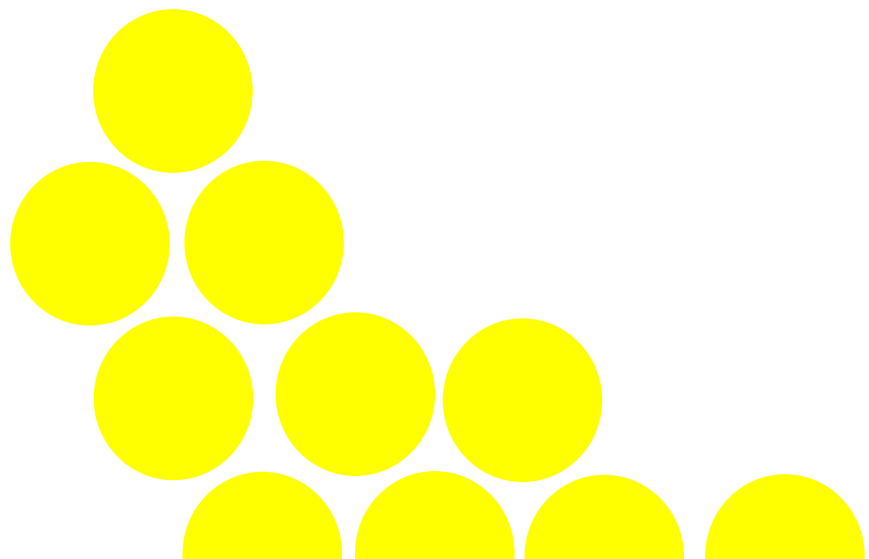




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Development of speed and strength abilities of children aged 12-13 years in physical education classes in the COVID-19 pandemic

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Author contributions: A - Study design; B - Data collection; C - Qualitative analysis; D - Manuscript preparation; E - Funds Collection

Abstract

Background and Study Aim The COVID-19 pandemic has created unusual conditions for physical education teachers to work with schoolchildren. Children are forced to spend some time at home, which reduces the time for physical activity. The aim of the work is to track changes in the indicators of speed and strength abilities of children aged 12-13 years during the year in the conditions of mixed and distance learning.

Material and Methods Schoolchildren aged 12-13 years took part in the study (Kharkiv, Ukraine; n=31; boys - n=16; girls - n=15). Parental consent was obtained for their children's participation in the study. The following tests were used: "30 meter sprint test, sec."; "60 meter sprint test, sec."; "Standing Long Jump Test (Broad Jump), cm"; "Long jump, cm". Assessment of schoolchildren's speed and strength abilities was conducted at the beginning of the school year and repeated data – at the end of the school year. The obtained results were analyzed by methods of mathematical statistics: correlation analysis was conducted to identify relationships between the results of control standards of schoolchildren, the reliability of the difference was determined by the Student's criterion.

Results There is a significant decrease in physical activity of children. Trends to reduce the level of development of speed and strength abilities of schoolchildren during the school year have been identified. There are high and medium correlations between speed and power tests.

Conclusions It is recommended to reduce the number of mandatory control standards in the school of choice between: "30 meter sprint test" - "60 meter sprint test"; "Standing Long Jump Test (Broad Jump)" - "Long jump".

Keywords: schoolchildren, physical culture, development, speed and power qualities.

Introduction

The need for regular assessment of the physical fitness of school-age children is actively raised by many scholars. In their work, they emphasize the importance of regular assessment of the level of development of physical qualities [1, 2, 3] and the state of physical development of children [4]. This approach allows to timely and expediently regulate the process of physical exercises at school, adjust the content and volume of schoolchildren workload, maintain the health of schoolchildren.

Increasingly, the authors point to negative trends in changing the level of physical training of schoolchildren. Researchers have established the assessment of junior high school schoolchildren in terms of strength [1] and speed [2] abilities at the level of the average mark, coordination skills [3] - at a sufficient and high level. The results of the assessment of these physical qualities in high school schoolchildren tend to deteriorate every year [4]. In turn, the reduction of physical activity among schoolchildren has a negative impact on their mental health [5, 6, 7].

The realities of the last school year have forced

many schoolchildren to acquire knowledge in terms of distance and blended learning. Teachers were forced to quickly master and develop a system of communication with schoolchildren remotely for the effective conduct of physical education lessons. Dunton et al. [7], Raiola et al. [8] note that during the pandemic, the number of schoolchildren who began to engage in various types of physical activity through the use of network systems and the Internet has increased significantly.

Hsu et al. [9], Jieun et al. [10] propose to use the ADDIE system for the organization of distance physical education classes – analysis, design, development, implementation and evaluation. At the first stage of the analysis, teachers determine the needs of schoolchildren. The second stage involves setting educational goals and determining what needs to be taught. At the design stage, teachers provide instructions for achieving goals according to a broad overview or plan. The instruction component is specifically planned at the development stage. Then teachers give instructions for practical training. During the assessment phase, teachers receive feedback on a practical lesson or lecture. Then adjust the training programs.

Avanesian et al. [11] analyzed the effectiveness of distance learning policies by ministries of

education in response to school closures due to the COVID-19 pandemic. The authors note that wealth and place of residence are key factors influencing the availability of distance learning policies. Another study [12] found that children from historically disadvantaged groups may be particularly vulnerable to the mental health consequences of the COVID-19 pandemic.

It is known that the sedentary lifestyle of schoolchildren has a negative impact on their health. These more negative consequences are quite possible during the COVID-19 pandemic. This is facilitated by the rampant fascination with mobile devices and the use of the Internet. Chen et al. [13] studied changes in children's health in problematic use of the Internet (problematic use of smartphones, problematic use of social networks and problematic games). The authors identified various changes in trends in additive behavior during the COVID-19 outbreak and recovery periods. Another study [14] noted the important role of parents in distance work with schoolchildren.

All of the above indicates the urgency of monitoring changes in the state of physical development and physical fitness of schoolchildren in the COVID-19 pandemic. The consequences of such a mixed and distance learning form force teachers to look for ways to adjust the curriculum

and control.

The aim of the study: to track changes in the indicators of speed and strength abilities of children aged 12-13 years during the year in terms of mixed and distance learning.

Materials and methods

Participants.

The study involved schoolchildren aged 12-13 years (Kharkiv Lyceum №89, Kharkiv, Ukraine). A total of 31 schoolchildren took part (boys - n=16; girls - n=15). Parental consent was obtained for their children's participation in the study.

Research design.

Pedagogical testing was aimed at determining the indicators of speed and strength abilities of children. Testing was conducted at the beginning of the school year and repeated data – at the end of the school year. During the school year, the educational process of schoolchildren was organized in three forms: full-time (traditional) education (5 months), distance (3 months) and mixed (1 month) forms of education. 4 test exercises were used (fig. 1, 2, 3): "30 meter sprint test, sec."; "60 meter sprint test, sec."; "Standing Long Jump Test (Broad Jump), cm"; "Long jump, cm". The test results were evaluated according to the recommendations of the Ministry of Education and Science of Ukraine [15].

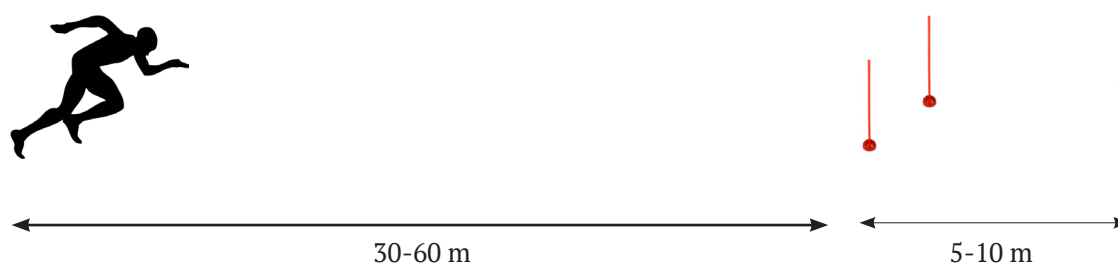


Figure 1. 30-60 m sprint test

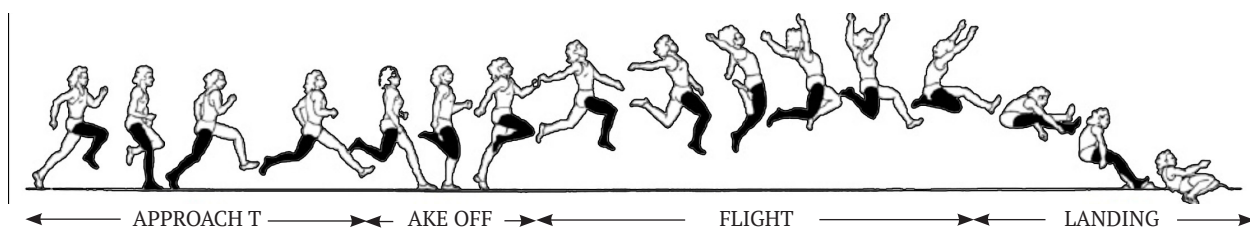


Figure 2. Long Jump [16]

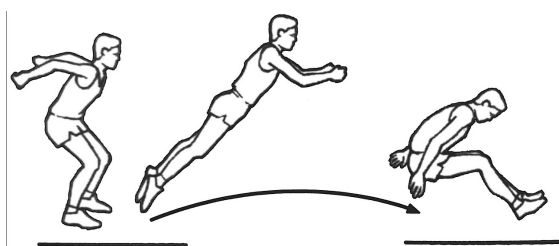


Figure 3. Standing Long Jump [16]

Statistical analysis.

The obtained results were analyzed by methods of mathematical statistics: correlation analysis was conducted to identify relationships between the results of control standards of schoolchildren; the reliability of the difference in indicators was determined by the Student's criterion.

Results

Table 1 shows the results of testing schoolchildren in different periods of the study (table 1).

Table 1 shows that at the beginning of the school year, the average result of the boys in the "Standing Long Jump Test" was 174.00 ± 5.96 cm. This corresponded to a high level of competence. The average result of the boys in the long jump test was 278.67 ± 8.34 cm. This corresponds to the average level of competence of schoolchildren. The result of the "30 meter sprint test" was recorded at a sufficient level of competence. The result of the "60 meter sprint test" was recorded at a high level of competence.

At the beginning of the school year the girls' results corresponded to a high level of competence: "Standing Long Jump Test", "Long jump", "30 meter sprint test". The result of the "60 meter sprint test" corresponded to a sufficient level of competence. It should also be noted that between the results of boys and girls, the level of development of speed

and strength qualities had no statistical significance ($p < 0.05$).

At the end of the school year the results of these test exercises showed the following: in boys the result of "Standing Long Jump Test" was 176.00 ± 4.39 cm. This corresponded to a sufficient level of competence of schoolchildren. The result of "Long jump" had an average level of competence. The increase for the year was only 2.87 cm. The average result of the "30 meter sprint test" remained high. The improvement rate was 0.06 s. The level of competence "60 meter sprint test" has changed for the worse – the indicator decreased by only 0.44 s. This figure was 10s (high level of competence).

Changes in levels of competence can be clearly seen in Figure 4.

The average score of the Standing Long Jump Test at the end of the school year was high. The increase was only 1.2 cm. This fact cannot be considered sufficient. The average result of "Long jump" increased by 4.89 cm. This is a high level of competence. The results of the "30 meter sprint test" remained at a high level of competence. The results of the girls' 60 meter sprint test remained in the "sufficient" position.

The correlation analysis of the obtained data shows that between all the results of test exercises there are relationships of medium and high level (Table 2).

Table 1. Indicators of speed and strength abilities of schoolchildren 12-13 years ($n = 31$)

Period of study, statistical indicators	Sex of schoolchildren	Standing Long Jump Test (Broad Jump), cm $\bar{x} \pm m$	Long jump, cm	30 meter sprint test, sec.	60 meter sprint test, sec.
At the beginning of the school year	boys	174.00 ± 5.96	278.67 ± 8.34	5.38 ± 0.30	10.44 ± 0.12
	girls	165.33 ± 3.33	263.67 ± 7.55	5.56 ± 0.08	10.90 ± 0.19
At the end of the school year	boys	176.00 ± 4.39	281.54 ± 5.76	5.32 ± 0.54	10.00 ± 0.21
	girls	166.51 ± 5.48	268.56 ± 6.45	5.52 ± 0.23	10.51 ± 0.31
t_{boys}		0.27	0.28	0.11	1.20
t_{girls}		0.24	0.49	0.16	1.10
p		< 0.05			

Table 2. Correlation analysis of test exercise results

Tests	Standing Long Jump Test (Broad Jump), cm	Long jump, cm	30 meter sprint test, sec.	60 meter sprint test, sec.
Standing Long Jump Test (Broad Jump), cm	1			
Long jump, cm	0.737067	1		
30 meter sprint test, sec.	-0.81241	-0.63979	1	
60 meter sprint test, sec.	-0,86806	-0,68909	0,817342	1

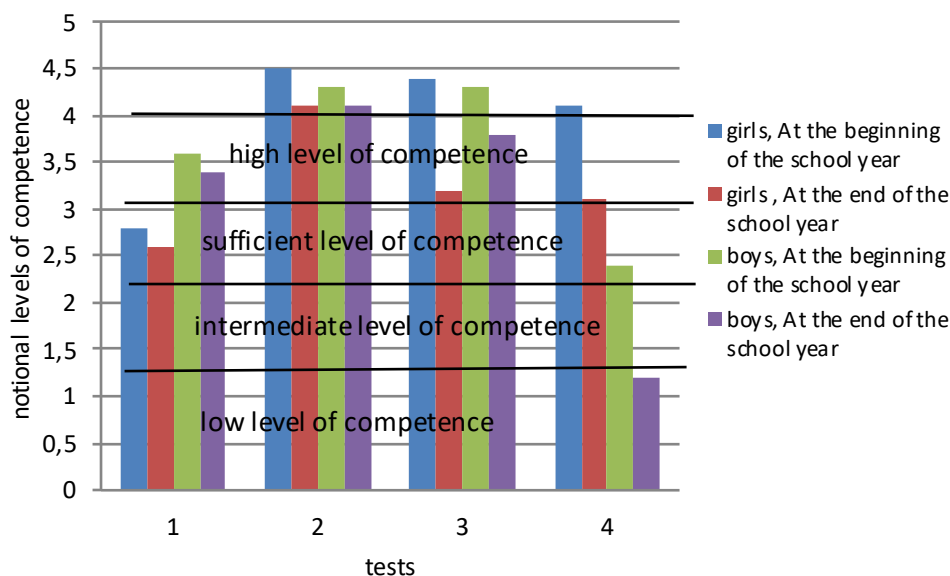


Figure 4. Changes in the levels of competence in the indicators of speed and strength abilities of schoolchildren during the year of mixed and distance learning: 1 - “60 meter sprint test”, 2 - “30 meter sprint test”, 3 - “Standing Long Jump Test”, 4 - “Long jump”.

Discussion

Our results confirm the data of other studies [17, 18]. The authors draw attention to the declining physical activity of the population during the COVID-19 pandemic. Mattioli et al. [19], Giustino et al. [20], Dunton et al. [7] note that under the conditions of quarantine restrictions during the COVID-19 pandemic, remote physical activity for the population intensified. However, the difficulty of performing technically correct individual movements through visual observation on the Internet carries certain risks of injury to the musculoskeletal system. The authors also point out that human inaction in just two weeks leads to the possibility of losing many beneficial metabolic and cardiovascular changes. Sopa et al. [5], Brooks et al. [6] noted the likelihood of deteriorating mental health in schoolchildren. According to the authors in conditions of reduced physical activity, the incidence of bad mood, imbalance, nervousness, poor sleep.

Some teachers quickly adapted to these conditions. They tried to improve the health of schoolchildren and develop their basic physical qualities. Teachers used a variety of multimedia platforms, messengers, social networks with these recommendations. However, this organization of the educational process in Ukraine had its downsides: the number of schoolchildren in online classes fell sharply; the rest of the schoolchildren simply did not perform any actions during the lessons. The reasons were voiced variously: lack of space to perform movements and the necessary equipment or improvised means, etc.

Josip Karuc et al. [21] studied the physical

activity of middle school schoolchildren in Croatia during the COVID-19 pandemic. The authors note a decrease in the level of physical activity in those schoolchildren who led an active lifestyle before quarantine. There was also an increase in the level of physical activity in schoolchildren who did not exercise before quarantine. Similar trends were observed by Dunton et al. [7] studying the impact of the COVID-19 pandemic on the physical activity and sedentary behavior of children living in the United States. Štveráková et al. [22] studied the physical activity of Czech children during the second wave of the COVID-19 pandemic. The authors note that Czech children are less physically active than their peers abroad. The authors note that further significant reductions in children’s physical activity due to epidemic restrictions are alarming and should be regulated by government agencies and school administrations. Atiković et al. [23] note a decrease in the time that schoolchildren began to devote to various types of physical activity during anti-epidemiological measures. However, most studies have shown a decrease in physical activity in different regions. These data are based on the use of online questionnaires. In our opinion, this may somewhat distort the real situation.

In our study, there is a tendency to reduce the growth rate of speed and strength qualities of schoolchildren. This is a consequence of reduced physical activity of schoolchildren. Similar conclusions were obtained by Natasa Zenic et al. [24]. The authors draw attention to the decrease in indicators of basic physical qualities and the level of physical activity in general of high school schoolchildren in Croatia. The authors also note that most schoolchildren did not follow the

recommendations of teachers on the recommended minimum physical activity. Wei Xia et al. [25] observed a decrease in the results of 50, 800 and 1000 m in boys and girls in China. The authors note the improvement of strength training in the exercises “Eurofit Sit Up Test”, “Pull-Up Bars” for boys and “Squats Test” for girls.

The results of the tests in our study indicate a deterioration in the health of schoolchildren. We attribute this fact to the fact that distance learning does not allow to fully master motor tasks. This is confirmed by studies of other authors. Research by Jarnig et al [26] suggests that joint efforts are needed to improve children’s health. This will prevent long-term negative health consequences.

The results of our study are just an attempt at one school level to show the ability to counter the negative effects of the COVID-19 pandemic. In this regard, we recommend taking the example of national measures for physical activity during the pandemic COVID-19 pandemic of the Republic of Slovenia. Jurak et al. [27] note that the Republic of Slovenia implements the world’s largest longitudinal database of physical fitness of children - SLOfit. Slovenia has some of the most physically active children in the world. The authors found that the crisis in children’s fitness requires integrated community participation and a strong response to health policies. In Cyprus and Greece, three enhanced health measures have been taken to control the COVID-19 pandemic [28].

The authors used wearable sensors to constantly monitor the personal location and physical activity of schoolchildren (mean age - 9.7 years). The authors argue that such technology provides objective, continuous real-time location and activity data. Although we have not studied children’s physical activity with such devices, we fully agree with this approach. This may be the goal of our next study.

The presence of high correlations between individual indicators of speed and strength training in our study indicates the appropriateness of reducing the number of test exercises for schoolchildren. This leaves more time for mastering movements, improving schoolchildren’ health and entertaining them during physical education lessons.

Conclusions

The presence of high and medium correlations between the tests of speed and power orientation allows us to recommend reducing the number of mandatory control standards in the school: the choice of long jump from a place or long jump from a run; running 30 meters or running 60 meters.

Over the last year, forced mixed and distance learning has led to a significant trend to reduce the level of development of speed and strength abilities of schoolchildren aged 12-13.

Conflict of interest

The author report no conflict of interest.

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Dynamics of special endurance of athletes aged 13-15 years under the influence of the program of the Cossack duel

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Author contributions: A - Study design; B - Data collection; C - Qualitative analysis; D - Manuscript preparation; E - Funds Collection

Abstract

Background and Study Aim

National sports are gradually spreading around the world and becoming international. One of such sports is the Cossack duel - a national martial art in Ukraine. In addition to the purely sports component, this sport has national traditions of educating healthy youth. The purpose of the study is to identify the impact of the Cossack duel program on the special endurance of athletes aged 13-15 year.

Material and Methods

Athletes (n = 6, age - 13-15 years) of the Cossack duel department of the sports school № 6 (Kharkiv, Ukraine) took part in the study. The children's parents agreed to participate in the study. The study was conducted with athletes of the basic training group on the Cossack duel (sports school №6, Kharkiv, Ukraine) for two years. At the beginning, a preliminary test of the level of special endurance of athletes was conducted. In the end, the final testing of the level of special endurance development of young athletes was conducted. SPSS was used to process the test results. The confidence level is 0.05.

Results

It is established that for two years of using the author's program the density of shock actions of athletes has increased significantly. This is manifested in an increase in the number of blows to the bag with his hands and feet ($p < 0.001$). It was found that the load of maximum intensity during one round caused significant changes in the cardiovascular system. These indicators were almost indistinguishable (0.7%). The process of restoring heart rate has become more advanced. After 60 sec. recovery difference was 13.2%, and after 120 sec. - 16.1%.

Conclusions

One of the main factors in the training of athletes in the Cossack duel is special endurance. Among the effective methods of improving special endurance are interval and interval-circle training methods. To control the development of special endurance of athletes, it is advisable to use a 1.5 - minute test with the performance of shock actions with hands and feet on a punching bag. Criteria for assessing special endurance should be the intensity of the kicks, heart rate. It is necessary to remember the harmonious upbringing of the individual, to apply health-preserving technologies, to pay great attention to the upbringing of young people in the spirit of respect for national traditions.

Keywords: basic training, national sport, spike motion, evaluation criteria.

Introduction

National sports are gradually spreading around the world and becoming international. One of such sports is the Cossack duel - a national martial art in Ukraine. In addition to the purely sports component, this sport has national traditions of educating healthy youth. Over the past few years, this type of martial arts has developed rapidly in various countries around the world. This has led to increased competition in international competitions, forcing athletes and coaches to find ways to optimize the training process. One of the key components of athletes' fitness is special physical fitness. It is the high level of special physical fitness that helps athletes realize their technical and tactical potential in competitive fights.

The level of special endurance of athletes is the key to success in competitions. This is noted in various studies [1, 2]. The authors emphasize that

high-intensity interval training improves certain important variables related to aerobic and anaerobic rates.

Many specialists have dealt with the problem of special physical training in various types of martial arts. Golokha [3] studied the problem of special endurance of judokas. The author identified effective means of increasing special endurance. The author considered exercises that cause maximum performance of the cardiovascular and respiratory systems. In other studies [4, 5], the authors analyzed the process of special physical training of kickboxers aged 15-16 years. The authors cited areas for optimizing the special physical training of athletes.

Some experts have studied changes in the functional systems of athletes in martial arts under the influence of special loads. The study of the respiratory system of kickboxers allowed Volodchenko [6] to determine the significant advantage of the capabilities of this functional system compared to standard criteria. Romanenko [7] determined that the same loads in junior taekwondo

athletes of the same age and qualification can cause different changes in the cardiovascular system. The author emphasizes the need for operational control to correct the training program. Pashkov and Palij [8] studied the response of taekwondo athletes aged 12-14 years to special physical activity. The authors propose their own method of improving the endurance of athletes, which increases the level of adaptation and economization of taekwondo. Rovnij et al. [9] considered the use of modern technologies for controlling heart rate under the influence of loads in martial arts. The authors offer a software application for registration and analysis of training load in martial arts using mobile devices. Romanenko and Golokha [10] studied the heart rate of experienced taekwondo practitioners. The authors propose to use the data obtained in monitoring the current state of athletes.

An equally important component of building programs to increase the endurance of young athletes in martial arts is its health component. Boguszewski et al. [11] assessed the health of students involved in sports and martial arts. The authors believe that lifestyle is one of the main factors in maintaining good health and mental and physical working capacity. Another study [12] found a positive correlation between martial arts practice and martial arts, health behaviors, and higher self-esteem quality scores. Kotarska et al. [13, 14] also believe that martial kinds of sport and martial arts have a special educational potential in the field of forming positive patterns of behavior regarding health and quality of life. Another study emphasizes that martial kinds of sport and martial arts see health as a goal of improvement [15]. In these respects, the Cossack duel is fully consistent with the above conclusions. Confirmation of the importance of raising healthy children in the days of the Cossacks is the research of other authors [16-18]. A motivational component to involve children in the Cossack duel is to watch international competitions on the website World Cossack Fight Federation [19].

An analysis of the publications available to us indicates that almost no research has been conducted on the training of athletes in the Cossack duel. The purpose of the study is to identify the impact of the Cossack duel program on the special endurance of athletes aged 13-15 years.

Material and Methods

Participants.

The study involved athletes (n = 6, age - 13-15 years) of the Cossack duel of the sports school №6 (Kharkiv, Ukraine). The children's parents agreed to participate in the study. The study was approved by the Ethics Committee of University and conformed to the Helsinki Declaration.

Research design.

The study was conducted for two years. At the beginning, the level of special endurance of the fighters of the basic training group was tested. In the end, the final testing of the level of special endurance development of young fighters was conducted. Then the dynamics of indicators of special endurance of athletes under the influence of the author's program was studied. The training program was based on the curriculum of the Cossack duel for sports schools [20]. The key place in the author's program was occupied by sets of exercises that were to be performed by the interval-circular method.

The study of the level of special training of athletes was performed using a 1.5-minute test. In the conditions of this test there was performance of punching work on a punching bag with the maximum possible intensity. The kicks were to be inflicted with the hands and feet in a ratio of 70-80% to 30-20%, respectively (Figure 1). The 1.5-minute period corresponds to one competitive round for athletes in this age group. During the test, the number of kicks with the hands and feet and their sum were counted. In the study of special physical training of athletes are used similar tests in the practice of such kinds of sport which have in the basis kicking actions (like marital arts) [21, 22].

Test - heart rate (HR).

The test was used to determine the effect of exercise on the cardiovascular system and its ability to recover after exercise. Heart rate was measured before and after exercise (immediately after exercise; 60 seconds; 120 seconds). Each time the number of heartbeats was counted for 10 seconds. Then the result was multiplied by six.

Exercise complexes.

Complexes of exercises were used to improve the level of endurance development of young fighters. Complexes of exercises are built on the principles of interval-circular training. Two complexes were developed: the first – consisted mainly of general training facilities; the second – consisted of special and competitive means. The intensity of exercise in the complexes was moderate (heart rate was about 150 beats / min).

The first set consisted of 10 exercises. The complex had a general preparatory orientation. Athletes performed it in the second half of the main part of the training session once at the end of the weekly microcycle. (Figure 2).

The cycle of exercises was repeated 3 times. There were 15 seconds to rest between the exercises. 5 minutes were allotted for rest between circles. Content of exercises:

- Cadence Push-Up Test, quantity of times (45 sec.);
- Eurofit Sit Up Test (for 45 sec.), quantity of times – (using 15-20% of his own weight);



Figure 1. 1.5-minute test, a study of the level of special training of young athletes.



Figure 2. Complex of exercises №1 general preparatory orientation.

- Box Jumps 30 cm (45 sec.);
- Trunk Lift Test, quantity of times – using 15-20% of his own weight of medium intensity (45 sec.);
- running on the tatami (45 sec.);
- lifting dumbbells with straight arms up using 15-20 % of his own weight (45 sec.);
- squats with dumbbells using 15-20% of his own weight (45 sec.);
- Pull Up Bar-Straight Leg Hanging Leg Raises, quantity of times (45 sec.);

- Battle Rope Exercise (45 sec.);
- Burpee exercise (45 sec.).

The second complex had a special preparatory focus. The set of exercises was performed once at the end of the weekly microcycle. Dosage was – 3 rounds with a rest interval of 5 minutes. Exercises between stations were performed in the absence of rest between circle exercises. The following exercises were used here:

- Jump Rope (3 minutes);

- battle with the shadows (1.5 minutes);
- exercises in the racks for two athletes (30 seconds in attack, 30 seconds in defense of 3 approaches);
- running on the spot - the athlete performs direct kicks in front of him (1.5 minutes);
- movement in the stances - the athlete performs protective actions; at the signal - the athlete performs acceleration on a combination of strokes) (1.5 minutes);
- exercises on the bag in the stances - the athlete performs alternating kicks at short and long distances (3 approaches of 30 s);
- imitation of kicks - the athlete alternately performs exercises with arms and legs (3 approaches of 30 s);
- exercises with a skipping rope (3 minutes).

Athletes performed these tasks once in a weekly microcycle on the last training day of the weekly microcycle (Friday). Changes were made to the first and second complexes. The first complex was performed in the preparatory period of the macrocycle, and the second - in the competition. The structure of microcycles depended on the period of the macrocycle.

The interval method was used to improve general and special physical fitness. The method was aimed at developing the speed and strength abilities of athletes. Depending on the period of the macrocycle, training aids also varied from mostly general preparatory to mostly competitive (Figure 3). Training sessions of this direction were held on

the third day of the weekly microcycle - Wednesday. On other days (Monday, Tuesday, Thursday) technical and tactical trainings were held. At the end of the study, the final endurance testing of athletes took place.

Statistical analysis.

The SPSS program was used. Indicators were determined: standard deviation - σ , Student's t-test. The level of reliability is selected $p < 0.05$.

Results

The dynamics of the development of special endurance of fighters are shown in tables 1, 2. Table 1 shows the dynamics of the impact of athletes. In two years, the density of athletes' strikes has increased significantly. This is manifested in an increase in the number of kicks to the bag with his hands and feet ($p < 0.001$). These indicators characterize a significant improvement in the special endurance of athletes.

One of the informative criteria for assessing the special endurance of athletes is the ability of the body's functional systems to recover quickly after exercise. We studied the functional state of the cardiovascular system under the influence of special loads. Spike motions were performed and the ability of the cardiovascular system to recover was assessed. Table 2 shows the dynamics of the cardiovascular system of athletes under the influence of special loads in percentage terms. From the data in table 2 it is seen that the load of maximum intensity



Figures 3. Using the competitive method in the training program of young athletes.

Table 1. Dynamics of special endurance of athletes

Indicator	$\bar{X} \pm \sigma$ at the beginning of the experiment	$\bar{X} \pm \sigma$ at the end of the experiment	t	p
Kicks by hands, number	104.0 \pm 4.44	121.8 \pm 3.97	6.98	<0.001
Kicks by feet, number	16.8 \pm 4.45	34.2 \pm 5.27	6.17	<0.001
Sum of kicks, number	120.8 \pm 7.92	156.0 \pm 6.83	8.20	<0.001

Table 2. Dynamics of functional fitness of athletes

Indicator	Heart rate at the beginning of the experiment	Heart rate at the end of the experiment	Difference in heart rate, bpm	Difference in heart rate %	t	p
Heart rate before the load, bpm	121.2±4.65 100%	118.8±3.84 100%	2.4	0	0.97	>0.05
Heart rate after the load, bpm	162.0±11.15 133.7%	158.0±6.32 133.0%	4.0	0.7	0.77	>0.05
Heart rate after 60 sec. after the load, bpm	140.3±15.77 116.5%	123.0±3.21 103.3%	17.3	13.2	2.59	<0.05
Heart rate after 120 sec. after the load, bpm	129.7±10.48 107.7%	109.0±3.78 91.6%	20.7	16.1	4.57	<0.01

during one round caused significant changes in the cardiovascular system. These indicators were almost indistinguishable (0.7%). Heart rate recovery processes have become more sophisticated. After 60 sec. recovery difference was 13.2%, and after 120 sec. – 16.1%.

Analysis of the results of the study of the dynamics of functional fitness of athletes confirmed the data of preliminary calculations (table 2). The first two indicators did not reveal a significant difference in the dynamics of functional changes (indicator of cardiovascular system). This is confirmed by the level of significance of heart rate indicators. But there is a significant improvement in the recovery process: after 60 sec.; after 120 sec.

The results of the study show that in two years, athletes have increased the intensity of kicks when working on a punching bag. At the same time, they had positive changes in the functioning of the cardiovascular system during the recovery, after performing special loads. All this testifies to the effectiveness of the author's training program to improve special endurance.

Discussion

We assumed that the use of interval and interval-circular training methods with a gradual increase in the intensity of exercise will have a positive effect on the special endurance of young athletes. The results of this study prove the ability of our program and complement the results of previous studies by other experts [1, 3, 5].

One of the components of special training of athletes in martial arts is the ability to quickly restore the functional systems of the body after exercise. After the experimental program, the functioning of the cardiovascular system of athletes has undergone significant positive changes. This is important to increase the level of fitness of athletes, to strengthen their health. A similar problem

has been considered in other studies [2, 13-15]. The authors emphasize that during this period of training, the health indicators of young athletes become important.

The results of our study complement the results of previous work of experts on the control of special physical fitness of athletes [21, 22]. The authors note that there is mandatory monitoring in training programs for young athletes.

It should be noted another component of the education of young athletes, which is no less important for the formation of the personality of athletes: the education of young athletes in the spirit of national traditions. In the educational and training process and in competitive activities in the Cossack duel, special attention is paid to respecting national traditions of educating healthy youth. A number of researchers have dealt with similar problems of youth education [16-18]. The authors emphasize that national sports have an educational component of respect and pride for loved ones and their country.

Conclusions

- one of the main factors of sportsmanship of athletes in the Cossack duel is special endurance;
- among the effective methods of improving special endurance in the Cossack duel are interval and interval-circle training methods;
- in a complex of exercises of an interval-circular method it is possible to include general-preparatory, special and competitive means of training;
- to control the development of special endurance of athletes aged 13-15 years in the Cossack duel, it is advisable to use 1.5 - minute test with the performance of kicks with hands and feet on a punching bag. This is in line with the rules of one round of competition for athletes of this age group;
- criteria for assessing the special endurance of athletes should be the intensity of percussion,

heart rate. Heart rate is measured: before exercise; immediately after loading; after the exercise in one and two minutes. This test characterizes the athlete's ability to recover;

- when training athletes in the Cossack duel, it is necessary to remember about the harmonious

upbringing of the individual, to apply health-preserving technologies. It is necessary to pay special attention to the education of young people in the spirit of respect for national traditions.

Conflict of interest

The authors report no conflict of interest.

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Features of the use of physical exercises at the long-term stage of rehabilitation after intra-articular fractures

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Author contributions: A - Study design; B - Data collection; C - Qualitative analysis; D - Manuscript preparation; E - Funds Collection

Abstract

Background and Study Aim The main demand after surgical treatment of the injury is to restore motor function and return to an active lifestyle. The inclusion of effective therapeutic exercises in the rehabilitation program will help to restore the physical activity of patients. The aim of the study is to develop and evaluate the effectiveness of a set of therapeutic exercises to restore the movements of the lower extremities of patients after surgery.

Material and Methods The program involved 14 patients who were randomized (n=6 - control group, CG; n=8 - main group, MG). All patients gave their informed consent to participate in the experiment and to the processing of their personal data. It was used the following scales: "6 minute walk test", "Knee injury and Osteoarthritis Outcome Score" (KOOS). The International Classification of Functioning (ICF) categories were assessed and program objectives were set. Conducted individual classes according to the developed rehabilitation program in the MG and the generally accepted in the CG. After 2 months, the implementation of the goals set in the program was evaluated. Nonparametric statistics were used to determine differences between groups, Wilcoxon test for related sets, and Mann-Whitney criteria for independent sets. Values of $p < 0.05$ were considered significant.

Results The goal of "Restore lower limb function" and "Ability to drive a car" was fulfilled in the MG and CG. Significant differences in the dynamics of KOOS subscales "Pain", "Symptoms and stiffness", "Quality of life" confirm this ($p < 0.05$). The goal "Ability to work in the backyard" was met only by MG patients. The distance traveled significantly improved in MG and CG ($p < 0.05$), but there was a significant difference between the comparison groups on this indicator ($p < 0.05$). The assessment of the scale of the KOOS "Sport" and "Active Recreation" subscales changed only for MG ($p < 0.05$) and at the end of the program differed significantly from the CG ($p < 0.05$). Category d850 "Paid work" significantly improved during the study period in MG ($p < 0.05$), with a significant difference between these indicators with CG. 2 of 6 CG patients ($33.3 \pm 21.1\%$) and 6 of 8 patients with MG ($75.0 \pm 16.4\%$) returned to previous work at $p < 0.05$.

Conclusions It is recommended to perform exercises with an emphasis on the posterior surface of the lower extremity. The author's program of physical rehabilitation is quite conditional. Depending on the situation and condition of patients, adjustments are made. But the general direction and nature of the impact must be maintained.

Keywords: kinesitherapy, therapeutic exercises, electromiostimulation, recovery.

Introduction

Restoring patients' movements after surgery and returning them to proper physical activity is an important part of maintaining good health. Studies by different authors point to different perspectives on solving the problems of restoring patients' movements. Birtwistle et al. [1] emphasizes the mandatory participation of family members in the restoration of lost functions. Hei Chow et al. [2] recommend monitoring the daily physical activity of patients. Another study [3] suggests using the recommendations of an exercise specialist. The authors note that this may lead to clinically significant benefits for quality of life and may affect

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some people's intention to engage in physical activity. Ng et al. [4] consider physical activity as a possible behavioral and rehabilitation strategy to improve quality of life related to health. Other studies [5-7] also emphasize the importance of rehabilitation measures using exercise and moderate exercise.

Closed knee joint injuries are quite common and form about 70% of all injuries of the musculoskeletal system [8, 9]. Prolonged dysfunction of the knee joint in most cases leads to muscular malnutrition, gait stereotype, limitation of active lifestyle [10, 11]. Byun et al. [12] assessed the frequency, type, and risk factors for knee injuries associated with femoral fractures. The authors found that 30% of fractures of the femur revealed knee injuries. Therefore, one needs to be careful because knee injuries may be accompanied by ipsilateral bone

fractures. Another study [13] reported that intra-articular tibial fractures can cause treatment-related problems. The authors propose a new device that provides double retraction in combination with MIPPO technology. This device gives a lower load than a traditional traction table. Zhao et al. [14] studied the epidemiological characteristics of large intra-articular fractures. The study revealed age and gender epidemiological characteristics of large intra-articular fractures, which became the basis for clinical assessment and practice.

The most pressing issue for the patient is the restoration of limb function after these injuries and return to active life [15]. Golovakha et al. [10] notes that therapeutic exercise programs may include: amplitude, strength, and intensive functional exercises; exercises for proprioception; feedback exercises; exercises in water. There are programs that additionally use hardware physiotherapy (electrical stimulation, interference currents), wearing hinged orthoses, passive joint development, manual correction and taping [10]. However, the available evidence confirms that only electrotherapy and exercise play a significant role in overcoming the effects of postoperative knee stiffness [15, 16]. The authors found that exercise under the supervision of a physical therapist is much more effective than home treatment. This is confirmed by the study of Hartley et al. [17]. The authors found that one-sided intensive exercise is a possible intervention to reduce the risk of hip fractures in healthy women. Hobusch et al. [18] recommend four to seven sports after surgery, depending on the type of surgery on the thighs or knees. Timpka et al. [19] studied injuries in football. The authors found that knee ligament injury was observed in 20% of adolescents (13-17 years of age) and 34% of adults (18-29 years of age). The authors recommend following the rules of the game and behavior on the field when playing football.

Therefore, kinesitherapy programs for patients after surgical treatment of intra-articular knee fractures still do not have a "gold standard". Therefore, the problem of determining effective therapeutic exercises depending on the rehabilitation period is relevant.

The hypothesis of the study was that the emphasis on exercises to strengthen the muscles of the posterior surface of the lower extremity will change the stereotype of walking. This will have advantages over the standard recovery approach.

The aim of the work is to develop and evaluate the effectiveness of a set of therapeutic exercises to restore the movements of the lower extremities of patients after surgery.

Material and Methods

Participants.

The program was attended by men after surgical treatment of intra-articular fracture of the distal femur (n=14, age - 35-65 years). Participants were randomly divided into two groups: control group (CG, n=6); main group (MG, n=8). All participants gave their informed consent to participate in the experiment and to the processing of their personal data. All of the procedures were in accordance with the Helsinki Declaration of 2021. This study was approved by Academy Ethics Committee for research on human participants.

Research Design.

It was used the following scales: "6 minute walk test", "Knee injury and Osteoarthritis Outcome Score (KOOS)". The International Classification of Functioning (ICF) was assessed and program objectives were set.

In patients with long-term dynamics, the structures according to the relevant categories and qualifiers of ICF were studied:

- s750 "Structure of the lower extremity";
- b280 "Feeling of pain";
- b710 "Joint mobility functions"
- d450 "Walking";
- d475 "Driving";
- d640 "Housekeeping";
- d850 "Paid work";
- d855 "Unpaid work".

Based on the ICF categories, program goals were formed depending on the individual needs of patients: to restore the function of the lower extremity, the ability to drive a car, work in the backyard and return to work.

The physical therapy program included 15-16 sessions within 2 months after the early and late postoperative periods. The program consisted of kinesitherapy and electromyostimulation. Patients of the main group were engaged in the developed program of physical rehabilitation. The program focused on the muscles of the posterior surface of the lower extremity and included all types of exercises of CG: exercises on a block simulator, lunges, overcoming stairs, dynamic balance exercises, exercises for torso stability, plyometric and cyclic exercises (exercise bike, running, graduated exercises, specific for each sporting activity). Electromyostimulation was used for hamstrings and quadriceps in MG and only quadriceps in CG.

Statistical Analysis.

The SPSS 11.0 program was used. Mean, standard deviation, and percentage frequencies were used for descriptive data analysis. To assess the difference in dynamics, the Wilcoxon test was determined, for the independent – Mann-Whitney. The level of reliability was chosen $p < 0.05$.

Results

In the dynamics of 2 months, the fulfillment of the

goals set in the program “Restore lower extremity function” was assessed and corresponded to two ICF categories: b280 “Feeling a pain” and b710 “Joint mobility functions” (Table 1). The assessment was based on the Knee injury and osteoarthritis outcome score (KOOS) scale. These criteria improved in almost all patients of MG and CG ($p < 0.05$). “Pain assessment” on the “Pain” subscale has improved in MG and CG. According to the estimates of the subscale “Symptoms and stiffness”, joint mobility increased ($p < 0.05$ in the dynamics in both groups). No difference in these indicators was found between the comparison groups.

The goal of “Ability to drive a car” was achieved in all patients in both groups. At the beginning of the qualification assessment program, severe impairment of performance and ability was shown in almost all patients. Category d475 “Driving” was evaluated according to the results of KOOS subscales “Daily activity” and “Quality of life”. During the program, the ratings of the “Daily Activity” subscale, which were high from the very beginning, have hardly changed. The assessment of the subscale “Quality of Life” increased significantly ($p < 0.05$). No difference in these indicators was found between the comparison groups. The qualifier had grades - mild and moderate violations.

The goal of “Ability to work in the backyard” was met only by patients of MG. Qualifiers of categories d450 “Walking”, d640 “Housekeeping”, d855 “Unpaid work” in MG improved by 1-2 points from severe and moderate performance disorders to mild and absent. In the CG, only the d450 “Walking” score had changes in the scores. The categories were evaluated based on the results of the 6-minute walk test and the

KOOS “Sports and active recreation” subscale. The distance traveled was significantly improved in MG and CG ($p < 0.05$). However, there was a significant difference between the comparison groups on this indicator ($p < 0.05$). The assessment of the KOOS subscale scale “Sports and active recreation” changed only in MG ($p < 0.05$). This indicator at the end of the program differed significantly from the CG ($p < 0.05$). The difference between MG and CG was established for two categories (d640, d855). Positive changes in productivity occurred in 1 of 6 patients from CG ($16.7 \pm 16.7\%$) and in 7 of 8 people from MG ($87.5 \pm 12.5\%$).

The goal of “Return to work” is a derivative of human participation in public life and is most important for human rehabilitation. Category d850 “Paid work” significantly improved during the study period in MG ($p < 0.05$). According to this indicator, the CG has not undergone significant changes. 2 of 6 patients of CG ($33.3 \pm 21.1\%$) and 6 of 8 patients of MG ($75.0 \pm 16.4\%$) returned to previous work.

Discussion

The hypothesis of the study was that the emphasis on the muscles of the posterior surface of the lower extremity will change the stereotype of walking and increase the activity and participation of patients compared to the standard approach to recovery. KOOS and the 6-minute walk test, which can characterize most of ICF criteria, were selected as performance criteria. These criteria are violated after a knee injury. This statement coincides with many studies of medium-term results [20, 21]. Data on KOOS subscales at the beginning of the program were not similar to identical estimates by Fändriks

Table 1. Evaluation of the effectiveness of rehabilitation based on the results of achieving the goals

Aim	Groups	Subscale of KOOS “Pain”, %		Subscale of KOOS “Symptoms and stiffness”, %	
		at the beginning of the program	at the end of the program	at the beginning of the program	at the end of the program
“Restore lower extremity function” (b280 “Feeling a pain”, b710 “Joint mobility functions”)	MG	72.9±9.7	91.5±10.6	62.8±10.3	83.9±11.5
	CG	73.1±10.8	91.8±11.7	62.9±10.4	81.8±10.7
“Ability to drive a car” (d475 “Driving”)		Subscale of KOOS “Daily activity”, %		Subscale of KOOS “Quality of life”, %	
	MG	93.0±8.7	95.3±9.1	70.1±10.8	89.8±9.4
	CG	95.2±9.8	95.9±9.7	73.1±11.3	90.9±10.7
“Ability to work in the backyard” (d450 “Walking”, d640 “Housekeeping”, d855 “Unpaid work”)		Subscale of KOOS “Sports and active recreation”, %		Distance in 6-minute walk test, m	
	MG	50.0 ± 6.9	77.6± 8.3	453±31	674±55
	CG	55.8 ± 5.7	57.6± 5.3	480±43	546±65

Note: CG - control group; MG - main group.

et al. [22]. The subscales “Daily Activity”, “Quality of Life” and “Sports and Active Recreation” were rated much lower than in our study. In our opinion, this may be due to cultural differences. After 2 months of the program, the results of all subscales significantly improved. The exception was the subscale “Daily activity” (the scale had high initial values). This indicates the effectiveness of long-term rehabilitation and coincides with the results of other studies [11].

The results of the 6-minute walk test at the beginning of the program also coincide with the results of Fändriks et al. [22]. At the end of the study, the results of MG patients correspond to the mean values in the population.

An important result of this study was the fulfillment of the “Return to Work” goal by the majority of MG patients. This fact is relevant for men of working age. The control group had lower results. These results were similar to those of other researchers [21]. According to Kraus et al. [21] a significant number (9/23.1%) of patients reported difficulties with work. As a result, five employees were forced to switch to less physical work and four patients to reduce the number of working hours per week (10.5 hours/week). That is, kinesitherapy with an emphasis on exercises for the posterior surface of the lower extremity in the long-term stage of rehabilitation may be recommended to increase the likelihood of returning to the previous load.

In our opinion, our kinesitherapy program is clinically sound. But there are some limitations

to this study. It was attended by men of working age (small sample) who lived in the private sector. Therefore, further research is needed.

Conclusions. Practical recommendations

The dynamics of many of the studied indicators showed positive changes in patients in both groups. Therefore, we may recommend performing exercises with an emphasis on the posterior surface of the lower extremity. These include exercises on the block simulator, lunges, climbing stairs, exercises on the step platform, dynamic balance exercises, exercises for torso stability, plyometric and cyclic exercises, exercises with a rubber shock absorber (lying on back, lying on side, lying on stomach; sitting on the floor, sitting on a chair). As the knee joint recovers, the following should be considered: the type and nature of the exercise; the amount of load and resistance; number of repetitions of exercises; speed of overcoming and yielding movements; number of repetitions of the exercise; the nature and duration of rest intervals between approaches.

It should be noted that the developed and implemented physical rehabilitation program is quite conditional. Depending on the situation and condition of patients, adjustments are made. But the general direction and nature of the impact must be maintained.

Conflict of interests

The authors declare there are no competing interests.

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Indicators of speed and strength abilities of young fencers 12-13 years old

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Author contributions: A - Study design; B - Data collection; C - Qualitative analysis; D - Manuscript preparation; E - Funds Collection

Abstract

Background and Study Aim The health of a young athlete in the early stages of training is a mandatory element of the training process. This is a guarantee of the integrity of the process of training athletes for the next stage of preliminary basic training. The purpose of the study is to determine the indicators of speed and strength qualities of young fencers 12-13 years old at the stage of initial training.

Material and Methods Fencers (n=13, age – 12-13 years, sports experience – 3 years) took part in the study. The children's parents agreed to participate in the study. The following tests were used: speed of overcoming the distance of 14 meters by fencing steps forward in the on-guard position, seconds; speed of overcoming distance of 14 meters by fencing steps back in the on-guard position, seconds; hits on the target in 10 seconds, the number of times; "Standing Long Jump Test", cm; "Vertical Jump Test", sm. The computer program Excel was used: the indicators of arithmetic mean and standard deviation were determined. Correlation analysis was performed to identify relationships between the results of athletes' control standards. Statistical reliability was determined by Student's t test.

Results A sufficient level of development of speed and strength abilities for fencers of this age and qualification has been established. The relationship between the speed and strength of the muscles of the upper and lower extremities in young fencers was observed.

Conclusions The selected content and load of athletes fully meet the objectives of training. This is emphasized by the steady development of speed and strength abilities of athletes during fencing.

Keywords: level of development, specific movements, health.

Introduction

Fencing is not only a rapid change of position and well-coordinated movements of the dominant hand, but also fast movements and good physical training. These elements are required to perform technical and tactical techniques and achieve high sports results. In humans, the ability to speed is laid down genetically. The speed and mobility of nervous processes in 12-13 year old athletes reaches the level of an adult. Therefore, the improvement of speed and power qualities is an important factor in achieving a high level of capabilities in the most favorable periods of age development of the organism.

Another important component of the content of training in the initial stages of training is to take into account the level of load and their impact on the health of young athletes. Chacon-Cuberos et al. [1] believe that exercise for school-age children should be with adequate parameters of volume and intensity of physical activity. Calvo-Munoz et al. [2] recommend the introduction of observation periods and rigorous methods that take into account the duration of physical activity and physical performance of each subject. Another study evaluated the reactions of the

cardiorespiratory functional system of boys aged 7-9 years when performing exercises in a wide range [3]. The authors attach special importance to the scientific substantiation of the normalization of children's motor activity. It is also noted that it is necessary to take into account the peculiarities of functional changes in the body of children when performing dosed muscle work. Seisenbekov et al. [4] calculated values of morphofunctional indicators for age groups used in sports practice as criteria for assessing the physical condition of athletes. Another study [5] recommends taking into account the level of individual somatic health of children, which leads to a safe zone of intense physical activity.

Improving the system of training young fencers requires finding and justifying new forms of organization of the training process on the basis of modern scientific achievements. Physical training in fencing is one of the most important components of sports training. It depends on a quick start, maneuvering on the fencing track, a long wait for a successful moment of attack and the ability to immediately make the right decisions.

Shubert [6] argues that the basis for improving athletic skills is the proper level of physical fitness of fencers. The better the health of the fencer, the more advanced the musculoskeletal system, the

more opportunities open up for him in mastering complex fencing movements. Of particular importance is the level of development of speed and power qualities. The author emphasizes that the athlete gains even more confidence in their abilities during the training process and participation in responsible competitions.

Some experts [7-9] recommend in the training of athletes to follow certain approaches to the development of speed and strength. The authors recommend the use of local exercises. This makes it possible to increase the level of development of a particular muscle group. This often increases the volume of muscle fibers. According to Pitin [10], the role of muscle diameter in fencing is small. The author notes that the level of manifestation of speed force depends on the degree of mastery of movements: the higher the technique of movement, the more effective intermuscular and intramuscular coordination, more rational dynamic, spatial and temporal characteristics of movement.

Effective work on the development of speed force is associated with the integrated use of various methods, means of strength training, simulators, special equipment. An experienced coach relies on practical knowledge. He finds certain means of training athletes that are best suited for each individual. But at any stage of improving speed and strength qualities it is necessary to follow the recommended sequence and intensity of exercises.

According to Kriventsova [8], training at least 6 hours a week is an important condition for success. The authors note the need for proper assembly of sets of exercises, which will increase the percentage of efficiency of the athlete.

In the above aspects, it is important to: adjust the training process; identify shortcomings in the development of physical and psychological qualities of athletes. All this helps the coach to implement routine testing in training in accordance with the programs of children's and youth sports schools [11].

The purpose of the study is to determine the indicators of speed and strength qualities of young fencers 12-13 years old at the stage of initial training.

Material and methods

Participants.

Fencers (n = 13, age - 12-13 years) took part in the study. All athletes had 3 years of sports experience. The children's parents agreed to participate in the study. This study was approved by the University's Bioethics Committee and conducted in accordance with the Declaration of Helsinki.

Research design.

Classes in the group were conducted in

accordance with the curriculum of sports schools [11]. The main tasks of the training process: health promotion, development of physical qualities, learning the basics of fencing techniques and tactics. Weekly lesson plan: 5 lessons of 2 hours – that is 10 hours per week and 508 training hours per year.

Testing of physical abilities was conducted after a warm-up for two days at the end of the school year.

The following tests were used:

- "Steps forward" - the speed of overcoming the distance of 14 meters fencing steps forward in the on-guard position, seconds (fig 1);

- "Steps backward" - the speed of overcoming the distance of 14 meters fencing steps back in the on-guard position, seconds;

- "Hit the target" in 10 seconds, number of times (fig. 2);

- "Standing Long Jump Test", cm (fig. 3);

- "Vertical Jump Test", sm (fig. 4).

Statistical analysis.

The computer program Excel was used: the indicators of arithmetic mean and standard deviation were determined. Correlation analysis was performed to identify relationships between the results of athletes' control standards. Statistical reliability was determined by Student's t test.

Results

The results of tests of fencing in comparison with the control requirements of the curriculum [3] are shown in Table 1. It was found that the results of athletes were at a high level and corresponded to the results of transferring athletes to the next group of basic training.

It should be emphasized that the difference in the result of overcoming the distance of 14 meters in the fighting stance steps forward and backward had no statistical significance ($t = 1.89$ at $p > 0.05$). This fact may be evidence of the uniform mastery of athletes in these movements on the track.

Table 2 shows that there is a high degree of positive relationship between forward and backward indicators ($r = 0.91$). The results of the "Vertical Jump Test" and the "Standing Long Jump Test" showed a medium degree of correlation ($r = 0.89$). Between the results of tests with jumps ("Vertical Jump Test", "Standing Long Jump Test") and the results of tests with steps ("Steps forward", "Steps back") traced the average degree of relationship ($r = -0.42 - -0.88$). There is a medium to a high degree of correlation between the "Hit the Target" tests and the results of the step tests ("Steps Forward", "Steps Backward") ($r = -0.74, -0.95$, respectively). A close and medium degree of correlation ($r = 0.94, 0.72$, respectively) was established between the "Hit the Target" and the "Vertical Jump Test" and the "Standing Long Jump Test".

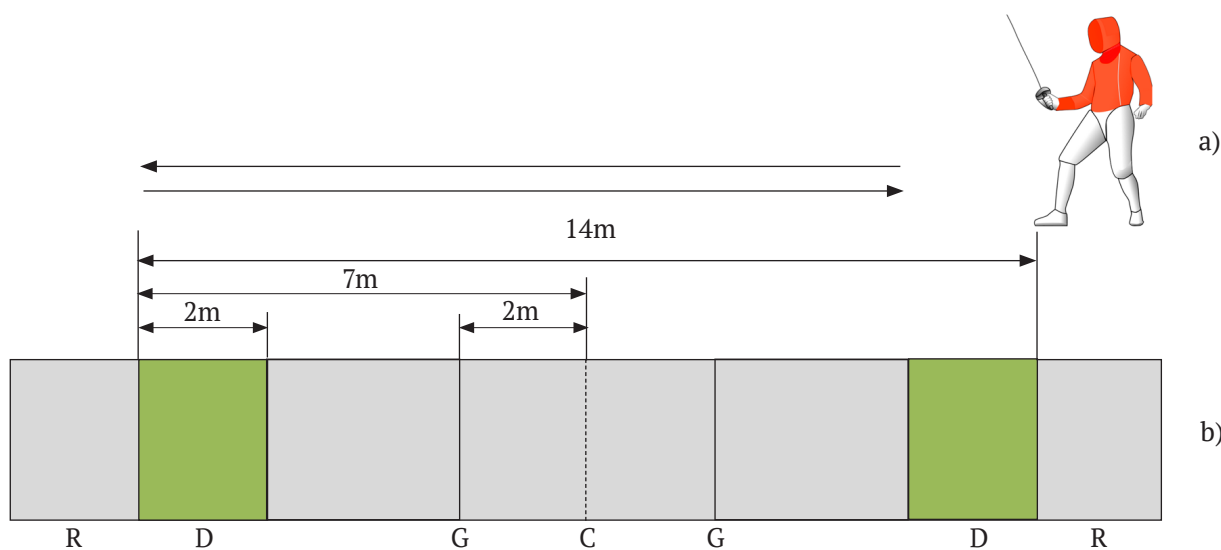


Figure 1. a) Targets (shaded areas) and on-guard position [12]; b) Fencing strip: C = center line; G - guard line; D = last two meters zone.

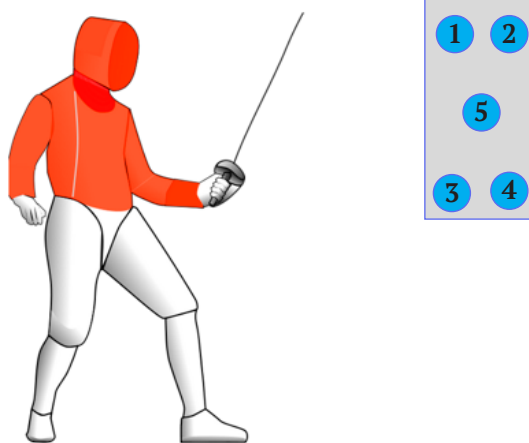


Figure 2. “Hit the target“ in 10 sec., number of times: a) on-guard position [12]; b) Target.

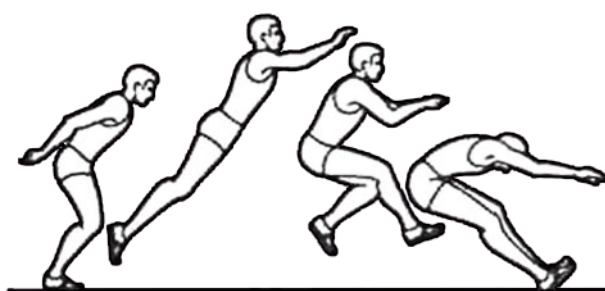


Figure 3. Standing Long Jump Test [13]



Figure 4. Vertical Jump Test [14]

Table 1. Indicators of speed and power abilities of fencers aged 12-13 years (n = 13)

Statistical indicators	Tests				
	Steps forward, sec.	Steps backward, sec.	Hit the target», number of times	Standing Long Jump Test, sm	Vertical Jump Test, sm
\bar{X}	4.95	5.87	50.75	176.25	34.25
σ	0.90	1.43	2.75	30.90	6.08

Table 2. Correlations of speed and power abilities of young saber players

Indicators	Standing Long Jump Test, sm	Vertical Jump Test, sm	Steps forward, sec.	Steps backward, sec.	«Hit the target» in 10 seconds, number of times
Standing Long Jump Test, sm	-				
Vertical Jump Test, sm	0.899	-			
Steps forward, sec.	-0.697	-0.427	-		
Steps backward, sec.	-0.885	-0.607	0.909	-	
«Hit the target» in 10 seconds, number of times	0.948	0.722	-0.747	-0.954	-

Discussion

Many authors point out the important role of individual physical abilities for fencers. Poliszczuk et al. [15] emphasize the importance of developing a speed of response to both auditory and visual stimuli. Norjali et al. [16] focuses on the study of motor coordination in athletes of different qualifications. Şahin et al. [17] indicate that aerobic and anaerobic abilities of athletes, lower body flexibility, reaction speed and coordination skills play an important role in fencing. Petronijevic et al. [18] emphasizes the role of speed in the work of the fencer's hands. Turner et al. [19] substantiate the need for fencers to develop strength and coordination skills. The authors recommend explosive training. Pavel et al. [20] reveal close correlations between the level of development of physical qualities of fencers and their technical and tactical skills. We fully agree with the above recommendations of the authors regarding the areas of decision-making control over the development of physical qualities of fencers.

Şahin et al. [17], Turner [21] confirm the relevance of assessing the level of development of individual physical abilities of fencers for effective and timely correction of the training process. We agree with the authors and therefore this fact is made in the preconditions of our study.

Turner et al. [19] emphasize that in fencing, the analysis of the training of athletes must be conducted taking into account the requirements of competitive activities. The authors recommend assembling test batteries and systematically determining the various aspects of fencing training. The same view is shared by Weichenberger et al. [22]. The authors propose a

new test to determine the endurance of fencers. The need to emphasize that tests to assess the physical abilities of athletes must be clearly consistent with the specifics of competitive activities.

The results of the "Standing Long Jump Test" in our study are similar in value to the results of other authors [16, 23]. The authors also point out that timely determination of fencing strength will make it easier for the coach to identify the most trained athletes.

Şahin et al. [17] give quantitative values of vertical jumps of Turkish fencers aged 12-13 years lower than those obtained by us. It should be noted that in the author's study there was no distribution of the contingent of the study by gender of a certain age. Therefore, we can assume that taking into account the gender of athletes, the results will be similar to the results of our study.

Conclusions

The selected content and load of athletes fully meet the objectives of training. This fact is emphasized by the steady development of speed and strength abilities of athletes during training. High correlations between the results of individual test exercises allow us to recommend reducing the number of test exercises in subsequent studies. So, it will be enough to choose one test: steps on the track in the battle post forward or backward; jump up from a place or long jump from a place.

Conflict of interests

The authors declare there are no competing interests.

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Jump serve performed by volleyball players of different qualifications

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Author contributions: A - Study design; B - Data collection; C - Qualitative analysis; D - Manuscript preparation; E - Funds Collection

Abstract

Background and Study Aim An important component of volleyball competitive activity is to obtain statistics on the performance of the jump serve. This allows the coach to decide on the appropriateness of its use in different moments of the game to obtain optimal results. The purpose of the work is to determine the indicators of the effectiveness of jump serve by volleyball players of student teams.

Material and Methods The analysis of statistical data obtained as a result of pedagogical observations of the performance of jump serve. Volleyball players (aged 17-21 years) were monitored during the competitions. 8 games with the total number of jump serve 410 were selected for analysis.

Results The corresponding indicators of efficiency of jump serve depending on number of a zone of a playground are defined. The efficiency of serve and different zones was the following: in zone 1 - 34.9%; in zone 5 - 31.1%; in zone 6 - 23.6%. Zones 1 and 5 have been determined to be the most vulnerable to the opponent's defensive actions in the jump serve. It was shown that the jump serve significantly reduces the chances of the opponent to attack effectively.

Conclusions The results can be used to solve the problem of improving the efficiency of jump serve in the training and competitive activities of student teams. It is recommended to use the jump serve in the first two games, when its effectiveness reaches its maximum values. It is also recommended to direct such a serve to the playground zones 1 and 5. It is necessary to find ways to improve the technique and accuracy of the jump serve and increase its efficiency in competitive activities.

Keywords: pedagogical observations, set, zone, competitive activity, playground.

Introduction

In modern volleyball, the serve is used as an effective means of attack, with which you can immediately gain a point or complicate the preparation of tactical combinations in the attack of the opposing team [1-6]. In recent years, a clear trend in the development of volleyball is the desire to widely use in the game of jump serve. The number of volleyball players who perfectly master this serve is constantly growing [7-9].

Thanks to the jump serve, the game gathers a large number of volleyball fans and makes it more exciting and emotional. This presentation can change the dynamics of the match. At high efficiency of jump serve the opponent does not have an opportunity to use fast attacks of teammates [10, 11].

At the same time, jump serve is a very risky type of attack. Achieving stability in the performance of the jump serve is incredibly difficult. Performing this serve requires considerable physical effort and can reduce the effectiveness of athletes during a difficult and protracted match. This technical element has the highest error rate than any other feed. Unsuccessful execution of this serve can lead to a decrease in the emotional mood of the player and reduce his/her ability to perform other technical elements [12, 13].

Therefore, technical and tactical improvement of the jump serve, increasing its efficiency is one of the main reserves for improving the effectiveness of competitive activities of volleyball players. A number of authors have studied this issue [3, 8, 14, 15]. It has been shown that not all players can make effective jump serve. This is especially evident against the background of fatigue and at the end of the set.

Previous studies [1] proposed a method for assessing the effectiveness and quality of serves in volleyball. The technique is based on mathematical processing using the theory of probability of data of pedagogical observations during the game. It is shown that: the quality of the jump serve is almost 2 times higher than the quality of the targeted supply; the efficiency of these feeds is quite high – more than 32%; the tendency to decrease the efficiency of the jump serve with each subsequent game is revealed; the efficiency of the targeted serve is at about the same level. Other studies [16, 17] conducted a detailed analysis of the performance of jump serve and targeted serve, which were obtained during the competitive activities of experienced volleyball players.

Shl'ons'ka [18] presents the results of a study of the jump serve of the teams of the World League and Super League of Ukraine. Volume and efficiency indicators were calculated. It was found that in the teams of the World League the most effective is the

jump serve with an efficiency of 32.7%. In the teams of the Ukrainian Super League, the efficiency of jump serve is 16.2%. It is noted that the teams of the Ukrainian Super League are significantly behind the teams of the World League in terms of volume and efficiency. It is also noted that the use of jump serve greatly facilitates the organization of technical and tactical actions of players after successful simple defensive actions of the opponent.

Gamaliy and Shl'ons'ka [19] found that the jump serve on the model indicators is used in 51.6% of cases: Jump Float Serve (target) - 21.7%; Jump Float Serve (shortened) - 4.4%. Attacks from the back line of the site, according to model indicators, are used in the amount of 20.8%. Their efficiency is 13.7%. It is proved that the indicators of technical and tactical actions in the attack can be used as models in the management system of training and competitive process of experienced volleyball players.

Artemenko [20] found that the distribution of jump and tactical serves in Ukrainian teams is almost the same. Tactical «jump float serve» serves have a slight advantage - 59.7% against 40.3%. The strongest teams in the world use jump serve much more often (72.5%) than jump float serve (tactical, 27.5%). This indicates the need to pay special attention to the use of force in the training process and in the game. The world's leading teams use jump serve much more often, which indicates the strength of world volleyball.

The purpose of the study is to determine the indicators of the effectiveness of the performance of power in the jump by students-volleyball players in competitive activities.

Material and Methods

Participants.

Pedagogical observations were conducted on the student team during the 8 games of the 2020-2021 championship. Indicators of jump serve performance were studied. Age of volleyball players - 18-21 years. The total number of jump serve by the appropriate team is 410.

Research design.

The corresponding protocol was filled in pedagogical supervision. The protocol used a special

system of conditionally coded recording, which captures the relevant information: player; in which zone the serve is directed; with what result the jump serve is executed. A seven-point rating scale (0 to 6) was used to analyze the feed efficiency. Each score corresponds to its coefficient of the corresponding game action. Research of efficiency of serve is carried out in the given work on the basis of a technique which is presented in works [3, 5]. The method is based on mathematical processing of statistical data obtained during pedagogical observations.

Statistical analysis.

Statistical analysis was performed using the MS Excel license package. The indicators were determined: arithmetic mean (\bar{x}) and standard deviation (σ).

Results

Indicators of efficiency of jump serve depending on number of a zone of a playground in which volleyball players most often performed jump serve are defined. Each set with numbers from 1 to 5 was also registered (Table 1).

Zones 1 and 5 are the most vulnerable to the defensive actions of the opponent during the jump serve. There is a tendency to reduce the efficiency of the service with each subsequent set. Its most effective use is in the first two games, when players are not yet tired and emotionally exhausted.

Discussion

The data obtained by us confirm and supplement the results of previous studies [3, 5] concerning experienced volleyball players. There is a tendency to reduce the efficiency of the corresponding filing with each subsequent set. We agree with other authors [3, 5] that increasing the efficiency of the feed in the jump serve will significantly affect the final result of the game. Therefore, it is necessary to find ways to improve the technique and accuracy of the jump serve and increase its efficiency in competitive activities.

Badami [21] investigated the influence of feedback type on students' intrinsic motivation and volleyball training. The authors note that «The effect of personality type on acquisition and intrinsic motivation was significant.» In our opinion, this

Table 1. Indicators of the effectiveness of jump serve in accordance with the zone of the playground and the game number (n = 8)

The effectiveness of jump serve							
Zone of a playground			Number of set				
Zone 1	Zone 6	Zone 5	Party 1	Party 2	Party 3	Party 4	Party 5
$\bar{x} \pm s$			$\bar{X} \pm s$				
34.86±1.7	23.63±1.27	31.11±2.22	36.31±1.30	35.13±1.95	30.21±2.67	26.44±2.09	23.34±1.20

approach should be used in the training of volleyball students.

Barzouka et al. [22] investigated current trends in serve skills for each of the high-level volleyball players' roles. The authors evaluated the actions of elite players in 20 volleyball matches of the final phase of the 2018 World League. Also highlight the main preferences that players choose when serve. In our research, student volleyball players follow a similar pattern. However, the performance of the serve is significantly lower than the teams of the 2018 World League.

Hunchenko et al. [23] determined the influence of the components of special physical training on the effectiveness of individual elements of the game technique in competitive activities. The use of the author's program allowed to significantly increase the number of jump serve. Lima et al. [24] studied the speed of the ball and the speed of the hand when perform the jump serve. We also compared the results between the game positions. The research was conducted with the participation of young elite volleyball players from the French national team. The results show that players reduce their variability in the result. Palao et al. [25] determined the influence of the method of admission on the effectiveness of admission in volleyball among men. The authors argue that the jump serve was the type of serve that most limited the actions of the opponent's players. Another study [26] noted a high degree of reliability

of the jump height during jump serve, which affects the quality of the feed itself. Our research has also shown that the jump serve significantly reduces the opponent's chances of an effective attack.

In study by Vargaset al. [27] fifteen matches between the six national teams (Japan, Brazil, China, Belgium, Turkey and Russia) participating in the 2014 Women's World Volleyball Grand Prix final were analyzed. A total of 56 sets and 7,176 ball possession situations. We followed similar recommendations for the organization of our study. This approach allowed us to obtain reliable results.

Conclusions

The results can be used to solve the problem of improving the efficiency of jump serve in the training and competitive activities of student teams. It is recommended to use the jump serve in the first two games, when its effectiveness reaches its maximum values. It is also recommended to direct such a jump serve to the playground zones 1 and 5.

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Conflict of interest

The authors declare no conflict of interest.

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