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Dynamics of geometry indicators of students' body mass in the process of their physical training under the influence of author's technology

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Abstract

Sublimation of advanced scientific ideas into the strategy of student youth's rehabilitation involves the creation and implementation of effective innovative technologies. At the present stage of physical culture and sports field development, in terms of effectiveness of body correction the most recognized are health fitness systems. **Objective.** The experiment involved 121 female students aged 17–18 with different body types, namely mesomorphs – 64, ectomorphs – 35, endomorphs – 22 individuals (n = 121). **Methods.** Theoretical ones have been used to study and substantiate the basic provisions of the study, outline its problem field, systematize the scientists' experience on the issue of female students' physique correction in the process of their physical training, study of modern scientific approaches to the development and improvement of physical education; empirical methods included pedagogical observation; anthropometric examination of female students; body type of students – using the Pinier index. Method of recording and analysis of female students' body static-dynamic stability (diagnostic and training complex "SportKat 650 TS" on the basis of a movable platform, the degree of mobility of which is adjustable); consistently pedagogical transformative experiment; statistical methods have been applied to process the results of the study. **Results of the study.** The positive impact of the suggested technology is evidenced by changes in the average values of the circumferential body size of female students with mesomorphic body type: increase in the average values of chest girth (\bar{x} ; S) (before: 85.3; 5.50 cm after: 88.2; 4.71 cm), (p < 0.01); increase in average values of shoulder girth (before: 26.2; 3.81 cm after: 27.7; 2.19 cm), (p < 0.01); decrease in the average values of the circumferential abdomen size (before: 68.1; 5.51 cm after: 66.3; 3.32 cm), (p < 0.05); decrease in the average values of the thigh girth (before: 55.0; 3.80 cm after: 53.9; 2.00 cm), (p < 0.05). Statistically significant changes have been found in the direction of increasing the average values of the shoulder circumferential size among female students of ectomorphic body type: (\bar{x} ; S) (before: 23.3; 3.71 cm after: 24.9; 2.21 cm), (p < 0.05); average values of the thigh circumferential size (before: 52.1; 4.94 cm after: 53.9; 2.01 cm), (p < 0.05). During the examination of female students of endomorphic body type, we have also observed the improvement (decrease) of the average values of the abdomen girth (\bar{x} ; S) (before: 75.4; 4.83 cm after: 72.1; 2.95 cm), (p < 0.05) and the average values of the hip circumference (before: 58.3; 4.25 cm after: 56.2; 2.19 cm), (p < 0.05). **Conclusions.** The substantiated technology of physique correction for female students taking into account geometry of their body mass in the course of physical training is aimed at achieving the corresponding purpose by using system, normative-target, personality-oriented approaches. The structure of the technology has included the

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purpose, tasks, principles, pedagogical conditions, stages, namely organizational-introductory, correctional-preventive, supportive.

Keywords: correction, technology, physique, body type, body mass geometry, female students, physical training.

Problem formulation

The importance of health in the system of universal values is associated with its status as a fundamental basis for the optimal implementation of each individual's abilities and potential [1, 3, 17]. Therefore, in the current context of reforms in Ukraine, the health of its population is recognized as a component of national development, which serves as a determinant of the range of tasks in the state-declared social program [12, 13, 14].

Under modern conditions the health state of adult Ukrainians in general and children and youth in particular is an unprecedented challenge to society and the state, and thus clearly poses a threat to humanitarian security of Ukraine [5, 6, 8]. This emphasizes the expediency of paying more attention to ensuring adequate motor activity as a condition for improving health, maintaining efficiency and promoting the diverse development of Ukrainian population, including students [4, 9].

Analysis of recent research and publications

Based on the systematization and generalization of sources devoted to the research issue [7, 10, 11], it is obvious that the physique is one of the parameters of physical development, which allows to gain an objective idea of the spatial organization of human body morphological components, constitutional features of its body, proportions, etc. It is also known that the physique is characterized by individual gender and age characteristics, which gives grounds to position it in the systemic dimension as an interdetermined and interrelated spectrum of human body morphofunctional components [14, 15].

Sublimation of advanced scientific ideas into the strategy of student youth's rehabilitation involves the creation and implementation of effective innovative technologies. At the present stage of the field of physical culture and sports development, health fitness systems are recognized the most in terms of body correction effectiveness means [15].

In this context, it should be noted that within current transformation of physical education paradigm, which is related to clarifying the range of interests and needs of students related to their physical and spiritual improvement [], the issues of female students' physique correction remain unresolved taking into account the peculiarities of their body mass geometry. As a result of a thorough study of the professional specialized literature, it has been established that the term "mass geometry" was introduced into scientific circulation by the Frenchman Anton de la Guerre in 1857 [2]. Digression into the history of formation and interpretation of "mass geometry" concept has made it possible to state that today the geometry of body mass is interpreted as a concept which outlines the distribution of human body biolinks in space relative to somatic frame of reference, it includes data on the location of the body general center of mass (GMC), moments of inertia of body biolinks according to their planes and axes of rotation, ellipsoids of inertia and a number of other indicators [2].

The scientific and methodological dimension of the relevance of this work is determined by the inconsistency between the need to correct the physique of female students given the peculiarities of their body geometry and improper methodological development of physical fitness means, used during physical training, which in its turn allows effective solution of the declared problem.

The study has been performed in accordance with the 2018 – 2023 Research plan of the Lesia Ukrainka East European National University on the topic “Modern technologies for formation and maintenance of health for various population groups by means of health-improving physical activity”, state registration number is 0118U004196.

Objective

The experiment has involved 121 female students aged 17–18 with different body types, among which: mesomorphs – 64 females, ectomorphs – 35 ones, endomorphs – 22 individuals (n = 121).

Methods and organization of the study

Completion of the tasks set in the dissertation involves a set of methods, namely: *theoretical ones* are used to study and substantiate the basic provisions of the study, outline its problem field, systematize the experience of scientists on the correction of female students' physique in the process of physical training, development of modern scientific approaches to development and improvement of physical education; *empirical methods* include pedagogical observation as a method of empirical level of research that helps get acquainted with the process of organizing physical education at Department of Physical Education at Kyiv National Economic University named after V. Hetman; anthropometric examination of female students with the use of standard tools (the examination has presupposed the use of a reference point when measuring anthropometric points with a very specific localization in relation to the selected skeletal bone formations, and for more accurate measurement – the use of somatic coordinate axis. The location of an anthropometric point has been determined based on palpation, painless pressing, and then further marking it with a demographic pencil; defining students' body type has been provided by using the Pinier index. Method of recording and analysis of static-dynamic stability of the female students body (diagnostic and training complex “SportKat 650 TS” on the basis of a mobile platform, the degree of mobility is adjustable), pedagogical experiment – consistently transforming, *statistical methods* – to process the results of the study, to determine the statistical significance of the results. Experimental data have been processed using conventional methods of mathematical statistics based on the calculation of averages (\bar{x}); standard quadratic deviations (S); errors of representativeness (m). In establishing the statistical significance of the differences between the sample indicators, the distribution of which did not comply with the normal law, nonparametric criteria have been used: for independent samples – Mann-Whitney U-test has been applied, for dependent samples Wilcoxon criterion has been applied [16].

All calculations required the use of computer software STATISTICA 7, Statista 6.0, offered by Microsoft, Statsoft.

The study was conducted during years 2018 – 2019 on the basis of Department on Physical Education, KNEU named after Vadym Hetman.

The technology of female students' physique correction, substantiated taking into account their body mass geometry in the course of physical training, is aimed at achievement of the corresponding purpose by observance of system, normative-target, personality-oriented approaches. The structure of the technology has contained the purpose, tasks, principles, pedagogical conditions, stages, namely organizational-introductory, correctional-preventive, supportive ones. The peculiarity of the suggested technology is the correctional and preventive direction reflected in the developed class-studio "Grace", which includes "Studio of postural disorders prevention", "Studio of static-dynamic stability" and "Correctional studio". Based on the content and structure of the author's technology, the criteria of its effectiveness are outlined, which determine the degree of its effectiveness in the process of female students' physical training.

Results

The technology previously developed and presented by us was further tested during a consistent transformation experiment, in particular during its implementation in the process of physical education for 17 – 18 year old female students.

The positive effect of the suggested technology is evidenced by changes in the average values of circumferential body size among female students of mesomorphic body type: increase in average values of the chest girth (\bar{X} ; S) (before: 85.3; 5.50 cm after: 88.2; 4.71 cm), ($p < 0.01$); increase in average values of shoulder girth (before: 26.2; 3.81 cm after: 27.7; 2.19 cm), ($p < 0.01$); decrease in the average values of the circumferential abdomen size (before: 68.1; 5.51 cm after: 66.3; 3.32 cm), ($p < 0.05$); decrease in the average values of thigh girth (before: 55.0; 3.80 cm after: 53.9; 2.00 cm), ($p < 0.05$).

Statistically significant changes have been found regarding the increase of average values of circumferential shoulder size among students of ectomorphic body type: (\bar{X} ; S) (before: 23.3; 3.71 cm after: 24.9; 2.21 cm), ($p < 0.05$); average values of thigh girth (before: 52.1; 4.94 cm after: 53.9; 2.01 cm), ($p < 0.05$).

During the examination of female students that belong to endomorphic body type, we have also noticed an improvement (decrease), namely: the average values of the circumferential abdomen size (\bar{X} ; S) (before: 75.4; 4.83 cm after: 72.1; 2.95 cm), ($p < 0.05$) and the average values of hip circumference (before: 58.3; 4.25 cm after: 56.2; 2.19 cm), ($p < 0.05$).

Analysing the results of tests aimed at performing motor tasks with more active body movements, in particular "Dynamic test – clockwise movement", it has been found out that 17 – 18 year old girls who participated in the study had some difficulties in implementation of these movements.

The subjects of the experiment could not clearly display or get as close as possible to the desired result of the movement, which is set by the software "Sport Kat 650 TS". In particular, it is necessary to repeat the trajectory of the point movement (circle shape; direction of movement clockwise or anticlockwise), the movement of which is displayed on the monitor screen, controlling the position of the body pressure centre (PC) on a movable support (platform), the movement of which is also shown on the monitor screen.

However, a certain tendency has been established, according to which the results of tests are the worst for 17 – 18 year old girls of endomorphic body type comparing to other experimental groups. Particularly, in fig. 1 it can be seen that the experimental group is characterized by a rather chaotic movement of their body PC with corresponding, rather

sharp, changes of motion due to macro-oscillations, which leads to a corresponding shape of the trajectory of the body PC on a moving support.

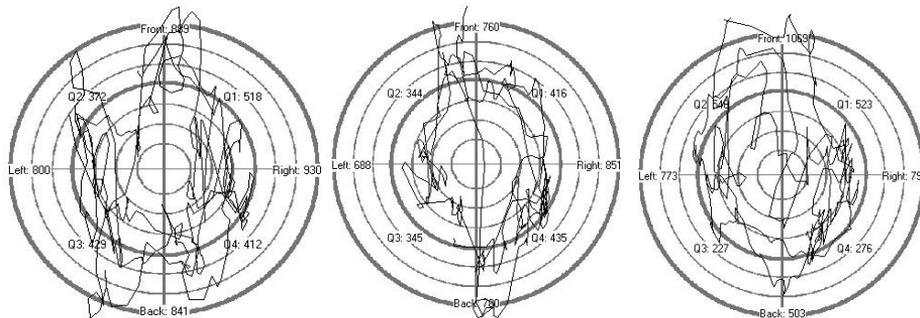


Fig. 1: Examples of test results, performed on the diagnostic and training complex “Sport Kat 650 TS” by 17 – 18 year old girls of endomorphic body type: “Dynamic test – clockwise movement”

Among 17 – 18 year old girls of ectomorphic and mesomorphic body types during the performance of these tests, the shape of the trajectory of the body PC is closer to the specified, although the nature of the movement should be associated with quite sharp changes in direction and macro-oscillations. It is an interesting fact that a common feature of the two groups is that during performing “Dynamic test – clockwise” the trajectory of the body PC, as a rule, is similar to an ellipse in its shape in which the anterior-left and posterior right traffic area prevail.

The available factual material allows noting that when conditions of exercises performance are complicated (it refers to test tasks), 17 – 18 year old girls of endomorphic body type have worse results in contrast to 17 – 18 year old girls of mesomorphic and ectomorphic body types. It is likely that increased body weight negatively affects the completion of more complex test exercises.

Conclusions

The technology of female students' physique correction, substantiated taking into account their body mass geometry in the course of physical training, is aimed at achievement of the corresponding purpose by observance of system, normative-target, personality-oriented approaches. The structure of the technology has contained the purpose, tasks, principles, pedagogical conditions, stages, namely organizational-introductory, correctional-preventive, supportive ones. The peculiarity of the suggested technology is the correctional and preventive direction reflected in the developed class-studio “Grace”, which includes “Studio of postural disorders prevention”, “Studio of static-dynamic stability” and “Correctional studio”. Based on the content and structure of the author's technology, the criteria of its effectiveness are outlined, which determine the degree of its effectiveness in the process of female students' physical training.

Prospects for further research are possible regarding issues related to development, implementation and testing of the effectiveness of multimedia technologies use in fitness programs for female students of different body types.

References

- [1] Goncharova N, Kashuba V, Tkachova A, Khabynets T, Kostiuhenko O, Pymonenko M. Correction of postural disorders of mature age women in the process of aqua fitness taking into account the body type. Теорія та методика фізичного виховання. 2020;20(3):127-136.
- [2] Kashuba, V. (2003). Biomechanics of posture. К.: Olympic literature. (in Ukrainian).
- [3] Kashuba V.A., Martynyuk O.A. To the issue of the use of corrective-prophylactic program sin the process of physical education of female students with various violations of the spatial organization of the body Scientific journal of the National Academy of Sciences of Ukraine / ed. by H.M. Arzytov. – К., 2013. – Issue 1 (27). – P. 28-35.
- [4] Kashuba V.A., Dudko M.V. Modern approaches, technique sand technologies to the formation of a healthy lifestyle of students in the process of physical education Youth scientific bulletin of the Eastern European National University named after Lesya Ukrainka. 2015. Issue 17. p. 52-57.
- [5] Kashuba V.A., Dudko M.V. Thetechnology of prevention of student post uraldisorders in the process of physical education Science and sport: modern trends. No. 2 (Volume 11), 2016. P. 24-31.
- [6] Kashuba, V. A. et al. (2016). Formation of motor skills of a person in the process of ontogenesis Lutsk: Vezha-Druk.
- [7] Kashuba, V. Kolos M., Rudnytskyi O., Yaremenko V., Shandrygos V., Dudko M., Andrieieva O. Modern approaches to improving body constitution of female students within physical education classes. Journal of Physical Education and Sport, 2017 (4), Art 227. 2472– 2476.
- [8] Kashuba V., Savlyuk S. Structure and content of the technology of prevention and correction of disturbances of spatial organization of the body of children 6-10 years old with sensory systems deprivation Journal of Education, Health and Sport, 7(8), 2017, pp.1387-1407.
- [9] Kashuba V., Futorny S. Modeling and integration of the information environment for the formation of a healthy lifestyle in the educational process of higher education institutions Scientifcan methodical bases of using information technologies in the field of physical culture and sports: a collection of scientific works [Electronicresource]. Kharkiv: KDAFK, 2017.Issue 1. P. 46-50.
- [10] Kashuba V, Asaulyuk I, Diachenko A. A modern view on the use of information technologies in the process of physical education of student youth. Journal of Education, Health and Sport. 2017;7(2):765-75. eISSN 2391-8306. <http://dx.doi.org/10.5281/zenodo.2538698>
- [11] Kashuba V, Asaulyuk I, Diachenko A. The Formation of theoretical knowledge of students in the discipline of "Physical Education" in the process of professional and applied physical training. Journal of Education, Health and Sport 2017;7(5):1054-65. eISSN 2391-8306. <http://dx.doi.org/10.5281/zenodo.2547839>.
- [12] Kashuba V, Asaulyuk I, Dyachenko A. Characteristics of the biogeometric profile of students' posture in the process of vocational and physical training. Journal of Education, Health and Sport. 2017;7(6):1255-64. eISSN 2391-8306. <http://dx.doi.org/10.5281/zenodo.2548845>
- [13] Kashuba, V.A., Golovanova N. L.Increase in efficiency of professionally applied physical training of pupils of 16-17 years old based on application of informational and methodicals sytems. Physical education of students, 2018, 22(2). p.57–62.

- [14] Kashuba V., Andrieieva O., Goncharova N., Kyrychenko V., Karp I., Lopatskyi S., & Kolos M. (2019). Physical activity for prevention and correction of postural abnormalities in young women. *Journal of Physical Education and Sport* ® (JPES), Supplement issue, 19 (2), 500 – 506.
- [15] Kashuba V, Rudenko Y, Khabynets T, Nosova N. Use of correctional technologies in the process of health-recreational fitness training by men with impaired biogeometric profile of posture. *Pedagogy and Psychology of Sport*. 2020;6(4):45-55. eISSN 2450-6605. DOI <http://dx.doi.org/10.12775/PPS.2020.06.04.005>.
- [16] Kashuba V, Stepanenko O, Byshevets N, Kharchuk O, Savliuk S, Bukhovets B, Grygus I, Napierała M, Skaliy T, Hagner-Derengowska M, Zukow W. The Formation of Human Movement and Sports Skills in Processing Sports-pedagogical and Biomedical Data in Masters of Sports. *International Journal of Human Movement and Sports Sciences*. 2020;8(5), 249-257.
- [17] Tkachova A, Dutchak M, Kashuba V, Goncharova N, Lytvynenko Y, Vako I, Kolos S, Lopatskyi S. Practical implementation of differentiated approach to developing water aerobics classes for early adulthood women with different types of body build. *Journal of Physical Education and Sport (JPES)*. 2020;20(1):456-460.