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Original Article

Additional physical training for children over five years old

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Abstract:
Research aim is to test and evaluate the effectiveness of fitball aerobics program used as an element of additional physical education for children over five. *Materials and methods.* 40 children aged 6-7 attending a preschool educational institution in Chelyabinsk (Russia) took part in the research. Before and after the pedagogical experiment, the children of both groups were measured body weight, evaluated the physical and functional abilities of the body. Compulsory physical education classes in the control and experimental groups were conducted 3 times a week for 30 minutes according to the «Rainbow» program. For the children of the experimental group, additional classes were conducted according to the proposed comprehensive training program «Fitball-aerobics for children aged 6-7» in the gym in the afternoon 2 times a week for 30 minutes, outside the mandatory training hours grid for physical culture in a preschool educational establishment. The proposed fitball aerobics program is designed taking into account the children's age and motion experience and contains a set of physical exercises with the ball and on the ball, corrective gymnastics, dancing, active and musical games, and a relay race. *Research results.* At the end of the experiment, the girls and boys of the experimental group had a significant increase in the indicated values in all motor tests and in all functional ones. The increase in the values of motor and functional tests in children of the experimental group was higher than in the children of the control group. The largest increase in the children's motor qualities values was observed in the experimental group in tests for speed and strength endurance of the trunk flexor muscles and spine and hip joints active flexibility. The highest increase in the functional indicators values was observed when testing girls and boys of the experimental group for statokinetic stability (Romberg test) and physical performance (Rufier index). *Conclusions.* The results of the additional physical education program for over-five-year-old children tested by the authors showed its effectiveness. The choice of the tools and pedagogical technologies offered in this program allowed us to increase significantly the children's conditioned and functional indicators before entering school. To improve conditioned abilities of children aged 6-7 and adapt them to school, preschool teachers should actively search for means and methods of additional physical education.
Key Words: **over five years old children, physical abilities, fitball-aerobics, physical education (PE)**

Introduction

A person's physical activity is an effective non-medical product for preserving and promoting health (Potop et.al., 2017; Zurita-Ortega et.al., 2019). Human physical health foundations formation is particularly intensive in the preschool age period (Marouli et. al., 2016). During this age period of the child's development, physical culture and health education in children's educational institutions is of great importance.

A child's health potential depends on its physical qualities (endurance, strength, speed, speed, flexibility), which determine the child's body morphofunctional development. An analysis of the literature

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indicates that many children who attend preschool educational institutions have low physical fitness (Karpov et. al., 2019). In the literature, there are materials on insufficient physical activity of a person (Chekhovska et. al., 2020; Bakiko et. al., 2020), may be the causes of some non-communicable diseases (Metalnikov et al., 2020). Reduced physical activity leads to an adverse effect on children's health and functional performance (Global Recommendations on Physical activity for Health, 2010; Piercy et.al., 2018).

The level of children's physical inactivity increases in primary school. 6-11-year-olds attending primary school classes in Russia have low physical activity, note the absence of a developing and teaching effect in PE lessons (Kondakov et. al., 2020). In recent years, there has been a decline in children's, adolescents' and young people's interest in the generally accepted forms of PE classes (Kuśnierz et. al., 2020).

One of these areas of children's physical fitness improving and preventing various diseases is fitball aerobics classes (Sbitneva, 2018; Mishchenko, Badretdinova, 2019 The results of the authors' research indicate the need to improve children's physical education even before entering school. An innovative approach to the content and technology of conducting a PE training session is a promising direction for the modernization of the system of physical education in educational institutions (Andrieieva et. al., 2020).

Exercises on large gymnastic balls cause an emotional and health-improving effect, which is confirmed by the experience of working in specialized correctional and rehabilitation medical centers (Pesina, Mishchenko, 2019). The use of fitballs in physical education provides a comprehensive development of the vestibular, auditory, visual, tactile and olfactory analyzers. Fitball aerobics forms the correct posture, increases the joints and spine mobility, strengthe ns the cardiovascular system, activates the sensory systems, normalizes the child's psycho-emotional state and arouses great interest in children, educates children's strength, agility, speed, flexibility, endurance and coordination abilities (Gorbunova, Steblius, 2015; Safronova et.al., 2016). The effectiveness of the gymnastic exercises with fitball is confirmed by scientific studies (Lavrukhina, Gorbunova, 2018). However, there are few reports of the use of phytballs aerobics in the system of preschool children's physical education, aimed at developing their reserve and adaptive capabilities of the body before entering school.

Research aim is to develop a modern fitball aerobics program for children's aged over five additional physical training and evaluate its effectiveness.

Material & methods

In the 2017-2018 academic year in the pedagogical experiment involved 40 children aged 6-7 (6.43□0.37 years) a preschool educational institution in Chelyabinsk (Russia). Of these, 20 boys and 20 girls. Before and after the pedagogical experiment, body weight was measured in children of both groups, and the physical and functional abilities of the body were evaluated. Motor tests were used to determine speed (running 30 m, s); speed endurance and agility (shuttle run 3 times x 10 m, s); high-speed endurance and agility (shuttle run 3 x 10 m, s); muscle strength of lower extremities (standing long jump, cm); strength endurance of the trunk flexor muscles (sit-up, the number of times in 30 s); active flexibility of the spine and hip joints (seated forward bend, cm). The Rufier Strength Index (RI) was calculated using the formula: RI =hand muscle strength / body weight x 100% (Nikitina et al., 2016).

The resting heart rate (bpm) was determined. For the children's cardiovascular system reserve capabilities characteristics, the Roufier index was calculated using the formula: IR= (4 x (p1 + p2 + p3) - 200): 10, where

p1 – heart rate at rest **(bp/15sec)**

p2 – heart rate after physical loading (30 squats for 45 seconds) (**bp/15sec)**

p3 - heart rate in 45 seconds after physical loading (**bp/15sec)**

The Rufier index results were evaluated in conventional units on a scale for children aged 6-7: excellent - 6; good-6.5 - 11; satisfactory - 12-16; weak - 17-21; very bad - over 21.

To determine the children's statokinetic resistance state, a simple Romberg test was used (Khasnis, & Gokula, 2003; Ustselemova, & Ilyina, 2015). The duration of sample retention was estimated in seconds. Compulsory PE classes in both groups were conducted 3 times a week for 30 minutes according to the «Rainbow» program (Grizik et.all., 2010).

For the children of the experimental group, additional classes were conducted according to the proposed comprehensive training program «Fitball-aerobics for children aged 6-7» in the gym in the afternoon 2 times a week for 30 minutes, outside the mandatory training hours grid for physical culture in an educational preschool establishment.

The exercises were performed with the help of a 55 cm diameter gymnastic oval ball, certified by children's weight and age Gymstick Oval Gymball ABS, manufactured by Reebok (USA), and were accompanied by a musical arrangement. Fitness aerobics training sessions were conducted in 4 stages (Table 1).

Table 1. Structure of «Fitball-aerobics for children aged 6-7» annual program.

Stages	Periods	Aims	Activity kinds	Lessons volume
Initial	Septem-ber 2017.	Children's control tes-ting. Children's ideas formation about exerci-ses with fitball. Training in the general basic positions of fitball gymnastics. Introduction to self-guarding and safety techniques.	Initial screening of children's physical and functional fitness. Learning how to roll and pass the ball on the floor, hlearning how to throw and hit the ball on the floor.	8 lessons 4 hours
Pre-para-tory	October201 7.	Mastering basic exerci-ses in fitball-aerobics.	Training in the correct fitball sitting; basic body positions when performing exercises with the ball on the ground; training in various starting positions on the floor (stomach and back, on the knees); mastering exercises for maintaining balance; learning exercises for different muscle groups.	8 lessons 4 hours
Basic trai-ning	Novem-ber 2017. April 2018.	Improving the tech-nique of performing learned exercises. Motor skills formation and the obtained results consolidation.	Performing a complex of fitball aerobics with dance and game components	28 lessons 14 hours
Final	May 2018.	Children's control testing.	Final screening of children's physical and functional fitness	4 lessons 2 hours
Total:				48 lessons 24 hours

The proposed fitball aerobics program is designed taking into account the children's age and motor experience and contains a set of physical exercises with the ball and on the ball, corrective gymnastics, dancing, active and musical games, and a relay race. The lesson structure consisted of three parts. In the preparatory part (5-6 minutes), hands free conditioning exercises were used. In the main part (15-20 minutes), exercises with a gymnastic ball were performed. In the final part (3-5 minutes), relaxation and recovery exercises were performed.

The dosage of physical activity was determined by the duration and pace of physical exercises, the number of exercises repetitions. In stages I and II, each exercise was repeated 4-5 times, gradually increasing the repetitions to 7-8 times in the third stage. The children performed a set of physical exercises for different muscle groups from different starting positions. Every month of the main stage, the complex was changed.

The work was performed the Helsinki Declaration of 2008 (WMA Declaration of Helsinki). Using the Microsoft Office Excel 2010 software package, the statistical parameters of the received data were determined. The differences between the indicators values at $p < 0.05$ were considered statistically significant.

Results

Table 2 shows the conditioning abilities of girls.

Table.2. **The girls' motor tests results (M □ m)**

Motor tests	Control group (n=10)		Experimental group (n=10)	
	Before the experiment	After the experiment	Before the experiment	After the experiment
Running 30 m, sec	7.8 □ 0.3	7.6 □ 0.6	7.9 □ 0.4	7.0 □ 0.2*
Shuttle run 3 times x 10 m, sec	10.4 □ 0.2	10.0 □ 0.3	10.3 □ 0.3	9.6 □ 0.1*
Standing long jump, cm	95.6 □ 4.6	103.0 □ 4.0*	96.1 □ 1.8	112.0 □ 3.5*
Sit-up, the number of times in 30 sec(number of times)	8.5 □ 0.1	10.5 □ 0.1*	8.4 □ 0.6	13.6 □ 1.3*
Seated forward bend, cm	3.6 □ 0.2	4.6 □ 0.6	3.4 □ 0.6	5.2 □ 0.7*

Note. * - tests indicators values significant difference after the experiment ($p < 0.05$)

Before the pedagogical experiment, conditioned abilities indicators values the girls did not differ ($p > 0.05$).

After the experiment in the girls of the control group (Table 2) the indicators values of only two tests («Standing long jump» and «Sit-up from a lying position») increased, $p < 0.05$. In the girls of the experimental group, there was a significant increase in the indicators values in all motor tests, $p < 0.05$. The increase in the values of all motor tests in the girls of the experimental group was higher than in the girls of the control one (Fig. 1).

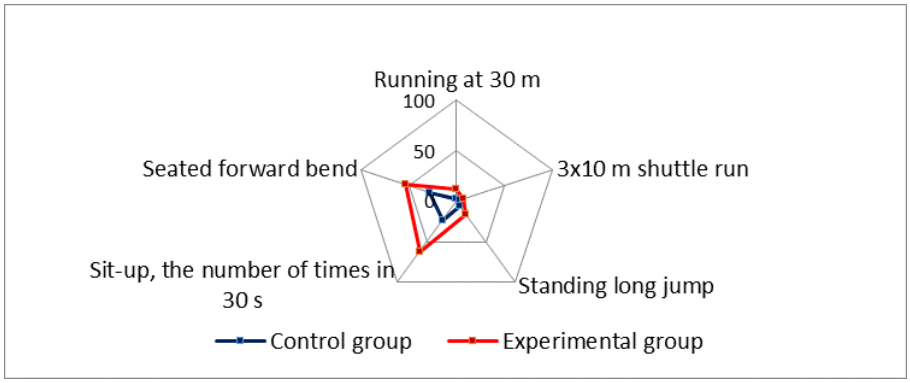

Fig. 1. **The increase in the values of the motor tests of girls after the experiment (%)**

At the end of the observation the largest increase in the motor tests values of girls was noted in the experimental group: 61.9 % in the test for speed and strength endurance of the flexor muscles of the trunk and 52.9 % in the test for active flexibility. Results of tests of motor qualities in boys are presented in Table 3.

Table 3. **The boys' motor tests results (M □ m)**

Motor tests	Control group (n=10)		Experimental group (n=10)	
	Before the experiment	After the experiment	Before the experiment	After the experiment
Running 30 m, sec	7.4 □ 0.3	7.1 □ 0.4	7.6 □ 0.2	6.9 □ 0.4*
Shuttle run 3 times x 10 m, sec	10.0 □ 0,2	9,6 □ 0,3	10,2 □ 0,1	8,2 □ 0,2*
Standing long jump, cm	98.9 □ 2.9	109.7 □ 4.7*	98.5 □ 1.7	117.6 □ 5.8*
Sit-up, the number of times in 30 sec(number of times)	9.8 □ 0.3	11.8 □ 1.0*	9.9 □ 0.1	14.6 □ 1.8*
Seated forward bend, cm	3.5 □ 0.1	4.4 □ 0.7	3.3 □ 0.9	5.6 □ 1.1*

Note. * - tests indicators values significant difference ($p < 0.05$)

After the experiment in the boys of the control group (Table.3) the indicators values increased only in two tests («Standing long jump» and «Sit-up from a lying position») $p < 0.05$. In boys of the experimental group the increase was in all motor tests. The higher in the motor tests values trunk muscles strength (by 47.5 %) and active flexibility of the spine and hip joints (by 69.6%), $p < 0.05$. The increase in the values of all motor tests in the boys of the experimental group was higher than in the boys of the control one (Fig. 2).

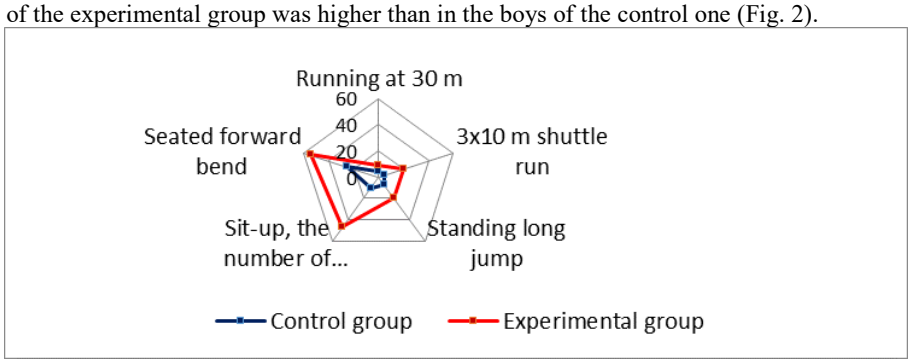

Fig. 2. The increase in the motor tests values of boys after the experiment (%)

After the pedagogical experiment, an improvement in all functional indicators of girls of both groups was established (Table 4).

Table 4. Girls' functional indicators values (M □ m)

Indicators	Control group (n=10)		Experimental group (n=10)	
	Before the experiment	After the experiment	Before the experiment	After the experiment
Heart rate at rest **(bpm)**	92.6 □ 2.1	90.5 □2.0	92.4 □ 2.2	88.2 □ 1.6*
Rufier index (c.u.)	18.4 □ 0.4	14.7 □ 0.3*	18.7 □ 0.5	10.3 □ 0.3*
Left hand strength (kg)	7.0 □ 0.3	9.1 □ 0.3*	7.1 □ 0.4	9.9 □ 0.3*
Right hand strength (kg)	7.5 □ 0.6	9.6 □ 0.9*	7.3 □ 0.4	10.2 □ 0.2*
Left hand muscles strength index (%)	31.8 □ 1.1	39.5 □ 1.5*	32.2 □ 1.2	43.0 □ 1.8*
Right hand muscles strength index (%)	35.9 □ 1.3	41.3 □ 1.7*	36.8 □ 1.3	44.3 □ 1.9*
Romberg test (sec)	9.2 □ 0.5	10,7 □ 0.7	9,3 □ 0.6	14.6 □ 0.9*

Note. * - tests indicators values significant difference after the experiment ($p < 0.05$)

In the girls' experimental group, there was an improvement in indicators values in all functional tests. In the girls' control group in five tests, $p < 0.05$. The increase functional indicators was lower in the control group the girls'(Fig. 3).

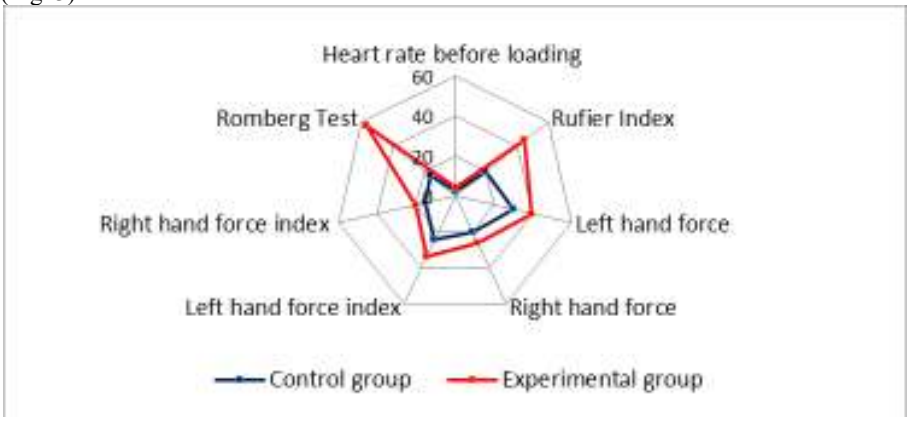

Fig. 3. The increase in the girls' functional indicators values after the experiment (%)

The girls of the experimental group have the highest increase in Rufier index values and the Romberg test ones. After the experiment, the boys of the control group showed a significant improvement in two of the seven values of functional indicators. In the experimental group of boys, the all functional tests significantly improved (Table 5).

Table 5. Boys' functional indicators values (M □ m)

Indicators	Control group (n=10)		Experimental group (n=10)	
	Before the experiment	After the experiment	Before the experiment	After the experiment
Heart rate at rest **(bpm)**	92.3 □ 2.1	90.2 □ 2.0	92.0 □ 2.3	86.4 □ 1.5*
Rufier index (c.u.)	18.0 □ 0.4	13.4 □ 0.3*	18.2 □ 0,5	9.6 □ 0.3*
Left hand strength (kg)	8.3 □ 0.6	9.4 □ 0.1*	8.5 □ 0.4	10.4 □ 0.8*
Right hand strength (kg)	8.6 □ 0.3	9.6 □ 0.9	8.7 □ 0.4	10.8 □ 0.6*
Left hand muscles strength index (%)	36.1 □ 1.4	39.1 □ 1.5	36.9 □ 1.3	43.3 □ 1.7*
Right hand muscles strength index (%)	37.4 □ 1.5	40.0 □ 1.6	37.4 □ 1.4	45.0 □ 1.8*
Romberg test (sec)	9.8 □ 0.6	12.7 □ 0.7	9.6 □ 0.6	17.6 □ 0.9*

Note. * - tests indicators values significant difference after the experiment ($p < 0.05$)

The values of the increase in the functional tests indicators in the boys of are shown in Fig. 4.

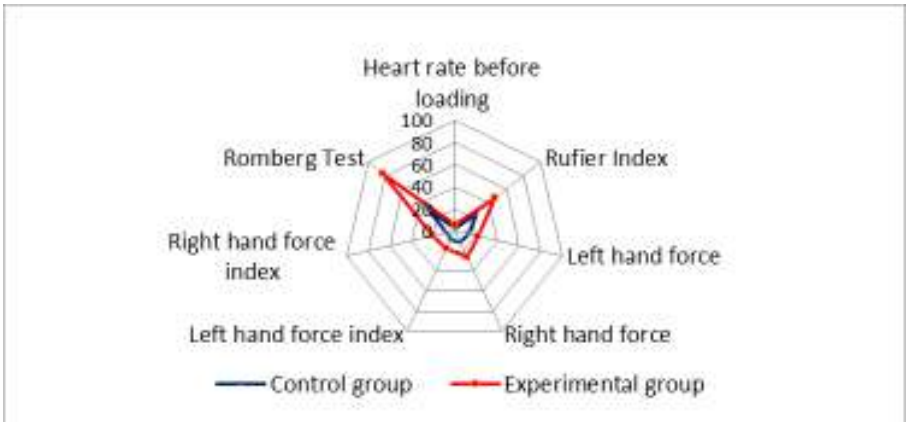

Fig.4. The increase in the boys' functional indicators values after the experiment (%)

In the boys of the experimental group, the increase in the indicators values of all functional tests, Romberg test and Rufier index was higher than in the boys of the control one.

The results of the conducted pedagogical experiment indicate a more effective increase in the over-fives children's motor qualities and functional indicators, who were additionally engaged in the fitball aerobics program proposed by us before entering school.

Dicussion

Low motor activity is reported to be responsible for the poor physical development of modern children and adolescents (Dževad Džibrić, 2017), physical and somatic health deterioration (Tolgfors, & Ohman, 2016; Bakiko et. al., 2020) and reduction of the body's reserve capacity (Nosko et. al., 2016). The authors consider the development of innovative technologies in the methodology of PE classes conducting in organized groups to improve children's physical condition to be an urgent and important issue (Kolumbet, & Dudorova, 2016). In the literature, there is information about the effective testing of fitness programs physical education in improving their physical health (Zhamardiy et. al., 2020).

Experience is available in increasing physical qualities of children through additional PE classes (Talović et. al., 2015). Our pedagogical experiment in the pre-school educational establishment confirm conclusions of this research. The proposed program «Fitball-aerobics for children aged 6-7» in preschool, had a much greater impact on improving the motor and functional characteristics of children's body, compared to the traditional one.

A gymnastic ball with an unusual shape in the form of an oval for children is both sport equipment for physical exercises and a toy. It increases the emotional and motivational components of the program. Exercises performed on the fitball allow strengthening the muscles of the back and pelvis.

In the children of the experimental group who were additionally engaged in our program, the increase in the indicators values of conditioned and functional characteristics was higher. The same results are received in other researchers' reports (Zorio-Ferrures et. al., 2018). We believe that the sports equipment and pedagogical technology choice, which we used in the program of additional physical education classes for children aged 6-7, develop children's cognitive abilities, which does not contradict the opinion of other authors (Kotov-Pavlova et. al., 2017).

At the end of the examination, there was a decrease in the resting pulse value, the Rufier index and an increase in the strength of the torso muscles in the children of the experimental group. Consequently, the children of this group increased the adaptive capabilities of their cardiovascular system to physical activity. Other authors write about this (Svyatova et.al., 2018). In the literature, there are reports on a person's physical fitness relationship with movements coordination and vestibular stability (Smolenskiy et.al., 2020). This is confirmed by our testing materials child coordination abilities in the experimental group (shuttle running test). We believe that creation and interpretation of health programs of fitball aerobics is a promising scientific direction of physical education of over-fives children and requires further study.

Conclusions

In children of the experimental group, there was a significant increase in the children's indicators values in all motor tests. In children of the control group, the indicators values significantly increased only in two motor tests (lower extremities muscles and trunk flexors muscles strength). In children who were engaged in the experimental program, the increase in the indicators values of all motor tests was higher than in children of the control group who were engaged in the traditional program. The increase in the motor tests values was higher in the children of the experimental group.

In girls of the experimental group, registered a significant increase in all functional tests indicators. In the girls of the control group, there is no significant increase in Romberg test values and the pulse at rest. In the boys of the control group, a significant increase in the functional indicators values was noted in Rufier index value and left hand muscles strength. In children who were engaged in the experimental program, the increase in all functional tests' indicators values was higher than in children of the control group who were engaged in the traditional program.

The results of the program of additional physical education of over-fives children tested by us showed its effectiveness. The choice of the type of means and pedagogical technologies offered in this program allowed increasing the children's conditioned and functional indicators before entering school.

We believe that in order to improve a child's aged older than 5, physical and functional abilities and adapt him/her to school, preschool institutions teaching staff should actively model the educational process of additional 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.

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