

Effect of living conditions on somatotype components of young individuals belonging to different socioeconomic strata: a preliminary study

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Abstract

Morphological characteristics of the human body are known to alter among different populations. Genetic factors are without doubt not the only cause of these variations. Independent of sex and age, environmental factors, nutritional habitudes, physical activity, and the socioeconomic status of an individual could cause differences in human body structure. In most anthropological studies, body structure has been determined by body mass index or somatotype components. Studies on the proportional values of the human body are limited. The main aim of the present study is to evaluate the influence of socioeconomic and cultural status on somatotypes of young adults. The study included 100 adult male subjects with a mean age of 19.54 ± 2.44 years. Thirteen anthropometric measurements were taken from all the individuals, and depending on these measurements body mass index and somatotype values were calculated for each subject. Monthly income of the family and the education level of the parents were taken into consideration in order to determine the socioeconomic and cultural status. The results of the study indicate that parental education levels are more influential on body structure when compared with the economic status of the family. Differences between the groups were marked in lower limb measurements, skinfold thicknesses and somatotype values of the subjects, especially in endomorphy component.

Keywords: Socioeconomic status, body mass index, somatotype, anthropometry

Introduction

The morphological structure of the human body is not only of importance to medical doctors working in the clinical field as plastic surgeons, pediatricians or geriatricians, but also for doctors in forensics, especially in forensic anthropology. Physical anthropologists are also interested in human morphology in order to analyze ancient and living populations. It is well known however, that body shape may alter among

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different populations, and genetic factors are not the sole cause of these variations. Body shape can also be influenced by environmental conditions, nutritional habitudes, and socioeconomic status as well (reviewed in Bogin, 1999; Roche and Sun, 2003).

Socioeconomic status is a complex concept including not only the purchasing power of an individual, but also his education, occupation and place in social life (Adler et al., 1994; Chen et al., 2006). Nutritional habitude is one of the best criteria reflecting one's socio-cultural status and level of income. Especially in childhood, even mild or moderate malnutrition can cause a remarkable decrease in school success (e.g. Behrman and Deolalikar, 1988; Chen et al., 2006). In addition to nutritional deficiency, nutritional disorders are common problems for child and adult health. Obesity rates are rising globally, independent of age, gender and ethnical origin (Hanson and Chen, 2007). The World Health Organization indicates an increase of approximately 15-20% in obesity rates all over Europe, and emphasizes that this increase in obesity is a severe problem, particularly in late adolescence and early adulthood (WHO, 2008). Though it is known that a relationship between socioeconomic status and nutritional habitudes exists; in developed western countries increased purchasing power, the influence of the media on nutritional habitudes, time and money spent on physical exercise and varying perceptions among the subgroups of the population have complicated this relationship between socioeconomic status and nutrition (WHO, 2008).

Body mass index (BMI) calculated from body weight and stature is the most common anthropometric variable used to determine body shape in studies on human body structure to-date. Another method used to describe body structure is somatotyping. Somatotyping is an indirect anthropometric method that determines body shape independent of body size. After being simplified by Head and Carter it was widely used in morphological studies on the body structures of children (e.g. Munoz-Cachon, 2007; Ventrella et al., 2008; Özener and Duyar, 2008; for details see Carter and Heath, 1990). Of the three components of somatotyping, endomorphy represents the ratio of a person's body fat to body mass. Mesomorphy represents the ratio of an individual's bone and muscle mass to their total body mass, and ectomorphy determines the slim figure of the individual. The first two of these components are very sensitive to changes in body composition. For this reason many authors have assessed the relationship between somatotype and health (see Carter and Heath, 1990).

Because of their extraordinary nutritional habitudes and with the adaptation process of their developing personality to the socioeconomic status to which they belong, young adults –especially university students– are good samples for such scientific studies. To-date however, pre-pubertal children have been preferred for the studies on body shape and body composition. In Turkey studies on individuals in their late adolescence and early adulthood are very limited. The aim of the present study is to evaluate the body structure of male Turkish young adults belonging to different socioeconomic groups, and to compare the groups with each other.

Subjects and method

The data was obtained from a cross-sectional sampling of 100 healthy male volunteer subjects living in the city of Ankara at different locations. The mean age was 19.58 ± 2.44 years, and when the sample was reclassified according to the monthly income of their families and the education level of their parents, no significant differences were observed between the age-related groups. In addition to body weight and stature, the

following 11 anthropometric measurements were obtained for each subject: tibia length, humerus breadth, femur breadth, shoulder breadth, hip breadth, upper arm girth, calf girth, triceps skinfold, subscapular, and supraspinal skinfolds and medial calfskinfold. All measurements were taken employing the method described in Carter and Heath (1990) by the same author at the same time of day. The study was approved by the local ethics committee of Baskent University.

Socioeconomic status

Income

Household income was calculated using self-reported measures of income by all working members of the family from primary and secondary occupations.

Low: Below 1000 TL/month

Medium: 1000 – 3000 TL/month

High: Above 3000 TL/month

Education

Low: Primary school graduate or below

Medium: Primary school graduate – high school graduate

High: University graduate or above

Statistical analysis

The differences in body height and weight, between the groups were tested by one-way analysis of variance (ANOVA). Multiple comparisons between pairs of groups were carried out according to the Duncan test. Body mass index and somatotype components were not normally distributed for these variables. Groups were compared by Kruskal-Wallis one-way analysis of variance by ranks test, and then multiple comparisons between pairs of groups were carried out according to the Dunn test. Statistical analysis was performed using the SPSS 13.0 for Windows (Statistical Package for the Social Sciences, version 13.0, SPSS Inc, Chicago, IL, USA).

Results

In Tables 1-3 descriptive statistics of stature, body weight and body mass index (BMI) were presented and evaluated in relation to the monthly income of the family, and the parents' education level. No significant differences were observed between the low, medium and high household income groups related to stature, body weight and BMI; however a positive correlation was observed between body weight and parents' education level. Greater educational attainment of the mother was significantly associated with body weight and BMI (Table 1). Notably, children of mothers with a high education level have significantly higher body weight and BMI values when compared with those of children in the other two groups. The same patterns were observed in relation to the education level of the father (see Table 2).

Table 4 presents the descriptive statistics of somatotype components related to household income. No significant correlation was observed between the monthly income of the family and the somatotype components mesomorphy and ectomorphy. However endomorphy, the component reflecting body fat mass, significantly differs between high and low income groups. The endomorphy component was also associated with fathers' education level. A significant difference was observed between the groups with high and low paternal education level related with endomorphy component (Table 6). On the other hand while the endomorphy values

Table 1: Descriptive statistics for stature, body weight and BMI related with household income

	Low SES Mean \pm SEM	Medium SES Mean \pm SEM	High SES Mean \pm SEM	<i>P</i>
Stature	1722.13 \pm 60.69	1742.79 \pm 75.16	1753.29 \pm 75.49	0.19
Body weight	69.92 \pm 11.16	72.39 \pm 14.15	76.39 \pm 11.89	0.12
BMI	23.63 \pm 3.67	23.75 \pm 3.54	24.85 \pm 3.67	0.36

Table 2: Descriptive statistics for stature, body weight and BMI related to mothers' education level

	Low SES Mean \pm SEM	Medium SES Mean \pm SEM	High SES Mean \pm SEM	<i>P</i>
Stature	1719.90 \pm 60.62 ^a	1743.84 \pm 62.21 ^a	1758.36 \pm 92.11 ^a	0.09
Body weight	69.33 \pm 11.72 ^a	70.91 \pm 11.22 ^a	78.85 \pm 14.29 ^b	0.01
BMI	23.42 \pm 3.40 ^a	23.31 \pm 3.43 ^a	25.53 \pm 4.07 ^b	0.04

Note: Different letters represent the statistically significant differences between the groups

Table 3: Descriptive statistics for stature, body weight and BMI related to fathers' education level

	Low SES Mean \pm SEM	Medium SES Mean \pm SEM	High SES Mean \pm SEM	<i>P</i>
Stature	1710.77 \pm 52.70 ^a	1741.15 \pm 73.69 ^a	1752.16 \pm 74.92 ^a	0.06
Body weight	67.54 \pm 11.8 ^a	70.70 \pm 10.47 ^a	76.45 \pm 13.59 ^b	0.01
BMI	23.14 \pm 3.95 ^a	23.27 \pm 2.87 ^a	24.89 \pm 3.89 ^b	0.08

Note: Different letters represent the statistically significant differences between the groups

Table 4: Descriptive statistics of somatotype components related to household income

	Low SES Mean \pm SEM	Medium SES Mean \pm SEM	High SES Mean \pm SEM	<i>P</i>
Endomorphy	3.31 \pm 1.52 ^a	3.47 \pm 1.43 ^{ab}	4.33 \pm 1.35 ^b	0.01
Mezomorphy	4.27 \pm 1.29 ^a	4.18 \pm 1.46 ^a	4.89 \pm 4.44 ^a	0.87
Ectomorphy	2.22 \pm 1.30 ^a	2.20 \pm 1.15 ^a	1.97 \pm 1.24 ^a	0.70

Note: Different letters represent the statistically significant differences between the groups

Table 5: Descriptive statistics of somatotype components related to mothers' education level

	Low SES Mean \pm SEM	Medium SES Mean \pm SEM	High SES Mean \pm SEM	<i>P</i>
Endomorphy	3.30 \pm 1.43	3.55 \pm 1.35	4.30 \pm 1.62	0.02
Mezomorphy	4.29 \pm 1.60 ^a	3.83 \pm 1.75 ^a	5.18 \pm 4.63 ^a	0.22
Ectomorphy	2.23 \pm 1.12 ^a	2.49 \pm 1.27 ^a	1.72 \pm 1.40 ^a	0.03

Note: Different letters represent the statistically significant differences between the groups

Table 6: Descriptive statistics of somatotype components related to fathers' education level

	Low SES Mean \pm SEM	Medium SES Mean \pm SEM	High SES Mean \pm SEM	<i>P</i>
Endomorphy	3.15 \pm 1.73 ^a	3.24 \pm 1.13 ^{ab}	4.22 \pm 1.41 ^b	0.01
Mezomorphy	4.79 \pm 1.73 ^a	3.94 \pm 1.70 ^a	4.59 \pm 3.77 ^a	0.87
Ectomorphy	2.36 \pm 1.32 ^a	2.41 \pm 1.19 ^a	1.91 \pm 1.29 ^a	0.14

Note: Different letters represent the statistically significant differences between the groups

of the young adults whose mothers were highly educated were significantly higher (although it is not statistically significant), ectomorphy values were lower. In other words, educated mothers have relatively fatter sons while mothers with lower education have slim children (Table 5).

Besides body shape, some anthropometric measurements, especially the proportional values, were also evaluated in the study. Notably, the ratio of tibia length to stature is positively associated not only with monthly income, but with parents' educational level as well ($P < 0.05$). Neither width nor girth values were associated with income; however mothers' education level is highly correlated with shoulder breadth, arm and calf girths. These values were significantly higher in the group with a high maternal education when compared with the other two groups. Conversely, when those anthropometric values were evaluated as they related to fathers' education level, shoulder breadth showed a significantly positive correlation with fathers' education. Similarly calf girth was also significantly higher in the group with higher paternal education level when compared with the other two groups.

Discussion

Stature, body weight and BMI are the most commonly used criteria in studies on body structure. In the present study somatotyping, a method describing body shape rather than body size was used in addition to other anthropometric values. Since it is known that males are more affected by socioeconomic conditions than females (see Bogin, 1999), the study sample was comprised of male subjects.

Socioeconomic status is a complex concept representing level of educational attained, occupation, level of income and an individual's, status in society. In other words socioeconomic status represents one's lifestyle. The effects of socioeconomic status on the morphological structure of the human body undoubtedly vary between different populations. In their studies Pearatakul et al. (2002) have reported that in western countries obesity is a problem of individuals with a lower socioeconomic status, particularly for women. Perhaps it can be argued that in those countries women from the lower socioeconomic status are less concerned about their physical appearance. Fernald et al. (2007) indicated a negative correlation between obesity and socioeconomic status for female individuals in developed countries. Conversely no association was observed between obesity and socioeconomic conditions for children and adult males (Fernald et al., 2007). Hanson and Chen (2007) in their study on adolescents with a mean age of 16.85 years reported a high BMI for teenagers in families with a lower socioeconomic status. Although the authors maintained the relatively sedentary lifestyle of the young individuals from the lower socioeconomic status was a significant factor in their interpretation of their findings, they also emphasized that the sedentary lifestyle might not be the only criterion to consider in understanding the relationship between socioeconomic status and body shape; and added that nutritional habitues, sleep disorders, and/or drug abuse should also be taken into consideration (Sundquist and Johansson, 1998). Contrary to those results, in developing countries a positive correlation was observed between obesity and socioeconomic status. In the present study in 15 of 100 subjects BMI was 27 or above. Most of these 15 individuals were from families with high income and high educational level.

The majority of studies to-date indicate that children from families of high socioeconomic status were taller and had higher body weight than their counterparts from families of lower socioeconomic status (see Eveleth and Tanner, 1990). Although most of the above-mentioned studies were conducted on subjects during their

childhood, the findings might also prove useful in predicting patterns in late adolescence and early adulthood. The results obtained in the present study showed no significant variability of stature regarding household income and parents' educational level. Body weight, however, showed a significant correlation with parents' educational level. In a study on Yogyakarta and Bantul children in Indonesia, Rahmawati et al. (2004) reported greater endomorphy values in Yogyakarta children who were from higher socioeconomic conditions when compared with Bantul children who were from relatively lower socioeconomic status. However by increasing age, endomorphy and mesomorphy values decreased while ectomorphy values increased. Indonesian male children, especially those aged between 12–15 years, were ectomorphic while children from Japan were mesomorphic (Takai and Wu, 2002).

In the present study endomorphy values of the individuals from the families with a higher income and parents' educational level, were significantly higher. While the individuals from higher socioeconomic status were mesomorphic (or ectomorphic in far east countries), here in Turkey they were commonly endomorphic. This varying effect of socioeconomic status on body shape in different countries could be explained by the nutritional habitues. Another point that should be emphasized in the present study is the lower mesomorphy values of the individuals in the middle socioeconomic status when compared with the ones from higher and lower groups. Contrary to the results obtained from the present study, in young Basque populations ectomorphy values were higher for individuals from higher socioeconomic status while endomorphy and mesomorph values were higher for subjects from lower socioeconomic status (Munoz-Cachon, 2007). Similar trends were reported in another study on the same population, but on children and young adolescents (Rebato et al., 1996). In another study on Hungarian children those from higher socioeconomic status were taller and had higher body weight. Their circumference values were also higher, especially for breast and calf. Skinfold measurements, however, were lower (Eiben et al., 2004). The results of the present study indicate that body weight was not influenced by the level of income, but was positively associated with parents' educational level. Eiben et al (2004) reported a positive correlation between mothers' education level and shoulder and hip breadths. In females both shoulder and hip breadths increase with an increase in the mothers' education level. However this positive correlation was only seen for hip breadth in male subjects (Eiben et al., 2004). In the present study on only male subjects, hip breadth was associated neither with income nor with education level. Shoulder breadth however, showed a significant positive correlation both with mothers' and fathers' educational level. Eiben et al. (2004) indicated that circumference measurements from arm and calf were negatively correlated with mothers' educational level. Contrary to Eiben's results in the present study children of highly educated mothers had significantly higher circumference values.

The results of the present study indicate that the influence of parents' educational level on body shape is significantly stronger than the effects of family income. Conversely, depending on results related to the effects of socioeconomic status on body shape it could be argued that Turkey is still not a developed country.

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