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The effectiveness of health-recreating programme of rock-climbing activities for 9 year old children with attention deficit hyperactivity disorders

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Abstract

The results of theoretical generalization and practical solution of the issue regarding increase of the effectiveness of health-recreating activities for children of primary school age with attention deficit hyperactivity disorders are described in this article.

The objective of the study was to evaluate the effectiveness of the health-recreating activities programme for children of 9 to 10 years of age attention deficit hyperactivity disorders, using rock climbing.

Methods and organization of the study. The following methods were used: theoretical analysis of special scientific and methodological literature; anthropometric and pedagogical techniques; and the methods of mathematical statistics. Children of the primary school age (9-year-olds, 26 children in total) took part in this study. Duration of the programme – 9 months. In each group, the activities were held 3 times a week, lasting 60 minutes. Among other methods, apart from rock climbing, were used the series of playing activities on the rock-climbing wall: relay races, physical activities, quests, role-play games with plot. The Wilcoxon signed-rank test (W-test) was used for the qualitative analysis of statistical data and for identifying reliable changes.

Results. At the end of pedagogical experiment, reliable changes ($p < 0,05$; $p < 0,001$) happened in indicators, which characterized total body size. Positive influence of rock climbing was reflected in decrease of overweight children. Probable changes ($p < 0.001$) appeared in indicators, which characterized the work of cardiovascular and respiratory systems. Under the influence of recreating rock-climbing activities for the children of primary school age (9-year-olds) reliable changes happened ($p < 0.001$) in indicators, which characterized strength, flexibility and agility. Significant positive changes determined in indicators, which reflected the level of physical health and physical preparedness. Analysis of the average group results, which reflected emotional-volitional sphere of children of primary school age after the pedagogical experiment did not correspond to the level of formation, even though its positive dynamic could be observed from 7.7% to 25.0%. Rock climbing activities contributed to reliable ($p < 0.05$) improvement of such volitional qualities: discipline, independence and persistence by 14.3% and 13.0%; endurance and organisation by 11.1% and 17.6%; initiative by 25%. Results indicated appropriateness of using rock climbing in health-recreating activities for children of primary school age.

Keywords: children, physical activity, attention deficit hyperactivity disorders (ADHD), rock climbing, programme.

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Problem formulation

In present times, studying patterns and unique features of physical and emotional state of primary school age children is in demand, which plays an important role in realisation of integrity and harmony of personal potential of a child [4,10,11]. Researchers emphasize on importance of finding the solution to the problem of emotional development, which is due to the growing tendency of the number of children with cognitive developmental disabilities, which are officially diagnosed with low level of cognitive function process, abnormal behaviour, maladjustment in educational and social environment can be seen [14, 24]. Young age is rather flexible for correction of emotional disorders that is why it is important to diagnose those in time and conduct counselling activities for developing emotional and volitional processes of the primary school aged children [19, 25]. The important thing in this context is using health-recreating physical activities, such as rock climbing [5].

Analysis of recent research and publications

Scientific research, which was done by many authors, attested that one of the best methods of health promotion and education had been, and still was, the physical activity [3, 9]. Physical activities helped to acquire essential skills and abilities, promoted renewal and extension of physical activities range and formation of many positive characteristics [2,13 17].

Data of global and national research regarding the effectiveness of using health-recreating activities for the children with attention deficit hyperactivity disorders (ADHD) were analyzed, generalized and systematized [15,16, 21].

Analysis of scientific and methodological literature testified that the authors gave a lot of attention to the studying the problem of the organisation of activities for the primary school age children and to the influence of different kinds of physical activities, such as: aqua fitness (Beetle A.O., 2011 [4]), swimming (Silva L.A.D., Doyenart R., Henrique Salvan P., Rodrigues W., Felipe Lopes J., Gomes K., Thirupathi A., Pinho R.A.D., Silveira P.C., 2019 [20]), elements of athletics (Boreyko M.M., 2002 [6]), volleyball (Trofimenko V., Romanyshyna O., Anichkina O., Ivanchuk M., Bohdanyuk A., Zoriy Y., Moseichuk Y., Koshura A., Yarmak O., Galan Y., 2019 [22]), recreational walking (Vovchenko I.I., 2003 [23]), tourism (Andreieva O., Golovach, I., 2015 [1]; Butenko G., Goncharova N., 2019 [7]), nordic walking (Sainchuk O.M., 2013 [18]) but, in the present days, the research, which scientifically justifies the effectiveness and influence of rock climbing in indicators of physical and psychological state of primary school age children with ADHD are scarce. In this regard, among the scientific interest of specialists in the fields of physical education and health-recreating fitness acquired evaluation of the effectiveness of programmes of health-recreating activities for children of primary school age with ADHD. Relevance and practical significance of the problem, which was being examined, and also the lack of its theoretical and methodological development were the reason of choosing this topic for research.

The research was carried out in accordance with the plan of Scientific Research of the NUUPES for 2016–2020 yrs. within the thematic research of the Department of Health, Fitness, and Recreation “Theoretical and methodological principles of health-enhancing and recreational physical activity of different population groups” (State Registration Number 0116U001630).

The **objective** of the study was to evaluate the effectiveness of the programme of health-recreating activities for children of 9 to 10 years of age with attention deficit hyperactivity disorders, using rock climbing.

Methods and organization of the study

The following methods were used: theoretical analysis of special scientific and methodological literature; anthropometric and pedagogical techniques; and the methods of mathematical statistics [8]. Children of primary school age (9-year-olds, 26 children in total) took part in this study. The criteria for elimination was having exacerbation of any illness. The criteria for admission to the programme was the urge of both, children and their parents, having psychoemotional disorders (attention deficit hyperactivity disorders – was diagnosed by a psychologist), poorly formed or the lack of formation of volitional qualities, problems with coordination, low level of physical preparedness. Having factors described above, made drastic difference between given category of primary school aged children and their peers with typical development. That is why, ways and methods of recreational activities included in this programme were implemented based on consideration of specific general components of physical state, and given individual results were compared to the age norms. Given data was used as a base for defining amount, intensity, duration and multiplicity of recreating rock-climbing activities. The principle of structuring every activity was based on strict following of the factors of long-term biological adaptation of organism systems of primary school aged children with ADHD to external corrective influences, which primarily were aimed to reach the given goal. Conditions of execution of each recreating activity, which included spatial, physiological and psychoemotional parameters, were foreseen by the programme. The programme duration was 9 months. In each group, the activities were held 3 times a week, lasting 60 minutes. Among other methods, apart from rock climbing, were used the series of playing activities on the rock-climbing wall: relay races, physical activities, quests, role-play games with plot.

Evaluation of child's physical development was conducted by comparing anthropometric (body length and body mass, chest girth) and physiometric (lung function and muscle power of wrist bones) indicators with age and regional standards using classical methods. Measuring of lung function was done with the help of spirometer, using mainly accepted methodic. Studying of muscle power of wrist bones was done using hand grip dynamometer. Level of somatic health was evaluated using methodic of H. L. Apanasenko. Tests were selected according to the aims of this study. The selection of the research methodes was justified by the content specific features of physical education and psychology of children of the studied age, also their validity, reliability and objectivity was proven by the number of studies. Systematization of materials and primary mathematic calculation was done using the tables of Microsoft®Excel 2010.

Results

According to the results of the study, indicators of physical state at the stage of formative experiment the significant statistical difference between 9-year-old girls and boys was not observed ($p > 0.05$) in the vast majority of indicators, with the exception of dynamometry of both right and left hands, where reliable dominance of the boys' results over the girls'

results was determined, but given exception was a regularity and that gave us the reason to unite children into one group. To determine the influence of rock climbing on the morphofunctional state of 9-year-old boys and girls with ADHD, we conducted a comparative analysis of indicators before and after the pedagogical experiment. Results are presented in the table 1.

Table 1 Dynamics of the morphofunctional state indicators of 9-years-old primary school children with ADHD under the influence of recreational activities, using the climbing means, (n=26)

Indexes	Before		After		T	Z	p
	\bar{X}	S	\bar{X}	S			
Body length, cm	132.2	3.70	133.5**	3.42	25.0	3.82	0.001
Body mass, kg	29.1	2.97	29.7*	2.62	72.0	2.63	0.05
Chest girth, cm	62.8	2.10	63.3**	2.10	18.0	4.00	0.001
Dynamometry of the right hand, kg	8.5	2.41	8.6	2.09	80.0	0.60	0.54
Dynamometry of the left hand, kg	6.5	1.95	6.8	1.64	10.0	1.78	0.07
Heart rates, bpm	92.5	4.72	90.4**	2.87	3.0	3.24	0.001
BP systolic, mmHg	103.9	2.27	104.1	1.73	0.0	1.82	0.07
BP diastolic, mmHg	63.9	2.31	64.1	2.18	0.0	1.82	0.07
EVC, l	1.3	0.12	1.4	0.11	0.0	1.82	0.07
Hench test, s	16.7	1.16	18.7**	1.96	0.0	4.01	0.001
Stange's test, s	14.2	1.11	15.7**	1.23	0.0	4.01	0.001

Note: * the difference is statistically significant for $p < 0.05$; ** the difference is statistically significant for $p < 0.001$, comparing to the results at the beginning of the pedagogical experiment.

The indicators that reflect the total body size, which is due primarily to natural biological changes in this sensitive period, occurred probable changes ($p < 0.05$; $p < 0.001$). Thus, the pupil's BL increased by 1.3 cm during the pedagogical experiment, bodyweight improved by 0.6 kg, and OGK by 0.5 cm. It should be mentioned that among the studied boys and girls the percentage of overweight children has decreased. This has appeared mainly due to the lifestyle change, which was previously accompanied by low physical activity.

Analysis of the changing aspects in dynamometry of the right and left hands of the primary school children with ADHD indicates the absence of probable changes ($p > 0.05$) at the end of the pedagogical experiment. At the same time, there was a significant variability of the studied indicators; the coefficients of variation exceeded 14.6%, which points at the heterogeneity of the sample and the formation process of this strength quality.

At the end of the pedagogical experiment, the indicators of the functional state that characterized the work of the cardiovascular and respiratory systems underwent probable changes ($p < 0.001$), in particular, the heart rate in the relative rest state, and the results of Hench and Stange's respiratory tests. Systolic and diastolic blood pressure and EVC did not change significantly ($p > 0.05$), although 9-years-old children with ADHD shown a positive dynamics of these pointers, which indicated a natural process of the cardiovascular and respiratory systems formation. Systematic involvement in climbing helped to reduce the heart rate at rest by 2.1 beats per minute, which was 2.3% and specified the optimization of the cardiovascular system.

The duration of inspiratory and expiratory breathe holding at the end of the pedagogical experiment increased by 12.0% and 10.6% resp., such an increase in those

indicators appeared primarily due to the large arsenal of physical routine in recreational classes, which promoted the better ability to hypoxic conditions of the schoolchildren.

Repetition testing of physical preparedness of the schoolchildren enabled to assess the impact of climbing means on the development of basic motor skills, the results are presented in table 2. Analysis of the ascertaining experiment results designates probable changes ($p < 0.001$) at the indicators that characterize the strength, flexibility and agility. The group averages in the 30 m running and long jump tests did not define a significant variation ($p > 0.05$). However, a significant increase among the group averages was observed in flexibility tests, by 134.8%, and in torso lifting, by 20.3%. The demonstrated results dynamics was due mainly to the specifics of the selected motor activity and the subjects' age. During rock climbing practice, flexibility is one of the main motor qualities because it affects the formation of rational climbing techniques.

Table 2 Dynamics of the physical preparedness indicators of 9-years-old primary school children with ADHD under the influence of recreational activities, using the climbing means, (n=26)

Indexes	Before		After		T	Z	p
	\bar{X}	S	\bar{X}	S			
Running 30 m, s	6.4	0.17	6.4	0.13	0.0	1.82	0.07
Lifting the torso in a squat, times	24.6	1.50	29.6**	1.27	0.0	4.46	0.001
Shuttle run 4x9 m, s	12.5	0.26	12.1**	0.22	0.0	4.28	0.001
Tilt the torso forward from a sitting position, cm	2.3	1.72	5.4**	1.33	0.0	4.46	0.001
Long jump from place, cm	126.7	3.47	127.0	3.16	0.0	1.60	0.11

Note: * the difference is statistically significant for $p < 0.05$; ** the difference is statistically significant for $p < 0.00$, comparing to the results at the beginning of the pedagogical experiment.

The involvement into moving games and relay races, as well as quests, promoted to a probable ($p < 0.001$) improvement of the average group score on dexterity. The schoolchildren began to do the motor tasks faster, which provided performing asymmetrical movements while making symmetrical exercises, the duration of time to perform exercises from unusual starting positions significantly reduced.

The results of the study determined that 9-years-old primary school children with ADHD had a low level of coordination skills. Various modifications of routine were selected to develop static and dynamic balance. The results of the dynamics of coordination abilities of the children are presented in table 3.

Table 3 Dynamics of the coordination abilities indicators of 9-years-old primary school children with ADHD under the influence of recreational activities, using the climbing means, (n=26)

Indexes	Before		After		T	Z	p
	\bar{X}	S	\bar{X}	S			
Complicated Romberg's test with open eyes, s	4.0	2.29	5.2*	1.62	17.0	2.98	0.05
Complicated Romberg's test with closed eyes, s	2.8	1.99	4.1**	1.42	14.0	3.53	0.001
Walking forward balancing with a gymnastic stick on the palm, m	2.7	1.19	3.7**	0.87	0.0	3.82	0.001
Walking in a straight line after 5 turns, cm	183.3	18.65	156.4**	11.89	1.5	4.41	0.001
Walking forward in a straight line with eyes closed, m	4.2	1.34	5.2**	1.10	0.0	3.62	0.001
Walking backwards in a straight line, with eyes closed, m	3.1	1.03	4.2**	0.85	6.5	3.68	0.001

Note: * the difference is statistically significant for $p < 0.05$; ** the difference is statistically significant for $p < 0.00$, comparing to the results at the beginning of the pedagogical experiment.

Analysis of the group averages for all 6 explored test exercises pointed at probable changes ($p < 0.05$; $p < 0.001$). The results of the complicated Romberg's tests of various types improved by 30.0% and 46.4% resp. The results obtained at the end of the pedagogical experiment determined the average group results rise for 9-years-old primary school children with ADHD by 23.8% and 35.5% resp. Therefore, climbing means have a significant positive effect on static and dynamic balance, including the visual analyzer participation. Significant outcomes were observed at the exercise of object balancing while walking and at the exercise of walking in a straight line after 5 turns. The implement of those exercises allowed evaluating the impact of climbing means on coordination skills with the vestibular analyzer participation. The increase in both exercises was 37.0% and 14.7%, which defined the improvement of children's ability to coordinate movements while balancing the object on the outstretched hand, as well as better reproduction of movements after rotation.

Before climbing practice, the vast majority of 84.6% of 9-year-olds had a low level of physical health, and the remaining 15.4% of children had the level below average; we didn't identify any child of average, above average and high levels of physical health. The results of re-testing the physical health level of primary school children defined positive changes for the vast majority of respondents. At the end of the pedagogical experiment the low level was observed only for 23.1% ($n = 6$) children. The results could be explained by irregular attendance of climbing classes, low activity during practical routine, as well as passive participation in moving games and relay races. 30.8% ($n = 8$) of the schoolchildren showed below average level of physical health, 46.1% ($n = 12$) corresponded to the average level. We did not disclose anyone with the above average and high levels of health among the studied contingent. Thus, the results designated the feasibility of introducing recreational activities with climbing means, which were aimed to improve health and eliminate the shortcomings of the physical condition main components for the studied contingent category.

After the pedagogical experiment for the vast majority of 50.0% ($n = 13$) children individual results corresponded to the average level of physical preparedness, for 30.8% ($n = 8$) of schoolchildren individual results corresponded to a satisfactory level, 15.4% ($n = 4$) of children had a sufficient level, only 3.8% ($n = 1$) rated a high level. The probability of differences in the average group results at the beginning and the end of the pedagogical experiment was determined by using nonparametric (rank) W-test for dependent samples. The average group result of the Ruffier test was 10.9 points, and corresponded to a satisfactory level of physical preparedness; after the pedagogical experiment of 8.6 points, which corresponded to the average level. Thus, the level of physical preparedness of the primary schoolchildren under the influence of climbing significantly ($p < 0.001$) improved by 21.1%. Significant improvement of individual results of the level of physical preparedness was caused by the game method use in practical classes.

Repeated testing results determined the probable changes ($p < 0.05$) of the indicators of the emotional-volitional sphere. The average group results at the end of the pedagogical experiment increased from 7.7% to 25.0% (Table 4). Volitional traits such as discipline, independence and persistence had a positive dynamics at the level of 14.3% and 13.0%, and endurance and organization increased by 11.1% and 17.6%, but all these indicators corresponded to the level of immaturity. Analysis of the variation coefficients of the studied indicators exceeded 14.6%, which indicated the sample heterogeneity and the process of basic volitional traits formation.

Table 4 Dynamics of the emotional-volitional traits of 9-years-old primary school children with ADHD under the influence of recreational activities, using the climbing means, (n=26)

Indexes	Before		After		T	Z	p
	\bar{x}	S	\bar{x}	S			
Discipline, point	2.1	0.56	2.4*	0.50	0.0	2.52	0.05
Independence, point	2.3	0.45	2.6*	0.50	0.0	2.52	0.05
Persistence, point	2.3	0.45	2.6*	0.50	0.0	2.66	0.05
Endurance, point	1.8	0.43	2.0*	0.34	0.0	2.20	0.05
Organization, point	1.7	0.49	2.0*	0.53	0.0	2.37	0.05
Decisiveness, point	2.6	0.50	2.8*	0.43	0.0	2.02	0.05
Initiative, point	1.2	0.40	1.5*	0.51	0.0	2.52	0.05

Note: * the difference is statistically significant for $p < 0.05$, comparing to the results at the beginning of the pedagogical experiment.

Conclusions

According to the formative experiment results, we could say about the importance and expediency of using climbing means to improve the physical state and the volitional sphere formation of the primary schoolchildren. Significant changes have been made in the indicators that characterized the work of the cardiovascular and respiratory systems. The indicators that characterized strength, flexibility and agility of 9-years-old schoolchildren demonstrated probable changes under the influence of recreational activities with climbing means. After re-testing the 6 exercises that reflected the level of the coordination abilities development of the children at the end of the pedagogical experiment, we determined probable changes in all the studied indicators. Climbing means had a positive effect on children's ability to better perform test exercises in balancing the subject while walking, as well as in the walking in a straight line after 5 turns exercise, the annual increase of the results is 37.0% and 14.7% resp.

Indicators that reflected the physical health and physical preparedness levels had undergone significant positive changes. The difference in comparison between the initial and final individual and average group results of 9-year-old primary school children had a high level of significance. The climbing means implementation helped to improve the psycho-emotional state of the studied children. Interpersonal relationships the 9-year-olds during the performance of individual and group tasks at the climbing wall had significantly improved. Thus, according to the results of the study, it was possible to draw conclusions about the positive impact of climbing on the physical and psycho-emotional state of 9-year-olds.

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