

Physical health vector of female students from different populations and medical health groups

MIKHAIL KOLOKOLTSEV¹, ELENA ROMANOVA², TATIANA MARTIROSOVA³, GALINA PURTOVA⁴,
ANTON VOROZHEIKIN⁵, MAXIM GURYANOV⁶, NATALYA BALASHKEVICH⁷, PAVEL TYUPA⁸,
SERGEY AGANOV⁹

¹ Irkutsk National Research Technical University, Irkutsk, RUSSIA

² Altai State University, Barnaul, RUSSIA

³ Reshetnev Siberian State University of Science and Technology, Krasnoyarsk, RUSSIA

⁴ Siberian Federal University, Krasnoyarsk, RUSSIA

⁵ Kaliningrad Institute of Management, Kaliningrad, RUSSIA

⁶ Privolzhsky Research Medical University, Nizhny Novgorod, RUSSIA

⁷ Semey Medical University, Non-Commercial Joint-Stock Company, KAZAKHSTAN

⁸ Immanuel Kant Baltic Federal University, Kaliningrad, RUSSIA

⁹ GPS Emercom of Russia St. Petersburg University, RUSSIA

Published online: March 31, 2023

(Accepted for publication March 15, 2023)

DOI:10.7752/jpes.2023.03074

Abstract:

Timely correction of students' educational process of physical education refers to an important and necessary and urgent problem of physical culture. *Research aim.* To conduct a comparative index assessment of female students' in various medical health groups for physical education physical development, body component composition and motor qualities with a significant time interval. *Materials and methods.* An index assessment of the 1368 in 17-20-year-old girls physical development was carried out in 2009-2010 (n = 756) and in 2019-2020 (n = 612) academic years. Physical development was assessed using the following indices: Quetelet; Quetelet II (BMI); Rohrer; Pinier; Erisman proportionality index; strength and Robinson index. In girls of all populations, the component composition of the body was studied with the calculation of the bone, fat and muscle composition of the body values according to Mateika formulas. Using motor tests, the state of physical fitness of all girls was studied. *Results.* It was found that the values of all female students' assigned to a special medical group anthropometric indices were significantly lower than such indicators values in girls of the main medical group in all years of observation, $p < 0.05$. The results of the data analysis of the survey of girls' population in the 2019-2020 academic year, compared with the data of female student's survey in the 2009-2010 academic year, indicate a higher body weight, a deterioration in physique, a decrease in the strength abilities of modern girls. There was an increase in fat mass and the Robinson index in modern girls, which indicates a decrease in the reserve capacity of the heart muscle for physical exertion. This is confirmed by lower results of testing the motor qualities of girls surveyed in the 2019-2020 academic year. *Conclusions.* The data of the physical development monitoring in combination with the results of the analysis of the body component composition and physical fitness of female students in different populations and health groups allowed determining the vector of changes in physical health. The data obtained make it possible to make adjustments to the planning of the students' educational process of physical education.

Key Words: physical education (PE), female students, indices of physical development, motor qualities, body component composition

Introduction

In many countries, the attention of medical professionals, specialists and scientists in the field of physical culture and sports to various population groups health study using quantitative anthropometric indices has been re-intensified (Takagishi et al., 2017; Jan Junger et al., 2019; Noor Fatin Nazieffa Fakri, Hairul Anuar Hashim, 2020; Mazin et al. al., 2021). This method of assessing physical health is based on the calculation using mathematical formulas of quantitative values of the human body anthropometric dimensions ratio. The peculiarity of the index assessment of human physical development is the simplicity of examination and calculations, relative reliability, the possibility of using this method for mass screening surveillance, especially among young people. Assessment of the physical development in certain population groups is important for creating standards of physical development (Krutsevich et al., 2019) and identifying the relationship between body mass index and a person's physical activity level (Syuro Ito et al., 2020). The research materials obtained in this way can be used to modernize physical culture and wellness technologies in PE classes in educational institutions.

Quantitative parameters of human physical development are considered by researchers as an informational marker of the course of metabolic, hormonal, immune, morphological and other processes of the body's vital activity (Lee, Gallagher, 2008). Physical development depends on the characteristics of the natural, climatic, environmental, social and other factors impact on the body which can affect the morphofunctional parameters of the body and be a trigger in the occurrence of various diseases in humans (Yang, & Dong, 2017; Kolokoltsev et al., 2018; Soleh Solahuddin et al., 2021). The calculation of the anthropometric Pinier index value makes it possible to assess the type of constitution of the human body according to the scheme of M.V. Chernorutsky with the allocation of hypersthenic, normosthenic and asthenic somatotypes (Fefelova et al., 2015).

It is important to study the specifics of anthropometric and functional indicators in girls of fertile age, in whom the state of physical health determines the gene pool of generations (Komissarova et al., 2016). The scientific literature presents materials on the dynamics of physical development indices during the menstrual cycle in female athletes aged 18-20, engaged in football and girls not involved in sports (Budzyn Vira et al., 2019). The authors expressed the opinion that the obtained results of the index study can be used in predicting the female football players' sports results.

There are significant changes in society associated with turbulence in the political, economic, social and everyday life of modern people, the influence of the acceleration and retardation process on young people's body (Sattarov, & Karelina, 2018; Ushakova, et al., 2017). Such processes can affect a person's somatic health (Kolokoltsev et al., 2021), morphological and functional parameters of his/her body, especially in the adolescent period of the body's development (Cronin et al., 2020). Therefore, an index assessment of the physical development of the body in combination with the study of its component composition and motor qualities of a person can serve as an informative marker of changes in the state of physical health of different generations of people.

It remains relevant to monitor young peoples of different populations physical development index assessment with a significant time interval and taking into account their component body composition, motor qualities, the state of somatic health and the medical health group for physical education (Prontenko et al., 2020). A comparative survey of female students with an interval of 10 years allows identifying the specifics and assessing the vector of changes in the parameters of physical development. This makes it possible to make adjustments to the organization of health-saving and health-forming physical culture technologies in student groups, taking into account the identified features of female students' physical health.

Research aim. To conduct a comparative index assessment of female students' in various medical health groups for physical education physical development, body component composition and motor qualities with a significant time interval.

Material & methods

Morphofunctional examination of girls in different populations aged 17-20 was carried out in 2009-2010 and 2019-2020 academic years of their studies at one of the Universities in Siberia (Russia). A total of 1,368 girls were examined, 756 of them in 2009/2010 and 612 in 2019/2020 academic years. According to the results of the medical examination, 516 girls had a somatic disease and were assigned to a special medical group, 852 girls were healthy and engaged in physical education in the main medical group. The distribution of the number of girls by medical health groups in different years is shown in Tables 1 and 2. Physical education classes for female students were conducted according to the generally accepted curriculum for higher education institutions. Using a generally accepted anthropometric technique, anatomical parameters of the body were measured (body length, cm; body weight, kg; chest circumference at rest, cm; girth dimensions of some parts of the body, cm; thickness of skin-fat folds; mm).

To calculate the Robinson index, the resting heart rate, beats/min was measured; systolic and diastolic blood pressure, mmHg were determined. The hands muscles strength (both hands) (kg) was determined. To assess physical development, the indices were used: Quetelet mass-growth index (body weight / body length), g/cm; Quetelet II or BMI (body weight/body length²), kg/m²; Rohrer (body weight/body length³), kg/cm³; Pinier index (standing body length, cm – body weight, kg + chest circumference on exhalation, cm), CU.; Erisman proportionality index (chest circumference, cm – weight / 2), cm. Functional indices were calculated: force index (dynamometry of the hand, kg / body weight, kg) × 100, %; Robinson index (resting pulse rate, beats/min × systolic blood pressure, mmHg, 100), CU. The determination of the main components in the body composition was carried out according to the formulas Mateika, 1921. Characterization of the girls' motor qualities development was carried out using a battery of motor tests (The president's challenge: Physical fitness test, 2011). The completed research project does not endanger or infringe on the rights of the examined girls in accordance with the ethical principles of the Human Rights Committee of the Helsinki Declaration of 2008. For statistical processing, the licensed software package Statistica 6.0 was used. The reliability of the difference in indicators was determined by the reliability criterion of the t - Student. The difference in the values of the indicators at p < 0.05 was considered significant.

Results

The index evaluation of the anthropometric indicators of girls is presented in Table 1.

Table 1. Indices' of physical development values in girls of different populations and medical health groups, $M \pm m$

Index	2009-2010 academic year			2019-2020 academic year		
	Main medical group (n=472)	Special medical group (n=284)	p	Main medical group (n=380)	Special medical group (n=232)	p
Quetelet, g/cm	360.2±6.23	375.3±7.12	<0.05	375.3±6.45	395.6±9.12	<0.05
Quetelet II, kg/m ²	20.3±0.22	22.0±0.23	<0.05	21.7±0.25	23.7±0.34	<0.05
Rohrer, kg/cm ³	11.5±0.13	12.0±0.15	<0.05	11.8±0.21	13.3±0.27	<0.05
Erisman, cm	4.1±0.8	3.9±0.07	<0.05	3.7±0.07	3.5±0.09	<0.05
Pinier, CU.	22.4±0.29	24.6±0.32	<0.05	23.5±0.35	26.8±0.42	<0.05

It was found that in all years of observation, the values of weight and height anthropometric indices indicators in students assigned to a special medical group were significantly higher than the values of such indicators in girls of the main medical one, $p < 0.05$. A higher body weight of girls examined in the 2019-2020 academic year was registered, compared with the 2009-2010 academic year in both medical groups. The lowest value of the Erisman index, characterizing the human chest development, was registered in girls of a special medical group in the 2019-2020 academic year (3.5±0.09 cm), $p < 0.05$. An increase in the Pinier index in the 2019-2020 academic year indicates deterioration in the physique of girls in the main and special health groups (4.9 and 14.0%).

It seems important to distribute the number of girls by the value of the Quetelet index II (BMI), which describes the state of human body weight, Table 2.

Table 2. Distribution of girls of different generations number in health groups by the value of the Quetelet II index, %

Качественная характеристика индекса Кетле II	2009-2010 academic year		2019-2020 academic year	
	Main medical group (n=472)	Special medical group (n=284)	Main medical group (n=380)	Special medical group (n=232)
Lack of body weight	27.3	19.3	27.1	22.4
Normal body weight	69.4	58.1	65.2	47.4
Excess body weigh	3.2	14.4	6.0	18.9
Obesity (degree I)	-	7.0	1.6	8.2
Obesity (degree II)	-	1.1	-	3.0

The number of girls according to the value of the Quetelet II index has significant differences in different populations and medical health groups. The increase (+) and decrease (-) in the 2019-2020 academic year compared to the 2009-2010 academic year in the number of female students according to the qualitative characteristics of the body mass index (BMI) is shown in Figure 1.

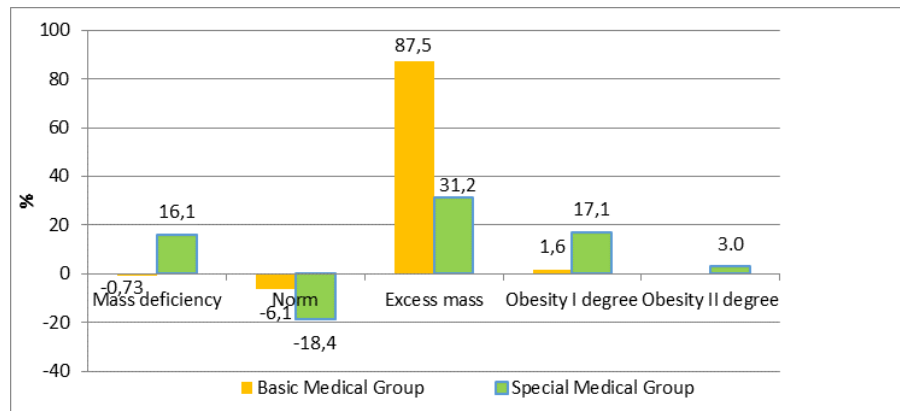


Fig. 1. Change in the number of female students by the value of the Quetelet II index in the 2019/2020 academic year compared to the 2009-2010 academic year

In the 2019-2020 academic year, there was a decrease in the number of girls with normal body weight in both medical groups (by 6.1 and 18.4%, respectively, Figure 1). In the special medical group, the number of

girls with a body weight deficit (16.1%) and obesity of the Ist and IInd degrees. (17.1 and 3.0%, respectively) significantly increased. The number of girls of the main medical group of health who have a body weight deficit has practically not changed. However, there was an increase in the number of girls with overweight (87.5%) and obesity of the Ist. (1.6%). The presented data indicate girls of both medical groups negative dynamics of the body weight state in the 2019-2020 academic year population.

Confirmation of the deterioration in the indicators of modern female students' physical development is the results of the girls' in different populations and medical health groups body component composition analysis compared with the 2009-2010 academic year, Figure 2.

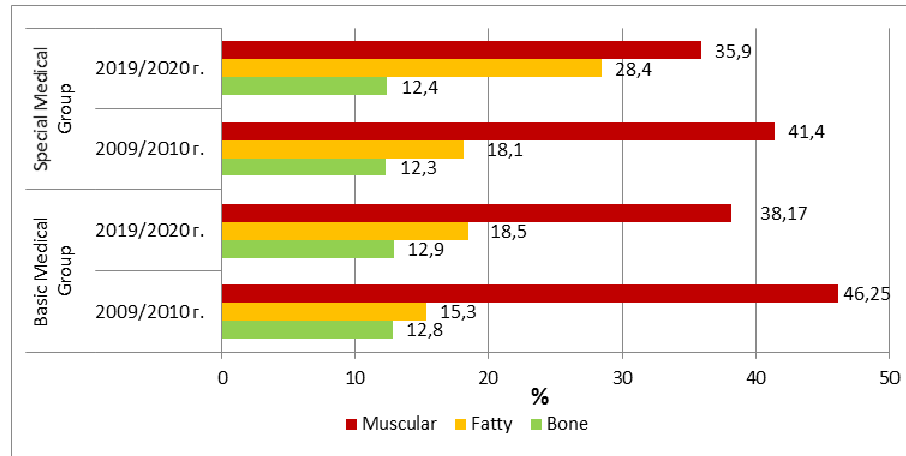


Fig. 2. Girls' in different medical health groups component composition of the body during different years of observation

In the 2019/2020 academic year, compared with the 2009-2010 one, there was a significant increase of 20.9% in the girls of the main group fat content in the body and 56.9% in the girls of the special medical group. The content of muscle mass in the girls' body decreased in the 2019-2020 academic year by 17.7 and 13.3%, respectively. The amount of the bone component in the girls' body practically did not change during the observation period ($p > 0.05$). Deficiency, overweight and obesity, physical inactivity in girls, negatively affected the strength index and decreased systolic blood output by the heart (Robinson index), Table 3.

Table 3. Values of functional indices indicators in girls of different populations and medical health groups, $M \pm m$

Index	Academic year			
	2009-2010		2019-2020	
	Main medical group (n=472)	Special medical group (n=284)	Main medical group (n=380)	Special medical group (n=232)
Power index of the left hand, %	28.6±2.44	23.4±1.34*	23.9±2.79 [#]	19.4±1.34* [#]
Power index of the right hand, %	29.2±2.17	24.2±1.26*	25.2±2.11 [#]	20.1±1.23* [#]
Robinson index, CU.	92.4±4.34	107.2±5.25*	102.5±4.12 [#]	122.7±6.2* [#]

Note. * - the significance of differences in the indicators values between health groups; [#] - the significance of differences in the indicators values in different years of observation, $p < 0.05$

It was found that the strength index of both hands in the girls of the main medical group was significantly higher than in the girls of the special medical one during all the years of observation, $p < 0.05$. The monitoring results indicate a decrease in hand strength in girls of both medical groups in the 2019-2020 academic year compared to the 2009-2010 academic year, $p < 0.05$.

An important functional index, characterizing the systolic blood output of the heart muscle is the Robinson index. A significantly lower volume of cardiac output was found in girls of the special medical group compared with the result of girls of the main medical one in all years of examination, $p < 0.05$. At the same time, in the 2019-2020 academic year, compared with the 2009-2010 academic year, there was a decrease in systolic blood output of the heart muscle in girls of both groups, $p < 0.05$. The comparative decrease in strength abilities and the deterioration of the Robinson index in MMG and SMG girls in the 2019/2020 academic year compared to the 2009/2010 academic year is shown in Figure 3.

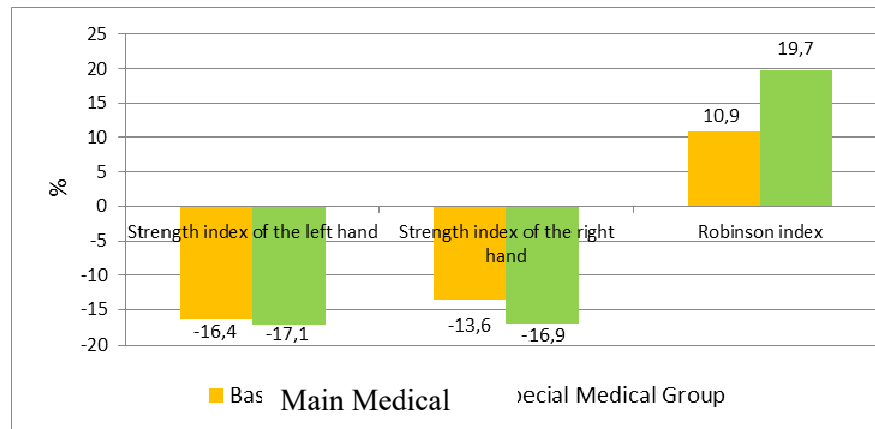
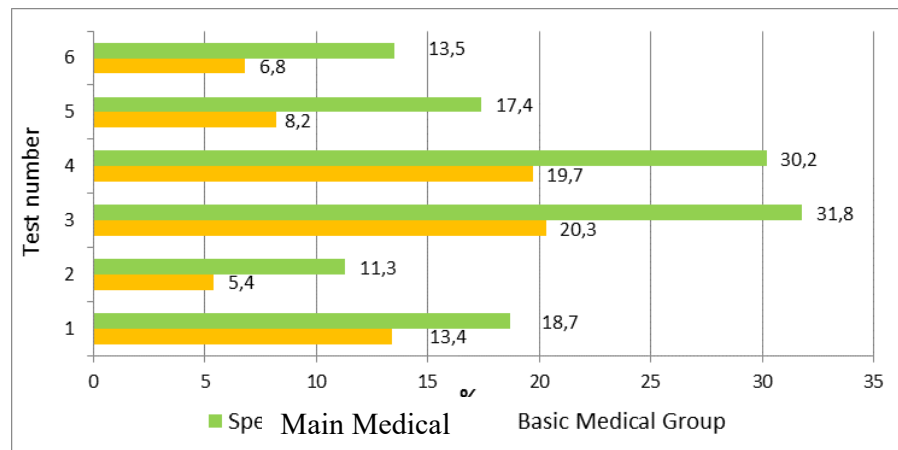


Fig. 3. Decrease in strength abilities and the Robinson index in girls in the 2019/2020 academic year compared to the 2009/2010 academic year

As can be seen from Figure 3, girls of both health groups showed a decrease in strength abilities in the 2019-2020 academic year compared to the 2009-2010 academic year. In the girls of the main medical group, the value of the Robinson index worsened by more than 10%; and in the special medical group by 19.7%.

An increase in the number of overweight and obese girls, a decrease in strength abilities and reserve capabilities of the heart led to a decrease in the motor qualities values of girls examined in the 2019-2020 academic year compared with the 2009-2010 academic year in both medical groups, Figure 4.



**Note. - test number: 1- 30 m run of the high start, s; 2- 1000 m run, min, s; 3 -sit-up, the number of times in 30 s; 4 -hanging on the crossbar, s.; 5 -seated forward bend, cm; 6 - standing long jump, cm*

Fig. 4. Decrease in the motor test indicators values in the 2019/2020 academic year compared to the 2009/2010 academic year

The data shown in Figure 4 indicate a decrease in the indicators values in all motor tests in the 2019/2020 academic year compared with the indicators of the 2009-2010 academic year. The greatest decrease in testing indicators was noted in the special medical group compared to the main one.

Dicussion

Due to major changes in the economic, political, social and other spheres of human activity, it is relevant to conduct monitoring observations of the young people's in different populations physical health with a significant time interval. Such studies are of scientific and practical interest, taking into account the component composition of the body, motor qualities, the state of somatic health and the medical group of youth health for physical education (Prontenko et al., 2020; Kolokoltsev et al., 2021). Therefore, such studies are timely and relevant.

We found that the values of indicators describing the state of body weight in students assigned to a special medical group were significantly higher than the values of indicators in girls of the main medical one, which is associated with the presence of somatic diseases. Among the girls examined in the 2019-2020 academic

year, compared with 2009-2010, both medical groups showed a negative characteristic of the body mass index. In the 2019-2020 academic year, the number of overweight and obese girls has increased significantly. An increase in the number of overweight and obese youth is noted in the materials of other researchers (Mazin et al., 2021). The predominance of adipose tissue content with a large body mass index value is indicated by our study of the body component composition. Such a study reflects not only the state of an individual's physical development, but is also a marker of the state of physical and somatic health and motor activity of a person (Syuro Ito et al., 2020).

We found that a decrease in the physical fitness of female students with overweight or body weight deficiency is closely related to the muscular component of the body composition (Kolokoltsev et al., 2018). The scientific literature presents data on a 2-fold decrease in the strength ability of the muscles of the hands of students with deviations from normal body weight (Solodovnikova et al., 2017). A similar relationship between human anthropometric indicators and excess body weight and obesity is noted by other authors (Zerf Mohammed et al., 2017). In our research, such students showed a low result in all motor tests, which confirms the research results of previous authors. Deterioration of systolic work of the heart muscle in modern girls plays a significant role in reducing the results of motor testing. The negative dynamics of the Robinson index in modern girls indicates a decrease in the reserve capabilities of the cardiorespiratory system (Zerf Mohammed et al., 2017).

The data obtained as a result of monitoring of physical development indices, indicators of body component composition and motor tests can be regarded as negative changes in the characteristics of somatic and physical health of modern girls, which requires further study of this issue.

Conclusions

The results of the physical development indices values analysis in modern female students indicate an increase in their number of overweight and obese compared with the results of the survey in the 2009-2010 academic year. The study of the component composition of the body confirms the negative vector of an increase in the body mass index due to an increase in the fat and a decrease in the muscle component of the girls' body, which led to a decrease in the strength index values. This, along with the deterioration of the systolic work of the heart, caused a decrease in the physical fitness of modern girls. The most negative dynamics of physical health is observed in girls assigned to a special medical health group.

The data we obtained from monitoring female students' in different populations and medical health groups physical health using an index assessment of anthropometric parameters allowed us to determine the vector of changes in the young people's physical development. In combination with the results of the analysis of the body component composition and the physical fitness of girls, these data make it possible to reasonably make adjustments to the planning of the educational process of students' physical education.

Conflicts of interest

The author declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

References:

- Budzyn Vira, Olha Matviyas, Ihor Lapychak, Natalia Bazylyak, & Natalya Zharska. (2019). Features of phase changes of some morphofunctional indices in girls during ovarian-menstrual cycle. *Journal of Physical Education and Sport*, Vol 19 (Supplement issue 1), Art 10, pp. 65 – 68. DOI:10.7752/jpes.2019.s1010
- Cronin, L. Marchant, D., Johnson, L., Huntley, E., Kosteli, M.C., Varga, J., & Ellison, P. (2020). Life skills development in physical education: A self-determination theory-based investigation across the school term. *Psychology of Sport and Exercise*, 49, 101711. DOI: 10.1016/j.psychsport.2020.101711
- Fefelova, V.V., Koloskova, T.P., Fefelova, Y.A., Kazakova, T.V., & Sergeeva, E.Y. (2015). Effect of food load on activities of enzymes of the main metabolic pathways in blood lymphocytes in girls with different anthropometric parameters. *Bulletin of Experimental Biology and Medicine*, 159(3), 309-313. DOI:10.1007/s10517-015-2949-y
- Jan Junger, Ferdinand Salonna, Józef Bergier, Andrea Junger, Karel Frömel, Pongrács Ács, & Barbara Bergier. (2019). Physical activity and Body-Mass-Index relation in secondary-school students of the Visegrad region. *Journal of Physical Education and Sport*, Vol 19 (Supplement issue 1), Art 35, pp.235–241. DOI:10.7752/jpes.2019.s1035
- Kenji Takagishi, Tetsuya Matsuura, Takashi Masatomi, Etsuo Chosa, Tsuyoshi Tajika, Mikihiro Watanabe, Tetsu Iwama, Toshiro Otani, Katsunori Inagaki, Hiroyasu Ikegami, Mitsuhiro Aoki, Ko Kato, Toru Okuwaki, Koichi Sairyo, Yasushi Kameyama, Akira Maeda, & Moroe Beppu (2017). Shoulder and elbow pain in elementary school baseball players: the results from a nation-wide survey in Japan. *Journal of Orthopaedic Science*, 22(4), pp. 682–686. DOI: 10.1016/j.jos.2017.03.016

- Kolokoltsev M., Kuznetsova L., Makeeva V., Ustselema N., Romanova, E., Savchenkov A., Mischenko N., Vorozheikin A., Bolotin A., & Skaliy A. (2021). Physical education of girls from different somatotypes and health groups. *Journal of Physical Education and Sport*, Volume 21, Issue 2, Art. 106, pp 852-859. DOI:10.7752/jpes.2021.02106
- Kolokoltsev, M., Iermakov, S., & Jagiello, M. (2018). Comparative analysis of the functional characteristics and motor qualities of students of different generations and body types. *Pedagogics, Psychology, Medical-Biological Problems of Physical Training and Sports*, 22(6), 287-295. DOI: 10.15561/18189172.2018.0602
- Komissarova, E.N., Panasyuk, T.V., Sazonova, L.A., & Tambovtseva, R.V. (2016). The initial stages of puberty of girls in the second childhood, taking into account constitutional affiliation. *New research*, 1, 29-36. (in Russian).
- Krutsevich, T., Panhelova, N., Trachuk S.(2019). Control of physical preparedness of schoolchildren using index method. *Journal of Physical Education and Sport*, Vol.19 (issue 2), Art 166, pp. 1145 – 1152. DOI:10.7752/jpes.2019.02166
- Lee, S.Y., & Gallagher, D. (2008). Assessment methods in human body composition. *Curr. Opin. Clin. Nutr. Metab. Care*, 11(5), 566-572. DOI:10.1097/MCO.0b013e32830b5f23
- Matiegka, J. (1921). The testing of physical efficiency. *Am. J. Phys. Anthropol.*, 4(3), 223-230.
- Mazin, V., Kovalov, Y., & Bytsiuk, V. (2021). Effect of fitness classes on the physical and mental health of 35-55-year-old women living in Australia, Ukraine, and the UAE. *Journal of Physical Education and Sport*, 21(3), Art 179, pp. 1406 – 1412. DOI:10.7752/jpes.2021.03179
- Noor Fatin Nazieffa Fakri, & Hairul Anuar Hashim (2020). The effects of integrating physical activity into mathematic lessons on mathematic test performance, body mass index and short term memory among 10-year-old children. *Journal of Physical Education and Sport*, Vol 20 (Supplement issue 1), Art 61, pp 425 – 429. DOI:10.7752/jpes.2020.s1061
- PCFSN. *The president's challenge: Physical fitness test (2011)*.
<https://www.presidentschallenge.org/challenge/physical/index.shtml>
- Prontenko, K., Griban, G., Bloshchynskyi, I. Melnychuk, I., Popovych, D., Nazaruk, V., Yastremska, S., Dzenzeliuk, D., & Novitska, I. (2020). Improvement of students' morpho-functional development and health in the process of sport-oriented physical education. *Wiadomości Lekarskie*, 73 (1), 161-168. DOI:10.36740/WLEk202001131
- Robinson, B.F. (1967). Relation of heart rate and systolic blood pressure to the onset of pain in angina pectoris. *Circulation*, 35, 1073-1083. DOI:10.1161/01.cir.35.6.1073
- Robinson, B.F. (1967). Relation of heart rate and systolic blood pressure to the onset of pain in angina pectoris. *Circulation*, 35, 1073-1083. DOI:10.1161/01.cir.35.6.1073
- Sattarov, A.E., & Karelina, N.R. (2018). Features of the growth processes in boys and boys of various body types and builds living in the southern part of Kyrgyzstan. *Pediatrician*, 9(5), 47-52. DOI: 10.17816/PED9547-52.
- Soleh Solahuddin, Iman Sulaiman, Bambang Kridasuwarto, Wahyu Indra Bayu, & Margono Lasiono (2021). Physical activity level and body mass index profile of the working-age population in Palembang City. *Journal of Physical Education and Sport*, Vol 21 (Suppl. issue 4), Art 310, pp 2318 – 2324. DOI:10.7752/jpes.2021.s4310
- Solodovnikova, Yu.V., Metina, K.I., Sakharova, O.B., Kiku, P.F., & Babko, S.V. (2017). Nutrition and physical development of students (retrospective assessment). health. medical ecology. *Science*, 68(1), 19-23. DOI:10.5281/zenodo.345608.
- Syuro Ito, Takahiko Fukumoto, & Hidetaka Imagita (2020). Relation between the Height-Weight ratio and physical fitness among Japanese elementary school students. *Journal of Physical Education and Sport*, Vol.20 (2), Art 101, pp. 690 – 706. DOI:10.7752/jpes.2020.02101
- Ushakova, E.V., Nalivaiko, N.V., & Vorontsov, P.G. (2017). On the understanding of health in the medical, pedagogical, social and physical aspects. *Health, Physical Culture and Sports*, (1(4), 18-29. Retrieved from <http://hpcas.ru/article/view/1735>
- Yang, C.B., & Dong, M.K. (2017). A Study of the correlation between teachers' teaching styles and students' participation motivation in the physical education. *Journal of Baltic Science Education*, 16(2), 199-206. DOI : 10.33225/jbse/17.16.199
- Zerf Mohammed, Atouti Noureddine, & Ben Farouk Abdullah (2017). Abdominal obesity and their association with total body: fat distribution and composition. Case of Algerian teenager male high school students. *Physical education of students*, 21(3), 146–151. DOI:10.15561/20755279.2017.0308