character analysis, which classifies individuals into specific classes based on whether they are lean, muscular, or fatty, has identified three fundamental body types: endomorphy, mesomorphy, and ectomorphy. Sheldon also defined and classified these body types using numbers 1-7 (Aksoy *et al.*, 2025). In 1963, Heath and Carter formulated and adapted the Sheldon classification system to develop the Heath-Carter Somatotyping Model, which is used today. The model is the most widely used somatotyping method worldwide. In this model, body types can be assigned a value up to 9 (Carter & Heath, 1990). The number 9 is used for the maximum ratio, while the number 1 is used for the minimum ratio. In this definition, the first number indicates endomorphy, the second number indicates mesomorphy, and the third number indicates ectomorphy. According to this definition, a somatotype of 9.1.1 indicates the greatest degree of endomorphy (fatness), a somatotype of 1.9.1 indicates the greatest degree of mesomorphy (muscularity), and a somatotype of 1.1.9 indicates the greatest degree of ectomorphy (thinness) (Pathak & Adhikari, 2018).

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Anthropometric measurements are used to compare existing facial structures such as eyes, ears, nose, lips, etc. This comparison is made by calculating the distance or angle between reference points on the face (Bulut & Yasli, 2008). It is thought that the physical appearance of individuals affects their psychological well-being, social acceptance, and self-esteem (Bergman, 1999). Facial appearance is crucial in determining the concept of beauty. Aesthetics hold a significant place in every society due to their positive appearance. Cosmetic surgery is a field in which individuals seek to achieve their desired perception of beauty and maintain their well-being. This field is quite popular for its aesthetic use and study of anatomy (Özkan & Bayramiçli, 2022). Located in the middle of the face, the nose's shape and proportions are crucial for facial aesthetics. For this reason, the nose is one of the most frequently operated areas in cosmetic surgery, and demand for it is increasing daily especially for women (Majidi Zolbin *et al*., 2015).

There are studies in the literature showing that nasal anthropometric measurements vary according to age (Sforza *et al*., 2011), sex (Maddux *et al*., 2017), ethnicity (Majidi Zolbin *et al*., 2015), climate and region (Maddux *et al*., 2017). However, we have not yet encountered any studies in the literature demonstrating whether somatotype influences facial and nasal structure. Therefore, our study aimed to investigate the relationship between somatotype and facial and nasal morphometry in female individuals.

MATERIAL AND METHOD

This study is a prospective cross-sectional study. Approval was received from the Turgut Ozal University Non-Interventional Ethics Committee (2025/232). The study included 158 healthy female volunteers aged 18-39, free of any mental or physical illness, and willing to participate in the test. Individuals with a history of nasal congenital anomalies, surgery, or trauma were excluded from the study.

Participants' age, Body Mass Index (BMI), nasal length, nostril length, nasal height, facial height, morphological nasal width, anatomical nasal width, nasal root width, nostril width, bizygomatic width, and nasal depth were recorded. Additionally, for somatotype analysis, height, weight, skinfold thickness (triceps/subscapular/suprailiac/medial calf), diameter measurements (humerus/femur), and circumference measurements (arm/calf) were obtained, and evaluation was performed using the Heath-Carter method. Measurements were taken in the anatomical position, with the subject transferring weight equally to both lower limbs.

Nose Measurements: (Farkas *et al*., 1986; Hwang & Kang, 2003; Singla *et al*., 2020)

Nasal Length: The distance between the nasion pronasale (n-prn) point was measured in mm.

Nostril Length: The longest part of the lateral wall of the nostril was measured in mm.

Nasal Height: The distance between the nasion and the subnasale (n-sn) point was measured in mm.

Facial Height: The distance between the nasion-gnathion (n-gn) points was measured in mm.

Morphological Nasal Width: The maximum width between the right and left ala nasi was measured in mm.

Anatomical Nasal Width: The width between the alar curvature points (ac-ac) was measured in mm.

Nasal Root Width: The width of the nose at the intersection of the maxillo-frontal and naso-frontal sutures was measured in mm.

Nostril Width: The medio-lateral widest part of the nostril was measured in mm.

Bizygomatic Width: The width between the most lateral points (zy-zy) on the zygomatic arch was measured in mm. Somatotype analysis (Denız *et al*., 2024).

Height (cm): The distance between the vertex of the head and the base of the foot, which touches the ground, was measured with a tape measure.

Weight (kg): A Xiaomi Mi 2, a precision scale, was used for weight measurement.

Body Mass Index (BMI): After measuring the participants' height and weight, the weight in kilograms was calculated by dividing the weight in kilograms by the square of the height in meters (kg/m^2).

Skinfold Thickness (Triceps): The individual was standing, with their arms hanging freely at their sides, and a skinfold caliper was positioned behind them. The measurement was taken over the right upper limb, at the midpoint of the triceps brachii muscle on the back of the arm.

Skinfold Thickness (Subscapular): The measurement was taken on the back, just below the scapula. The skin and subcutaneous fat were lifted using the index finger, thumb, and middle finger of the left hand, at the level of the normal skinfold orientation. The measurement was taken on the right side.

Skinfold thickness (Suprailiac): While the subject was standing, the skin and subcutaneous fat were grasped at the midaxillary line over the ilium and measured with a skinfold caliper on the right side.

Skinfold thickness (Medial calf): The subject was asked to sit with their leg relaxed. A skinfold caliper was used to fold the skin along a vertical line in the medial region of the leg, at the level of the maximum circumference of the gastrocnemius and soleus muscles, and the measurement was taken from the right side with a skinfold caliper.

Diameter measurement (Humerus): The subject's arm was pulled forward, palm facing up, and the arm was flexed 90 degrees. Measurements from the medial and lateral epicondyle of the humerus were recorded in cm from the right side.

Diameter measurement (Femur): The subject was asked to position the articular aspect of the leg and thigh at a 90-degree angle, with the feet perpendicular to the floor. The subject was positioned in front of the subject, and measurements were taken from the right side, including the articular aspect, at two prominent points on the medial and lateral sides of the knee. Data were recorded in cm.

Circumference Measurement (Arm): The subject was asked to flex their forearm toward the arm, clench their hand into a fist, and contract the biceps brachii muscle. A tape measure was taken from the widest part of the biceps brachii muscle on the right upper limb and recorded in cm.

Circumference Measurement (Calf): The subject was asked to sit and flex their leg. The tape measure was wrapped around the leg, perpendicular to the long axis of the leg, at the maximum calf circumference. The result was recorded in cm. The measurement was taken from the right upper limb.

Statistical Analysis: Data were tested for normal distribution using the Kolmogorov Smirnov test, and it was determined that the data did not exhibit a normal distribution. The median, minimum, and maximum values for data not showing a normal distribution were presented. The Kruskal Wallis H test was used to compare data by somatotype. Based on the Kruskal Wallis H test results, the Mann Whitney U test was applied as a post hoc test to determine which somatotype caused the statistically significant difference. The IBM SPSS Statistics 22.0 package program was used in the analyses. $P<0.05$ was considered statistically significant.

RESULTS

As a result of the somatotype measurements, a total of 158 people were included in our study: 16 people with balanced ectomorph somatotype, 23 people with balanced endomorph somatotype, 33 people with ectomorphic endomorph somatotype, 18 people with endomorph ectomorph somatotype and 68 people with mesomorphic endomorph somatotype.

Median (min-max) values of age, weight, height and BMI data according to somatotypes are given in Table I. According to the Kruskall Wallis H test analysis result, a statistically significant difference was determined in terms of weight and BMI measurements between somatotypes ($p<0.05$) (Table I).

The median (min-max) values of the measurements taken from the participants to calculate the somatotype are given in Table II. According to the Kruskall Wallis H test analysis result, it was determined that all measurements taken between somatotypes had a statistically significant difference ($p<0.05$) (Table II).

Table I. Comparison of age, weight, height and BMI according to somatotypes

Parameter	balanced ectomorph	balanced endomorph	ectomorphic endomorph	endomorph ectomorph	mesomorphic endomorph	*P*
Age	22 (19-31)	21 (18-32)	21 (18-35)	21 (18-34)	22 (18-39)	,241
Weight (kg)	45 (40-62)	55 (50-76)	53,5 (44-73)	50 (45-61)	65 (54-86)	**<0.001**
Height (cm)	161 (155-179)	162 (155-177)	163 (155-180)	163 (154-176)	163 (153-177)	,363
BMI (kg/m^2)	18 (16 -20,5)	20,5 (18,5-23,4)	20 (17,5-25)	18,9 (17,5-22)	23,8 (21-28,5)	**<0.001**

Table II. Comparison of somatotypes and its components used to determine somatotype.

Parameter	balanced	balanced	ectomorphic	endomorph	mesomorphic	*P*
Triceps ST* (mm)	11 (7–17)	20 (13–33)	17 (12–31)	15 (10–21)	24 (13–36)	**<0,001**
Subskapular ST* (mm)	9 (6–13)	15 (8–27)	13 (8-24)	10 (6-13)	22 (11-37)	**<0,001**
Suprailiak ST* (mm)	10 (5–16)	14 (7–22)	14 (7-20)	12 (7-17)	19 (7-26)	**<0,001**
Calf ST(mm)	13 (8-21)	16 (11-26)	14 (10–23)	14 (11–21)	21 (13–30)	**<0,001**
Contracted Arm Circumference (cm)	52,8 (46,0–61,0)	55,0 (42,0–65,0)	51,0 (39,0–59,0)	52,0 (45,0–62,0)	55,5 (45,0–84,0)	**<0,001**
Calf Circumference (cm)	75,5 (66,0–86,0)	81,0 (71,0–91,0)	78,5 (66,0–92,0)	79,0 (67,0–89,0)	87,0 (56,0–100,0)	**<0,001**
Elbow Width (cm)	21 (20–25)	27 (24–32)	24,5 (22–28)	23,5 (21–28)	29 (25–35)	**<0,001**
Knee Width (cm)	32 (28–37)	35 (32–40)	34 (30–38)	33 (24–37)	39 (32–45)	**<0,001**

Significant differences at the P<0.01 level; ST: skinfold thickness

The median (min-max) values of the measurements taken from the participants included in the study according to somatotypes are given in Table III. According to the Kruskall Wallis H test analysis result, it was determined that the measurement results of facial height, nostril width and bizygomatic width had a statistically significant difference between the somatotypes (p<0.05) (Table III).

A Mann Whitney U analysis was applied to the data as a post hoc test to identify the somatotype that caused the differences in facial height, nostril width, and bizygomatic width measurements among the somatotypes. Model Viewer images of the pairwise comparison results are shown in Table IV. According to the pairwise comparison results, the balanced ectomorph somatotype was determined to have a greater impact on facial height, nostril width, and bizygomatic width measurements than other somatotypes (Table IV).

Table III. Comparison of somatotypes.

Parameter	balanced ectomorph	balanced endomorph	ectomorphic endomorph	endomorph ectomorph	mesomorphic endomorph	*P*
Nasal Length	47,1 (42,5–52,3)	48,2 (43,1–57,2)	46,5 (41,8–54,3)	46,7 (40,9–54,4)	47,3 (32,0–56,6)	0,231
Nostril Length	14,6 (8,6–17,8)	14,8 (9,5–21,0)	14,3 (6,5–17,9)	14,7 (11,6–23,0)	14,9 (8,9–31,5)	0,618
Nasal Height	50,1 (43,9–53,5)	50,3 (48,1–59,2)	49,7 (44,0–58,6)	50,2 (44,9–58,7)	51,2 (39,0–60,2)	0,242
Fascial Height	101,3 (96,0–116,1)	106,6 (97,1–123,9)	104,4 (93,0–123,1)	104,7 (88,8–113,9)	106,5 (93,0–123,1)	**0,034**
Morphological Nasal Width	33,0 (28,4–38,2)	31,5 (25,1–36,7)	31,0 (18,4–34,7)	31,5 (22,4–35,6)	32,5 (25,3–37,7)	0,126
Anatomical Nasal Width	19,9 (14,9–23,1)	21,0 (12,8–27,5)	20,0 (12,9–28,0)	20,7 (15,8–28,9)	20,9 (11,8–29,5)	0,614
Nasal Root Width	14,7 (10,6–16,8)	14,8 (10,6–17,9)	14,6 (11,6–17,8)	14,7 (12,6–18,9)	14,8 (11,6–20,0)	0,255
Nostril Width	7,4 (4,3–9,6)	8,4 (5,4–12,5)	8,2 (4,3–10,5)	8,5 (6,3–11,6)	8,6 (4,3–11,6)	**0,010**
Bizygomatic Width	117,5 (114,7–130,5)	121,9 (109,6–132,6)	116,9 (107,5–128,4)	118,1 (105,5–128,4)	123,1 (30,0–139,5)	**0,015**
Nasal Depth	17,7 (13,7–22,0)	17,9 (14,7–24,0)	17,5 (13,7–24,1)	17,8 (14,8–23,1)	17,9 (9,8–27,3)	0,691

Table IV. Model viewer display of pairwise comparison analysis results

Pairwise comparison	**Yüz Yükseklígi**	**Nostril Genislik**	**Bizigomatik Genislik**
Balanced ectomorph - Balanced endomorph	,582	,102	,624
Balanced ectomorph - Endomorphic ectomorph	,192	**,008**	,603
Balanced ectomorph - Ectomorphic endomorph	**,012**	**,002**	**,041**
Balanced ectomorph - Mesomorphic endomorph	**,014**	**,004**	**,011**
Balanced endomorph - Endomorph ectomorph	,452	,276	,961
Balanced endomorph - Ectomorphic endomorph	,073	,142	,092
Balanced endomorph - Mesomorphic endomorph	,058	,113	,062
Endomorph ectomorph - Ectomorphic endomorph	,283	,691	,128
Endomorph ectomorph - Mesomorphic endomorph	,218	,438	,080
Ectomorphic endomorph - Mesomorphic endomorph	,769	,581	,652

DISCUSSION

This study compared the facial and nasal morphometric features of women aged 18–39 from different somatotype groups and evaluated the influence of somatotypes on these parameters. The study found statistically significant differences in weight and body mass index (BMI) between somatotypes, suggesting that body structure is closely related to somatotype characteristics. Furthermore, the finding of significant differences in all skinfold thickness, circumference, and width measurements used in calculating somatotype (p<0.05) demonstrates that structural differences between somatotypes are evident at the anthropometric level. The finding of significant differences in craniofacial measurements such as facial height, nostril width, and bizygomatic width, particularly in women with the balanced ectomorph somatotype, suggests that balanced ectomorph individuals not only have more distinct facial morphological features, but that this somatotype characteristic may be a variable influencing facial morphology.

The Heath Carter technique for somatotype analysis is not only about an individual's physical appearance but also closely related to body composition parameters. Therefore, somatotype also provides information about body fat percentage, muscle mass, and skeletal structure (Galic *et al*., 2016).

The finding of statistically significant differences in body weight and body mass index (BMI) between the somatotype groups in the study supports this information. Furthermore, the significant differences ($p<0.05$) found between the skinfold thickness, circumference, and diameter measurements used in the somatotype analysis clearly support the anthropometric diversity of these body types. These measurements provide important clues regarding the proportional distribution of fat, muscle, and bone components within the body, thus demonstrating a physiological basis for the differences between somatotype groups.

Craniofascial and nasal morphometry may vary depending on age (Sforza *et al*., 2011; Kiliç Safak *et al*., 2023), sex (Farkas *et al*., 1986; Sforza *et al*., 2011; Maddux *et al*., 2017; Kiliç Safak *et al*., 2023), ethnicity (Hwang & Kang, 2003; Majidi Zolbin *et al*., 2015), race (Farkas *et al*., 2005) and the geographic region where the individual resides (Farkas *et al*., 1986; Maddux *et al*., 2017). In addition, while there are limited and contradictory studies examining the relationship with body composition such as height, weight, body mass index, there is no study examining the relationship with somatotype character. Raza & Wang (2012) show that nasal cavity geometry is not affected by increasing BMI or by increasing height and weight separately in healthy adult Singaporeans. Saadeh *et al*. (2024) reported a weak but positive correlation between BMI and nasal root width and nose height in their study on young Lebanese adults. In their study on Turkish young adults, Bahsi *et al*. (2021) evaluated parameters such as nasal length, nasal width, nasal root width and facial height, but found no significant relationship with anthropometric data such as BMI and height. In their study on young adults with nasal septum deviation, Desticioglu *et al*. (2024) found a significant correlation between BMI and nasal length, nasal base length, nasal width, facial width, nasal root width, intranasal angle, nasal length angle, external nostril length, and nasal dorsum length, but noted no correlation between facial height, nasal height, nasal depth, right nostril width, right nostril length, left nostril width, philtrum length, and alar thickness. Located at the center of the face and significantly influencing facial proportions, the nose plays a critical role in aesthetic appearance. Therefore, interest in rhinoplasty and medical surgery is increasing daily, especially among women. In this context, the creation of anthropometric databases is invaluable (Dogru *et al*., 2020). In our study, which aims to support the literature on the effect of somatotype on nose-face measurements, it was determined that the balanced ectomorph somatotype group was significantly different from other somatotypes in terms of facial height, nostril width, and bizygomatic width measurements ($p<0.05$). This result suggests that somatotype may be an important factor affecting facial and nasal structure and should be taken into consideration in future morphometric studies.

This study was conducted only on female subjects; therefore, the results cannot be generalized to the male population. Furthermore, the ethnicity and lifestyle variables of the participants were not controlled. Future studies that include comparisons across different age groups and sexes will more comprehensively demonstrate the impact of somatotype on facial and nasal morphology.

CONCLUSIONS

This study demonstrated that somatotypes can have significant effects not only on body composition but also on facial and nasal morphology. The differences in facial height, nostril width, and bizygomatic width, particularly in balanced ectomorph individuals, suggest that somatotype may be a determining factor in craniofacial structure. These findings highlight the need to consider somatotype analysis in the assessment of individual differences among anthropometricians and aesthetic surgeons.

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RESUMEN: El objetivo de este estudio fue investigar si existe una relación entre el somatotipo y la morfometría facial y nasal en mujeres. En este análisis se incluyeron 158 mujeres. Se registraron la edad, el índice de masa corporal (IMC), la longitud nasal, la longitud de las fosas nasales, la altura nasal, la altura facial, el ancho nasal morfológico, el ancho nasal anatómico, el ancho de la raíz nasal, el ancho de las fosas nasales, el ancho bizigomático y la profundidad nasal. También se tomaron medidas de altura, peso, pliegues cutáneos (tríceps/subescapular/suprailíaco/pierna medial), diámetro (húmero/fémur) y circunferencia (brazo/pierna) para el análisis del somatotipo. La evaluación del somatotipo se realizó utilizando el método de Heath-Carter. Se identificaron cinco somatotipos diferentes. En consecuencia, al examinar la edad, la estatura, el peso y el IMC, se encontró una diferencia estadísticamente significativa entre los grupos en términos de peso e IMC ($p<0,05$).

Al evaluar las medidas corporales utilizadas en el cálculo del somatotipo, se encontraron diferencias significativas entre los somatotipos en todas las medidas (p<0,05). Al examinar las medidas de morfología facial, los valores de altura facial, ancho de las fosas nasales y ancho bizigomático mostraron diferencias significativas entre los grupos de somatotipos (p<0,05). Las comparaciones por pares revelaron que el somatotipo más significativo en estas diferencias fue el ectomorfo equilibrado. Este estudio muestra que puede haber relaciones significativas entre el carácter del somatotipo y las características morfométricas de la nariz y el rostro en mujeres de 18 a 39 años. Especialmente en individuos con somatotipo ectomorfo equilibrado, se observaron diferencias significativas en las medidas de altura facial, ancho de las fosas nasales y ancho bizigomático. Estos hallazgos sugieren que las estructuras craneofaciales pueden estar asociadas no solo con factores genéticos y ambientales, sino también con la composición corporal. En este sentido, se pueden evaluar soluciones no quirúrgicas para mujeres insatisfechas con su apariencia estética. De esta manera, se puede reducir la necesidad de cirugía estética y evitar procedimientos perjudiciales para la salud. En el futuro, se recomienda investigar esta relación con mayor detalle mediante estudios más exhaustivos en ambos sexos y en diferentes grupos de edad.

PALABRAS CLAVE: Somatotipo; Mujer; Nariz; Morfometría.

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