

Individualizing physical education for female students through somatotyping methodology

MIKHAIL KOLOKOLTSEV¹, LARISA KUZNETSOVA², ELENA ROMANOVA³, OLGA LIMARENKO⁴, VIKTOR KRAYNIK⁵, ANTON VOROZHEIKIN⁶, ELENA REDI⁷, IVAN BOCHARIN⁸, PAVEL TYUPA⁹, VERA MAKEEVA¹⁰, NATALYA BALASHKEVICH¹¹

^{1,2} Irkutsk National Research Technical University, Irkutsk, RUSSIA

³ Altai State University, Barnaul, RUSSIA

⁴ Siberian Federal University, Krasnoyarsk, RUSSIA

⁵ Altai State Pedagogical University, Barnaul, RUSSIA

⁶ Kaliningrad Institute of Management, Kaliningrad, RUSSIA

⁷ Reshetnev Siberian State University of Science and Technology, Krasnoyarsk, RUSSIA

⁸ Privolzhsky Research Medical University, Nizhny Novgorod, RUSSIA

⁸ Nizhny Novgorod State Agrotechnological University, Nizhny Novgorod, RUSSIA

⁹ Immanuel Kant Baltic Federal University, Kaliningrad, RUSSIA

¹⁰ The Russian University of Sport "GTSOLIFK", Moscow, RUSSIA

¹¹ Semey Medical University, NCJSC, Semey, KAZAKHSTAN

Published online: April 30, 2024

(Accepted for publication April 15, 2024)

DOI:10.7752/jpes.2024.04095

Abstract:

Recognizing the principle of individualization in physical activities is paramount. However, the scientific literature lacks comprehensive analysis on the relationship between individuals' body types and their engagement in physical education, potentially limiting its efficacy. **Purpose.** The purpose of this study is to tailor physical education for female students with chronic somatic diseases by evaluating their somatotype, anatomical components, and motor qualities development. **Material & methods.** The research project was conducted among 180 female students of the Technical University in Irkutsk (Russia). The girls' somatotype was determined according to the scheme Carter, Heath (1990). The use of calculation formulas allowed characterizing three body parameters in points: the degree of fat deposition (endomorph), the development of the skeleton and muscle tissue (mesomorph) and the longitudinal dimensions of the body (ectomorph). The functional parameters of the muscular and cardiorespiratory systems were determined by conventional methods. The characteristics of physical fitness parameters were given based on the analysis of all girls' motor testing results. **Results.** A significant variability of somatotypes was found among the examined girls with a predominance of meso-endomorphic (23.4%) and endo-mesomorphic (22.8%) somatotypes with high body weight, BMI and chest circumference in the population. It reduces the reserve capabilities of functional systems to perform physical activities and impairs motor abilities. The girls with meso-ectomorphic, ecto-endomorphic and endo-ectomorphic somatotypes turned out to be the most physically prepared, with high functional reserves. They are characterized by high growth, low body mass index and BMI values, and good reserves of the cardiorespiratory system, which provides them with the opportunity to perform motor tests with high results. **Conclusions.** When planning PE classes in groups of female students with chronic diseases, it is necessary to take into account their somatological characteristics. It will make it possible to individualize the educational process of physical culture and thereby increase its effectiveness.

Key Words: physical education, physical training, female students, somatotyping, functional indicators, physical fitness

Introduction

For individual and population characteristics of human physical health, along with generally accepted anthropometric indicators, various schemes for assessing types of constitution and methods for assessing body component composition are used (Miroshnichenko et al., 2019; Prontenko et al., 2020; Ciftci, & Kurtoglu, 2023). For more than a century of studying issues related to the types of human body constitution, a large number of somatotyping schemes have been proposed. There are quite simple schemes of constitutional typology, for example, the scheme of M.V. Chernorutsky, in which, according to the value of the Pinier index, three types of constitution are distinguished (asthenic, normosthenic and hypersthenic). This somatotyping scheme continues to

be used in the field of physical culture and sports to date (Kolokoltsev et al., 2021). There are more complex somatotyping schemes that take into account many anthropometric indicators and body component composition and are more accurate for describing body type. This scheme includes a technique that was proposed in the 60s of the twentieth century by B. H. Heath and J. E. Carter (1967). Currently, this scheme is most widespread in clinical medicine, pedagogy, physical education and sports.

Scientists in the field of physical education and sports point out the importance of using the human somatotyping results to increase the effectiveness of training programs (Kostykevich et al., 2019; Campa et al., 2020). The proposed methods for optimizing individual elements of motor actions in highly qualified weightlifters having different body types have made it possible to increase their performance in competitions (Antoniuk et al., 2017). The identification of biological maturation rate dependence on the type of constitution in young football players showed that players who have less adipose tissue and more pronounced muscle mass have advantages in circumference and longitudinal body dimensions and are represented by a mesomorphic type of constitution. According to the authors, this feature of somatotypes can help in the sports selection of young talented players (Čaušević et al., 2023). According to F.S. Cinarli et al. (2022), it was found that the balanced mesomorph had a higher indicators of vertical jump and a running speed of 30 m than the mesomorph-endomorph. In addition, balanced ectomorphs had a lower sprint momentum compared to balanced mesomorphs. A number of researchers suggest that coaches conduct longitudinal monitoring of somatotype components in gymnasts during the athletes' training in order to make corrections to the training process. In addition, knowledge of the characteristics of somatotypes makes it possible to identify promising athletes (Sterkowicz-Przybycien, & Gualdi-Russo, 2019).

As can be seen from the presented data, somatotyping schemes are widely used in sports practice. In the field of physical education, much less such research has been conducted.

There is still a significant number of students having various chronic diseases (Baker et al., 2022; Bocharin et al., 2023; Hermassi et al., 2024), low quality of life (Kolokoltsev et al., 2020) and poor physical fitness (Syamsudin et al., 2021; Mazin et al., 2021; Faílde-Garrido et al., 2022). This is especially true for students with chronic somatic diseases (Baba et al., 2021; Li, 2022). Such a negative impact on the body reduces the effectiveness of vocational education among students. Scientists and practitioners in the field of physical culture are aware of the reasons for the low effectiveness of students' physical education (Drachuk et al., 2018). These include the significant academic nature of the subject (Tuan Tran Minh, & Cuong Tran Ngoc, 2022), limited choice of the type of classes, insufficient material and technical base, incorrect construction of the educational process, etc. Special medical groups are organized to improve the PE classes effectiveness for students who have health problems. In these study groups, a specific technology for conducting PE classes and strict control over the dosage of physical activity is carried out (Mozolev, 2020).

A key role in the PE classes of students in such groups is assigned to the observance of the principle of loads individualization (Gumenyuk et al., 2021). Along with the factors that are aimed at individualizing the educational process of students' physical education, scientists propose to study students' somatotypes to make adjustments to their physical activities. There is information about the relationship of the somatotype with the level of human motor qualities development (Druz et al., 2017) and on the ratio of the muscle and fat components content in the body (Kutseryb et al., 2019; Rybakova et al., 2020).

According to a research by V. Miroshnichenko et al. (2019), it was found that the use of physical activity, depending on body type, allowed to achieve significant positive results in the physical health of university students in Ukraine. At the same time, an analysis of the scientific literature has shown that the results of using somatotyping schemes in students who have chronic somatic diseases and are classified as a special medical group are very limited. It may reduce the effectiveness of the health-improving orientation of students' physical education. We believe that the results of this research will allow us to implement the data obtained to individualize the loads of students who have deviations in their somatic state of health.

Purpose is to individualize the physical education of female students with chronic somatic diseases, to assess their somatotype, anatomical components and the level of motor qualities development.

Material & methods

The research project was conducted among 180 female students of the Technical University in Irkutsk (Russia). The age of the girls was 17-20 years (18.8 ± 1.5 years). During mandatory medical and laboratory examinations, they were diagnosed with some kind of chronic somatic disease, so they attended PE classes as part of a special medical group 2 times a week for 90 minutes each. Diseases of various origins were detected mainly from the musculoskeletal system, cardiorespiratory, endocrine, genitourinary and nervous systems.

The anthropometric examination of the students was carried out using a generally accepted instrument: a height meter, medical scales, thick compasses, a centimeter tape and a caliper. 10 anthropometric features were determined: total, transverse, longitudinal, circumference of the body and thickness of skin-fat folds on various parts of the body (Carter, 2002). The body mass index (BMI) was calculated using the formula: $BMI = \text{body}$

weight (kg), / body length (m)². The interpretation of BMI was based on the recommendations of the World Health Organization (World Health Organization. Obesity and overweight, (2021).

Anatomical parameters were measured according to the requirements of the international standard for anthropometric measurements (Stewart et al., 2011). The conducted examination of female students does not violate the ethical standards that apply to biomedical research with humans, according to the Helsinki Declaration of 2008.

The girls' somatotype was determined according to the Carter, & Heath (1990) scheme, which has a wide range of applications by age, gender and national characteristics. The use of calculation formulas in this scheme allowed us to characterize three body parameters in points: the degree of fat deposition (endomorph), the development of the skeleton and muscle tissue (mesomorph) and the longitudinal dimensions of the body (ectomorph). According to the simplified classification (Carter, & Heath, 1990), the somatotype category was determined by the calculated score value: ecto-mesomorphic; meso-ectomorphic; endo-ectomorphic; ecto-endomorphic; meso-endomorphic; endo-mesomorphic and balanced mesomorphic, endomorphic and ectomorphic types.

Functional parameters were determined in girls with different somatotypes. To measure the muscles strength of the left and right hands, a wrist dynamometer was used, kg. To characterize the reserve capabilities of the cardiovascular system, systolic and diastolic blood pressure, mmHg, was measured and an exercise stress test with 20 squats in 30 seconds was used. The pulse rate was determined before and after exercise (bpm), as well as the pulse recovery time after the test, s. The functional state of the respiratory system was assessed based on the results of hypoxic tests of the Stange and Genchi, s.

The characteristics of physical fitness parameters were given based on the analysis of the motor testing results of all girls. For this purpose, motor tests were used to assess the development of motor qualities: "speed" (running at 30 m, s), "general endurance" (running at 1000 m, m/s), "strength" (lifting the trunk from a supine position in 30 seconds and push-ups, the number of times), «speed and strength endurance of the lower extremities muscles" (standing long jump, cm) and "flexibility" (leaning forward from a standing position, cm).

The obtained digital data were processed using parametric statistical calculation methods with the determination of the arithmetic mean and its error, as well as the sigma deviation. Digital data verification for the normality of the distribution was performed using the Shapiro-Wilk criterion. We used the software Statistica 10.1 and MS Excel 2016. The reliability was determined by the value of the Student's t - test. The value of the t criterion, which corresponded to $p < 0.05$, was taken as a reliable result.

Results

The results of the somatotype categories distribution among the examined girls using the Heath, & Carter (1967) scheme are shown in Figure 1.

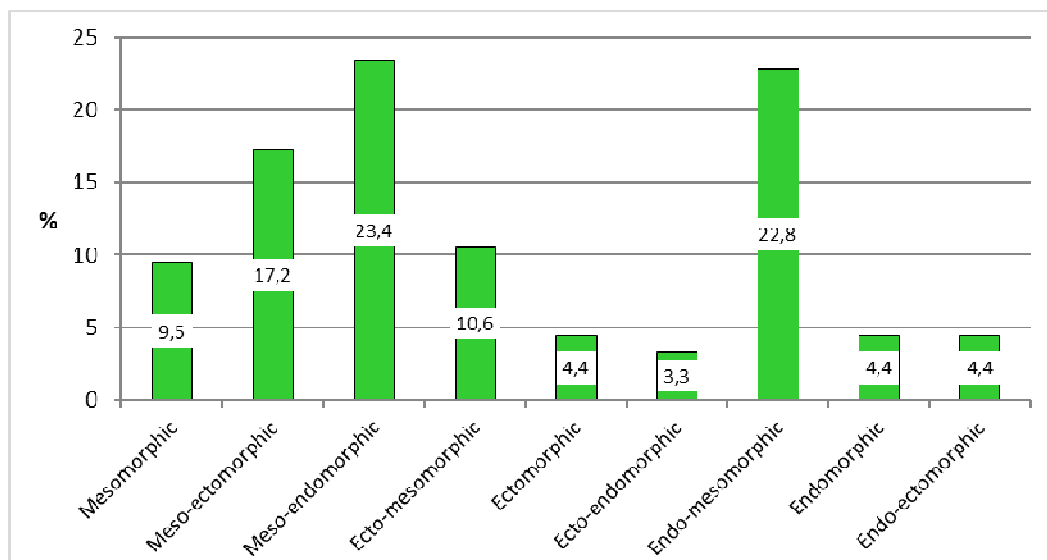


Fig. 1. Distribution of the number of examined female students with different categories of somatotypes

A significant variability of somatotypes was found among the examined female students. Meso-endomorphic (23.4%) and endo-mesomorphic (22.8%) somatotypes predominate in the observed girls, which are characterized by a pronounced component of ENDO and MESO, respectively. In the examined group of girls, there were fewer students with meso-ectomorphic somatotype (17.2%), which is characterized by the severity of the ECTO component. More than 10% of the students had an ecto-mesomorphic and 9.5% balanced mesomorphic somatotype, which are characterized by the severity of the MESO component. Other somatotypes in girls were much less common and did not exceed 5.0%.

The girls having endo-ectomorphic (168.3±1.5 cm) and meso-ectomorphic (167.4±1.01 cm) somatotypes were the highest in terms of body length, Table 1. Compared with these girls, the representatives of mesomorphic, ecto and endo mesomorphic types of constitution were significantly the shortest, $p < 0.05$.

Table 1. Anthropometric indicators and BMI in girls of various types of constitution (M±m)

Somatotype	Body length, cm	Body weight, kg	Chest circumference, cm	BMI, kg/m ²
Mesomorphic (n=17)	163.3±2.53	53.4±2.75	81.1±1.75	20.02±0.32
Meso-ectomorphic (n=31)	167.4±1.01	51.2±1.28	80.6±0.94	18.63±0.25
Meso-endomorphic (n=42)	167.05±1.17	66.27±2.67	89.5±1.6	23.74±0.45
Ecto-mesomorphic (n=19)	163.5±1.6	50.4±1.75	79.1±1.45	18.85±0.21
Ectomorphic (n=8)	165.5±2.87	56.75±5.92	85.0±4.52	20.72±0.28
Ecto-endomorphic (n=6)	164.0±1.23	49.66±0.33	80.6±3.28	18.46±0.12
Endo-mesomorphic (n=41)	163.6±1.83	61.75±3.04	86.3±2.26	23.07±0.56
Endomorphic (n=8)	166.0±1.82	54.8±1.7	81.75±2.13	19.89±0.35
Endo-ectomorphic (n=8)	168.3±1.5	51.3±2.17	80.5±4.83	18.11±0.11

Tall girls are characterized by insufficient body weight compared with other types of constitution, as indicated by their BMI (18.11±0.11 and 18.63±0.25 kg/m²) and low values of the chest circumference index (80.5±4.83 and 80.6±0.94 cm), respectively, $p < 0.05$. These data of anthropometric parameters may indicate the process of physique asthenization of these girls. An asthenic physique can also include an ecto-endomorphic somatotype, whose parameter values approach this type of constitution. Relatively low values of body length indices were found in girls of mesomorphic and ecto-mesomorphic somatotypes (163.3±2.53 and 163.5±1.6 cm), respectively, and with normal BMI values (20.02±0.32 and 18.85±0.21 kg/m²), respectively, which brings them closer to the parameters of normosthenics.

Girls of the meso-endomorphic and endo-mesomorphic somatotype had the highest body mass indices (66.27=2.67 and 61.75=3.04 kg), respectively. They have the highest BMI (23.74±0.45 and 23.07±0.56 kg/m²), respectively, and chest circumference (89.5±1.6 and 86.3±2.26 cm), respectively, which brings their physique closer to the parameters of hypersthenics. The values of the functional parameters of the body of girls with different somatotypes are presented in Table 2.

Table 2. Functional indicators values of girls with different types of constitution (M±m)

Somatotype	Dynamometric of the hands, kg		Sample 20 squats in 30 s			Stange's test, s	Genchi's test, s
	Right	Left	Pulse before load, bpm	Pulse after load, bpm	Pulse recovery time, s		
Mesomorphic (n=17)	29.8±1.1	27.8±1.0	12.5±1.1	17.1±1.3	85.7±4.8	56.0±3.8	32.0±2.9
Meso-ectomorphic (n=31)	26.8±1.0	25.2±1.1	12.5±0.6	17.4±0.7	88.0±9.2	55.6±3.4	30.6±2.0
Meso-endomorphic (n=42)	22.2±0.9	20.3±1.1	14.4±0.4	23.6±0.7	110.0±9.5	40.3±3.1	24.1±2.3
Ecto-mesomorphic (n=19)	28.2±2.2	26.0±2.1	13.0±0.6	18.7±1.3	82.3±4.5	58.2±3.8	30.9±3.9
Ectomorphic (n=8)	25.7±1.5	23.7±2.1	13.5±0.6	19.7±1.2	92.5±5.6	52.5±5.1	30.0±3.0
Ecto-endomorphic (n=6)	26.3±2.1	25.0±1.3	12.3±0.3	19.5±2.1	84.5±3.6	53.3±4.9	32.7±3.0
Endo-mesomorphic (n=41)	23.6±1.3	21.3±1.3	13.4±0.4	22.5±0.6	97.5±6.8	44.4±3.0	26.7±1.8
Endomorphic (n=8)	24.8±2.3	22.7±2.1	13.7±1.1	19.5±2.0	102.0±25.9	46.7±6.5	28.3±2.9
Endo-ectomorphic (n=8)	27.5±1.4	54.5±3.2	13.7±0.2	19.5±0.6	85.0±25.9	48.5±6.7	32.3±2.1

Among girls with mesomorphic and ecto-mesomorphic somatotypes, which are characterized by the severity of the MESO component, the highest values of the right and left hands muscle strength of both hands are recorded (29.8 ± 1.1 , 27.8 ± 1.0 and 28.2 ± 2.2 , 26.0 ± 2.1 kg), respectively. Among the girls of these somatotypes, after performing a load of 20 squats in 30 seconds, the lowest pulse rate at rest was established, after the load and the shortest time to restore the pulse rate. It indicates the high reserve capabilities of their cardiorespiratory system in performing physical activities.

Girls of meso-endorphic and endo-mesomorphic somatotype have the lowest functional characteristics, in which the ENDO component is expressed. They have the lowest strength abilities, as can be evidenced by indicators of wrist dynamometry and weaker reserve capabilities of the cardiorespiratory system in performing physical exercises. It is indicated by the results of the cardiovascular and respiratory systems testing, which are significantly lower than the results of testing these systems in representatives of somatotypes with a pronounced MESO component, $p < 0.05$.

Girls of the mesoectomorphic, ethno-endorphic and endo-ectomorphic somatotype also have high strength abilities, as evidenced by the hand dynamometry results. Representatives of these somatotypes have high reserve capabilities of the cardiorespiratory system in performing physical activities. Balanced ectomorphs and endomorphs are superior in their characteristics to girls of meso-endorphic and endo-mesomorphic somatotypes, but lower than the values of girls of meso-ectomorphic, ecto-endorphic and endo-ectomorphic somatotypes. The characteristics of the girls with various somatotypes motor qualities are presented in Table 3.

Table 3. Values of physical fitness indicators of girls with different types of constitution (M \pm m)

Somatotype	Running at 30 m, s	Running at 1000 m, m/s	Lifting the trunk from a supine position in 30 s, number of times	Leaning forward from a standing position, cm	Standing long jump, cm	Push-ups, the number of times
Mesomorphic (n=17)	5.15 \pm 0.28	6.27 \pm 0.54	23.1 \pm 0.72	13.4 \pm 1.84	163.1 \pm 5.63	22.4 \pm 1.25
Meso-ectomorphic (n=31)	4.46 \pm 0.14	6.08 \pm 0.24	19.4 \pm 1.31	12.4 \pm 1.11	163.5 \pm 3.30	18.6 \pm 1.51
Meso-endorphic (n=42)	6.01 \pm 0.12	8.51 \pm 0.28	13.1 \pm 0.9	13.1 \pm 1.34	145.7 \pm 4.07	14.2 \pm 1.38
Ecto-mesomorphic (n=19)	5.14 \pm 0.27	6.16 \pm 0.14	22.5 \pm 1.22	12.5 \pm 2.19	165.2 \pm 5.33	21.1 \pm 1.26
Ectomorphic (n=8)	5.41 \pm 0.23	7.43 \pm 0.13	14.9 \pm 1.22	12.5 \pm 3.61	153.2 \pm 6.18	14.5 \pm 1.54
Ecto-endorphic (n=6)	5.07 \pm 0.41	6.15 \pm 0.19	18.6 \pm 1.30	12.3 \pm 2.72	164.6 \pm 6.72	18.2 \pm 3.28
Endo-mesomorphic (n=41)	6.26 \pm 0.13	8.25 \pm 0.23	12.2 \pm 0.77	11.4 \pm 1.54	147.4 \pm 2.27	13.4 \pm 1.34
Endomorph (n=8)	5.56 \pm 0.14	7.55 \pm 0.85	14.3 \pm 1.43	12.2 \pm 3.56	153.5 \pm 7.47	14.2 \pm 2.45
Endo-ectomorphic (n=8)	5.16 \pm 0.16	6.18 \pm 0.48	17.8 \pm 1.25	16.5 \pm 1.51	162.3 \pm 3.22	19.3 \pm 3.18

It was found that in the motor quality of "speed" (test "Running at 30 m"), the best result was shown by girls with meso-ectomorphic, ecto-endorphic and endo-ectomorphic somatotypes (4.46 ± 0.14 ; 5.07 ± 0.41 ; 5.16 ± 0.16 s) which have the most pronounced component of MESO and ECTO.

The lowest result was shown by girls of meso-endorphic and endo-mesomorphic types of constitution (6.01 ± 0.12 ; 6.26 ± 0.13 s), respectively, $p < 0.05$ in whom the ENDO component is expressed. A good result is recorded in the 30 m run in girls of balanced mesomorphic and ecto-mesomorphic somatotypes (5.15 ± 0.28 and 5.14 ± 0.27 s). Balanced ectomorphs and endomorphs surpass girls of meso-endorphic and endo-mesomorphic types of constitution in their speed indicators, $p < 0.05$.

"General endurance" motor quality is most developed in girls with meso-ectomorphic, ecto-endorphic and endo-ectomorphic somatotypes (6.08 ± 0.24 ; 6.15 ± 0.19 ; 6.18 ± 0.48 m/s) respectively. Their result in the 1000 m run was significantly better than that of representatives of meso-endorphic, endo-mesomorphic and balanced ectomorphs and endomorphs, $p < 0.05$. Girls with mesomorphic and ectomorphic somatotypes have good overall endurance (6.27 ± 0.54 ; 6.16 ± 0.14 m/s), respectively.

The pronounced component of MESO in girls with mesomorphic and ectomesomorphic somatotypes provides them with high results in strength tests. The highest values were found in the indicators of strength tests «Lifting the trunk in 30 seconds» and «Push-ups» compared with girls of all other body types, $p < 0.05$. The lowest result in strength testing was registered in girls of meso-endomorphic and endo-mesomorphic types of constitution. The values of these girls were lower than those of girls with the highest result of strength abilities (23.1 ± 0.7 times) in the test "Lifting the trunk in 30 seconds" by 42.9 and 46.9% and in the test «Push-ups» by 36.5 and 40.2%, respectively.

Well-developed motor qualities of speed and strength provide girls with higher results in the "Standing long jump" test. The best results of speed and strength qualities were recorded in girls whose somatotypes have a well-expressed component of MESO and ECTO. The lowest results were shown by girls of meso-endomorphic and endo-mesomorphic types of constitution, $p < 0.05$.

In the motor quality of "flexibility", there are no significant differences between the values of the test indicators and the somatotype. It may indicate a weak relationship between this motor quality and the type of the girls' constitution.

Dicussion

Currently, research in the field of physical culture and sports has been updated, which is related to the study of the types of constitution of people performing physical activity (Kostykevich et al., 2019; Campa et al., 2020; Cinarli et al. 2022; Čaušević et al., 2023). It is due to the possibility of using knowledge in the field of human somatotypology for the sports selection of promising athletes (Sterkowicz-Przybycien, Gualdi-Russo, 2019), optimizing the educational and training process in various sports and improving athletes' performance (Antoniuk et al., 2017; Ciftci, & Kurtoglu, 2023).

The results obtained during the study of human constitution types began to be used in the field of physical culture (Miroshnichenko et al., 2019; Kolokoltsev et al., 2021). It is due to the search for ways to improve the traditional physical education programs effectiveness (Drachuk et al., 2018; Miroshnichenko et al., 2019). It is known that the effectiveness of physical education is significantly increased when the principle of physical activity individualization is used in educational programs (Gumenyuk et al., 2021).

To do this, knowledge that is related to the characteristics of the human constitution type in the physical education of young people can be used. According to V. Miroshnichenko et al. (2019), the use of author's programs in the physical education of female students in Ukraine, taking into account the characteristics of their different somatotypes, made it possible to obtain a good health effect among them, compared with the control group, where the type of constitution was not taken into account. At the same time, the issues of students' having various chronic somatic diseases somatotyping and, in this regard, restrictions on physical activity in PE classes are insufficiently covered in the scientific literature. Therefore, this research can be considered relevant and important in practical terms for making corrections to the work physical education programs of students who have deviations in their health status.

Our somatotyping of girls using the Heath and Carter scheme allowed us to identify not only their types of constitution, but also the features of anatomical and functional indicators, as well as their motor abilities manifestation.

According to our data, a significant variability of somatotypes was established among the examined female students with a predominance of meso-endomorphic (23.4%) and endo-mesomorphic (22.8%) somatotypes in the population. These types are characterized by a pronounced component of ENDO and MESO, i.e. fat deposition and skeleton, body musculature. The presence in the population of more than 46% of girls with meso-endomorphic and endomesomorphic and somatotypes confirms the presence of girls with serious health conditions among them. Among them, the highest body weight indices were established (66.27 ± 2.67 and 61.75 ± 3.04 kg), respectively, the BMI index (23.74 ± 0.45 and 23.07 ± 0.56 kg/m²), respectively, and chest circumference (89.5 ± 1.6 and 86.3 ± 2.26 cm), respectively, which brings their physique closer to the parameters of hypersthenics with pronounced fat mass. Such relatively high values of body weight and BMI negatively affect the functional parameters of the cardiorespiratory system.

The girls with these somatotypes have the lowest reserves of this functional system, as indicated by the values of pulse at rest, pulse after exercise in the form of 20 squats in 30 seconds and pulse recovery time after exercise. Among these somatotypes, the lowest results are recorded in hypoxic samples. When testing their motor qualities, we established low values of indicators in all physical fitness tests, with the exception of the motor quality «flexibility». These data are consistent with the results of our earlier research (Kolokoltsev et al., 2021), where we obtained approximately the same conclusions using other somatotyping schemes. It confirms the correctness of the opinion about the features of morphofunctional and motor parameters in girls with different somatotypes.

Among the examined girls, the best morphofunctional and motor qualities are possessed by girls with meso-ectomorphic, ecto-endomorphic and endo-ectomorphic somatotypes, in which the EXO component is

expressed. However, a relatively small number of such girls were identified (25%). They have high indicators of functional and physical fitness, which can be explained by the peculiarities of their physique. It is characterized by low values of body mass index and BMI, good reserves of the cardiorespiratory system, which provides them with the opportunity to perform motor tests with high results. Our data are consistent with the research results (Čaušević et al., 2023). The authors proved that those athletes who have a well-defined muscle component and reduced adipose tissue in the body composition are physically more prepared. According to our data, among the girls of these somatotypes, the most significant indicators in motor qualities "speed", "general endurance", "strength", "speed-strength endurance» were registered. There are no differences in the values of indicators in the motor quality of "flexibility". It indicates the absence of dependence of this motor quality manifestations on the body constitution type.

According to the results of the morphofunctional parameters and motor qualities study, girls with other types of body constitution occupy an intermediate position between the extreme parameters of somatotypes. This fact should be taken into account by the teaching staff of the physical culture departments when planning work programs for conducting classes with students who have health abnormalities.

The study and analysis of the identified somatotypes in girls with chronic somatic diseases showed a great variability in body types and the relationship with anatomical, functional indicators and motor qualities. These data can be used in planning the educational process of female students' physical education. Knowledge of the constitution types allows individualizing PE classes for students. It has a more effective health-improving effect on young people's studying health.

Conclusions

Using the Heath and Carter method, somatotyping of female students, having chronic somatic abnormalities in health and limitations of physical activity in PE classes was carried out. It was found that representatives of meso-endomorphic (23.4%) and endo-mesomorphic (22.8%) somatotypes with high body weight, BMI and chest circumference predominate in the population of the examined girls, which is associated with excessive adipose tissue. It reduces the reserve capabilities of functional systems to perform physical activities and impairs motor abilities. Among girls with these somatotypes, the lowest motor ability test results are recorded.

The most physically prepared and having high functional reserves, were girls with meso-ectomorphic, ecto-endomorphic and endo-ectomorphic somatotypes, of whom 25% were identified and in whom the EXO component was expressed. They are characterized by high growth, low body mass index and BMI values, and good reserves of the cardiorespiratory system, which provides them with the opportunity to perform motor tests with high results. Girls with other somatotypes occupy an intermediate position between these types of constitution.

A close relationship between the somatotypes of girls and their morphofunctional parameters and motor abilities has been established. When planning PE classes in groups of female students with chronic diseases, it is important to take into account the somatotypical characteristics of those involved. It will allow individualizing physical activity and thereby increase their effectiveness.

Conflicts of interest. The authors declare no conflict of interest.

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