Original Article

The use of special exercises in the preparatory period of skiers

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ABSTRACT

Background

Recently, there has been a tendency to decrease the results of domestic skiers, in order to solve this problem, it is necessary to change the training approach in the preparatory period before the competition.

The purpose of the study

Improving the physical fitness of skiers using special training tools.

Materials and methods

In the Russian Federation, a pedagogical experiment was conducted in the village of Korshik. It was attended by teenagers aged 13-14 who were engaged in cross-country skiing. A total of 40 children participated (20-control and 20-experimental groups). The difference between the experimental group was the use of special exercises at the preparatory stage of training. The study used control standards that show the level of physical qualities, such as pull-ups, squats, long jumps, simulated 100m lifting and 500m running.

Results

The children from the experimental group significantly improved their performance in the pull-up test (22.2%; $p<0.05$), squats (5.9%; $p<0.05$), long jumps on two legs (6.8%; $p<0.05$), 100-simulated lifting per meter (7.8%; $p<0.05$) and running at 500 meters (4.2 %, $p<0.05$). At the same time, children from the control group were unable to show significant improvements in physical fitness ($p>0.05$).

Conclusión

During the preparatory period of ski racers, it is recommended to include special exercises that will significantly increase the level of physical qualities.

Keywords

Sportsmen, Snow sports, Simulation Training, Physical fitness.

INTRODUCTION

The Olympic Games most often reflect the level of higher achievements in the country. Over the past 20 years, the number of gold medals won by Russian skiers at the Olympic Games has been decreasing[1,2]. It can be concluded that the training process does not meet the modern requirements for ski racers. To correct this situation, close attention should be paid to the problem of preparing reserves. The world's modern achievements in cross-country skiing today are so great that without systematic training from a young age, one cannot count on the high performance of an athlete in adulthood. Therefore, the issues of training young ski racers are currently among the most relevant in sports training[3,4,5].

The most important thing in the preparation of a ski racer is the preparatory period. During this period, the foundation for future achievements in the competitive period is laid. The foundation of success in competitions is a large amount of load that falls on the development of physical qualities, increasing functional fitness, improving the technique of methods of movement on skis, where a purposeful choice of the method of dosing physical activity can contribute to improving the effectiveness of training, and in the future – competitive activities. The preparatory period in the training of a ski racer is divided into three stages[6,7,8]:

Spring-summer (May to August). Gradual increase in the level of general physical fitness. Much attention is paid to the development of

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physical qualities, as well as mastering or improving the elements of technology.

Summer-autumn (September to November). The training is mainly aimed at developing special endurance, improving moral and volitional readiness, creating prerequisites for improving the technique of movement on skis. The total amount of training load continues to gradually increase, and the intensity of performing cyclic exercises is also increasing. The main means are cross–country, mixed movement (alternating running on the plain and descents with overcoming ascents by simulating alternating two-step running with ski poles), imitation of hand movements in alternating and simultaneous moves on training devices.

The 3rd stage is winter (the period of performance in competitions on snow). The control stage. It is advisable to conduct classes on several standard training circles of different lengths, differing in the nature and complexity of the terrain. This increases the efficiency of the training process, since there is no need to spend time on the selection and preparation of tracks, it is easier to control and regulate the load of athletes.

The exact choice of exercises during training and training largely determines the effectiveness of long-term training at all its stages. Simulation exercises can be used both to improve a single element of the technique, and for several elements in a bundle[9]. During the training of ski racers, imitation of alternating two-step ascents with and without sticks in combination with running on the plain and descents is widely used. The imitation of an alternating two-step course has four varieties: specialized walking, walking, jumping, running imitation[10,11,12,13].

At the beginning of the preparatory period, simulation exercises used in a small volume are used as a means of teaching and improving the elements of the technique. In autumn, the volume and intensity of these exercises increase, and they contribute to the development of special qualities. The complex or selective use of special preparatory exercises in snowless time ensures the development of special physical qualities and the formation of variably stable, reliable motor skills when moving in conditions of competitive activity of athletes[10,11,12,13].

Materials and methods

Study based on the ‘’Transparent Reporting of Evaluations with Non-Randomized Designs’’[14]. The protocol was approved by the ethics committee of the Vyatka University (Russia), while the participants being authorized by the parent or legal guardian through an informed consent in accordance with the ethical standards established in the Declaration of Helsinki[15].

Participants

The study was conducted based on a sports school in the village of Korshik (Kirov region, Russia). The experiment involved boys aged 13 - 14 years, engaged in cross-country skiing, who formed a control group (n=20) and an experimental group (n=20). The eligibility criteria were as follows.

INCLUSION CRITERIA:

- Boys ages of 13-14 years who attend Sports School in the Village of Korshik (Russia).
- Boys who do not present acute or chronic diseases that prevent them from participating in the experiment.
- Boys who cross-country skiing regularly at least 3 times a week.

EXCLUSION CRITERIA:

- Children who did not agree to participate in the experiment if their parent or legal guardian did not sign the informed consent.

Organization of the study

The control group classes were carried out according to the usual training plan [16], while the experimental group was subjected to classes that incorporated simulation exercises aimed at improving physical condition in the preparatory period. Classes were held 5 times a week. They were given 20 minutes out of the 90-minute training session. Basically, uniform and circular training methods were used. The first stage of the preparatory period (May 1 to July 31 of the 2022). At this stage, the following simulation exercises were applied to develop strength resistance:

- Imitation of hand movements of an alternating two-step stroke with a rubber shock absorber.
- Simulation of simultaneous one-step hand movements with a rubber shock absorber.
- Simulation of simultaneous stepless running with a rubber shock absorber.
- Changing the position of the legs with a load of 5 kg.
- Walking with resistance.

The second stage of the preparatory period (August 1 to November 1 of the 2022). At this stage, the following simulation exercises development of high-speed and high-speed strength endurance, maintaining the level of strength endurance.

- Jumping on one leg with an imitation of the work of the hands as in an alternating two-step course.
- Multiple jumps from foot to foot with strong and fast repulsion and flight.
- Jumping simulation of a simultaneous one-step move.
- Put the legs under the trunk and pushing off with the supporting leg.
- Squatting on the supporting leg and pushing away with the body moving sideways – forward.
- Simulation of a simultaneous one-step move on the spot.
- Simulation of simultaneous two-step movement in motion.
- Jumping - multi-jumps from foot to foot from side to side.
- Jumping simulation with ski poles.
- Overcoming the height by means of a jumping simulation of an alternating two-step move with sticks.

The following methods were used to develop high - speed endurance:

- Variable method: 3 - 4 accelerations of 1 km. The ascents are overcome by a jumping imitation of an alternating two-step move with sticks.
- Repeated method: repeated overcoming of climbs of various steepness by jumping imitation with sticks.
- Repeated method: running 2-3 segments equal to 1/2 or 1/3 of the competitive distance with an intensity of 90-100% of the maximum. The ascents are overcome by a jumping imitation of an alternating two-step move with sticks. Rest between runs is at least 4-6 minutes.

Variable

- Strength endurance: The strength endurance was assessed through the pull-up and squat tests. The pull-up consisted subjects were instructed to use an overhand grip with hands placed slightly wider than the shoulder width. Each repetition would begin at a dead hang (elbows fully extended, shoulders fully flexed, and shoulder girdle elevated) with legs placed behind the body, ankles crossed, and knees flexed. Once in the correct starting position, subjects were to perform the concentric phase of the pull-up explosively, without swinging or kicking the legs. The concentric phase ended once the subjects chin passed the pull-up bar. Immediately after the concentric phase was completed, subjects were instructed to perform the eccentric phase of lowering their body back to the starting position at a comfortable speed[17]. The full squats for 1 minute consisder subjects were instructed to descend until the back of the thighs and calves made contact with each other, or when the angle of the lumbar spine equaled 0°, repeating the movement for 1 minute[18].
- Speed and strength endurance: The speed and strength endurance were assessed through the long jump two legs test. This consisted were instructed to flex their knees while moving their arms back and forth with a strong push, then jump forward as far as possible, assisting with both arms and trying to land on the floor with feet together, without losing the equilibrium for proceeding to measure the distance[19].
- Develop high - speed endurance: The develop high - speed endurance was assessed through the simulated 100-meter climb and 500-meter run tests. The simulated 100-meter climb consider standardized instructions were given for the 100-meter climb with 7 degrees of incline, the result being expressed in seconds[20]. The 500-meter run test consider standardized instructions were given on the 500-meter race. Subjects were instructed to run as fast as possible for 500 meters for measurement the time in seconds[21].

Allocation method

Each subject was assigned to an experimental group or a control group in a non-probabilistic way, this designation being made by pairing in two groups of equivalent size. In such a way that each group was made up of 20 boys.

Analysis unit

Groups of boys were considered the lowest administrative unit used to assess the effects of the intervention. This consists of the comparison of pull-up, squats for 1 min, long jump from a place, simulated 100-meter climb and 500-meter run test.

Analysis of data

The data were analyzed with the statistical software IBM SPSS Statistics version 27.0 for Windows operating system. The normality of the data distribution was determined using the Shapiro-Wilk test and the homogeneity of the variances using the Levene test, with the data reflected through the descriptors of central tendency and dispersion, mean and standard deviation. The differences between groups were determined with the T Student test considering for all the analyzes an alpha level of 0.05.

RESULTS

The analysis of the initial data showed that there were no statistically significant differences between the control and experimental groups in any of the five indicators (p>0.05). This indicates the relative homogeneity of the groups at the beginning of the experiment (Table 1).

Table 1. Comparison of physical fitness indicators of the control and experimental groups at the beginning of the experiment

Indicators	Control group (n=20) M ± m	Experimental group (n=20) M ± m	t	p
Pull-up on a high crossbar (number of times)	14,3±1,08	15,8±0,97	1,03	>0,05
Number of squats per 1 min.	60,3±0,76	61,1±0,97	0,65	>0,05
Long jump from a standing position (cm)	212,3±3,03	213,4±4,33	0,21	>0,05
Jump simulation of a 100 m ascent in 7° (sec)	25,8±0,32	25,5±0,54	0,48	>0,05
Running 500 m (sec)	97,2±0,65	97,3±0,97	0,09	>0,05

Comparison of the results of the control and experimental groups at the beginning of the experiment showed that with the number of degrees of freedom d = 18, we obtained a value of t > 0.05 for all five tests. This result is considered unreliable, and the difference between the arithmetic averages in the groups is random. Based on this, it can be argued that the groups at the beginning of the experiment are almost equal and a pedagogical experiment can be conducted between them.

The difference in the results in pulling up on a high crossbar between the control and experimental groups is 1.5 times, at t = 1.03. The difference is unreliable (p>0.05).

In squats for 1 minute, the difference between the groups is 0.8 times, at t=0.65. The differences are unreliable (p>0.05).

The difference in the results in the long jump from a place between the groups is 1.1 cm, at t = 0.21. The differences are unreliable (p>0.05).

The jump simulation of a 100 m ascent in 7° was measured in seconds, the intergroup difference was 0.3 seconds, at t=0.48. The differences are unreliable (p>0.05).

The difference in performance between the groups in the 500 m run is 0.1 sec, at t = 0.09. The differences are unreliable (p>0.05).

Repeated testing revealed positive dynamics in the development of physical fitness, both in the control group and in the experimental one. However, the increase in results in these groups is different.

Comparing the physical fitness indicators of the control group at the beginning and at the end of the experiment, we observe the following results (Table 2).

Table 2. Comparison of physical fitness indicators of the control group at the beginning and at the end of the experiment (n=20)

Indicators	The beginning of the experiment M ± m	End of the experiment M ± m	t	p
Pull-up on a high crossbar (number of times)	14,3±1,08	16,2±0,77	1,43	>0,05
Number of squats per 1 min.	60,3±0,76	62±0,54	1,83	>0,05
Long jump from a standing position (cm)	212,3±3,03	218,2±2,49	1,51	>0,05
Jump simulation of a 100 m ascent in 7° (sec)	25,8±0,32	25,1±0,43	1,32	>0,05
Running 500 m (sec)	97,2±0,65	96,6±0,86	0,56	>0,05

Comparison of the results at the beginning and end of the experiment in the control group showed that t > 0.05 for all five tests. This result is considered unreliable,

and the difference between the arithmetic averages in the group at different control stages is random. Based on this, it can be argued that we observe a slight increase in physical fitness indicators in the control group at the end of the experiment in relation to the initial measurement results when using the usual set of exercises in training sessions.

The difference in the results in pulling up on a high crossbar at the beginning and at the end of the experiment is 1.9 times, at t = 1.43. The difference is unreliable (p>0.05).

Squats in 1 minute – in this test, the difference is 1.7 times, at t= 1.83. The differences are unreliable (p>0.05).

The difference in the results in the long jump from a standing position is 5.9 cm, at t=1.51. The differences are unreliable (p>0.05).

The jump simulation of a 100 m ascent in 7 °, the intra-group difference is 0.7 seconds, at t = 1.32. The differences are unreliable (p>0.05).

Differences in speed endurance indicators in the 500 m run are also unreliable, the difference is 0.6 seconds, t=0.56, (p>0.05).

When comparing the initial and final results in the experimental group, we observe an increase in various types of physical fitness as a result of the application of a set of exercises developed by us based on the use of simulation exercises. The results of the experiment are presented in Table 3.

A comparison of the results at the beginning and end of the experiment in the experimental group showed that with the number of degrees of freedom d =18, we obtained a value of t <0.05 for all tests. This indicator is considered reliable. Based on this, it can be argued that the dynamics of increasing physical fitness in the experimental group when using the developed set of exercises is higher than in the control group.

The difference in the results in pulling up on a high crossbar at the beginning and at the end of the experiment is 3.5 times, at t = 2.41. The differences are significant (p<0.05).

In squats for 1 minute, the difference in indicators was 3.6 times, with t = 2.77. The differences are significant (p<0.05).

The difference in the results in the long jump from a standing position is 14.6 cm, at t= 2.86. The differences are significant (p<0.05).

Table 3. Comparison of indicators of physical fitness of the experimental group at the beginning and at the end of the experiment (n=20)

Indicators	The beginning of the experiment M ± m	End of the experiment M ± m	t	p
Pull-up on a high crossbar (number of times)	15,8±0,97	19,3±1,08	2,41	<0,05
Number of squats per 1 min.	61,1±0,97	64,7±0,87	2,77	<0,05
Long jump from a standing position (cm)	213,4±4,33	228±2,7	2,86	<0,05
Jump simulation of a 100 m ascent in 7° (sec)	25,5±0,54	23,5±0,43	2,9	<0,05
Running 500 m (sec)	97,3±0,97	93,2±1,08	2,83	<0,05

Jumping simulation of a 100 m ascent in 7°, intra–group difference is 2 seconds, at t=2.9. The differences are significant (p<0.05).

Differences in indicators in the 500 m run are also significant, the difference is 4.1 seconds, t=2.83, (p<0.05) Table

4 presents a comparative analysis of the average group indicators of physical fitness of the control and experimental groups at the end of the experiment.

Table 4. Comparison of physical fitness indicators of the control and experimental groups at the end of the experiment

Indicators	Control group (n=20) M ± m	Experimental group (n=20) M ± m	t	p
Pull-up on a high crossbar (number of times)	16,2±0,77	19,3±1,08	2,33	<0,05
Number of squats per 1 min.	62±0,54	64,7±0,87	2,57	<0,05
Long jump from a standing position (cm)	218,2±2,49	228±2,7	2,67	<0,05
Jump simulation of a 100 m ascent in 7° (sec)	25,1±0,43	23,5±0,43	2,67	<0,05
Running 500 m (sec)	96,6±0,86	93,2±1,08	2,7	<0,05

The difference in the results in pulling up on a high crossbar between the control and experimental groups was 3.1 times, at t= 2.33. The differences are significant ($p<0.05$).

Squats in 1 minute – in this test, the difference is 2.7 times, at t=2.57. The differences are significant ($p<0.05$).

The difference in the results in the long jump from a place between the groups is 9.8 cm, at t=2.67. The differences are significant ($p<0.05$).

A jumping simulation of a 100 m ascent in 7°, an intergroup difference of 1.6 seconds, at t= 2.67. The differences are significant ($p<0.05$).

The difference in indicators between the groups in the 500 m run is 3.4 seconds, at t= 2.7. The differences are significant ($p<0.05$).

A comparison of the results at the end of the experiment in the control and experimental groups showed that with the number of degrees of freedom d = 18, we obtained significant differences ($p<0.05$) for all five tests. Based on this, it can be argued that the set of exercises we have developed is effective for improving physical fitness.

Thus, the developed set of exercises based on the use of simulation exercises has a positive effect on improving the physical fitness of ski racers aged 13-14 years. This suggests that this set of exercises is effective and is recommended for widespread use.

DISCUSSION

Analysis of literature sources has shown that in skiing, physical fitness is crucial for achieving athletic results and that when using simulation exercises, there is a positive transfer of physical qualities, since they are similar to skiing in terms of motor characteristics and the nature of the effort. Many authors consider it necessary to apply simulation exercises in each training session[9,10,11,12,13].

Thus, we saw that there is a problem in the training of skiers in sports schools, the solution to such a problem can be the development and implementation of a set of exercises that could improve the training process and results in sports schools, and in the future – the performance of high-level athletes. We have developed a set of exercises. It includes simulation exercises aimed at improving physical fitness. The set of exercises is the result of continuous pedagogical influence on athletes during the first and second stages of the preparatory period. Simulation exercises were included in each training session. They were given 20 minutes of the total time. The effectiveness of the use of the complex is proved by the following indicators obtained during the pedagogical experiment:

Thus, simulation exercises should be used in every training session. At the first stage of the preparatory period (May – July), mainly means that develop strength endurance should be used. At the second stage of the preparatory period (August – November), running with jumping simulation on ascents up to 100 m is more often used in the main part of classes.

All coaches in the world are looking for ways to improve the training process, not only teachers in sports schools, coaches, but also scientists, specialists who study different techniques and improve them are working on this[9,10,11,20,22], where in general we can observe that the ski training proposals have been oriented towards proposing changes to the standard training programs, emphasizing the specific training load together with the technical elements as fundamental links for injury prevention[23,24]. Of course, the methodology we have proposed cannot be ideal, probably in the future it can be supplemented with other data, but it has shown a significant positive result and can be applied in practical work in sports schools daily.

It should be noted that children's health is important[25,26,27]. At school age, it is necessary to engage in active physical activity in order to avoid problems with obesity and other diseases[28,29,30]. Unfortunately, every year we see fewer and fewer athletes in different sports competing with each other, despite the fact that the effectiveness of sports and training activities for health and physical development has been experimentally proven[31,32,33,34].

CONCLUSION

If, in the preparatory period, a set of simulation exercises is included in the training program for 13-14-year-old skiers, then the level of physical fitness of athletes will significantly improve.

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