



## CHILDREN SOMATOTYPE STUDY OF DIFFERENT ETHNIC GROUPS FROM PLOVDIV REGION, BULGARIA

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### ABSTRACT:

The purpose of the present study was to determine and compare the children's somatotypes of three ethnic groups living in the Plovdiv region, Bulgaria.

**Material and Methods:** A cohort of 194 children were enrolled in the study. They were divided into four groups by sex and age. Each group were divided by ethnicity into three subgroups: Bulgarian, Turkish and Roma origins. The regression equations introduced by Heath and Carter were used to determine the somatotype components.

**Results:** The somatotype of Bulgarian and Roma boys aged 11-12 years was defined as mesomorph-ectomorph, while the somatotype of Turkish boys was determined as central. The somatotype of boys aged 13-14 years was defined as follows: Bulgarian boys- balanced endomorph, Turkish boys- endomorph-ectomorph and Roma boys with central somatotype. The mean somatotype of Bulgarian girls aged 11-12 years was defined as ectomorph-ectomorph, while the somatotype of both Turkish and Roma girls was defined a mesomorphic endomorph. Similar results were found analyzing the mean somatotype of girls aged 13-14 years.

**Conclusion:** The period of puberty has a very important impact on the development of the human body. The mean somatotype of Bulgarian boys aged 11-12 years has changed from mesomorph-ectomorph to balanced endomorph. The mean somatotype of Turkish boys aged 11-12 has changed from central to endomorph-ectomorph. The mean somatotype of Roma boys aged 11-12 has changed from mesomorph-ectomorph to central. The mean somatotype of Bulgarian girls was ectomorph-ectomorph; for Turkish and Roma girls it was mesomorphic endomorph for both age group.

**Keywords:** Anthropology, somatotype, children, ethnic groups,

### INTRODUCTION

Sheldon WH. et al. was the first to introduce the somatotype concept in defining the morphological constitutional type [1]. He determined three components of the human somatotype: endomorphic, mesomorphic, and ectomorphic. Later, Carter JEL, Heath BH. developed the concept of human somatotype and the methods of anthropometric measurements. They introduced the regression mathematical equations for calculating the values of the somatotype components [2]. Human somatotype can be characterized using the mean values of its components: endomorphy, mesomorphy, and ectomorphy. Endomorphy reflects the development of tissues of endodermal origins and the relative predomination of structures associated with digestion and assimilation of internal organs, including fat deposition. Mesomorphy reflects the development of human body structures of mesodermal origins; for example, It appears that your sentence or clause uses an incorrect form of the verb **introduced**. Consider changing it skeleton and muscle system. Ectomorphy reflects the development of structures of ectodermal origin (skin, nerve system).

The **aim** of the present study was to determine and compare the children's somatotypes of three ethnic groups living in the Plovdiv region, Bulgaria.

### MATERIAL AND METHODS:

#### Material

A cohort of 194 children living in the Plovdiv region, South Bulgaria, were enrolled in the study. They were divided into four groups by sex and age as follows: 1st group boys aged 11-12 years, 2nd group boys aged 13-14 years, 3rd group girls aged 11-12 years and 4th group girls aged 13- 14 years. Each group were divided by ethnicity into three subgroups: Bulgarian, Turkish and Roma origins.

The study was conducted in cooperation between The Department of Anatomy, Histology and Embryology –

Medical Faculty, Department of Physiology – Medical Faculty, Department of Nursing Care – Faculty of Public Health, Medical University of Plovdiv, Bulgaria in the period 2020-2023.

**Methods**

Our team used the anthropological method of Martin-Saller, modified by Y. Yordanov [3].

**Directly measured anthropological parameters:**

Body height, Body weight

Biepicondilar breadth of Humerus, Biepicondilar breadth of Femur

**Circumferences**

Upper limb: arm relaxed, arm contracted, forearm.

Lower limb: thigh and calf

**Skin folds**

Skinfold thickness was measured at 9 sites on the right side of the body, using a Harpenden skinfold caliper.

1. Triceps brachii skinfold
2. Biceps brachii skinfold
3. Forearm skinfold
4. Subscapular skinfold
5. Tenth rib skinfold
6. Suprailiac skinfold
7. Abdominal skinfold (front abdominal wall)
8. Thigh skinfold

9. Medial calf skinfold

**Statistics**

The regression equations introduced by Heath and Carter were used to define the somatotype components: endomorphy, mesomorphy and ectomorphy [2].

$$\text{Endomorphy} = -0.7182 + 0.1451*(X) - 0.00068*(X^2) + 0.0000014*(X^3)$$

(X = triceps skinfold + subscapular skinfold + suprailiac skinfold)

$$\text{Mesomorphy} = 0.858* \text{biepicondylar diameter of humerus} + 0.601* \text{biepicondylar diameter of femur} + 0.188* \text{corrected circumference of contracted arm} + 0.161* \text{corrected circumference of calf} - 0.131* \text{height} + 4.5$$

$$\text{Ectomorphy} = \text{height (cm)}^3 \text{ weight(kgr)} * 0.732 - 28.58$$

Somatoplots were done according to Toteva – Nacheva [4]. The data obtained was analyzed using statistical software SPSS version 23 (SPSS Inc., Chicago, IL) and Instat version V2.02. The Student’s t-test was used to compare the means of the two groups. Statistical significance was considered high at  $p \leq 0.001$ , moderate at  $p \leq 0.01$ , low at  $p \leq 0.05$ .

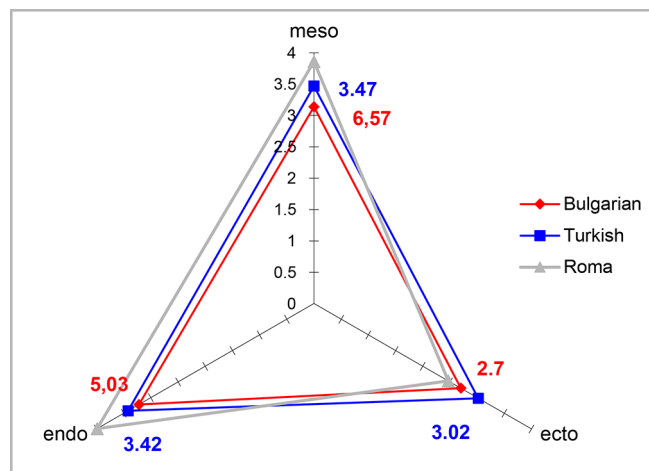
**RESULTS:**

**Table 1.** Mean somatotype of boys aged 11-12 years.

components	Bulgarian				Turkish				Roma			
	N	Mean	SEM	SD	N	Mean	SEM	SD	N	Mean	SEM	SD
Endomorphy	50	3.22	0.32	1,86	50	3.42	0.65	2,26	50	3.99	0.43	2.07
Mesomorphy	50	3,14	0,61	3,51	50	3,47	0,55	1,90	50	3,86	0,42	2,00
Ectomorphy	50	2,70	0,28	1,59	50	3,02	0,60	2,07	50	2,47	0,42	2,03
	Mesomorph-endomorph				Central				Mesomorph-endomorph			

We have defined the somatotype of Bulgarian and Roma children aged 11-12 years as mesomorph-endomorph. The children’s somatotype of Turkish ethnicity was determined as central. (Table 1, Fig 1.) No significant differences were found between the values of endo-, meso-, and ectomorphic components among studied boys from different ethnic groups ( $p > 0.05$ ).

**Fig. 1.** Mean somatotype, boys aged 11-12 years.

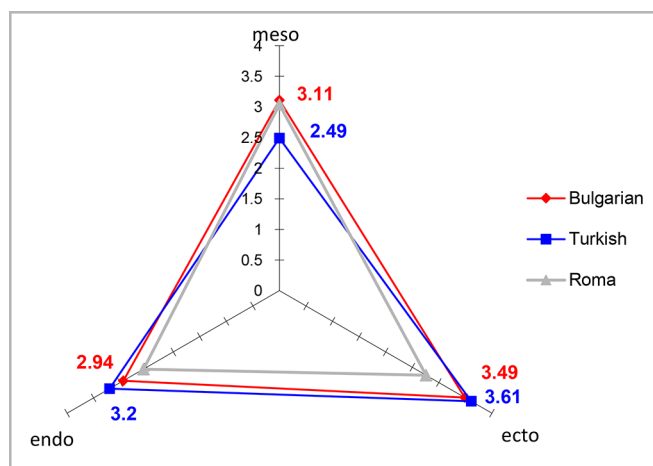


**Table 2.** Mean somatotype of boys aged 13-14 years.

components	Bulgarian				Turkish				Roma			
	N	Mean	SEM	SD	N	Mean	SEM	SD	N	Mean	SEM	SD
Endomorphy	45	2.94	0.43	1.89	45	3.20	0.34	0.68	45	2.56	0.56	1.76
Mesomorphy	45	3,11	0,46	2,00	45	2,49	0,19	0,37	45	3,04	0,47	1,50
Ectomorphy	45	3,49	0,48	2,10	45	3,61	0,24	0,47	45	2,76	0,60	1,88
	Balanced endomorph				Endomorph-ectomorph				Central			

The children somatotype of boys aged 13-14 years was defined as follows: Bulgarian boys- balanced endomorph, Turkish boys- endomorph-ectomorph and Roma boys with central somatotype. (Table 2, Fig 2.) The mean value of the endomorphic component in Turkish boys was significantly greater than in Roma boys ( $p < 0.05$ ). The mean value of the mesomorphic component in Turkish boys was significantly lower than in Bulgarian and Roma boys ( $p < 0.05$ ). The mean value of the ectomorphic component in Turkish boys was significantly higher than in Roma boys ( $p < 0.05$ ).

**Fig. 2.** Mean somatotype of boys aged 13-14 years.

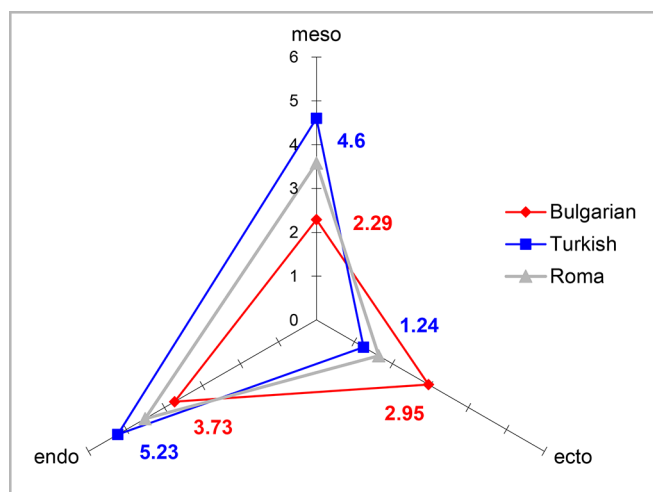


**Table 3.** Mean somatotype of girls aged 11-12 years.

components	Bulgarian				Turkish				Roma			
	N	Mean	SEM	SD	N	Mean	SEM	SD	N	Mean	SEM	SD
Endomorphy	47	3.73	0.30	1.60	47	5.23	0.49	1.61	47	4.51	0.33	1.39
Mesomorphy	47	2,29	0,69	3,80	47	4,60	0,57	1,89	47	3,58	0,40	1,71
Ectomorphy	47	2,95	0,31	1,70	47	1,24	0,42	1,38	47	1,64	0,35	1,46
	Ectomorphic endomorph				Mesomorphic endomorph				Mesomorphic endomorph.			

The mean somatotype of Bulgarian girls aged 11-12 years was defined as an ectomorphic endomorph, while the somatotype of both Turkish and Roma girls was defined as a mesomorphic endomorph. (Table 3, Fig 3.) The mean value of the endomorphic component in Turkish girls was significantly the highest, on the second place was the mean value of Roma girls, and the lowest was the mean value in Bulgarian girls ( $p < 0.001$ ). Similar results showed the mesomorphic component. The greatest mean value was in Turkish girls, then in Roma girls and in the end, in Bulgarian girls. The differences were significant ( $p < 0.05$ ). The contrary result showed the ectomorphic component. Its value in Bulgarian girls was significantly the greatest in comparison to the other girls ( $p < 0.001$ ).

**Fig. 3.** Mean somatotype of girls aged 11-12 years.



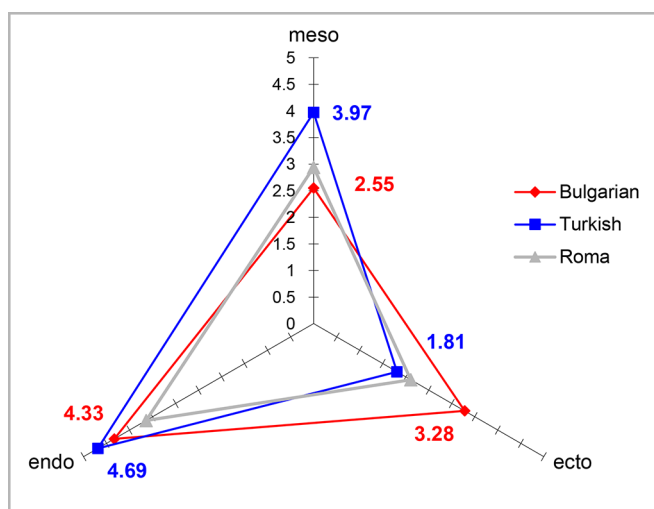
**Table 4.** Mean somatotype of girls aged 13-14 years.

components	Bulgarian				Turkish				Roma			
	N	Mean	SEM	SD	N	Mean	SEM	SD	N	Mean	SEM	SD
Endomorphy	52	4.33	0.38	1.42	52	4.69	1.57	2.71	52	3.64	0.53	1.49
Mesomorphy	52	2,55	0,48	1,81	52	3,97	0,825	1,42	52	2,94	0,60	1,71
Ectomorphy	52	3,28	0,27	1,01	52	1,81	1,10	1,91	52	2,11	0,45	1,27
	Ectomorphic endomorph				Mesomorphic endomorph				Mesomorphic endomorph			

Similar results were found analyzing the mean somatotype of girls aged 13-14 years. The mean somatotype of Bulgarian girls was defined an ectomorphic endomorph, while the somatotype of both Turkish and Roma girls was defined as a mesomorphic endomorph. (Table 4, Fig 4.)

The mean value of the endomorphic component in Turkish girls was the greatest, followed by the mean value in Bulgarian girls and in the third place was the mean value of Roma girls. The differences were with statistical significance ( $p < 0.05$ ). Similar results showed the mesomorphic component. The highest significant value had Turkish girls, but in the second place was the mean value of Roma girls ( $p < 0.05$ ). The mean value of the ectomorphic component in Bulgarian girls was the greatest, followed by the mean value in Roma girls and in the third place of Turkish girls. All differences were significant statistically ( $p < 0.001$ ).

**Fig. 4.** Mean somatotype of girls aged 13-14 years.



**DISCUSSION:**

**Analysis of boys' somatotype**

The mean somatotype of Bulgarian and Roma boys aged 11-12 years in our study was defined as mesomorph-endomorph. Both endomorphic and mesomorphic components were dominant, but the value of ectomorphic components remained far behind. These data indicated that these boys had a well-developed skeleton and muscle system as well as internal organs and adipose connective tissue [5]. The Turkish boys in the same age group had a central mean somatotype. The endomorphic, mesomorphic and ectomorphic components were equally expressed. We

didn't find any significant difference between the three mentioned components of the human somatotype. Therefore, the boys of Turkish origin aged 11-12 years had more harmoniously developed body than the boys from other investigated groups.

The mean somatotype of Bulgarian boys aged 13-14 years was defined as a balanced ectomorph. The leading components were mesomorphy and ectomorphy without significant difference between them, but the value of the endomorphic component was significantly lower. Therefore, the development of the skeleton and the muscle systems had continued, but more intensive development had the nerve system related to the ectomorphic component. The mean somatotype of Turkish boys was determined as endomorph-ectomorph. Both components, ectomorphic and endomorphic, were dominant without significant difference between them, but the value of the mesomorphic component was significantly lower. A very interesting development had the somatotype of Roma boys, from mesomorph-endomorph at the age of 11-12 years to central type at the age of 13-14 years. They had the most harmoniously developed body among the boys at this age. All reported changes of in boys' somatotype components can be explained with the start of puberty at the age of 12-13 years. Especially the development of the nervous system. [6].

**Analysis of girls' somatotype**

The mean somatotype of girls aged 11-12 years was defined as ectomorphic endomorph for Bulgarians and mesomorphic endomorph for Turkish and Roma girls. The endomorphic component was dominant for all compared ethnic groups. Data indicated that the girls from the three compared groups had well-developed connective tissue, including adipose. These connective tissue and internal organs, for example, the digestive system.

The mean somatotype of girls from the age group 13-14 years was similar to that of the age group 11-12 years. Ectomorphic endomorph somatotype for Bulgarian girls, and mesomorphic endomorph for Turkish and Roma girls. The impact of puberty on the somatotype's components has been not so expressive in comparison to the boys. The dominant somatotype component remained the endomorphy in both age groups among all compared ethnicities.

Numerous different scientific studies report data for secular change in body size and somatotype of children of different ages, nations and different ethnic groups.

The Mapuche are a group of indigenous inhabitants of south-central Chile and southwestern Argentina, including parts of Patagonia. Bruneau-Chávez et al. indicate that 12-year-old Mapuche children from Malleco, Araucanía, Chile, presented lower values of endomorphy and higher values of mesomorphy than non-Mapuche ones. The 13-year-old Mapuches presented lower endomorphy and mesomorphy values than non-Mapuche children. Mapuche schoolchildren present a mesomorphic predominance, while non-Mapuche present a predominance of the endomorphic component [7].

The Mising, also known as Miris, is one of the major ethnic groups of north-east India. A study of 278 Mising boys ranging in age from 10 to 18 years finds that the somatotype characteristics of Mising adolescent boys showed co-dominance of both mesomorphic and ectomorphic components of physique over endomorphy. Endomorphic components tend to increase slightly with age. The mesomorphic component remained more or less the same with an increase in age. In the ectomorphic component, there is a fluctuating increase and decrease across different ages, however, it tended to decrease more with the advancement of age. Thus, the three components of body physique do not vary on a regular basis with age [8]. A similar finding is reported by a study of Chakhesang Naga boys aged between 8 and 18 years in Sodzihou village of Dimapur district of Nagaland state in India [9].

Indonesian study of secular change in body size and somatotype of children aged 7-15 years living in Yogyakarta Province concluded that, in general, children from 1999 to 2019, there were positive trends in weight, Body Mass Index (BMI, kg/m<sup>2</sup>), endomorph, and mesomorph components, there was a negative trend for the ectomorph component [10].

Obesity during childhood is likely to continue into adulthood and is associated with cardiometabolic and psychosocial comorbidity as well as premature mortality [11, 12, 13, 14, 15]. The association between somatotype and physical fitness in children has important public health implications since good cardiorespiratory fitness is associated

with better metabolic risk factors in childhood [16], and this association lasts into adulthood [17, 18].

## CONCLUSION:

The period of puberty has a very important impact on the development of the human body.

It is very well expressed in the somatotype component of the boys. The mean somatotype of Bulgarian boys aged 11-12 years has changed from mesomorph-endomorph to balanced endomorph for boys aged 13-14 years. The mean somatotype of Turkish boys aged 11-12 has changed from central to endomorph-ectomorph for boys aged 13-14 years. The mean somatotype of Roma boys aged 11-12 has changed from mesomorph-endomorph to central for boys aged 13-14 years.

The mean somatotype of Bulgarian girls was ectomorphic endomorph for both age groups. The mean somatotype of Turkish and Roma girls was mesomorphic endomorph for both age groups, too. The impact of puberty hasn't changed the balance between the components of human somatotype in girls.

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## Conflicts of interest:

There is no conflict of interest in the realization of this scientific work. The scientific work was presented to the Scientific Ethics Committee on June 13 2019, which gave its opinion with an order of The Rector of Medical University - Plovdiv No. P-1742 / 28. 06. 2019. This scientific study has been conducted under project No.-12/2019 of the Medical University of Plovdiv on the topic: Physical development and health behavior of adolescents (11-14 years old) from different ethnic groups in the Municipality of Plovdiv.

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## REFERENCES:

1. Sheldon WH, Stevens SS, Tucker WB. The Varieties of Human Physique: An Introduction to Constitutional Psychology. Harper. 1940. 347 p.
2. Carter JEL, Heath BH. Somatotyping: Development and Applications. In: Cambridge Studies in Biological and Evolutionary Anthropology. Series No.5. Cambridge University Press. 28. 06. 1990. 503p. [[Internet](#)]
3. Yordanov Y. (Editor). Anthropology of the Bulgarian population at the end of the 20th century: 30-40 years old persons. [in English & Bulgarian Academicno Izdatelstvo, Sofia. December 31, 2006. 431 p.
4. Toteva M. [Somatotype characteristics of sportsmen.] [PhD thesis] Sofia (Bulgaria): National Sports Academy. 1994. [in Bulgarian].
5. Becheva MV. [Textbook of kinesitherapy.] MU-Plovdiv. 2019. 531p. [in Bulgarian]
6. Becheva MV, Viteva E. [Handbook of kinesitherapy for some neurological diseases.] MU-Plovdiv. 2013. [in Bulgarian]
7. Bruneau-Chávez J, Maldonado-Hernández V, Lagos-Hernández R. Somatotype differences between 12 and 13-year-old Mapuche and non-Mapuche children from Malleco, Araucanía, Chile. *Rev Fac Med*. 2021; 21(1):124-129. [[Crossref](#)]
8. Nutsolu L, Thejashano N, Ngaranmi M, Tsukru V. Anthropometric Somatotype among the Adolescent Boys of a Tribal Population in India. *Antrocom J of Anthropology*. 2021; 17(2):271-280. [[Internet](#)]
9. Tsukru V, Dkhar JW. Age Changes in Somatotypes among the Chakhesang Naga Boys of Dimapur District, Nagaland. In: Human Diversity

in North-East India: Bio-Anthropological Approaches. Edited by: Sengupta S, Dutta D. Kalpaz Publications. 2021; Chapter 18, pp. 227-238.

10. Rahmawati NT, Hastuti J. Secular Change in Body Size and Somatotype of Indonesian Children aged 7–15 Years (1999–2019). *Open Access Maced J Med Sci*. 2021 May 13; 9(E):419-27. [[Internet](#)]

11. Albataineh SR, Badran EF, Tayyem RF. Overweight and obesity in childhood: Dietary, biochemical, inflammatory and lifestyle risk factors. *Obes Med*. 2019 Sep;15:100112. [[Crossref](#)]

12. Jebeile H, Kelly AS, O'Malley G, Baur LA. Obesity in children and adolescents: epidemiology, causes, assessment, and management. *Lancet Diabetes Endocrinol*. 2022 May; 10(5):351-365. [[PubMed](#)]

13. Pulgarón ER. Childhood obesity: a review of increased risk for physical and psychological comorbidities. *Clin Ther*. 2013 Jan;35(1): A18-32. [[PubMed](#)]

14. Horesh A, Tsur AM, Bardugo A, Twig G. Adolescent and Childhood Obesity and Excess Morbidity and Mortality in Young Adulthood—a Systematic Review. *Curr Obes Rep*. 2021 Sep;10(3):301-310. [[PubMed](#)]

15. Jebeile H, Cardel MI, Kyle TK, Jastreboff AM. Addressing psychosocial health in the treatment and care of adolescents with obesity. *Obesity (Silver Spring)*. 2021 Sep;29(9):1413-1422. [[PubMed](#)]

16. Ruiz JR, Ortega FB, Meusel D, Maarike Harro M, Oja P, Sjöström M. Cardiorespiratory fitness is associated with features of metabolic risk

factors in children. Should cardiorespiratory fitness be assessed in a European health monitoring system? The European Youth Heart Study. *J Public Health*. 2006 Mar;14:94–102. [[Crossref](#)]

17. Mintjens S, Menting MD, Daams JG, van Poppel MNM, Roseboom TJ, Gemke RJJ. Cardiorespiratory Fitness in Childhood and Adolescence Affects Future Cardiovascular Risk Factors: A Systematic Review of Longitudinal Studies. *Sports Med*. 2018 Nov;48(11):2577-2605. [[PubMed](#)]

18. Silventoinen K, Maia J, Jelenkovic A, Pereira S, Gouveia É, Antunes A, et al. Genetics of somatotype and physical fitness in children and adolescents. *Am J Hum Biol*. 2021 May;33(3):e23470. [[PubMed](#)]

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