

SOMATIC PROFILE OF FEMALE ADOLESCENT STUDENTS IN THE PREŠOV REGION

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Keywords:

- body height
- body weight
- BMI
- somatotypes
- female high school students

Abstract:

The study presents partial results of the research task supported by the Slovak Research and Development Agency based on agreement No. APVV-0768-11 titled 'Physical, functional and motoric development of high-school youth in relation to their physical activity'. Research problem of the study is focused on the assessment of basic anthropometric parameters and body constitution of female high school students in the Prešov region. The screened sample consisted of 506 girls aged between 15 and 18. We measured body height, body weight and BMI. To determine somatotypes, we used the Heath – Carter method (1967). Using an intra-individual analysis we identified 5.3 % of girls in the overweight zone (90th – 97th percentile) and 7.1 % in the zone of obesity (> 97th percentile). Average somatotypes of girls in the monitored age categories took place in categories with dominant endomorph component, namely in the mesomorphic endomorph category (category 10) and mesomorph – endomorph category (category 11). In these categories we also recorded the highest percentage proportion of girls, about a quarter up to a third of each age category. Analysis of body constitution points to the greater proportion of fat mass and insufficient muscular development in most monitored adolescent girls as well as to the incidence of girls with higher risk in the overweight zone or even in the zone of obesity.

INTRODUCTION

Population health status depends on a number of genetic, environmental and cultural variables; however, to promote health and prevent lifestyle diseases, the most important factors, related to behaviour of people, are eating and exercise habits [14]. Reduced energetic expenditure due to the decline in physical activity and high energy intake are considered to be two major factors contributing to the development of global epidemic of overweight and obesity [7]. In recent years, a number of obese children have increased worldwide, whilst obesity, already at this age, is not only a health problem but it also means an increased risk of lifestyle diseases in adulthood [10]. Nowadays, 10 to 30 % of European children aged between 7 and 11 and 8 to 25 % of adolescents aged between 14 and 17 suffer from obesity [5]. It has been showed that sedentary lifestyle correlates with childhood obesity prevalence [6]. Adolescence is an important risk period of development of obesity, especially in girls, and is also characterised by decreased spontaneous physical activity, more pronounced in girls over 14 years and boys between 16 and 18 year. Approximately a third of 36-year-old obese women report its origin in adolescence [1]. Preference of sedentary lifestyle in this period significantly influences the amount of physical activity practised in adulthood. Physical activity during adolescence can help to develop healthy lifestyle of adults, which reduces the risk of chronic disease incidence [8]. There are claims that achieving an adult healthy lifestyle

is rooted in habits acquired at early ages, thus pointing at importance of childhood and adolescence in building a positive relationship with physical activity and lifelong physical activity habits [13]. Moreover, only 2 – 5 % of overweight or obese people have objective medical reasons [2].

Physical development parameters are important indicators of health and nutrition status of the body. Physical activity and nutrition influence not only body weight but also body composition and constitution, so called somatotype [16]. Although mesomorph and ectomorph components are genetically determined up to 60 – 80 %, the endomorph component is less genetically influenced and is more affected by environmental factors [4]. Monitoring of basic somatic characteristics of children and youths allows as to assess the influence of exogenous factors on individual's physical development and simultaneously detect the prevalence of overweight and obesity in this population group. Based on national anthropological surveys implemented in 10-year intervals, the Slovak Republic dispose of national standards for body height, body weight and BMI that enables individual assessment of physical development of children and youths [17].

In this paper, authors present partial results of research focused on analysing the current somatic status of female adolescent students from selected high school in the Presov region. This study was supported by the Slovak Research and Development Agency based on agreement No. APVV-0768-11.

METHODS

A non-randomized cross-sectional study in high school students from Eastern Slovak region was used. A research sample consisted of 506 female adolescents aged between 15 to 18 years. The participants' average age at the time of measurements was 16.9 ± 1.1 years, average body weight 57.5 ± 9.7 kg and average body height 165.0 ± 5.7 cm. The research group was divided into four subgroups according to their age. At the beginning of measurement, participants' basic somatic characteristics were identified. Body height was measured using a portable stadiometer (SECA 217, Hamburg, Germany) with an accuracy of 0.1 cm. Body weight measured with an accuracy of 0.1 kg and body fat percentage were recorded using an InBody 230 digital scale (Biospace Co., Ltd.; Seoul, Korea). Identification of somatotype components was carried out according to the method by Heath and Carter [9]. In addition to basic somatic characteristics, to assess individual somatotype components we measured thickness of four skin folds (triceps, subscapular, supraspinale and medial calf) using Best calliper (Trystom, Olomouc, Czech Republic), biepicondylar breadth of humerus and femur using a digital calliper with an accuracy of 0.1 mm and the flexed arm and calf girth in the greatest circumference using a tape measure. Somatotypes were further evaluated according to dominance of respective components and their mutual ratio. Values of somatotype components were set using Somatotyp 1.2.5 for Windows software. Prevalence of obesity was assessed according to Slovak National Reference Standards based on the 7th National Anthropological Survey 2011, which was carried out on representative groups of girls in all age categories, taking into account eating habits and demographic specifics. BMI value below the 25th percentile was classified as underweight, BMI value between the 25th and 75th percentile was classified as proportional, between the 75th and 90th percentile it was assessed as plump, between the 90th and 97th percentile it means being overweight and value exceeding 97th percentile indicates obesity. The participants were assessed with regard to their age since the level of the degree of obesity (BMI value) shifts in relation to participant's age.

Measurements were taken according to the ethical standards of the Declaration of Helsinki. Participant's legal guardian (A participant's legal guardian (in the cases where a participant was younger than 18 years) or participants (in the cases where a participant was older than 18 years) received a verbal description of the study procedures before testing and

completed a written informed consent that was approved by the ethical committee of the University of Presov.

Collected data were subjected to statistical analysis. From methods of descriptive statistics we used the mean as a measure of central tendency and standard deviation.

RESULTS AND DISCUSSION

Parameters of physical development of female adolescents in the Presov region were assessed according to Slovak National Reference Standards in comparison to data from the 7th National Anthropological Survey carried out in 2011. Body height and body weight belong to the most frequently monitored somatic parameters and main factors that influence them include quality of nutrition, physical activity, health status, psycho-social factors and social-economic conditions under which children grow up. In recent years, we can observe that a trend of increasing final body height in both genders, more remarkably in girls than boys, is slowing down or even stopping; moreover, the onset of accelerated pubertal growth and sexual maturation has been shifted in younger age categories [3]. Comparison of average values of basic anthropometric indicators of the Slovak population over the decade 2001 – 2011 showed that girls aged 15 – 18, measured in 2011, achieved lower average values of body height and higher average values of body weight, which determined a significant increase in average BMI values. These findings indicate that secular trend of body height is stopping along with maintaining unfavorable increase of body weight [18].

Table 1 presents descriptive characteristics of anthropometric indicators of the girls' sample and samples of the same age measured within the 7th National Anthropological Survey in 2011. Girls of all age categories are, with their average values of body height, body weight and BMI, at the level of nationwide Slovak population of girls of the same age. According to national growth charts, their average values of the monitored anthropometric indicators are between the 50th and 60th percentile, i.e. in the zone of medium body height and normal body weight. 18-year-old girls achieved body height of 165.6 cm, body weight of 58.9 kg and BMI value of 21.5 kg.m⁻². When compared with 15-year-old girls, we recorded increase in body height by 1.5 cm, in body weight by 2.2 kg and in the average BMI value by 0.45 kg.m⁻².

Table 1 Descriptive characteristics of anthropometric indicators

Age	Parameter	Mean	Standard deviation	Minimal value	Maximal value	NAS 2011	
						Mean	Standard deviation
15 years (n = 137)	BH (cm)	164.1	5.6	151.0	184.5	164.6	6.1
	BW (kg)	56.7	9.1	39.2	85.5	57.5	10.2
	BMI (kg.m ⁻²)	21.1	3.2	15.6	31.8	21.2	3.6
16 years (n = 132)	BH (cm)	165.5	5.7	147.4	180.0	164.8	6.6
	BW (kg)	57.4	10.1	40.2	97.0	57.7	10.5
	BMI (kg.m ⁻²)	20.9	3.2	15.3	33.8	21.2	3.4
17 years (n = 130)	BH (cm)	164.7	5.3	147.1	180.2	165.1	6.4
	BW (kg)	57.0	9.3	42.6	87.7	58.2	9.1
	BMI (kg.m ⁻²)	21.0	3.1	15.9	32.1	21.3	3.1
18 years (n = 107)	BH (cm)	165.6	6.2	147.4	180.2	165.4	6.5
	BW (kg)	58.9	10.2	42.7	92.5	59.3	11.1
	BMI (kg.m ⁻²)	21.5	3.4	15.8	34.3	21.7	3.7

Note. n = number of participants; BH – body height; BW – body weight; BMI – body mass index; NAS 2011 – National Anthropological Survey 2011

In terms of preferring passive leisure time among current adolescent girls, it is very important to monitor BMI, which is the most widely used parameter for evaluation of the incidence of overweight and obesity. The Slovak Republic, as one of the few countries, created national standards of percentile zones of BMI to evaluate the incidence of overweight

and obesity in children and youths. The analysis of BMI values indicates that in the recommended zone of normal weight (25th – 75th percentile) we identified approximately two thirds of girls in each age category. Low body weight (< 25th percentile) was found in a quarter of 15 and 16-year-old girls, in a third of 17-year-old girls and only in less than a fifth of 18-year-old girls. In the risk zone of overweight (90th – 97th percentile), 5.1 % of girls were placed and in the zone of obesity (> 97th percentile) it amounted to 6.8 % of girls. In individual age categories, percentage proportion of girls in the zone of obesity ranged between 6.3 % and 7.9 %. Concerning the younger age categories, in 15 and 16-year-old group we identified 6.6 % and 6.4 %, respectively, of obese girls. In the group of 17-year-old girls it increased to 7.9 %; on the contrary, in 18-year-old girls we recorded the lowest representation of obese participants, namely 6.3 %. However, greater differences were recorded in the incidence of overweight. While in the youngest age category we found 9.5 % of overweight girls, in 16 and 17-year-old it only was 2.8 % and 3.1 %, respectively, and in 18-year-old girls it slightly increased to 4.7 %. [12]. reported that adolescent girls gain weight due to increased body fat, while among boys it is rather determined by gaining muscle mass and higher bone weight. However, adolescent girls tend to change their physical appearance and achieve slimness, which often results in reduction of energy intake accompanied by normalization of body weight [2].

In the Czech – Slovak population, authors reported overweight in 12.0 % of girls and obesity in 5.6 % of girls [10]. Although the results of the 7th National Anthropological Survey 2011 are not yet available, based on results of the 6th National Anthropological Survey taken in 2001 we can see that total percentage of Slovak adolescent girls with overweight and obesity was 12.1 %, out of which 6.9 % were obese [15]. These findings corresponds with our results, so, to sum up, after 14 years we did not record higher incidence of overweight or obese adolescent girls.

On the contrary, monitored 1995 female high school students from the Bratislava region and found higher prevalence of overweight and obesity, namely in 14.0 % and 8.2 %, respectively, of girls aged 15 – 18 [11]. In 2004, in the Slovak Republic there was a project titled “Nutrition and health in education” within which the researchers also monitored the incidence of overweight and obesity in more than 1000 children. In children aged 9 – 11 years, they found 16.5 % of overweight and obese children while in adolescents they recorded a decrease to 12 %. Moreover, particularly in girls, they found a dependence on age, when the prevalence of overweight and obesity firstly slightly and after reaching puberty sharply declined.

The most comprehensive indicator of body constitution is a somatotype. It reflects the current morphological status of a man and consists of three components. The first component, endomorph, primarily expresses the relative fatness with a tendency to its central storage and is also characterised by only hardly visible muscles. The second component, mesomorph, as an indicator of the relative musculoskeletal development of the body, is characterised by robust skeleton and strong musculature. The third component, ectomorph, primarily reflects relative height and slimness with a small tendency for body fat storage [19]. Table 2 presents descriptive characteristics of somatotype components among girls from particular age categories. An average somatotype of 15-year-old (4.1 - 4.0 - 2.9) and 17-year-old girls (4.3 - 3.9 - 3.0) took place in the mesomorph – endomorph category (11), while the somatotype of 16-year-old (4.3 - 3.7 - 3.1) and 18-year-old girls (4.8 - 4.1 - 2.8) was placed in the mesomorphic endomorph category (10), which is a category with dominant endomorph component. Average values of the endomorph component of girls in individual age categories ranged between 4.3 and 4.8 points, while the values of mesomorph component varied from 3.8 to 4.1 points. In all age categories, average values of the ectomorph component were the lowest, in the range of 2.8 and 3.1 points. The highest average value of the endomorph

component (4.8 points) was recorded in 18-year-old girls, whilst the lowest (4.1 points) in 15-year-old girls. The highest average value of the mesomorph component (4.1 points) was found in 18-year-old girls and the lowest (3.7 points) in 16-year-old girls.

Table 2 Descriptive characteristics of somatotype components

Age	Somatotype components	Mean	Standard deviation	Minimal value	Maximal value
15 years (n = 137)	Endomorph	4.1	1.6	1.0	8.2
	Mesomorph	4.0	1.5	0.5	9.2
	Ectomorph	2.9	1.4	0.1	6.0
16 years (n = 132)	Endomorph	4.3	1.7	0.9	9.1
	Mesomorph	3.7	1.4	0.7	8.0
	Ectomorph	3.1	1.5	0.6	8.1
17 years (n = 130)	Endomorph	4.3	1.7	0.8	8.0
	Mesomorph	3.9	1.5	0.3	10.0
	Ectomorph	3.0	1.8	0.1	16.3
18 years (n = 107)	Endomorph	4.8	1.6	0.9	8.7
	Mesomorph	4.1	1.5	0.9	8.0
	Ectomorph	2.8	1.5	0.1	6.4

Intra-individual analysis of somatotypes showed the highest percentage of girls of all age categories in the mesomorphic endomorph category (10), which included 21.3 % of 15-year-old, 23.6 % of 16-year-old, 26.0 % of 17-year-old and, finally, 36.4 % of 18-year-old girls. Other most represented categories were the mesomorph – endomorph category (11) represented by from 11.2 % up to 15.0 % of girls and central somatotype category (13) represented by from 10.3 % up to 15.0 % of girls from all age categories. Figure 2 illustrates representation of girls in somatotype categories according to dominancy of particular components in percentage.

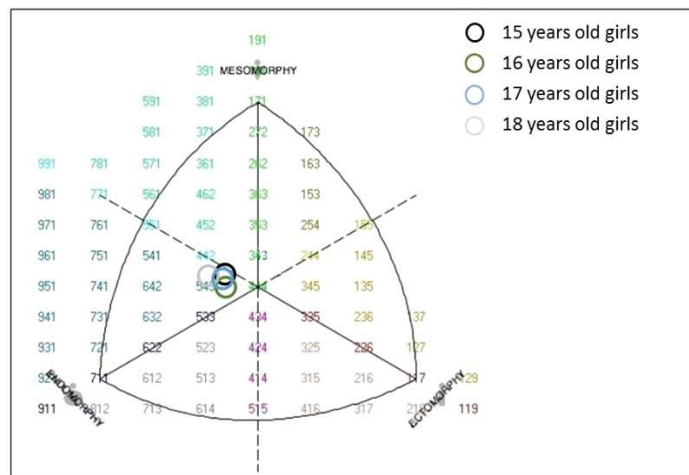


Figure 1 Average somatotypes of girls in different age categories

The greatest representation was found in categories dominated by the endomorph component (categories 7,8,9,10), which included from 32.3 % of 15-year-old girls up to 49.5 % of 18-year-old girls. These girls have higher proportion of body fat. Categories dominated by the mesomorph component (categories 1,2,11,12) included fewer participants, namely from 21.4 % of 18-year-old girls up to 35.3 % of 15-year-old girls. This category also includes categories 11 and 12 in which a higher value of the mesomorph component is accompanied by a higher value of the endomorph component. The lowest representation, from

18.6 % of 18-year-old girls to 25.7 % of 15-year-old girls was found in categories dominated by the ectomorph component (categories 3,4,5,6). These girls are thin with a low proportion of body fat, delicate skeleton and insufficiently developed muscle mass. A separate category is the central somatotype (category 13) which includes somatotype with values of components ranging between 3 and 4 points and they do not differ by more than 1 point. This category was the third most represented in individual age categories, with girls' representation between 10.3 % and 15.0 %.

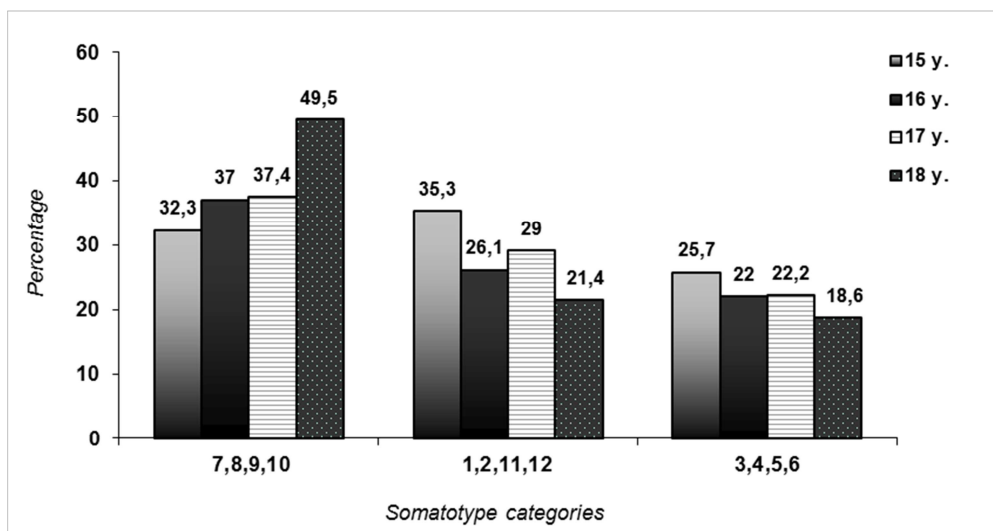


Figure 2 Percentage proportion of girls of different age in categories dominated by the endomorph component (7,8,9,10), mesomorph component (1,2,11,12) and ectomorph component (3,4,5,6)

Analysis of percentage proportion of girls in categories according to dominancy of individual components indicates that along with increasing age we recorded a gradual decrease in girls' representation in categories dominated by the ectomorph and mesomorph component and, on the contrary, an increase in girls' representation in categories dominated by the endomorph component. While in 15-year-old girls we revealed 32.3 % of girls in categories with prevailing endomorph component, in 18-year-old it amounted to 49.5 %, which makes an increase by 17.2 %. These changes are related to the fact that in age of 14 and 15, the endomorph component increases among girls due to an increase in body fat and, naturally, the values of the ectomorph component decrease, which is determined by gradually stopping growth, stabilisation of body height and increasing body weight in adolescent girls. This is also manifested in somatotypes' shift from the right side of somatochart to the left side, in the direction of increased endomorph, which is a natural feminine phenomenon. In the right side of the somatochart there are girls with tendency to slenderness.

CONCLUSION

Analysis of data on physical development of female high school students from the selected schools in the Presov region shows that the incidence of overweight, 5.1 %, and obesity, 6.9 %, in the screened sample of girls is at the level of nationwide average and is not epidemic. Along with increasing age, we recorded an increase in average values of the endomorph component accompanied by higher representation of 18-year-old girls in categories with higher proportion of body fat. With respect to this fact, already in this period of ontogeny, it is important to promote active life style in which physical activity is irreplaceable. Its lack is considered to be the one of major causes of deteriorating health status, decrease in physical fitness and disturbance of mental balance. The lack of physical activity and sedentary life style also causes adaptation of the musculoskeletal system to a low

number of movement impulses and thus muscle imbalance as a disorder of muscle interplay occurs. Moreover, we have to realize that physical activity is the most physiological approach to prevention and treatment of obesity.

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