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ON ANTHROPOMETRIC DATA OF THE MALE STUDENT CANDIDATES OF THE INSTITUTE OF SPORT SCIENCES AND PHYSIOTHERAPY AT THE UNIVERSITY OF TARTU IN 2017

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ABSTRACT

The purpose of this study was to investigate some anthropometric variables of student candidates of the Institute of Sport Sciences and Physiotherapy, Faculty of Medicine, University of Tartu in 2017. All anthropometric measurements were made according to the recommendations of R. Martin [7].

Comparison of the height and weight data of the studied subjects with the height and weight norms of Estonia provided by Kaarma et al. [9] revealed that the entrants were taller in height but with the same average weight.

In our study, the somatotypes recommended by Kaarma et al. [9] were used for the first time on entrants to the university. Our study found that male student candidates' body somatotypes were divided into SD classes as follows: small 8.6%, medium 22.9%, large 18.6%; subtypes of pycnomorphic somatotypes: 7.1% in class I, 1.4% in class II, and 8.6% in class III; leptomorphic somatotypes were divided: 11.4% in class I, none in class II and 31.4% in class III.

Based on the recommendations of several authors, we calculated the ideal body weight for all the entrants enrolled in the study.

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Comparison of the average body weight of entrants with the average weight calculated using the ideal weight method revealed an interesting situation. Namely, the mean values calculated using the Devine (1974) formula did not differ statistically significantly from the mean of the measured weights ($t=0.101$, $p> 0.05$). Neither did Devine's (1974) ideal weight and BMI, Rohrer's index and ponderal index calculated from it, and the body surface calculated according to the formulas of Dubois and Dubois and Mosteller differ from the actual figures.

Keywords: *anthropometry; height; weight; ideal weight; indices*

INTRODUCTION

The founder of contemporary physical anthropology in Estonia, Juhan Aul, considered it important to assess the physical development of a great number of schoolchildren, to pay greater attention to anthropometric studies of women and men and regularly publish papers on anthropology [1, 2, 3, 4, 5].

In 1932–1936, Aul investigated the physical anthropology of 15 110 servicemen of the Estonian army. The studies were carried out before their release from military service. The investigated persons were mainly 22 years old. Aul also notes that some anthropologists did not consider it correct to study servicemen's body build, as they were persons whom the medical commission had found suitable for military service, and, therefore, they were persons with good mental and physical health [2].

In Aul's opinion, there were good conditions for anthropological measuring in the Estonian army. Aul also followed the rule that all Estonian towns, counties and parishes should be proportionally included. At anthropological measuring, Aul followed the well-known rules of R. Martin.

In 1956, Aul [5] started a broad-based anthropometric study of Estonian schoolchildren aged 7–18 years. The study finished in 1967. The material of the study contained the data of more than 30 000 children – 14 862 boys and 15 195 girls.

Kaarma et al. [9, 10] recently published two important papers concerning Estonians' anthropology – based on women's and men's height and weight data, the means of Estonian women and men aged 20–70 years, the national norms and also the classification of somatotypes of body build were presented. The second work concerns the height and weight norms and somatotypic height-weight classification of contemporary schoolchildren (10 062 boys and 11 204 girls) aged 7–18 years.

The aim of the present study was to investigate some anthropometric parameters – height and weight, waist and hip circumference of the male student candidates of the Institute of Sport Sciences and Physiotherapy in 2017.

Another aim of our study was to investigate the relationship between the ideal weights recommended by several authors and the actual weights of our subjects and the relationship between the anthropometric indices found by the ideal weights and the indices calculated from the actual anthropometric data.

MATERIAL AND METHODS

The subjects of the present study were 72 male student candidates of the Institute of Sport Sciences and Physiotherapy in 2017.

Total body weight was measured with a Soehnle digital scale with the precision of 0.1 kg. During the anthropometric investigation the rules of R. Martin [7] were followed. The measurements included body height and waist and hip circumferences.

Omron ®BF 300 body fat monitor (Omron/Matsusaka Co Ltd., Japan) – the hand-held BIA segmental unit – was used to assess body fat percentage. Information about the subject's height, weight, age and sex was entered into the BIA data collection equipment. The resistance value was measured for each person while he comfortably gripped the handles of the BIA unit. Feet were placed shoulder width apart, and the unit was held in front of the body. The BIA unit has electrodes planted in its handles, and the electrodes measure impedance to the current as it travels between the right and the left hand. Approximately seven seconds after pressing the start button, the fat percentage and the fat mass are shown on the display. The measurements were taken twice, and the values averaged [6].

The body mass index (BMI) was calculated: BMI = weight kg / height m^2.

The ponderal index (PI) is a measure of leanness of a person; it is calculated as a relationship between mass and height: PI = weight kg / height m^3.

The Rohrer index (RI) was calculated: RI = 1000 × weight g / height cm^3.

The body surface area (BSA) was calculated by the formula of DuBois and DuBois: BSA = 0.20247 × height $m^{0.725}$ × weight $kg^{0.425}$.

The body surface area was also calculated by the formula of Mosteller:

$$\text{BSA} = \sqrt{\frac{weight\ kg \times height\ cm}{3600}}$$

The waist/hip ratio was calculated: waist cm / hip cm.

The waist/hip ratio percentage was calculated: waist cm / hip cm × 100.

The waist/height ratio percentage was calculated: waist cm /height cm × 100.

The hip/height ratio percentage is calculated: hip cm / height cm × 100.

The radius (r) of the waist (cm) was calculated by formula $r = C / 2\pi$.

The surface area of the waist (SAW) in cm^2 was calculated by formula $SAW = \pi \times r^2$.

The radius of the hip (cm) was calculated by the formula $r= C / 2\pi$.

The surface area (SAH) of the hip in cm^2 was calculated by formula $SAH = \pi \times r^2$.

The amount of time spent in sports was assessed by the subjects themselves.

Paul Broca, one of the founders of physical anthropology, was interested in the ideal weight of an individual as early as in the 19th century. Broca (1871) [11] proposed the formula for calculating an individual's ideal weight – ideal weight in kg = height in cm – 100.

Hamwi (1964) [11] suggested a new formula for calculating the ideal weight of a person. For men, the ideal weight could be calculated as follows: weight (lb) = 106 + 6 × (height – 60 inches).

Devine (1974) [11] updated the formula for calculating the ideal weight for men as follows: the ideal weight for a man in kg = 50 + 2,3 × (height – 60 inches).

Robinson et al. (1983) [11] proposed the following formula for the calculation of the ideal male weight: the individual's ideal body weight in kg = 52 + 1.9 × (height – 60 inches).

In the same year, (1983), Miller et al. [11] calculated the ideal male weight using the new formula: male ideal weight in kg = 56 + 1.41 × (height – 60 inches).

In 2000, Hammond [11] proposed to calculate the ideal weight of a man according to an advanced formula: the man's ideal weight in kg = 48 + 1.1 × (height – 150 cm).

The most recent formula for calculating the ideal male weight was suggested by Peterson et al. (2016) [11]: ideal male weight in kg = 2.1 × BMI + 3.5 × BMI × (height in metes – 1.5 meters). The BMI is set to 22.

RESULTS

The results of the study are presented in two tables. We would emphasize the observation that the ideal weight calculated by Devine's formula has very close values to the actual weight and, therefore, the calculated BMI, Rohrer's, ponderal index and body surface area do not differ significantly from the measured values.

Table 1. The anthropometric data, indices and ratios of the male student candidates of the Institute of Sports Sciences and Physiotherapy of Tartu University in 2017

No	Variable	Mean±SD	Small	Medium	Big
1.	Age (years)	20.771±2.910			
2.	Height (cm)	182.897±6.387	≤179.6	179.7–186.1	≥186.2
3.	Weight (kg)	77.751±9.722	≤72.8	72.9–82.6	≥82.7
4.	Body mass index (BMI)	23.213±2.398	≤21.9	22.0–24.4	≥24.5
5.	Ponderal index (PI)	43.023±1.501	≤41.4	41.5–44.5	≥44.6
6.	Rohrer index (RI)	1.271±0.141	≤1.1	1.2–1.3	≥1.4
7.	Body surface area (BSA) DuBois and DuBois m^2	1.992±0.141	≤1.8	1.9–2.1	≥2.2
8.	BSA Mosteller m^2	1.984±0.146	≤1.8	1.9–2.1	≥2.2
9.	Waist circumference (cm)	79.907±5.319	≤77.1	77.2–82.6	≥82.7
10.	Hip circumference (cm)	100,467±5.290	≤97.7	97.8–103.1	≥103.2
11.	Waist/hip ratio	0.795±0.029	≤0.77	0.78–0.81	≥0.82
12.	Waist/hip ratio %	79.526±2.982	≤77	78–81	≥82
13,	Waist/height ratio %	43.719±2.995	≤41	42–45	≥46
14.	Hip/height ratio %	54.953±2.687	≤53.5	53.6–56.3	≥56.4
15.	Radius of the waist cm	12.724±0.847	≤12.2	12.3–13.1	≥13.2
16.	Surface area (SA) of the waist cm^2	510.591±68.689	≤475	476–545	≥546
17.	Surface area of the waist/BSA DuBois %	2.557±0.252	≤2.3	2.4–2.7	≥2.8
18.	Radius of the hip cm	15.497±0.842	≤15.5	15.6–16.4	≥16.5
19.	Surface area of the hip cm^2	805.824±85.450	≤762	763–848	≥849
20.	Ratio surface area of the hip/BSA DuBois %	4.038±0,237	≤3.8	3.9–4.2	≥4.3
21.	Body fat percentage by Omron BF monitor	10.527±3.904	≤8.5	8.6–12.5	≥12.6
21.	Body fat in kg-s	8.496±3.986	≤6.4	6.5–10.5	≥10.6
22.	Experience of sport in years	10.881±3.324	≤9.1	9.2–12.5	≥12.6
23.	Exercising hours per week in preparatory training period	12.361±6.452	≤9.1	9.2–15.6	≥15.7

Table 2. Comparison of real anthropometric data and indices of entrants of the Institute of Sports Sciences with those calculated using ideal weights

Nr.	Author of the formula	Mean±SD	t-value	p-value
1.	Broca	82.897±6.387	3.753	≤0.05
2.	Hamwi	80.758±6.843	2.146	≤0.05
3.	Devine	77.616±5.783	0.101	≥0.05
4.	Robinson	74.812±4.778	2.302	≤0.05
5.	Miller	73.130±3.545	3.789	≤0.05
6.	Hammond	84.187±7.026	4.552	≤0.05
7.	Peterson	73.731±4.918	3.130	≤0.05
	BMI index			
8.	Broca	24.738±0.204	5.376	≤0.05
9.	Hamwi	24.087±0.386	3.053	≤0.05
10.	Devine	23.166±0.133	0.166	≥0.05
11.	Robinson	22.346±0.130	3.063	≤0.05
12.	Miller	21.876±0.467	4.643	≤0.05
13.	Hammond	25.112±0.369	6.641	≤0.05
14.	Peterson	22.019±0.072	4.223	≤0.05
	Rohrer's index			
15.	Broca	1.271±0.141	4.839	≤0.05
16.	Hamwi	1.318±0.026	2.781	≤0.05
17.	Devine	1.268±0.038	0.174	≥0.05
18.	Robinson	1.224±0.049	0.073	≥0.05
19.	Miller	1.198±0.068	3.956	≤0.05
20.	Hammond	1.374±0.028	6.079	≤0.05
21.	Peterson	1.205±0.046	3.776	≤0.05
	Reciprocal ponderal index			
22.	Broca	42.026±0.384	4.840	≤0.05
23.	Hamwi	42.402±0.278	2.781	≤0.05
24.	Devine	42.955±0.429	0.369	≥0.05
25.	Robinson	43.475±0.591	2.671	≤0.05
26.	Miller	43.797±0.822	3.956	≤0.05
27.	Hammond	41.817±0.292	6.079	≤0.05
28.	Peterson	43.689±0.552	3.775	≤0.05

Nr.	Author of the formula	Mean±SD	t-value	p-value
	BSA by DuBois and DuBois			
29.	Broca	2.050±0.119	2.667	≤0.05
30.	Hamwi	2.027±0.124	1.581	≥0.05
31.	Devine	1.994±0.144	0.094	≥0.05
32.	Robinson	1.963±0.103	1.409	≥0.05
33.	Miller	1.944±0.089	2.442	≤0.05
34.	Hammond	2.064±0.126	3.230	≤0.05
35.	Peterson	1.950±0.104	2.034	≤0.05
	BSA by Mosteller			
36.	Broca	2.052±0.115	3.104	≤0.05
37.	Hamwi	2.024±0,121	1,789	≥0.05
38.	Devine	1.985±0.108	0.046	≥0.05
39.	Robinson	1,949±0.096	1.699	≥0.05
40.	Miller	1.927±0.080	2.905	≥0.05
41.	Hammond	2.068±0.122	3.746	≤0.05
42.	Peterson	1.935±0.098	2.364	≤0.05

DISCUSSION

We compared the anthropometric data – height and weight – of the subjects of this study with the latest normative values of the Estonian population according to Kaarma et al. [9]. An interesting observation was made here that the entrants were taller than the normative values of men aged 20–24 in Estonia (t=2.386, p 0.05). The position of modern researchers is that body height of a person is an important signal of person's functioning and condition [12].

We were interested in investigating which somatotypes appear in the entrants when classifying them in the SD-height and weight classes published by Kaarma et al. [9]. In the above-mentioned article, Kaarma et al., classify Estonian subjects into nine classes. These are three proportional classes of height and weight – small, medium, large – and three subclasses of pycnomorphs and three subclasses of leptomorphs. The entrants we studied belonged to the following somatotype classes: small 8.6%, medium 22.9%, large 18.6%, pycnomorphs in class I 7.1%, in class II 1.4%, in class III 8.6%, subtypes leptomorphic somatotypes in class I 11.4%, none in class II and 21.4% in class III. Comparison of the average body weight of the entrants with the mean values

obtained using the ideal weights method also revealed an interesting situation. Only the mean values of the ideal weights calculated by Devine's formula did not differ statistically significantly from the mean values of the actual weights of the entrants. Similarly, the mean values calculated by Devine's formula, using ideal weight, calculated BMI, Rohrer's index, ponderal index, calculated body surface area, both by DuBois and DuBois formula and Mosteller formula, did not differ from the mean values of the same parameters of entrants. It should be mentioned that the principles for the classification of somatypes recommended by Kaarma et al. [10] were also used by Õun et al. [13] in their article published in *Papers on Anthropology*.

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