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COMPARATIVE ASSESSMENT OF THE PHYSICAL DEVELOPMENT OF BOYS AND GIRLS OF TAJIKISTAN

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Abstract. *Introduction.* Student youth is the most socially active and mobile group, which significantly determines the strategy and future of the country**.** *Purpose of research.* To evaluate the anthropometric indicators of the physical development of students in Tajikistan and compare them with the results of similar studies. *Material and methods.* We studied 390 students of the Khatlon State Medical University (KhSMU) of Tajikistan, among which there were 279 boys (71.5%), girls — 111 (28.5%), the average age was 19.3±1,7 years. The research program included the measurement of the main indicators of physical status: height (cm), body weight — BW (kg), body mass index — BMI (kg/m^2), right hand dynamometry (kg), somatotype determination. The results obtained were compared with data from similar studies of 15,686 students from 22 countries, whose average age was 20.8±2.6 years (Peitzer K. et al., 2014). *Results.* Average indicators of BMI, height and weight of students of KhSMU were 21.6±0.14 kg/m^2, 168.8±0.4 cm and 61.5±0.5 kg, respectively, while the same indicators of BMI, height and the weight of a similar group of young people from other countries were equal to: BMI from 18.1±1.9 kg/m^2 to 25.4±4.5 kg/m^2; height — from 163±0.07 m to 178±0.07 m, weight — from 56.7±7.8 kg to 78.0±13.9 kg, respectively. According to comparing, it was found that there were more students with normal weight in KhSMU than the average among girls and boys from other countries of the world, among the girls more than 15.4% and more than 19.1% among the boys. Body weight deficiency among girls of KhSMU was detected 6.8% less and indicators of overweight and obesity in girls from other countries were on average 7.6% more often than girls in KSMU. To assess the significance of differences was used Student's t-test, they were considered reliable at a significance level $p < 0.05$. *Conclusion.* It was revealed that the indicators of the physical development of boys and girls in Tajikistan in terms of weight and height parameters differed from those of their peers from other countries, which may be an indicator of the socio-economic characteristics of living.

Key words: *physical development; anthropometry; somatometry; dynamometry; indices; boys and girls*

СРАВНИТЕЛЬНАЯ ОЦЕНКА ФИЗИЧЕСКОГО РАЗВИТИЯ ЮНОШЕЙ И ДЕВУШЕК ТАДЖИКИСТАНА

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Резюме. *Введение.* Студенческая молодежь является наиболее социально активной и мобильной группой, которая в значительной мере определяет стратегию и будущее государства. *Цель исследования* — оценить антропометрические показатели физического развития студентов Таджикистана и сравнить их с результатами подобных исследований. *Материалы и методы.* Обследовано 390 студентов Хатлонского государ-

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ственного медицинского университета (ХГМУ) Таджикистана, среди которых юношей было 279 (71,5%), девушек — 111 (28,5%); средний возраст составлял 19,3±1,7 года. Программа исследований включала измерение основных показателей физического статуса: рост (см), масса тела — МТ (кг), индекс массы тела — ИМТ (кг/м^2), динамометрия правой кисти (кг), определение соматотипа. Полученные результаты сравнили с данными подобных исследований 15 686 студентов из 22 стран мира, средний возраст которых составлял 20,8±2,6 лет. *Результаты.* Средние показатели ИМТ, роста и массы тела студентов ХГМУ составили 21,6±0,14 кг/м^2, 168,8±0,4 см и 61,5±0,5 кг соответственно, в то время как такие же показатели ИМТ, роста и массы тела аналогичной группы молодежи из других стран составляли: ИМТ от 18,1±1,9 кг/м^2 до 25,4±4,5 кг/м^2; рост — от 163±0,07 см до 178±0,07 см, масса тела — от 56,7±7,8 кг до 78,0±13,9 кг соответственно. При сравнении установлено, что студентов с нормальной массой тела было больше на 15,4% среди девушек ХГМУ, а среди юношей — на 19,1%, чем в среднем среди девушек и юношей других стран мира. Показатели дефицита массы тела у девушек ХГМУ были на 6,8% меньше, чем у девушек других стран. Одновременно показатели избыточной массы тела и ожирения у девушек других стран были больше на 7,6% по сравнению с девушками ХГМУ. При определении достоверности различий использовали t-критерий Стьюдента, считали его достоверным при уровне значимости p <0,05. *Заключение.* Выявлено, что показатели физического развития юношей и девушек Таджикистана по весо-ростовым параметрам отличались от таковых у сверстников из других стран, что может быть индикатором социально-экономических особенностей проживания.

Ключевые слова: *физическое развитие; антропометрия; соматометрия; динамометрия; индексы; юноши и девушки*

INTRODUCTION

Students (boys and girls), united by specific conditions of education and lifestyle, constitute a special social group. Their physical health is a feature that determines the level of public health. Studying in higher education is a specific form of intellectual activity, which leads to changes in lifestyle, affects health, requires the development of adaptive properties of a human body, reliability of its physical and mental state. The impact of educational loads, intensification of the educational process, increased requirements to the volume and quality of knowledge, as well as violation of the motor regime negatively affects the functional capabilities of the students' organism. This leads to a decrease in adaptation reserves, situation of inconsistency of regulation mechanisms of autonomic functions, which are manifested in the form of impairment of performance, increased fatigue of students [2–4].

In the last two decades, physiologists, physicians, and educators have increased interest in studying the problem of correlation between the general, private, and local constitution of the human organism, which makes it possible to determine and predict the specificity of reactive processes occurring in any organ or organ system. The relationship between constitutional features and health is one of the most important aspects of researches in constitution [5].

Nowadays, to optimize physical education and health promotion of a person, an approach based on taking into account the peculiarities of physical constitution is used. At the same time, it is necessary to take into account that the constitutional belonging of a person is quite dynamic at the population level, depending on many factors (age, sex, ethnicity, environmental and other features), which requires constant revision of the somatic status of a person. Not the whole period of individual development is equally reflected from the standpoint of anatomical and anthropological science. According to the literature sources, there is a sufficient number of publications on physical development and features of somatotype in the period of newborn, in childhood and adolescence, in people of mature, elderly and old age [6]. To a lesser extent, attention is paid to adolescence, which is caused by intensive changes in body composition during this period, the need for "fractional" analysis of the considered indicators in the age aspect (no more than in the age of one or two years) [6, 7].

The anthropometrics for determining the level of physical development is extremely informative and allows to examine a large contingent in a short time, which makes it indispensable for population monitoring. The need for continuous monitoring of the younger generation in different regions can hardly be overestimated [8–10].

AIM

To evaluate anthropometric indicators of physical development of students in Tajikistan and compare our results with results of similar studies.

MATERIALS AND METHODS

Anthropometric measurements were performed in 390 students of Khatlon State Medical University (KSMU) of Tajikistan, among whom 279

(71.5%) were males and 111 (28.5%) were females. The age of students ranged from 17 to 26 years (mean age 19.3±1.7 years). At the same time, the predominant majority (96.4%) corresponded to the age group of 18–19 years. The anthropometric research program included measurement of the main indicators of physical status: height (cm), body weight — BW (kg), body mass index (BMI) (Kettle II index, kg/m^2), muscle strength of the leading arm (kg) and determination of somatotype.

Conducted anthropometric studies was done due to the requirements that ensure accuracy and enable comparison of the obtained results. The data on anthropometric measurement were entered into a spreadsheet, as well as into individual cards, which had certain rules of filling in to avoid errors in further processing of the obtained data.

Determination of height, body weight and dynamometry were performed according to the requirements known in propaedeutics. Body mass index (BMI, Kettle II index, kg/m2) was calculated according to the formula:

$$I = \frac{m}{h^2},$$

where I — BMI; m — body mass; h^2 — squared body length.

According to the World Health Organization (WHO) classification, the Kettle II index can be used to determine a person's weight category: normal — 18.5–24.9, deficit BW — less than 18.5–16, overweight — 25–30, obesity — 30–35 [3]. According to morphological constitutional classification, all students were categorized into normosthenic, hypersthenic and asthenic body types (methodology of M.V. Chernorutsky's was used). The obtained results were compared with the data of studies of 15 686 students from 22 countries of the world, the average age of whom was 20.8±2.6 years. One study was made by comparison based on the large-scale number of subjects and countries. This was the main factor for the legitimate use of this research work for comparison with our results.

Anthropometric method of research is the "gold standard" for assessing physical development, including overweight and obesity. This method was also applied in the studies of foreign scientists, which allowed us to compare the indicators [1, 9]. To compare individual anthropometric indicators of boys and girls, students from the following countries were selected: Tunisia, Jamaica, Philippines, Laos, Madagascar, Russia, in which the data had sharp or more significant differences in minimum and maximum indicators in relation to the compared group of students from Tajikistan.

To evaluate the results of the study, descriptive statistics was applied in the MS Excel application software package by calculating the main statistical indicators: for quantitative characteristics we calculated the mean (arithmetic) value (M), standard deviation (SD), standard error of the mean (SEM), for qualitative characteristics — frequency of occurrence (%). The Student's t-criterion was used to determine the reliability of differences; they were considered reliable at a significance level of $p < 0.05$.

RESULTS AND DISCUSSION

It was revealed that the average height of male students of Tajikistan was 172.5±0.51 cm, girls — 159.4±0.8 cm, and the average value of body mass index was 63.9±0.59 kg/m2 and 55.2±0.92 kg/m^2 respectively. In KSMU students, the individual value of the minimum of length was 148 cm and the maximum was 193 cm. The value of individual minimum and maximum of BW ranged from 38 kg to 113 kg. When BMI results were evaluated, the mean value in students was 21.6±0.14 kg/m^2, including 21.4±2.8 kg/m^2 in boys and 21.7±3.1 kg/m^2 in girls. The minimum and maximum BMI values ranged from 16.4 kg/m^2 to 36.2 kg/m^2. Normal length to weight ratio calculated by Kettle II index was observed in 319 (81.8%) students: 233 (83.5%) boys and 86 (77.5%) girls. It should be noted that 39 (10.0%) students were underweight: 27 (9.7%) males and 12 (10.8%) females. Overweight was detected in 27 (6.9%) students: 16 (5.7%) males and 11 (9.9%) females. Obesity was detected in 5 (1.3%) students: 3 (1.1%) boys and 2 (1.8%) girls.

When people were distributed by morphological constitutional types, it was found that the majority of students corresponded to the normosthenic type of physique 203 (52.1%), asthenic — 125 (32.0%) and hypersthenic — 62 (15.9%). It was revealed that the most frequent normosthenic somatotype was found in 140 (50.2%) boys and 63 (56.8%) girls; 90 (32.3%) and 35 (31.5%) students respectively had asthenic type of physique, 49 (17.5%) boys and 13 (11.7%) girls had somatotype defined as hypersthenic.

Dynamometric index of muscle strength in normosthenic young men was 72,1±1,95 kg, in girls — 31,0±2,5 kg; in asthenic young men — 66,07±2,44 kg, in girls — 30,1±3,95 kg; in hypersthenic young men the index of muscle strength was 75,6±3,3 kg, and in girls — 38,0±6,6 kg. The individual maximum of the index of muscle strength of the right hand in students of all somatotypes was: in boys — 92–95 kg, girls — 55–63 kg, the indi-

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vidual minimum — 35–38 kg in boys and 13–27 kg in girls.

The dependence of arm strength on the type of constitution was revealed as important regularity in analysis: arm strength in the general group of students of hypersthenic type is significantly greater (P_1 <0.001). In young men, this pattern is also present, except for an unreliable difference between the normosthenic and hypersthenic types (P_2 >0.05). In girls, a similar unreliable difference was found between asthenic and normosthenic type of constitution (P_1 >0.05) (Table 1).

As the result of our study, we obtained a complete picture of the degree of correspondence of students' BW to their height, as well as their quantitative representation in different constitutional groups, dynamometric indices of the leading hand depending on the type of constitution.

There were more boys with normal weight and height (83.5%) than girls (77.5%). It should be noted that BW deficiency as well as overweight and obesity were relatively more frequent in girls than in boys — 1.1 and 4.2%, respectively. Height was significantly higher in males (172.5±0.51 cm) than in females (159.4±0.8 cm). Also, obesity was more frequently detected in girls (1.8%) than in boys (1.1%). Total deviation from normal weight and height was more frequent in girls than in boys.

According to the data of foreign researchers, the average value of height and body mass indices in the population of a similar group of students was equal to 162.9±6.9 and 62.3±7.6, respectively. BMI averaged 22.3±3.6 kg/m^2. Normal BW values was observed in 62.1% of girls and 64.4% of boys, and BW deficiency was found in 17.6% of girls and 10.8% of boys. Excess BW was found in 14.1% of girls and 18.9% of boys, and obesity was found in 5.2% of girls and 5.8% of boys [8].

We found that the indicators of normal BW in female students of KSMU were 13.6% higher than in girls in other countries of the world during comparing the obtained data. The indicators of body mass deficiency in KSMU girls were 6.8% less than in girls in other countries. At the same time, the rates of overweight and obesity among girls in other countries were 7.6% higher compared to girls in KSMU (Fig. 1).

Indicators of normal BW in young men of KSMU students were 14.8% higher than those in young men in other countries of the world. The indicators of excess BW and obesity in young men of different countries were 17.9% higher than in young men of KSMU (Fig. 2).

Tables 2 and 3 present the indicators of physical development of students of countries of the world, in which the maximum and minimum indicators of physical development were found, in comparison with the data of our study.

According to the Table 3, Tajikistan's boys outperformed Laos and India in body length, but had lower results compared to boys from Russia, Tunisia and Pakistan. In terms of weight, boys of Tajikistan outperformed boys from Laos, India and Pakistan, but had a less levels to their peers from Russia and Tunisia. The BMI values of all young

Table 1. Indicators of dynamometry of muscle strength of the right hand (kg) in accordance to the somatotype

Таблица 1. Показатели динамометрии мышечной силы правой кисти (кг) в зависимости от соматотипа

Sex / Контингент	Somatotype / Конституциональный тип			Reliability (P) / Достоверность (P)
	asthenic arm strength, kg / астенический сила руки, кг	normosthenic arm strength, kg / нормостенический сила руки, кг	hyperstenic arm strength, kg / гиперстенический сила руки, кг	
Young men, n=279 / Юноши, n=279	66,1±2,44	72,1±1,95	75,6±3,30	P_1 <0,001 P_2 >0,05 P_3 <0,001
Young women, n=111 / Девушки, n=111	30,1±3,95	31,0±2,50	38,0±6,60	P_1 >0,05 P_2 <0,001 P_3 <0,001
All students, n=390 / Все студенты, n=390	56,0±0,44	59,3±0,33	67,8±0,62	P_1 <0,001 P_2 <0,001 P_3 <0,001

Note: P_1 — reliability of differences in arm strength between asthenic and normosthenic types; P_2 — reliability of differences in arm strength between normosthenic and hypersthenic types; P_3 —reliability of differences in arm strength between asthenic and hypersthenic types.

Примечание: P_1 — достоверность различий силы руки между астеническим и нормостеническим типами; P_2 — достоверность различий силы руки между нормостеническим и гиперстеническим типами; P_3 — достоверность различий силы руки между астеническим и гиперстеническим типами.

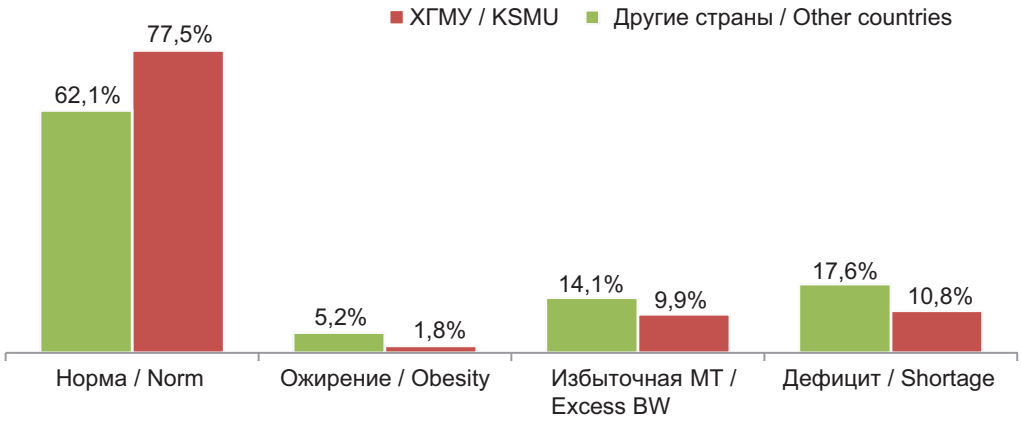

Рис. 1. Сравнительные показатели количества девушек по уровню ИМТ (%)
Fig. 1. Comparative indicators of girls number by the level of BMI (%)

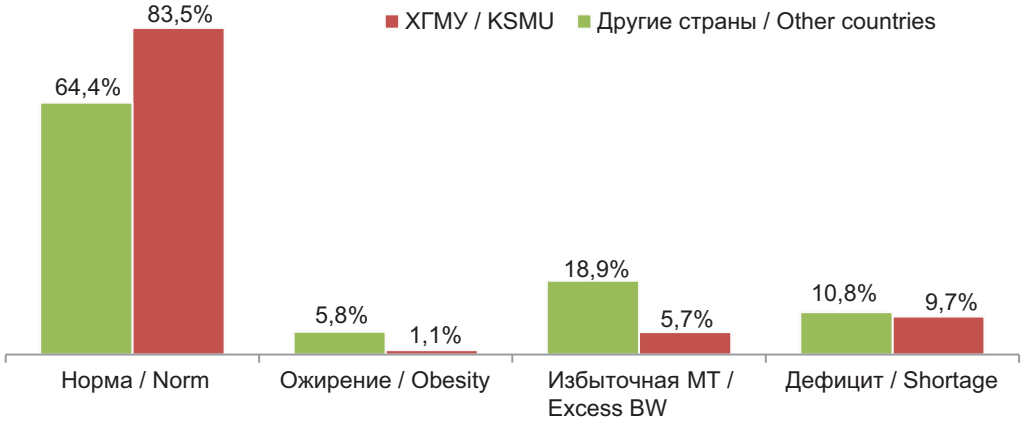

Рис. 2. Сравнительные показатели количества юношей по уровню ИМТ (%)
Fif. 2. Comparativeindicators of boysnumber by the level of BMI (%)

Table 2. Comparative indicators of the physical development of girls in some countries [9]

Таблица 2. Сравнительные показатели физического развития девушек некоторых стран [9]

Country / Страны	N / N	Age (SD) / Возраст (СО)	Height (SD), cm / Рост (СО), см	Body weight (SD), kg / Вес (СО), кг	BMI (SD), kg/m^2 / ИМТ (СО), кг/м^2	Deficiency of BW, % / Дефицит МТ, %	Normal BW, % / Норм. МТ, %	Over-weight, % / Избыток МТ, %	Obesity, % / Ожирение, %
Russia / Россия	404	19,8 (1,7)	167 (0,06)	57,3 (8,6)	20,5 (2,9)	24	69,3	5,9	0,7
Tunisia / Тунис	615	21,0 (1,7)	165 (0,06)	62,5 (9,9)	23,0 (3,6)	7,3	67,3	20,3	5
Jamaica / Ямайка	516	21,1 (4,9)	164 (0,09)	63,1 (15,3)	23,4 (5,6)	11,8	60,1	17,4	10,7
Philippines / Филиппины	573	18,3 (1,3)	154 (0,09)	49,3 (10,6)	20,6 (3,6)	27,1	54,3	14,1	4,5
Laos / Лаос	499	22,1 (1,9)	156 (0,06)	50,5 (8,8)	20,8 (3,6)	28,7	52,5	14,6	4,2
Madagascar / Мадагаскар	398	19,6 (1,5)	156 (0,06)	50,7 (7,7)	20,8 (2,8)	20,1	74,3	4,6	1
Tajikistan , Таджикистан	111	19,1 (1,1)	159,4 (0,8)	55,2 (0,9)	21,7 (3,1)	10,8	77,5	9,9	1,8

Note: SD — standard deviation (SD).

Примечание: СО — среднеквадратическое отклонение (SD).

men are also almost the same. Young men from Tajikistan have a slightly higher prevalence of BW deficiency than young men from Russia and Tunisia. Excess BW and obesity are significantly less common in Tajikistan than in the comparison group, with the exception of boys from Pakistan.

Table 3. Comparative indicators of the physical development of boys in some countries [9]
Таблица 3. Сравнительные показатели физического развития юношей некоторых стран [9]

Country / Страны	N / N	Age (SD) / Возраст (СО)	Height (SD), cm / Рост (СО), см	Body weight (SD), kg / Вес (СО), кг	BMI (SD), kg/m^2 / ИМТ (СО), кг/м^2	Deficiency of BW, % / Дефицит МТ, %	Normal BW, % / Норм. МТ, %	Over-weight, % / Избыток МТ, %	Obesity, % / Ожирение, %
Russia / Россия	381	20,1 (1,9)	179 (0,09)	76,7 (11,0)	23,7 (3,3)	2,9	69	24,4	3,7
Tunisia / Тунис	295	23,7 (4,1)	178 (0,07)	74,8 (13,7)	23,7 (4,1)	4,1	67,1	23,4	5,4
Pakistan / Пакистан	319	20,2 (1,8)	177 (0,11)	57,0 (5,1)	18,1 (1,9)	61,1	36,7	2,2	0
Laos / Лаос	260	22,6 (1,8)	163 (0,07)	56,7 (7,8)	21,3 (2,8)	8,1	68,1	19,2	4,6
India / Индия	541	17,9 (0,6)	167 (0,09)	63,2 (11,9)	22,7 (4,5)	11,8	47,9	28,5	11,8
Tajikistan , Таджикистан	279	19,29 (0,06)	172,5 (0,5)	63,9 (0,59)	21,4 (2,8)	9,7	83,5	5,7	1,1

Note: SD — standard deviation (SD).
Примечание: СО — среднеквадратическое отклонение (SD).

It should be noted that, according to our data and available literature, in general, girls are more often have a deficiency of BW than boys. Explaining this phenomenon, we can assume that modern girls strive to conform to some "ideal" ideas about how they should look. Such a social phenomenon as fashion in this context can be considered as a rather powerful social factor that has a significant impact on gender features in the morphological transformation of modern youth [10].

At the same time, the comparative analysis shows that the indicators of physical development corresponding to age norms in young men and girls of KSMU are much higher than those of their peers from other countries of the world.

CONCLUSION

Thus, the study on measurement of the main anthropometric and dynamometric parameters revealed the facts characterizing the features of physical development of students of KSMU and some countries according to the data similar to our study. The obtained indicators, if necessary, can be used as norms in analyzing the physical development of young men and girls of the corresponding population at the regional level, which is important in preventive examinations and in many branches of practical medicine. It was found that the physical development indicators of young men and girls in Tajikistan differed in weight and height parameters from those of their peers from other countries, which may be an indicator of socio-economic characteristics of the territories of residence.

ADDITIONAL INFORMATION

Author contribution. Thereby, all authors made a substantial contribution to the conception of the study, acquisition, analysis, interpretation of data for the work, drafting and revising the article, final approval of the version to be published and agree to be accountable for all aspects of the study.

Competing interests. The authors declare that they have no competing interests.

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Конфликт интересов. Авторы декларируют отсутствие явных и потенциальных конфликтов интересов, связанных с публикацией настоящей статьи.

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