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## Changes in somatotype characteristics in the middle-aged Bulgarian men

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### Abstract

**Objective:** the objective of this cross-sectional research was to outline the different somatotypes and the trends in the changes of the three basic components (endomorph, mesomorph and ectomorph) among the middle-aged Bulgarian men.

**Material and methods:** the Heath-Carter method was used to identify the anthropometric somatotypes of 860 adult men, aged 30-50 years old, from the city of Plovdiv, located in Central Bulgaria. The men were divided into 4 age groups, in five-year intervals. In each case body height, weight and a series of skinfolds, circumferences and diameters were measured to calculate the somatotype. The SPSS package was used for the statistical analysis.

**Results:** the results show a prominent endo-mesomorphic model in the study sample of male population. We found age-related increase of the values of the muscle-bone component, retention of the level of the fatty component and a decline in the ectomorphy. Regardless the quantitative changes of the three components, the correlation between them remains constant and the mean somatotype is preserved. A greater variety of morphotypes is found in the group of men aged 30-35. The most homogeneous group is that of the 45-50 year old men. This group is entirely dominated by the mesomorphic component (strength), and the endomorphic component (obesity) is greater than the ectomorphic one (linearity).

**Conclusion:** the study finds that in the years between 30 and 50 the men tend to build muscle rather than fat. The 50 year-old men are more mesomorphic than the men at the age of 30, but they are shorter and with less elongated body segments.

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Key words: Adults. Males. Age. Changes. Somatotype.

### CAMBIOS EN LAS CARACTERÍSTICAS DEL SOMATOTIPO EN HOMBRES BÚLGAROS DE MEDIANA EDAD

### Resumen

**Objetivo:** el objetivo de esta investigación transversal fue esbozar los diferentes somatotipos y las tendencias en los cambios de los tres componentes básicos (endomorfa, mesomorfa y ectomorfa) entre los hombres búlgaros de mediana edad.

**Material y métodos:** el método de Heath-Carter se utilizó para identificar los somatotipos antropométricos de 860 hombres adultos, con edades entre 30-50 años, de la ciudad de Plovdiv, ubicada en el centro de Bulgaria. Los hombres fueron divididos en 4 grupos de edad, en intervalos de cinco años. En cada caso la altura del cuerpo, el peso y una serie de pliegues cutáneos, circunferencias y diámetros se midieron para calcular el somatotipo. El paquete SPSS se utilizó para el análisis estadístico.

**Resultados:** los resultados muestran un modelo de endo-mesomorfo destacado en la muestra de estudio de la población masculina. Encontramos aumento relacionado con la edad de los valores del componente masa muscular-ósea, retención del nivel del componente grasa y un descenso en el ectomorfa. Independientemente de los cambios cuantitativos de los tres componentes, la correlación entre ellos sigue siendo constante y el somatotipo medio se conserva. Una mayor variedad de morfotipos se encuentra en el grupo de hombres de 30-35 años de edad. El grupo más homogéneo es el de los hombres de 45-50 años de edad. Este grupo está dominado totalmente por el componente mesomórfico (fuerza), y el componente endomórfico (obesidad) es mayor que el ectomórfico (linealidad).

**Conclusión:** el estudio revela que entre los años 30 y 50 los hombres tienden a construir músculo en lugar de grasa. A los 50 años de edad, los hombres son más mesomórficos que los hombres a la edad de 30, pero son más bajos y con segmentos corporales menos alargados.

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Palabras clave: Adultos. Hombres. Edad. Cambios. Somatotipo.

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## Introduction

The technique of somatotyping is a widely-applied universal method of appraising body shape and structure. The somatotype indirectly characterizes the body composition, the level of metabolism, the predisposition to certain diseases, and in this sense it is viewed as an integral characteristic of the morphological status of man. The great variety of somatotype studies provides useful information for the description and comparison of man's physical characteristics in various populations. Most frequently somatotype studies are conducted during adolescence, when the body structure changes considerably under the influence of active growth processes<sup>1,2,3</sup>. Studies are also carried out in the field of sports medicine, for the purpose of selection of athletes<sup>4,5,6</sup> or for health control<sup>7,8,9</sup>. Changes in the morphological structure are discussed in relation to changes in altitude<sup>10,11</sup>, nutrition<sup>12</sup>, and those related to age and sex<sup>13,14</sup>, as well as under the influence of urbanization factors<sup>15,16</sup>. Connections are sought between somatotype components and intellectual abilities<sup>17</sup>.

The somatotype methodology for physical classification of the human body was developed by Sheldon WH in 1940<sup>18</sup> and later developed by Heath BH, Carter JL<sup>19,20</sup>. This methodology describes the human body as a single unit, containing three basic components endomorphy, mesomorphy and ectomorphy. The first component, endomorphy, characterizes the relative obesity of the individual. The second, mesomorphy, determines the development of the skeleton and the muscles. The third – ectomorphy, identifies the relative length of the body and the length of each of the segments in relation to the height. The three basic components altogether determine the body shape of each person. Each component is designated by a number. The mean somatotype is a figure made up of three numbers which appraise the development of the three components. Scores under 2.5 are considered low, between 3 and 5 – average, between 5.5 and 7 – high, and over 7.5 – very high<sup>21</sup>.

In every society there is a small number of representatives of the three extreme somatotypes. The extreme endomorphic type is characterized by big and strong bones, chubby shape and a high percentage of body fats. The extreme mesomorphic type has the best genetic prerequisites for building muscle mass, athletic body and naturally great physical strength. The extreme ectomorph is characterized by a long lean body, long arms and legs, and low percentage of subcutaneous fats. There are few men who belong entirely to any of the extreme morphotypes. The core of the population is a mixture of these three components in various combinations, on the basis of which thirteen somatotypes can be found. Studying the somatotype characteristics is a challenge for all researchers working in the field because of the great variety of body types.

In each of us there are genetic prerequisites which determine the shapes and structures of our bodies. Some studies of family correlations prove the role of genetic factors in explaining the variations in human physiology<sup>22,23</sup>. On the other hand, the somatotype is affected by the environment as well. Physical activity, nutrition habits, age, professional, medical and other variables may account for the different morphological structures.

In Bulgaria somatotype is most often applied to study the morphometric variations during growth<sup>24,25</sup> or sports<sup>26</sup>. Associations are also sought between the somatotype and its basic components with regard to the spread of diseases<sup>27,28,29,30</sup>. Somatotype variations are studied not only in children and adolescents, but also in young people in the age of transition into adulthood, namely at the age of 19-20 years, when a number of metric indicators have reached their definitive values, while others continue changing and developing<sup>31</sup>. There are relatively fewer studies treating questions of age-related features in body structure among middle-aged population. In this respect the last nation-wide study of the physical development (including a somatotype study) of the adult population of Bulgaria aged 30-40 years was conducted during the previous century in the period 1989-1993<sup>32</sup>.

The small number of studies of the variations in people's physique among middle-aged people who are in a biologically stable phase defined the interest in the present study. It aims at outlining the different somatotypes and the trends in the changes of the three basic components (endomorphy, mesomorphy ectomorphy) among the Bulgarian adult male population between 30 and 50 years of age.

## Materials and methods

A cross-section population study was carried out on a sample of 860 men aged 30-50 (mean age of 39.08 ± 6.68 years) in 2004-2008 in Plovdiv, the second largest administrative city of Bulgaria. All men volunteered to take part in the study. They were clinically healthy and employed in a number of factories and companies in the city. The study was made in accordance with the ethical principles for medical research involving human subjects based in the Helsinki Declaration of World Medical Association<sup>33</sup>. The men were divided into 4 age groups, in five-year intervals: 30-35 years, 36-40 years, 41-45 years and 46-50 years. In each case the following parameters were tracked - height, weight, distal humerus and femur bone diameters, biceps and calf girths, skinfolds at triceps, subscapular, calf and supraspinal sites by means of standard anthropometric tools.

Body height is taken standing upright, barefoot with a precision of up to 0.1 cm by means of an original GPM anthropometer. Body weight is taken barefoot, with minimal clothing, by means of Tanita BC 465

electronic scales with a precision of up to 0.1 kg. Distal humerus and femur bone diameters are measured by means of a pair of calipers with a precision of up to 1 mm. Biceps girth is taken with a centimeter tape, measured with a precision of up to 1 mm during maximally flexed upper limb. The girth of the shank is taken by means of a centimeter tape in a relaxed position of the lower limb, at the level of the greatest circumference of the shank. The skin folds were measured thrice by means of a Harpenden caliper with a constant pressure of 10 g/mm, with a precision of up to 0.1 mm on the right side of the body. The somatotype characteristic is determined through the method of Heath-Carter (1957, 1990). The statistical data analysis was made with SPSS for Windows software. Descriptive statistics was applied. Age-related differences were checked against t-criteria of Student at significance level  $p < 0.05$  and  $p < 0.01$ .

## Results

The mean values of the three somatotype components are presented by age in table I, table II and table III.

The first somatotype component – endomorphy, showed similar values in all four age groups (4.25; 4.41; 4.42; 4.46). Changes in the development of this component are in the range of 0.01 to 0.21 somatotype units (SU). The highest mean value is registered in the last age range, 45-50 but the increase is insignificant ( $p > 0.05$ ).

The second somatotype component, mesomorphy, has the lowest mean value among the youngest group of men aged 30-35 (5.59 SU). Mesomorphy increases considerably in the next age group, aged 36-40, reaching 6.41 SU ( $p < 0.01$ ), and maintaining almost the same levels in the next 5 years (6.55 SU). A second, significant change is observed in the last group. The mean value of mesomorphy among the group aged 45-50 years decreases, reaching 6.16 SU ( $p < 0.05$ ), but nevertheless retaining higher values than the group of 30-35 year-old-men.

The third somatotype component – ectomorphy, has its highest values in the beginning of the studies age range 30-35 years (1.49 SU). After that ectomorphy decreases significantly. The first time is during the ages of 36-40 (1.13 SU,  $p < 0.01$ ) and a second time at the end of the study period within the age range of 45-50 years (0.89 SU,  $p < 0.05$ ).

Table IV presents the mean somatotype by age range on the basis of the mean values of the three components. The results show that mesomorphy has highest values in all four age groups, followed by endomorphy, with ectomorphy with the lowest occurrence. This means that men aged between 30 and 50 all belong to the same morphotype: Endomorphic mesomorph.

Table V presents the percentage rate of the various somatotype categories within the age range of 30-50 years of age. The highest percentage of men among the first age range included in the study – males between

30 and 35 years of age have a predominant mesomorphic component. The largest relative share belongs to the category Endomorphic mesomorph (73.68%), followed by the category Balanced mesomorph (9.90%) and Ectomorphic mesomorph (6.2%). The second most widely spread body type has equal shares of two or three components: Endomorph-Mesomorph (3.10%), Mesomorph-Ectomorph (1.86%) and Central somatotype (1.55%). The least frequent somatotype categories have a predominance of the endomorph or ectomorph component. Yet, even with low occurrence (between 1.55% and 0.62%) all variant do exist.

In the late phase of the study, among the men of 45-50 years of age 90% fall within the category Endomorphic mesomorph somatotype. The remaining 10% at this age are allocated in a number of similar somatotypes in which mesomorphy is once more the main component.

**Table I**  
Mean value of the endomorphic component by age

Age (years)	N	Endomorphy		p-value
		Mean	SD	
30-35	323	4.25	1.52	
36-40	175	4.41	1.43	0.259
41-45	161	4.42	1.41	0.948
45-50	201	4.46	1.31	0.780

**Table II**  
Mean value of the mesomorphic component by age

Age (years)	N	Mesomorphy		p-value
		Mean	SD	
30-35	323	5.59	1.62	
36-40	175	6.41**	1.51	0.000
41-45	161	6.55	1.54	0.401
45-50	201	6.16*	1.33	0.016

$p < 0.05^*$ ;  $p < 0.01^{**}$

**Table III**  
Mean value of the ectomorphic component by age

Age (years)	N	Ectomorphy		p-value
		Mean	SD	
30-35	323	1.49	1.14	
36-40	175	1.13**	0.97	0.000
41-45	161	1.09	1.04	0.715
45-50	201	0.89*	0.78	0.037

$p < 0.05^*$ ;  $p < 0.01^{**}$

**Table IV**  
Mean somatotype by age

Age (years)	N	Endomorphy	Mesomorphy	Ectomorphy	Mean somatotype
30-35	323	4.25	5.59	1.49	Endomorphic mesomorph
36-40	175	4.41	6.41	1.13	Endomorphic mesomorph
41-45	161	4.42	6.55	1.09	Endomorphic mesomorph
45-50	201	4.46	6.16	0.89	Endomorphic mesomorph

**Table V**  
Age-related somatotype category distribution

Age (years)	30-35		36-40		41-45		46-50		
Somatotype	N	%	N	%	N	%	N	%	
Categories with equal shares of 2 or 3 components	Central	5	1.55%	2	1.14%	-	-	-	-
	Mesomorph-Ectomorph	6	1.86%	-	-	3	1.90%	-	-
	Endomorph- Ectomorph	-	-	-	-	-	-	-	-
	Endomorph-Mesomorph	10	3.10%	3	1.71%	6	3.70%	5	2.50%
Categories with dominating endomorphic component	Balanced endomorph	-	-	-	-	-	-	-	-
	Mesomorphic endomorph	3	0.93%	2	1.14%	2	1.20%	1	0.50%
	Ectomorphic endomorph	2	0.62%	-	-	-	-	-	-
Categories with dominating mesomorphic component	Balanced mesomorph	32	9.90%	14	8.00%	7	4.30%	9	4.50%
	Endomorphic mesomorph	236	73.68%	144	82.30%	134	83.20%	181	90.00%
	Ectomorphic mesomorph	20	6.20%	7	4.00%	8	5.00%	5	2.50%
Categories with dominating ectomorphic component	Balanced ectomorph	2	0.62%	-	-	-	-	-	-
	Endomorphic ectomorph	2	0.62%	-	-	-	-	-	-
	Mesomorphic ectomorph	5	1.55%	3	1.71%	1	0.60%	-	-

## Discussion

The results of the present study are discussed in relation to human middle-aged physical appearance, with a focus on the application of the Heath-Carter method of somatotype study. The analysis focuses on possible changes in male adult morphostructure during the age range of 30-50 years

The results show that for that 20-year time span the endomorphic component remains relatively stable, maintaining similar mean values. This means no change in the growth of subcutaneous body fat. The endomorphy values of 5.00 however, correspond to relatively moderate obesity.

Unlike the endomorphic component, the mesomorphic undergoes considerable change. During the age range 30-45 this muscle tissue-related component progresses and increases from 5.59 to 6.55. This condition is probably due to the physical and professional activity of the persons during this age range. Similar

results have been reported in another transversal study which points to the fact that endomorphy in men remains almost unchanged after the age of 30q whereas mesomorphy continues to grow until the end of the fifth decade<sup>34</sup>.

In comparison with the other two components, the third – ectomorphy has the lowest mean values and decreases considerably with age. The decline of ectomorphy, which characterizes the relative linearity of the body, may logically be related to the differences in height and weight of men between 30 and 50 years of age. Other studies also report an increase in mesomorphy and reciprocal decrease of ectomorphy up to the age of 55<sup>34,35</sup>.

The results of our study show that regardless of the quantitative changes during the 30-50 year age range in men, the correlation between the components does not change. Mesomorphy is the dominant component in all age groups, endomorphy comes second in significance, and ectomorphy is least frequent. This means



that despite variations in mean values, the mean somatotype in men remains constant. It is the category of endomorphic mesomorph. Men belonging to this category typically have a solid bone structure, prominent muscles, medium to low height, moderate to high percentage of subcutaneous fats.

Our results coincide with the data from the representative national anthropological study of the Bulgarian population carried out in 1989-1993 at the Institute of Experimental Morphology and Anthropology at the Bulgarian Academy of Sciences<sup>32</sup>. According to it at the end of the last century the mean male somatotype of men aged 30-40 years belongs to the category endomorphic mesomorph (4.06-5.95-1.29).

It must be noted that the youngest men included in our study display a greater variety of individual body types. Apart from the high percentage of the endo-mesomorphic somatotype (73.68%), their group contains almost all morphotype categories with the exception of endomorph-ectomorph and the balanced endomorph. By the end of the study period the relative share of the endo-mesomorph increases significantly (90%), and number of the remaining morphotypes decreases considerably, especially those with a dominant ectomorphic component. Our results support the data from another population survey conducted in 2000 in Sofia, regarding age-related increase of the percentage of the endo-mesomorphic somatotype in men above the age of 40<sup>29</sup>.

The results show that in the years between 30 and 50 men tend to build muscle rather than fat. The 50 year-old men are more mesomorphic than women, but they are shorter and with less elongated body segments.

## Conclusion

Anthropometric somatotype is a useful method of providing a biometric appraisal of the changes occurring the people's morph structure during the different phases of their lives. We studied the characteristics of the body structure during the period between 30 and 50 years of age in cross section sample of 860 men from Central Bulgaria – the city of Plovdiv. We found age-related increase of the values of the muscle-bone component, retention of the level of the fatty component and a decline in the ectomorphy. Regardless the quantitative changes of the three components, the correlation between them remains constant and the mean somatotype is preserved. The results show clearly a prominent endo-mesomorphic model in the study sample of male population. A greater variety of morphotypes is found in the group of men aged 30-35. The most homogeneous group is that of the 45-50 year old men. This group is entirely dominated by the mesomorphic component (strength), and the endomorphic component (obesity) is greater than the ectomorphic one (linearity).

The age-related body characteristics of the 30-50-year-old male population of Plovdiv are probably due not only to genetic factors, but also to lifestyle, nutrition and sports habits, access to health services and general knowledge of medicine which has a reflection on the quality of their lives. This will be the subject of analysis in our future research.

## Conflicts of interest statement

The authors report no conflicts of interest. The authors alone are responsible for the content and writing of the paper.

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