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SOMATOTYPE CHARACTERISTICS OF BULGARIAN PATIENTS WITH TYPE 1 DIABETES MELLITUS

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Abstract

The aim of the present study was to determine the somatotype of adult Bulgarian patients with type 1 diabetes mellitus. Sixty male and 60 female patients aged 20 to 40 years were involved in the study. A sample of healthy Bulgarian individuals (40 females and 40 males) in the same age range as the patients was used as a control group. The measurements were done by direct anthropometry. The Heath–Carter anthropometric method was used to rate the somatotype components of each participant. The mean somatotype of the female diabetic patients was mesomorphic endomorph (endo 5.37; meso 4.51; ecto 1.42). The endomorphic component was dominant, followed by the mesomorphic component and the ectomorphic component with the lowest rating. The mean somatotype of the control females was balanced endomorph (endo 3.74; meso 2.81; ecto 2.98). The endomorphic component was dominant, but the mesomorphic and ectomorphic components were equally presented. The values of endomorphic and mesomorphic components were significantly higher in the female patients than in the healthy women. In males, both the diabetic patients and control individuals presented with endomorphic mesomorph somatotype: patients (endo 3.94; meso 4.66; ecto 2.37) and controls (endo 4.34; meso 5.19; ecto 2.22). The mesomorphic component was dominant, followed

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by the endomorphic component and the ectomorphic component was with the lowest rating. The mesomorphic component was significantly greater in the healthy males than in the male patients.

Key words: type 1 diabetes mellitus, Bulgarians, anthropometry, body composition, somatotype

Introduction. Nowadays diabetes mellitus has become a global problem. It is a chronic metabolic disease, characterized by hyperglycemia, which is due to impaired insulin secretion, insulin action or both. An estimated 537 million people are affected by the disease worldwide (8.8% of the adult population). Approximately 6–8% of the Bulgarian population suffers from diabetes mellitus. This number is predicted to rise to 643 million by 2030 and 783 million by 2045 [1]. Type 2 diabetes makes up about 90% of the cases, whereas type 1 diabetes mellitus (T1DM) makes up 5 to 15 percent of diabetic patients and often involves children [1]. Rates are similar in women and men [2]. Type 1 diabetes mellitus (T1DM) is an autoimmune disease that leads to the destruction of insulin-producing pancreatic beta cells [3]. The destruction of the beta cells in the pancreatic islets over months or years causes an absolute deficiency of insulin. The chronic hyperglycemia is associated with long-term damage and failure of various organs, especially eyes, kidneys, nerves, heart, and blood vessels [4].

Most of the researchers have been predominantly interested in studying the etiology, pathogenesis, clinical course, and treatment of the disease, while the evaluation of the anthropological status of patients suffering from T1DM draws little attention.

W. Sheldon was the first who introduced the somatotype concept in defining the morphological constitutional type. He determined three components of the human somatotype: endomorphic, mesomorphic, and ectomorphic. Later Heath and Carter [5] 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. The lack of relevant data in this scientific field has provoked our interest in studying the somatotype of patients with T1DM in the age range 20 to 40 years. This survey is original for Bulgarian patients with type 1 Diabetes mellitus.

The aim of the present study was to determine the somatotype of adult Bulgarians with type 1 diabetes mellitus.

Material and methods. ***Patients.*** The type 1 diabetes mellitus group comprised 120 subjects (60 males and 60 females) aged 20 to 40 years. The mean age was 29.09 ± 1.29 years of the female patients and 30.08 ± 1.16 years of the male patients. The study was conducted in the Clinic of Endocrinology and Metabolic Diseases at the University Hospital "St. George" in Plovdiv, Bulgaria, in the period 2019 to 2022.

The inclusion criteria were Bulgarian ethnicity, type 1 diabetes mellitus, duration of the disease no less than one year, and clinically controlled diabetes at the time of the study.

The exclusion criteria were previous or existing metabolic, oncological, and other disorders that could compromise the anthropological study: thyroid-related diseases, adrenal glands related diseases, carcinoma, type 2 diabetes mellitus, pregnant and lactating women, the presence of heart, respiratory, renal or hepatic failure, proliferative retinopathy, diabetic macroangiopathy, the presence of acute decompensation of metabolic disease at the time of the study, hormonal (contraceptive) therapy less than 3 months prior to the start of the study, treatment of chronic concomitant pathology that could affect hormonal indices.

The control group included 40 healthy Bulgarian women and 40 healthy Bulgarian men aged 20 to 40 years. The mean age of the females was 30 ± 0.47 years, and 31.01 ± 0.31 years of the males.

The study was approved by the Ethics committee at the Medical University-Plovdiv, Protocol No. 4/08.06.2022. All participants have given their written informed consent in accordance with the Declaration of Helsinki 1964.

Methods. The anthropological method of Martin–Saller, modified by Yordanov et al. [6] was used.

Directly measured anthropological parameters:

- Biepicondilar breadth of Humerus
- Biepicondilar breadth of Femur

Circumferences

Upper limb: arm relaxed, arm contracted, forearm

Body: waist, hip

Lower limb: thigh and calf

Skin folds

Skinfold thickness was measured at nine sites on the right side of the body, using 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 [5].

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

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

Mesomorphy = 0.858*biepicondylar diameter of humerus + 0.601*biepicondylar diameter of femur + 0.188*corrected circumference of contracted arm + 0.161*corrected circumference of calf − 0.131*height + 4.5

$$\text{Ectomorphy} = \text{height (cm)}/\sqrt[3]{\text{weight(kg)}} * 0.732 - 28.58$$

Somatoplots were done according to Toteva [7]. The data obtained was analysed 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. ***Mean somatotype of female patients suffering from type 1 diabetes mellitus and healthy females.***

The mean somatotype of the female patients with T1DM was defined as **mesomorphic endomorph**. The endomorphic component was dominant, followed by the mesomorphic component and the ectomorphic component much lower. High level of statistical significance was found between the somatotype components endomorphy > mesomorphy > ectomorphy ($p < 0.001$) (Table 1, Fig. 1).

The mean somatotype of healthy women was defined as **balanced endomorph**. The endomorphic component dominated significantly ($p < 0.001$). No significant difference was found between the mesomorphic and ectomorphic components ($p > 0.05$). Endomorphy$^{(p<0.001)}$ > Mesomorphy = Ectomorphy$^{(p>0.05)}$ (Table 1, Fig. 1).

The ratings of the endomorphic and mesomorphic somatotype components were significantly greater in the female patients than in the healthy controls

Table 1

Mean somatotype of women with type 1 diabetes mellitus and healthy controls

	Female patients				Healthy women					
Components	N	Mean	SEM	SD	N	Mean	SEM	SD	P	t
Endomorphy	60	5.37	0.36	1.94	40	3.74	0.19	1.13	< 0.001	4.79
Mesomorphy	60	4.51	0.22	1.18	40	2.81	0.24	1.48	< 0.001	6.37
Ectomorphy	60	1.42	0.30	1.62	40	2.98	0.23	1.36	< 0.001	5.02
	Mesomorphic endomorph				Balanced endomorph					

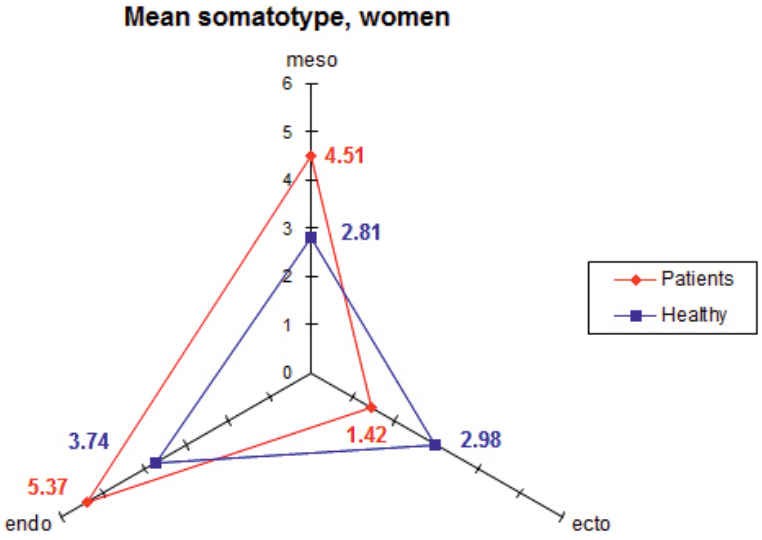


Fig. 1. (Somatoplot) Mean somatotype of women with type 1 diabetes mellitus and healthy controls

($p < 0.001$). Conversely, the ectomorphic component was significantly greater in the healthy females than in female patients ($p < 0.001$).

Mean somatotype of male patients suffering from type 1 diabetes mellitus and healthy males.

The mean somatotype of both diabetic and healthy males was defined as **endomorphic mesomorph**. The mesomorphic component was dominant, followed by the endomorphic component and the ectomorphic component was the lowest in both groups. The differences between the somatotype components were of high statistical significance ($p < 0.001$). The mesomorphic component was significantly greater in the healthy individuals than in the diabetic patients. No statistically significant differences were found in the ratings of the endomorphic and ectomorphic components between the male patients and healthy controls ($p > 0.05$) (Table 2, Fig. 2).

T a b l e 2

Mean somatotype of men with type 1 Diabetes mellitus and healthy controls

	Male patients				Healthy men					
Components	*N*	Mean	SEM	SD	*N*	Mean	SEM	SD	*P*	*t*
Endomorphy	60	3.94	0.35	2.01	40	4.34	0.27	1.69	> 0.05	1.18
Mesomorphy	60	4.66	0.22	1.25	40	5.19	0.19	1.16	< 0.05	2.14
Ectomorphy	60	2.37	0.32	1.82	40	2.22	0.20	1.24	> 0.05	0.60
	Endomorphic mesomorph				Endomorphic mesomorph					

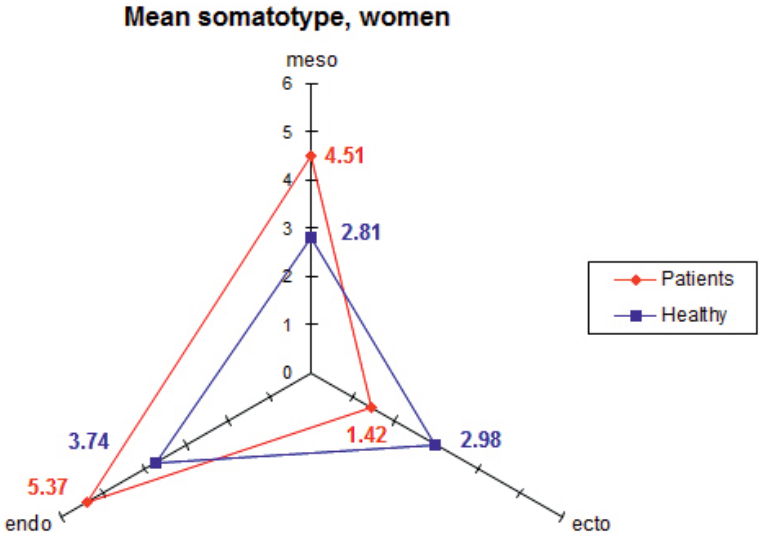


Fig. 2. (Somatoplot) Mean somatotype of men with type 1 diabetes mellitus and healthy controls

Discussion. 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 relative predomination of structures associated with digestion and assimilation, internal organs, including fat deposition. Mesomorphy reflects the development of human body structures of mesodermal origins, for example skeleton and muscle system. Ectomorphy reflects the development of structures of ectodermal origin (skin, nerve system).

The scientific literature provides scanty information on somatotype characteristics of patients with type 1 diabetes mellitus. Most studies have reported on the somatotype in patients suffering from type 2 DM [8, 9]. The somatotype of Bulgarian adults with type 2 Diabetes mellitus (T2DM) has also been studied [10, 11]. However, the etiology and pathogenesis of T2DM is very different as well as the age range of the studied patients (41–80 years). A study of the somatotype of Bulgarian children with T1DM has been performed by Baltadjiev et al. [12]. However, the intensive growth of the body and the different age ranges should be considered [13–15].

The mean somatotype of the female patients in our study was mesomorphic endomorph. The endomorphy was dominant, followed by mesomorphy and the ectomorphy remained far behind. However, the mean somatotype of the same aged healthy women was balanced endomorph. The dominant component also was the endomorphy, and mesomorphy and ectomorphy were presented almost equally: meso 2.81, ecto 2.98 ($p > 0.05$). The comparison of both groups showed that the mean values of endo- and mesomorphic components were significantly higher in the female patients than in the healthy women. A very interesting finding was

the opposite proportion of the ectomorphic components. The ectomorphy was significantly greater in the healthy women than in the female patients. Therefore, the mean somatotype of female patients was more endomorphic than that of the healthy women. These findings are in accordance with the findings of our previous studies. We reported significantly higher values of neck, arm, forearm, waist, and calf circumferences in female patients with T1DM than in healthy women at the same age [16]. We assume that the reported results are a consequence of the greater deposition of adipose connective tissue in the bodies of female patients than in healthy women. Similar results reported by Kusumaningnastiti et al. [17] correlated the endomorphy with a metabolic syndrome risk score. The different somatotypes of healthy and diabetic patients can be explained by the effect of T1DM.

The mean somatotype of the male patients matches the mean somatotype of the healthy men. Both somatotypes were defined as endomorphic mesomorph. The mesomorphy was the highest rating, followed by the endomorphy and the ectomorphy was far behind. These data indicated that both groups – diabetic patients and healthy men had a well-developed skeleton and muscle system. Such somatotype in same-aged Bulgarian healthy men was defined by Koleva et al. [18] and Andreenko and Mladenova [19]. The mean value of mesomorphic component in the healthy men was significantly higher than in the male patients ($p < 0.05$). That means that the healthy men had a more developed skeleton and muscle system compared to the male patients. This difference could be a consequence of the impact of the disease. A very interesting finding was that the mesomorphic component was more expressed in the female patients than in the healthy women at the same age ($p < 0.001$). The endomorphic component was second, whereas the ectomorphic component was with the lowest rating. No statistically significant difference was found in the mean values of endo- and ectomorphic components between the male patients and the healthy males ($p > 0.05$). Close to our results were reported by Kuźmicka et al. [20].

Conclusion. The mean somatotype of the Bulgarian female patients with type 1 diabetes mellitus is mesomorphic endomorph. The endomorphic component is dominant, followed by the mesomorphic component and ectomorphic component with the lowest rating.

The mean somatotype of the healthy Bulgarian females is balanced endomorph. The endomorphic component is dominant, while the mesomorphic and ectomorphic components are equally presented. The values of endomorphic and mesomorphic components are significantly higher in female patients.

Both the Bulgarian male patients with type 1 diabetes mellitus and the healthy Bulgarian males have endomorphic mesomorph somatotype. The mesomorphic component is dominant, followed by the endomorphic component and the ectomorphic component with the lowest rating. The mesomorphic component is significantly greater in the healthy males than in the male patients.

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