

Pilates program use for high school girls' additional physical education

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Abstract:

The aim of the research is to modernize and experimentally test the «Pilates» training program as an element of additional physical education to improve the girls' aged 15-17, physical health and functional characteristics level. *Materials and methods.* The pedagogical experiment was conducted during the 2019-2020 academic year at school No. 11 of Yemanzhelinsky municipal district in Chelyabinsk region (Russia). 15 girls of high school age (15-17 years) participated in it. Additional classes were held in the afternoon, outside the grid mandatory training hours for physical education 2 times a week for 60 minutes, as we developed the program «Physical culture and health system «Pilates» for girls, aged 15-17», which is designed for 144 academic hours, including 12 theoretical hours and 96 practical ones. Self-tuition classes are given 48 hours (once a week for 60 minutes). In additional classes, the girls were performing basic «Pilates» exercises on mats. After two months of training, basic exercises were performed with small equipment, using the complexes of exercises developed by us with a «Pilates ball» and an isotonic «Pilates ring». Before and after the experiment, the schoolgirls' physical health level was assessed using an express-method based on a point assessment of anthropometric and physiometric indicators. Hypoxic breath-holding tests were performed. Physical fitness of the girls was determined using motor tests. *Research results.* The developed and tested fitness technology for improving the girls', aged 15-17, physical health and functional indicators level in the conditions of additional physical education had a pronounced positive effect on these indicators' values. There was a significant increase in the schoolgirls' physical health and functional fitness indicators values at the end of the experiment. *Conclusions.* The proposed upgraded fitness technology based on «Pilates» system in additional physical education can be recommended for improving schoolgirls' aged 15-17 physical health and functional indicators level.

Key Words: Fitness Technologies, «Pilates» System, Additional Physical Education, Physical Health, Functional Indicators

Introduction

Research relevance. The goals and objectives of physical education are to strengthen young people's health (Görner, Reineke, 2020; Zanova, 2015), increase motivation for physical activity (Sawicki, 2018; Pesina, Mishchenko, 2019), acquire knowledge in the field of physical culture and sports activities and form healthy lifestyle habits (Nesterchuk et. al., 2020).

The analysis of scientific and methodological literature shows that currently there is a decrease in interest in traditional forms of organizing and conducting PE classes at school among young students. One of the reasons for low motivation is the lack of choice of the motor activity type (Cezary Kuśnierz et. al., 2020). The system of physical education in educational institutions needs to be modernized, both in terms of content and technology (Andrieieva et. al., 2020; Ustseleмова, & Ustselemov, 2018).

One of the innovative trends in fitness technologies is «Pilates» exercise system use. It is a «direction of health-improving physical culture that has a high impact degree on students' functional state and physical abilities, helps to improve posture, develop flexibility, strength and general endurance» (Pilates, J., 2007) As D. Reyneke (1993) notes, «Pilates» system has an effect on such physical qualities development as strength and

flexibility, and has a positive effect on students' psycho-emotional state. In addition, such exercises have a minimal load on the cardiovascular system, which is safe for any level of a person's physical fitness (Dan, 2007).

Despite the age-old history of studying issues related to «Pilates» exercise system comprehensive assessment, the available scientific papers do not reflect the full range of possible effects of the proposed exercises on students' physical condition.

In the available literature there are no research works associated with «Pilates» introduction in high school age girls' physical education, no specific, practical recommendations for planning, organizing and conducting sports and recreational activities on «Pilates» system with the girls, aged 15-17 in additional schooling. All this allowed us to identify the direction of our research on the means and methods of modernization of «Pilates» system using in the conditions of additional school education for girls aged 15-17.

Research aim. is to modernize and experimentally test the «Pilates» training program as an element of additional physical education to improve the girls' aged 15-17, physical health and functional characteristics level.

Material & methods

The pedagogical experiment was conducted during the 2019-2020 academic year at school No. 11 of Yemanzhelinsky municipal district in Chelyabinsk region (Russia). 15 girls of high school age (15-17 years) participated in it. Additional classes were held in the afternoon, outside the grid mandatory training hours for physical education 2 times a week for 60 minutes, as we developed the program «Physical culture and health system «Pilates» for girls, aged 15-17». Before and after the experiment, the schoolgirls' physical health level was assessed using an express-method (Apanasenko, 2011), based on a point assessment of anthropometric and physiometric indicators: weight (kg) and body length (m), systolic blood pressure (mmHg), lungs vital capacity (ml), hands strength (kg), heart rate at rest (beats per minute), pulse recovery time after a standardized load (20 squats in 30 seconds, min). The sum of points 17-21 characterizes the «high» level of girls' health (V), 14-16 points – «above average» (IV), 10-13 points – «average» (III), 5-9 points – «below average» (II), less than 4 points – «low» (I) level.

Genche and Stange hypoxic breath-holding tests were performed during our research. To quantify the girls' body energy potential, the indicator of the cardiovascular system reserve was determined: the Robinson index, $IRob = \text{heart rate} : 100$, relative units (Robinson, 1967). The hands muscles strength of both hands (kg) was determined by a dynamometer.

To assess the girls' physical fitness (speed qualities, endurance, strength, flexibility, agility) before and after the experiment, control tests included in the European physical fitness tests (PCFSN, 2011) were used: «running 30 m», (s); «shuttle run 4x9 m», (s); «standing long jump», (cm); «6-minute run», (m); «forward bend from a standing position», (cm); «pull-up on a low crossbar from a prone position», (times); «hopping over a skipping rope, 1 minute», (times); «lifting the torso from the prone position, for 1 min» (times); «throwing a stuffed ball 1 kg», (cm).

The experimental program, worked out by us, is designed for 144 academic hours, including 12 theoretical hours and 96 practical ones. Self-tuition classes are given 48 hours (once a week for 60 minutes).

Table 1. Physical culture and health-improving «Pilates system» experimental program curriculum for girls, aged 15-17»

Theme #	Title	Total amount (hours)	Theoretical classes	Practical classes	Self-tuition classes
1	Introductory lesson	4	2	2	2
2	Breath technics	6	2	4	2
3	Basic body positions technics	24	2	20	4
4	Basic motions technics	24	2	20	4
5	Basic «Pilates» exercises technics	82	2	48	34
6	Control lessons	8	2	4	2
Total:		144	12	96	48

During September and October 2019, during extracurricular classes, the girls were performing basic «Pilates» exercises on mats (Pilates Matwork), without equipment. After two months of training, basic exercises were performed with small equipment (fitballs, expanders, body bars, and isotonic rings).

From November 2019 until the end of the experiment (May 2020), basic «Pilates» exercises with small equipment complexes use alternated with exercises without equipment (4 classes were held monthly using small equipment and 4 classes without it). All exercises were performed with musical accompaniment.

To perform the program developed by us, we used a set of exercises with a «Pilates ball» TOGU Redondo-Ball. This is a soft and light ball with a diameter of 20-30 cm, which helps to concentrate on the

exercise performing, to control the softness and smoothness of movements. Training with a ball is not only a way to make training more emotional, interesting and diverse, but also physical loading that helps prevent posture disorders. Strength exercises with a «Pilates ball» increase the load on the muscle corset and ligamentous apparatus stretching by creating additional resistance of the deep stabilizer muscles. Redondo-Ball can be used as a tool for relaxation and massage. The next set of exercises we proposed an isotonic «Pilates ring» use to strengthen the chest, abdomen, buttocks, back muscles, to develop a sense of balance and coordination.

Experimental sets of physical exercises were used in the main part of the lesson. When learning the complexes, information technologies were actively used, in particular, a computer for demonstrating video materials. The work performed does not infringe on the rights or endanger the schoolchildren's well-being in accordance with the ethical standards of the Human rights Committee of the Helsinki Declaration of 2008. (WMA Declaration of Helsinki). The consent of the girls' parents to conduct the survey was obtained.

Statistical analysis. The average value (M), minimum, maximum, standard deviation (σ), standard error (m), and confidence score were calculated using the Microsoft Excel and StatSoft Statistica 6.1 application software package.

Results

«Pilates» experimental method use in secondary school education had a positive effect on the girls' physical health characteristics (Fig.). At the end of the experiment, the number of girls with «below average» health level decreased by 50%, the number of girls with «average» health level increased by 42.7%, there were girls with «above average» level and there were no girls with «low» and «high» health levels.

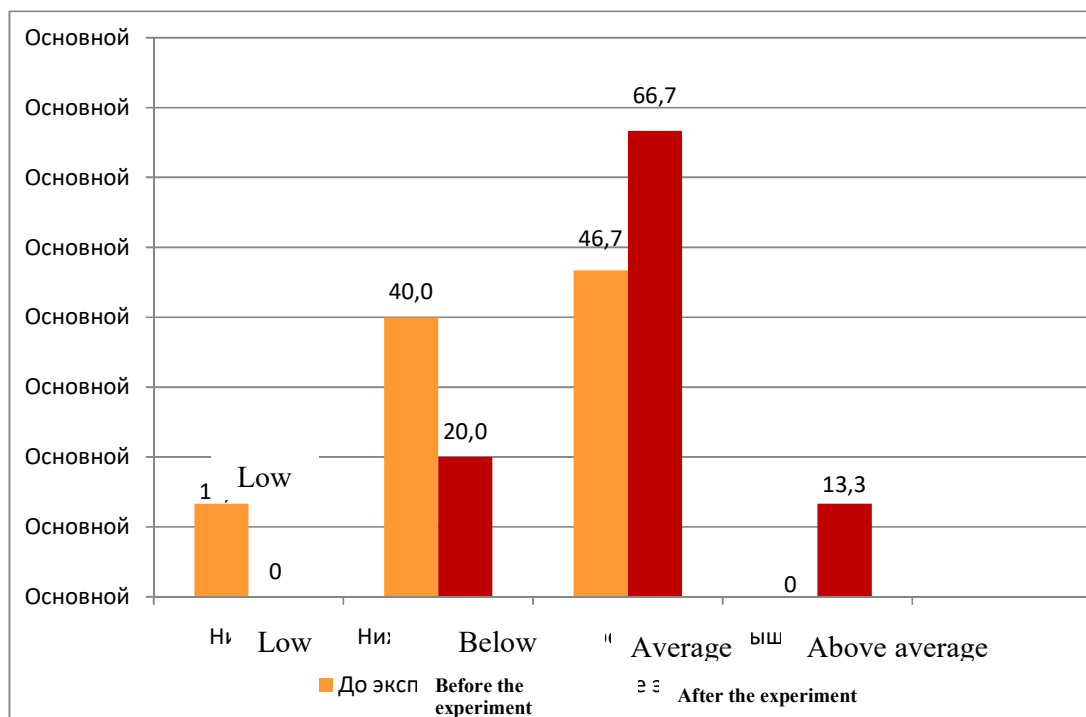


Fig. Number of girls with different health levels before and after the experiment (in %)

A comparative analysis of the cardiovascular and respiratory systems performance after the experiment showed that during the experiment period there were statistically significant positive changes in the heart rate at rest, «Stange's and Genche's test» (timed expiratory capacity) indicators (Table 2).

Table 2. The girls' cardiovascular and respiratory systems performance indicators before and after the experiment ($X \pm \sigma$)

Indicator	Before experiment ($X \pm \sigma$) (n=15)	After experiment ($X \pm \sigma$) (n=15)	t	p	Indicator growth (%)
1. Heart rate at rest (bpm)	69,2±3,64	58,8±2,53	2,43	<0,05	15,1
2. Robinson index	86,2±3,82	70,2±3,24	2,04	<0,05	18,6
3. Stange's test (s)	42,0±2,98	58,6±3,31	2,67	<0,05	39,5
4. Genche's test (s)	34,0±2,44	46,0±2,85	2,39	<0,05	35,2

At the end of the experiment, there were no girls with «low» level of cardiovascular system activity. The number of girls with «average» heart rate at rest level decreased by 11%, and the number of girls with such «high» level increased by 3.5 times.

Table 3. The number of girls with different cardiovascular and respiratory systems functional state levels before and after the experiment (%)

Systems functional state indicator	Before the experiment		After the experiment	
	Number of girls	% girls of the total number	Number of girls	% girls of the total number
Heart rate				
Low	4	26,7	0	0
Average	9	60,0	8	53,3
High	2	13,3	7	46,7
Stange's test (s)				
Low	4	26,7	0	0
Average	8	53,3	9	60,0
High	3	20,0	6	40,0
Genche's test (s)				
Low	5	33,4	0	0
Average	8	53,3	10	66,6
High	2	13,3	5	33,4

After the experiment, girls with a «low» level of indicators values in both hypoxic samples were not detected. The number of girls with «average» and «above average» indicators has increased (Table 3).

Girls' testing at the end of the experiment revealed statistically significant positive changes in physical fitness indicators in all control tests performance (Table 4). The largest increase in the indicators values (50.0%) was noted in the test «pull-up on a low crossbar from a prone position» and by 39.2 % in the test «lifting the torso from the prone position», for 1 min. The smallest increase in the indicators values (5.5%) was registered in the test «shuttle run 4x9 m» and in the test «throwing a stuffed ball» (9.4 %).

Table 4. Indicators values of the girls' physical fitness before and after the experiment ($X \pm \sigma$)

Tests	Before experiment ($X \pm \sigma$) (n=15)	After experiment ($X \pm \sigma$) (n=15)	t	p	Indicator growth (%)
Running 30 m, (s)	5,7±3,62	4,8±3,23	2,23	<0,05	17,1
Shuttle run 4x9 m (s)	11,2±5,41	10,6±4,29	2,34	<0,05	5,5
Standing long jump (cm)	146,8±4,84	163,5±5,94	3,43	<0,05	10,8
6-minute run (m)	989,6±8,62	1157,8±99,53	3,21	<0,05	15,7
Forward bend from a standing position (cm)	11,4±6,34	14,8±7,31	2,45	<0,05	26,0
Pull-up on a low crossbar from a prone position (times)	6,0±5,72	10,0±7,85	2,42	<0,05	50,0
Hopping over a skipping rope, 1 minute (times)	87,5±5,43	98,6±5,89	2,98	<0,05	11,9
Lifting the torso from the prone position, for 1 min (times)	24,8±5,89	36,9±6,45	2,76	<0,05	39,2
Throwing a stuffed ball 1 kg, (cm)	463,2±6,91	508,7±7,86	3,43	<0,05	9,4
Handgrip test right, kg	31,8±3,22	39,8±3,63	2,62	<0,05	22,3
Handgrip test left, kg	29,7±3,87	35,8±4,65	2,53	<0,05	18,6

At the end of the experiment the number of girls with «average» level of physical training increased from 7 (46,7%) to 10 (66,6%), and the number of girls with such «high» level increased from c 3 (20%) to 5 (33,4%). There were no girls with «low» physical training level. The examined girls' comparative handgrip tests results showed an increase in right hand strength by 22.3 %, and the left by 18.6% at the end of the experiment.

Dicussion

Young students' hypokinesia and hypodynamia leads to insufficient development of motor skills (Dževad Džibrić, 2017), health deterioration (Tolgfors, & Ohman, 2016) and functional body systems activity in a number of countries in Europe (Nosko et. al., 2016) and Russia (Osipov et. al., 2017). According to Ihor Bakiko et. al. (2020), boys in grades 5 and 6 in Ukraine have a low health level, 91.0% and 88%, respectively. A similar situation is observed among girls. The existing generally accepted physical education system effectiveness for young students is still not high enough (Drachuk et. al., 2018; Furman et. al., 2018). Therefore, the search for new approaches to improving PE lessons effectiveness in schools is relevant (Kolumbet, & Dudorova, 2016), it confirms the importance of our chosen research. Complex physical activity programs in schools, providing for coordination in five areas: quality physical education at school during a school day,

students' physical activity before and after school, teachers', parents' and families' participation in increasing children's physical activity, are becoming popular in the world. Such physical education models have shown high efficiency (Kriemler, 2011). In comparison with the traditional form, the experimental work of researchers from Poland showed a high efficiency of intensive interval training (GB-HIIT) in PE classes at school (Segovia, Gutiérrez, 2020). The literature provides information about the fitness technologies use to increase students' motivation and physical fitness in PE classes (Zhamardiy et. al., 2020). At present, it is not always possible to increase the compulsory school hours' number for schoolchildren's physical education. Some researchers in Slovenia and Bosnia suggest increasing physical loading through extracurricular activities. Increasing the amount of physical activity as a supplement to basic physical education activities has a positive impact on students' physical health (Talović et. al., 2015). This is consistent with the data from our study. The results of using the proposed program «Pilates fitness system for girls aged 15-17» showed an increase in the number of girls with «average» and «above average» physical health levels of and a decrease in the number of girls with «low» and «below average» ones. After the experiment, the girls had pulse decrease (heart rate) at rest by 15.1% ($p < 0.05$) and a decrease in Robinson index value by 18.6% ($p < 0.05$), it indicates cardiovascular system work economization and an increase in the body's adaptation to physical loadings. Our results do not contradict other authors' research materials (Svyatova et.al., 2018), where it is shown that the bradycardia phenomenon is a specific effect of general endurance training. Previously, we have shown that the students' cardiovascular system reserve capacity increasing during exercise increases their motor abilities in motor tests for general endurance (Kolokol'tsev et.al., 2018). According to the results of our study, at the end of the experiment, the girls' overall endurance index value in the «6-minute run» test increased by 15.6%. After the experiment, the breath retention time in hypoxic breath samples of Genche's and Stange's tests increased. It indicates an increase in the girls' body aerobic capacity when performing physical work. Other authors have noted an increase in swimmers' aerobic abilities using breath retention (Ziambetov et.al., 2016). We believe that further study of fitness technologies use in schoolchildren's additional physical education is a promising direction of the program, aimed at improving modern youth's physical health.

Conclusions

The pedagogical experiment of «Pilates» system fitness technology use in additional physical education allowed the girls' aged 15-17 physical health level, cardiovascular and respiratory systems functional indicators and physical fitness level increasing.

This experimental program makes it possible to increase schoolchildren's pedagogical process of physical education effectiveness and can be recommended for use in other educational institutions.

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

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