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Original Article

Monitoring the effectiveness of innovative forms of orienteering during the Covid-19 pandemic

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Abstract

Given the steady decline in physical activity among schoolchildren and due to quarantine restrictions caused by the Covid-19 pandemic, there is a threatening trend of declining levels of their physical health. Lately, the world has undergone significant changes, namely the emergence of the Covid-19 virus, which marked all human lives. Under the conditions of the Covid-19 pandemic, physical fitness is essential for preventing physical and mental health problems among schoolchildren. This requires scholars to develop preventive measures aimed at increasing the body's resistance to disease. *Materials and methods of research*. The study was conducted in Chernivtsi specialized school with physical and mathematical profile № 6. The experiment involved 36 boys who attended a club in orienteering. They belong to the main medical group. They have been introduced to the specially designed 234-hour orienteering-based program which included theoretical and practical classes, most of which were conducted outdoors in a variety of landforms. We used active and interactive forms of training, technical means, information and communication technologies of training, which contained topographic computer programs, orienteering simulators (computer games "Catching Features", "Virtual-O"). *Results.* The results of the study indicate positive changes demonstrated by the 11-year-old boys under the influence of orienteering. At the end of the pedagogical experiment, we observed a statistically significant difference ($p<0.05$; $p<0.01$) in the dynamics of the right-hand dynamometer, resting heart rate, lung vital capacity, and Rufier index. The indicators of cognitive functions, in particular, the amount of short-term memory had significantly ($p<0.01$) improved among 11-year-old boys by 83.2 % ($p<0.01$), and the rate of information processing improved by 101.1 bits ($p<0, 01$). Moreover, the indicator which characterizes the coordination abilities of boys underwent the greatest changes. The average result for orienteers improved by 6.9 s, which was 90.7 % ($p<0.01$). The most positive changes were observed in motor tests, which characterize dexterity, strength, endurance and speed-power qualities. A statistically significant difference was observed among children when they were performing the tests, such as shuttle runs 4x9 m ($p<0.05$); long jump ($p<0.05$); running without taking into account the timing ($p<0,01$); flexion, an extension of the arms in the supine position ($p<0,01$), as well as special physical training in overcoming the distance in orienteering at 8 checkpoints. *Conclusions.* The obtained results testify to the effectiveness of the proposed program based on the innovative forms of orienteering applied to the group of 11-year-old boys. Thus, the proposed program should be included in the organisational and methodological support of health and recreational activities in out-of-school educational institutions of tourism and local lore during the Covid-19 pandemic.

Key words: program, guys, planning, efficiency, orienteering.

Introduction

In modern conditions, physical activity is extremely important. Currently, there is a significant need for the formation of schoolchildren's physical health, social, mental and spiritual health, which is impossible without physical and motor activity (Rattray & Roberts, 2012; Sainchuk, 2013; Andrieieva & Hakman, 2018; Andrieieva et al., 2020).

In recent years, humanity has changed dramatically: much attention has been given to a healthy lifestyle, namely physical activity, a healthy balanced diet, getting rid of bad habits, and personal and public hygiene. Lately, the world has undergone significant changes, namely the emergence of a new virus (Covid-19), which divided human life into the "before" and "after". The pandemic has changed the lives of everyone around the world in one way or another (Alosaimi et al., 2022).

The United Nations General Assembly resolution calls for the inclusion of sport and physical activity in post-Covid-19 recovery plans in national sustainable development strategies, given the contribution that sport and exercise make to health, improving the upbringing of children and young people, including people with disabilities, strengthening their physical and mental health, preventing diseases, including non-communicable diseases, preventing drug abuse, implementing gender equality, maintaining health and activity at school age,

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tolerance, mutual understanding and respect, and promoting social integration and peacebuilding (Yelizarova et al., 2020; Yelizarova et al., 2022).

Much consideration has been given to the health of the younger generation, namely schoolchildren. Current realities have forced them to spend more time at home, studying remotely, which has affected their mobility. It is known that an important level of the health-promoting factor for schoolchildren is the optimal level of physical activity. Under quarantine conditions, maintaining physical shape is necessary for the prevention of physical and mental health disorders among modern schoolchildren (Kozhokar et al., 2018; Kirwan et al., 2022).

A sedentary lifestyle leads to health problems. Quarantine restrictions require organizing and conducting physical education lessons remotely, which prevents students from getting the necessary physical activity and negatively affects their health. Many studies show that the likelihood of developing the disease increases with low levels of physical activity (Andrieieva et al., 2019).

Regular physical activity has a positive effect on the treatment and prevention of chronic diseases, as well as some infectious diseases caused by Covid-19. Due to social restrictions applied to combat the spread of the virus, the problem of a sedentary lifestyle among schoolchildren has arisen. On the contrary, regular physical activity reduces the risk of pandemic consequences. To help people stay active during the pandemic, the World Health Organization (WHO) has developed recommendations claiming that everyone needs to increase physical and motor activity to stay healthy (Chan et al., 2021; Caputo et al., 2022; Hortigüela-Alcalá et al., 2022).

In recent years innovative technologies in all areas of human life are been developed extremely rapidly and on a large scale. The introduction of such technologies in physical education and sports are very important and appropriate because it increases the popularity and accessibility of sports activities among people of various age groups and social categories. Sports orienteering has not become the exception. Moreover, innovative technologies play a significant role in improving sportsmanship and shaping citizens' attitudes to sports in the 21st century.

One of the effective ways to prevent diseases caused by Covid-19 is orienteering. It involves running through the unfamiliar territory using a compass and a sports map, which presupposes the involvement of mental activity. This sport evokes emotions, requires high intellectual abilities, and has a positive effect on the development of the following physical qualities: endurance, speed, strength, flexibility and more. Therefore, to more effectively encourage students to lead a healthy lifestyle during the pandemic, it is necessary to expand existing methods to newer ones, including sports orienteering.

It has been proved that sports orienteering has a positive effect on the psychophysiological state of schoolchildren, as it directly involves active motor activity. Orienteering tools have a positive effect on morpho-functional and psycho-emotional state, cognitive functions, physical fitness and productivity of students. In the context of the Covid-19 pandemic, orienteering itself can be an important factor in the prevention of various diseases among school-age children (Kolomiets, 2009; Celestino & Pereira, 2012; Korol, 2015; Berezovskyi, 2016; Selcuk et al., 2017; Paliichuk et al., 2018; Sirakov & Belomazheva-Dimitrova, 2018; Vaskan et al., 2019).

Thus, the research shows that orienteering tools have not only a health effect but are also aimed at developing both schoolchildren's physical and mental abilities, especially during the Covid-19 pandemic, which significantly undermines people's health. In addition, through sports orienteering students develop and strengthen such qualities as observation, courage, perseverance, and the ability to navigate in difficult situations and maintain their body and health, regardless of external factors.

Material and methods

Participants

The study was conducted in Chernivtsi school № 6 specialising in physical and mathematical profiles. The study involved 36 11-years-old boys. They formed an experimental group (EG). The study determined the level of motor activity of adolescents who participated in the experiment, the number of unattended lessons and the level of students' physical fitness in orienteering.

Procedures

The proposed program for orienteering clubs contained 6 components, namely theoretical, topographic, technical, tactical, physical and psychological training, which consisted of 234 teaching hours per academic year (Galan, 2018). But in connection with the Covid-19 pandemic, group work with schoolchildren was organised through distance learning. The program involved orienteering lessons online twice a week and training in the woods on weekends. Orienteering itself made it possible to maintain the physical condition even during the online lessons. For the students of the experimental group, innovative forms of organizing orienteering lessons (36 hours) were introduced into the program, which compensated for the reduced number of lesson hours in basic tourist training and separate units of technical and tactical training in orienteering. The reduction of hours for mastering the technical and tactical training of orienteering was due to the use of innovative approaches to the organization of classes, which allowed to optimize the time of mastering this material. Within the program, each lesson had a clearly defined structure, which consisted of preparatory, main and final parts. The time of one lesson was 90 minutes.

Among the innovative tools used during the implementation stage were those that have proven their effectiveness in previous studies (Midtbø, 2014; Blagii et al., 2018; Andrieieva et al., 2020; Galan et al., 2022). Computer programs (*OCAD* (Switzerland), *Orienteering Mapper* (Germany), and *Momap* (Sweden)) were used for topographic training. Using these programs in technical training allowed us to prepare cartographic materials for training in various forms (full map, relief, vegetation, partially closed map, etc.), plan different distances and use the program to study symbols and build different complex technical tasks in orienteering. Special computer games and stimulators were widely used. One of the first world-famous orienteering simulators was the computer game "Catching Features", which was developed in 2008 in the United States. Given the requirements for computer software and systems, this simulator has become available to every router. The developers planned to use similar approaches to replace real training, which can best be used in quarantine restrictions. There are several game modes available in the simulator: individual, relay, and network. Individual distances are held with interval launch against computer rivals or with a mass start against the same rivals. Relay competitions allow you to run one of the stages scattering relays. In *online* mode, it is possible to create measures on terrain and distances chosen in advance. We also used the simulator "*Virtual-O"* that carries out *online* competitions from high graphics and complex distances. Computer simulators allowed students to practise various techniques of orienteering without leaving their homes, and also analyze their own errors. Moreover, we used the program *QuickRoute* for the analysis of *GPS* tracks training, which allowed us to display the athlete's route on the map for orienteering. The great advantage of this program was that it does not require access to the internet and allows integration of these training or competition with *Google Earth*, which provides great opportunities for analysing geographical data. To increase students' technical skills athletes used a "*Sports maze*", which is a kind of sports orienteering simulator, in which participants with the help of a mapping scheme pass the specified number of checkpoints that are located on a specially created for this purpose artificial terrain. The results are determined by passage distances (in certain cases taking into account penalty time or penalty circles). Artificial locality consists of aggregated standard objects type 'wall', which are placed on a small, flat, open area of at least 30x30 meters size, which imitates linear objects (walls). Orienteering in mazes is a classic orienteering activity, only more concentrated in space and time. In the maze, every athlete always knows exactly what objects are expected at a distance, and the result depends only on the physical speed and thinking speed. The value component of thinking obviously prevails over physical speed. Interactive tests were used to measure the theoretical readiness of orienteers and control the increase of motivation to participate in such lessons.

Methods

Pedagogical observation, pedagogical testing and pedagogical experiment were used in this research. We applied anthropometric research methods. The main somatometric features of the morphological status of 11-year-old schoolchildren were studied by anthropometric measurements. Pedagogical testing of physical fitness was carried out by determining the level of manifestation of basic physical qualities based on the results of a set of motor tests. To assess physical fitness, we applied the tests of the school program "Physical Education. Grades 5 - 9" in secondary schools (Krutsevych et al., 2012). Psychophysiological research methods were used to determine the speed of reaction, speed of information processing, level of attention and memory, mental capacity and static coordination.

Data analysis

The results of the research were subjected to mathematical processing using the following statistical methods: descriptive statistics, sampling method, Wilkie-Shapiro consistency criterion, Student's parametric criterion, non-parametric Wilcoxon and Mann-Whitney criteria. Statistical processing of the obtained data was performed using the software package "Statistica 13.0" and spreadsheets "Excel 2019" (Microsoft, USA), which allowed the analysis of measurements and calculation of baseline values.

Results

In physical education and sports, effective physical and intellectual training are considered to be an important tool in health training. An effective element of this is orienteering because it combines cross-terrain running and specialized mental activity. This process is a set of various actions and operations aimed at solving the problem of purposeful movement through unfamiliar terrain using a sports map and compass. Orienteering during the educational process allows you to solve a number of pressing issues, namely improving the level of physical qualities, improving personality traits and purposeful improvement of mental development. It is an effective means of preventing disorders of the musculoskeletal system, and cardiovascular and respiratory systems. It helps to shape and maintain schoolchildren's health.

The basis for the implementation of the program in orienteering in extracurricular activities of orienteers for 11-year-old boys was the hypothesis that innovative forms used during the Covid-19 pandemic have a positive impact on schoolchildren's health. The proposed program provided 234 hours per year, and 6 hours per week during the first year of study. The boys who took part in the pedagogical experiment, due to their state of health, belong to the main medical group, they passed the medical examination.

Table 1 presents the results of the morpho-functional state of the orienteers before and after the pedagogical experiment. Analysis of the results of anthropometric data indicates the natural biological changes

that have occurred among the participants during the school year. The average group result of body length in 11 - year-old boys at the end of the pedagogical experiment increased by 3.9 cm ($p>0.05$), and body weight by 3.1 cm ($p>0.05$). The obtained results of heart rate at the beginning of the pedagogical experiment indicated that the boys had individual results that exceeded the age norms. We also found that among 11-year-old boys at the beginning of the pedagogical experiment, 40.0 % had a low level of physical fitness. The obtained results pointed out a sedentary lifestyle, emotional stress, etc.

The results of the study indicate positive changes demonstrated by the 11-year-old schoolboys after taking part in the orienteering program. A statistically significant difference ($p<0.05$; $p<0.01$) at the end of the pedagogical experiment was observed in the dynamometry of the right hand, heart rate at rest, vital capacity of the lungs, as well as the Rufier index. In our opinion, the positive effect on the cardiovascular and respiratory systems is due to the increase in physical activity in the fresh air.

Table 1. Dynamics of the morpho-functional indicators among 11-year-old boys participating in orienteering program (n = 36)

Researched indicators	Before the pedagogical experiment	After the pedagogical experiment	± Δ, %
	$\bar{x}_{\pm}$ S	$\bar{x}_{\pm}$ S	
Body length, cm	147.4 ± 4.57	151.4 ± 7.21	2.7
Body weight, kg	41.3 ± 7.21	44.4 ± 11.54	7.5
Chest girth, cm	66.9 ± 5.21	68.7 ± 8.22	2.7
Chest girth on inspiration, cm	75.1 ± 5.22	77.9 ± 7.12	3.7
Chest girth on exhalation, cm	66.2 ± 7.24	69.1 ± 9.12	4.4
Chest excursion, cm	8.7 ± 2.64	8.1 ± 3.21	6.9
Dynamometry of the right hand, kg	13.1 ± 5.21	14.7* ± 4.21	12.2
Dynamometry of the left hand, kg	10.1 ± 5.26	11.6 ± 4.22	14.8
Heart rate $_{sp}$ beats · min. $^{-1}$	94.6 ± 7.14	91.1* ± 8.13	3.7
BP $_{syst.}$ mmHg.	111.5 ± 8.24	109.1 ± 7.25	2.2
BP $_{diast.}$ mmHg.	64.4 ± 7.54	65.2 ± 6.21	1.2
Rufier Index, CU	10.1 ± 5.41	8.4** ± 4.31	16.8
Vital capacity, ml.	1540 ± 142.1	1886** ± 224.6	22.5

Note: the ± Δ, % is the difference at the end of the pedagogical experiment;
Note: * the difference is statistically significant at the level of $p<0.05$; ** the difference is statistically significant at the level of $p<0.01$

One of the criteria that defined the effectiveness of the orienteering program was the evaluation of boys' cognitive functions at the end of the pedagogical experiment and a comparative analysis of the results, which are presented in table 2. Analysis of the results shows that the indicators of cognitive functions had significantly ($p<0.01$) improved, in particular, the participants' short-term memory improved by 83.2 % ($p <0.01$). The rate of information processing improved by 101.1 bits ($p<0.01$).

Table 2. Dynamics of the psycho-physiological indicators among 11-year-old boys participating in sports orienteering (n = 36)

Researched indicators	Before the pedagogical experiment	After the pedagogical experiment	± Δ, %
	$\bar{x}_{\pm}$ S	$\bar{x}_{\pm}$ S	
Short-term memory capacity, %	22.6 ± 12.27	41.4** ± 6.52	83.2
Information processing, bits	258.1 ± 69.14	359.2** ± 42.50	39.1
Simple visual-motor reaction to light, ms	368.4 ± 52.42	341.2** ± 41.21	7.3
Simple visual-motor reaction to sound, ms	379.5 ± 52.14	352.1** ± 36.15	7.2
Complex reaction of choice, ms	487.2 ± 54.12	418.7** ± 29.12	14.1
Complicated Romberg test, s	7.6 ± 4.41	14.5** ± 4.25	90.7

Note: ± Δ, % - the difference at the end of the experiment;
Note: ** the difference is statistically significant at the level of $p<0.01$

Indicators that characterize neurodynamic functions have not undergone significant positive changes. The results of a simple visual-motor reaction improved by 27.2 % ($p <0.01$). The indicators of the time of simple visual-motor response to sound in orienteering decreased by 7.2 % ($p <0.01$). The indicators of the complex reaction of choice improved by 14.1 % ($p<0.01$). The biggest changes were in the indicator, which characterizes the participants' coordination abilities. The average result for 11-year-old boys improved by 6.9 s, which was 90.7 % ($p<0.01$).

Significant positive changes in the cognitive functions are due to the fact that in practical sports orienteering much attention was paid to mastering skills with different sources of information, including reading maps, orienteering skills, distance measurement, tilt angle, etc.

To study the impact of orienteering on the physical boys' fitness, we conducted a comparative analysis of changes in motor tests. The results are presented in Table 3. At the end of the pedagogical experiment, there is a statistically significant difference ($p<0.05$; $p<0.01$) in most studied indicators.

Table 3. Dynamics of the participants' general and special physical fitness indicators (n = 36)

Researched indicators	Before the pedagogical experiment	After the pedagogical experiment	± Δ, %
	$\bar{x}_{\pm}$ S	$\bar{x}_{\pm}$ S	
Running 30 m, s	6.4 ± 1.41	6.1 ± 1.24	4.6
Shuttle run 4x9 m, s	12.6 ± 2.41	11.9* ± 2.03	5.5
Tilt the torso forward from a sitting position, cm	1.8 ± 3.21	2.2 ± 2.49	22.2
Long jump from a place, cm	129.1 ± 21.24	139.1* ± 17.21	7.7
Covering the distance in orienteering, 8 checkpoints, 600 m, min.s	15.1 ± 4, 1 2	11,12** ± 3, 2 1	26.3
Running - 1000 m, min.s	5.29 ± 2.42	5.16* ± 1.52	2.4
Lifting the torso in a sitting position for 30 s, number of times.	10.1 ± 4.52	13.2* ± 3.52	30.6
Flexion and extension of the arms in a supine position, number of times.	7.9 ± 6.64	11.2** ± 2.42	41.8

Note: ± Δ, % - difference at the end of the study;
Note: * the difference is statistically significant at the level of $p<0.05$; ** the difference is statistically significant at the level of $p<0.01$

The obtained average results of flexibility indicate the low development of this quality and the inability of orienteers to meet the standard for a positive score. Indicators that characterize the speed qualities have undergone slight positive changes: the time needed to cover the distance of 30 m decreased by 0.3 s, which is 4.6 % ($p>0.05$). The special physical fitness, determined by the ability to cover the distance in orienteering by 8 checkpoints, improved after the pedagogical experiment by 26.3 %.

The most recognisable positive changes occurred in motor tests, which characterize dexterity, strength, endurance and speed-power qualities. A statistically significant difference was observed when the participants were performing the tests: shuttle runs 4x9 m ($p<0.05$); long jump ($p<0.05$); steady running without taking into account time ($p<0.01$); flexion and extension of the arms in a supine position ($p<0.01$).

The improvement of the motor skills demonstrated by the 11-year-old boys can be explained by the use of motor elements in orienteering in practical classes during the Covid-19 pandemic.

Discussion

Today the focus of human development is on a healthy lifestyle (physical activity, healthy eating, getting rid of bad habits, personal and social hygiene), healthy information space (the ability to learn and use the information for optimal action in new circumstances, positive thinking), healthy social space (intellectual well-being, safe and favourable living conditions, spiritual and emotional well-being), however, due to the spread of the Covid-19 pandemic, the incidence rate continues to rise. This trend has a particularly negative effect on school-age children, who are forced to spend an enormous amount of time at home, which in turn reduces their motor activity and adversely affects the general state of their well-being (Yarmak et al., 2017; Galan, Andrieieva, Yarmak, & Shestobuz, 2020; Schmidt et al., 2020).

The results of the research show that leading risk factors for diseases in children (schoolchildren, in particular) are the following: constant staying indoors (in an enclosed space) during quarantine; distance learning mode which deprives students of the possibility of real communication with the teacher and classmates; predominance of sedentary lifestyle (low level of physical activity).

An analysis of research studies done in this field and the scientific literature show that physical and motor activity is extremely important. In particular, we highlight sports orienteering as one of the main factors when dealing with the pandemic and its consequences. Orienteering enhances the body's functional capabilities, promotes all-around harmonious development, eliminates bad habits, improves students' mental and physical performance, and builds the habit of doing regular exercise to improve health, physical self-improvement and a healthy lifestyle. It does not only ensure obtaining the necessary knowledge, skills and abilities in the field of sports orienteering and physical education in general but also helps to prevent diseases, restore health and improve the mental capacity of students during the pandemic (Palchuk, 2012; Celestino et al., 2015; Galan et al., 2017; Celestino, Leitão & Pereira, 2018; Pasichnyk et al., 2018; Batista et al., 2021).

We agree with the opinion that the application of health-oriented principles of sports orienteering in preventing post-pandemic consequences and morbidity will create safe and comfortable conditions for their future life (Leonenko et al., 2019).

Due to the lack of a thorough program designed for organising orienteering activities, there is an urgent need to find tools and methods, including innovative ones. This issue became especially relevant during the Covid-19 pandemic. After all, sports orienteering allows to increase the level of the students' physical and mental qualities, improves the body's cardiovascular and respiratory systems, and forms and maintains a proper level of students' health during this period. These benefits are due to the fact that sports orienteering is the type of physical activity which is performed in the field and in the fresh air, which also reduces the risk of spreading diseases among children (Korol, 2013; Dotsenko, 2013; Paliichuk et al., 2018; Rosen & Heijne, 2018; Galan et al., 2022; Kulczycka, Staśkiewicz, Stelmach & Kardas, 2022).

The study proves that orienteering lessons that involve innovative forms of teaching have a positive effect on students' physical activity and their health. The experiment expands the data giving evidence of the impact of the orienteering program aimed at schoolchildren during the Covid-19 pandemic.

Conclusions

Increasing the level of physical activity under quarantine restrictions is a necessary element of the modern lifestyle. Proper physical activity in a safe environment is an important health promotion strategy during a coronavirus pandemic. Due to the unstable state and the sharp decline in the health of children, especially schoolchildren, accompanied by their reduced physical activity, there is a need to implement modern programs that could improve the general physical condition of schoolchildren and prevent new diseases during the pandemic.

The proposed program is aimed at maintaining children's physical condition at the same level as it was before the Covid-19 pandemic. The program also focuses on preventing health deterioration.

The effectiveness of the proposed program is confirmed by the data of the formative experiment. Thus, the analysis of indicators of the physical state of the 11-year-old boys at the end of the pedagogical experiment showed significantly higher ($p<0.05$) average results. The obtained positive changes in the indicators that characterize physical fitness, and psycho-physiological state confirmed the effectiveness of the proposed program. Such a program, aimed at correcting schoolchildren's physical and physiological well-being and preventing its deterioration in the conditions of the Covid-19 pandemic, can be introduced in the educational framework as a part of a distance learning course.

With conflict of interest

Authors state no conflict of interest.

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