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THE METHODOLOGY OF SPEED-POWER TRAINING OF YOUNG SPRINTERS OF 12-15 YEARS OLD IN AN ANNUAL MACROCYCLE

The analysis and generalization of scientific literature and sports practice data allows us to assert that the development of recommendations regarding the high-quality organization of physical culture classes with children of different ages is an urgent and practically significant problem of modern society.

The innovative methodology for the development of motional abilities of 11-13 years old boys was developed using the combined method and the circuit training method in a cycle of physical education classes, as well as using additional basic athletics exercises and the game method. The effectiveness of the developed methodology was tested in a molding experiment lasting three years. Classes in the control group were conducted on the basis of the curriculum, and in the experimental one using the developed innovative methodology based on the use of the combined method of development of motional abilities and the circuit method of training in the cycle of physical education classes, as well as using additional basic athletics exercises and the game method.

During the three years (grades 4-6) the dynamics in the following speed and speed-strength tests were recorded: long jump and triple standing jump, high jump standing, long jump with a running start, running 20 m with a maximum speed and running 30 m from a high start. It should be noted that the results in the presented tests considering boys of 10-13 years old in two groups are constantly increasing. However, these increases are uneven. Thus, for example, the greatest increase in the standing long jump among the trainees in the EG was recorded at the age from 10 to 11 years old (15 cm), and among the representatives of the CG the improvement was 8.0 cm. In general, over a three-year period, the shifts among those who practiced according to the innovative methodology in this test are 36.3 cm (20.4 %), and among their peers – 16.0 cm (10.0 %). Thus, it can be assumed that the increase in a standing jump, determined by the method, was 10.4 % (statistically significant at 5 % significance level). Moreover, the smallest increase is observed at the age of 12-13 years.

The results of testing the indices of motional abilities which were carried out according to the "Eurofit" testing system indicate that when conducting training sessions using the innovative methodology, the indices of motional conditions ($p<0.05$) of 11-13 years old boys increased statistically to a greater extent, in comparison to those involved in the control groups. Moreover, the statistically significant (for a 5 % significance level) fact is that the best results of boys of grades 4-6 in the experimental group were observed when estimating the increase in running and jumping exercises, as well as strength and speed-strength indicators of muscles, leg extensors in the knee and hip joints.

Key words: *methodology, strength characteristics, speed-strength abilities, indicators, athletics exercises: game method, 11-13 years old boys.*

Introduction. Nowadays, the success of sports training is determined not only by a successful choice of means and methods of training, but also, to a greater extent, by the ability to organize them in a certain system, which gives the maximal training effect in a minimal period of time (Борзов, 2000; Врублевский и Козьмин, 1983; Иссурин, 2016; Мирзоев и др., 2007; Платонов, 2004; Vrublevskiy и др., 2020). Such a system should provide a steady increase in the training impact of exercises, taking into account the level of preparedness of the athlete, the period and training tasks. Naturally, this can be done only by obtaining a clear understanding of the means used and the optimal conditions for their simultaneous and consistent combination in one training session in a weekly, annual and long-term training cycles.

At present, there has been accumulated a large methodological material on the use of various speed-strength exercises in training runners (Анпилогов и Врублевский, 2011; Врублевский, 2005; Гусинец и др., 2012; Костюченко и др., 2017; Маслаков и др., 2009; Озолин, 2010; Dasteridis и др., 2011). However, the problem of choosing rational means of speed-strength training, the peculiarities of their use in training with different representative groups of sprinters, did not receive a satisfactory substantiation and theoretical explanation. At the same time, it is increasingly postulated that the main means of developing speed-strength abilities used in the training process of sprinters are not always adequate in regards to the specific influences that arise during running at maximum speed, and the method of special strength training used is often far from the purposeful improvement of the musculoskeletal system of sprinters of various qualifications, capable of providing an effective growth of the sportsmanship (Бальсевич, 2000; Балахничев и Зеличенок, 2013; Верхошанский, 1988; Врублевский и Мирзоев, 2006; Врублевский и др., 2019; Костюкевич и др., 2017; Cissik, 2005).

In most cases, the recommendations concerning the systemic use of the means of speed-strength training are developed for the qualified athletes (Борзов, 2013; Врублевський и др., 2018; Гусинец и др., 2012; Козлова и Фахми, 2019; Vrublevskiy и др., 2018). However, the foundation of the highest skill is laid in the initial stages of training. And it is of primary importance how rationally the training of sprinters-beginners will be organized in various structural units of an annual training cycle (Борзов, 2013; Врублевский, 2016; Иссурин, 2016; Платонов, 2004; Vrublevskiy, 2019a; Wychowański, 2008). In addition, the methodological provisions prepared for qualified athletes quite often, without appropriate understanding, are extended to the educational and training process of young athletes.

The aim of the study was to determine the effectiveness of the methodology of training young sprinters in a one-year macrocycle with the use of outdoor games, sports games and game exercises.

Analysis of relevant research. The success of a special training in a particular sport is determined not only by a successful choice of means and methods of training, but also, to a greater extent, by the ability to organize the latter into a certain system, which gives the maximal training effect in a minimal period of time (Верхошанский, 1988; Врублевский, 2005; Мирзоев и др., 2007; Sannders, 2004; Vrublevskiy, 2019в). Moreover, such a system should ensure a steady increase in the training impact of exercises, taking into account both the period and objectives of training and the level of preparedness of a particular athlete (Платонов, 2004; Vrublevskiy, 2019c; Wychowański, 2008). It is not so easy to implement, since there is a vast necessity to know specifically both the effectiveness of the means used and the optimal conditions for their combination not only in a training session, but also in various structural units of an annual training cycle.

At the present stage of development of sports training of sprinters, the need for the effective principles of the connection of leading physical qualities that ensure an athlete's mastery is becoming more and more prominent. This problem is especially relevant in the training of young athletes. Thus, it has been noted that in the practice of training sprinters, there is a violation of long-term staging and excessive enthusiasm for highly directed training means and methods of performing exercises already at the initial stages of sports training (Анпилогов и Врублевский, 2011; Балахничев и Зеличенок, 2013; Vrublevskiy, 2019c). This especially leads to the premature implementation of the functional capabilities of young sprinters, their lack of progress when moving to the groups of juniors and adults (Козлова и Фахми, 2019; Яковлев и др., 2020). In our opinion, one of the most important reasons for this can be attributed to the lack of a unified approach among specialists to the orientation of the training process and physical training at the stage of initial sports specialization, as well as to the ratio of low-specific training means with a wide training effect and highly focused ones at various stages of long-term training.

The literature provides recommendations on the construction of the training process of young sprinters at the stage of initial sports specialization. According to the majority of authors (Анпилогов и Врублевский, 2011; Балахничев и Зеличенок, 2013; Врублевский др., 2019; Vrublevskiy и др. 2019c), the most important thing at this stage is creation of the basis of physical training with an emphasis on physical qualities, for the development of

which there are favorable conditions, considering children of 12-15 years old. These include: speed, strength and speed-strength abilities.

Methods and organization of the study. To solve the set tasks, the following research methods were used: analysis of literary sources, pedagogical testing, pedagogical experiment, methods of mathematical statistics. 68 sprinters-beginners of 14-15 years old took part in the ascertaining experiment, in the educational process of which during 11 weeks various variants of using the means of speed-strength training were used. Based on the obtained material, a methodology of speed-strength training of young runners-sprinters of 12-15 years old in an annual cycle was developed, with the dominant use of play training means, which were tested in a molding experiment. Athletes-sprinters trained according to the developed schemes of the complex organization of the training process of athletes of the first (12-13 years old) and second (14-15 years old) experimental group.

When developing the methodology, we focused on the volumes of general and special physical training of the annual cycle as 70 % and 30 % of the total amount of load, while the means of general physical training with the specific pulse value of the load in terms of heart rate were not higher than 170 beats/min. (Балахничев и Зеличенок, 2013; Мирзоев и др., 2007). Means of special physical training with a specific pulse value of the load in terms of heart rate were not lower than 160 beats/min. Therefore, 30 % of SPT (Special Physical Training) is 140 hours per year, with four sessions and a load of nine hours per week, heart rate up to 170 beats/min – 20 % or 94 hours, heart rate 171-189 beats/min – 8 % or 38 hours and heart rate above 180 beats/min – 2 % or 10 hours.

For the instrumental assessment of the strength and speed-strength capabilities of the muscles of sprinters, the method of computer tensodinamography was used, which made it possible to record the “strength-time” curve, as well as to observe the rate of the increase in muscle strength (Анпилогов и Врублевский, 2011; Верхошанский, 1988; Vrublevskiy и др., 2019c). The absolute strength was determined, recorded during the manifestation of isometric tension of a muscle group without fixing the time, the “explosive” muscle contraction in the isometric mode was assessed – the force gradient (the ratio of the maximum manifested muscle effort to the time it was reached) and those values of power indicators that sprinters could develop in 0,1 sec. The recording and processing of the obtained tensodinamograms of the strength characteristics of those muscle groups that are involved in the extension of the leg in the knee and hip joints were made.

Research results and their discussion. On the basis of a broad generalization of advanced pedagogical experience, a questionnaire survey of coaches, analysis of documentary material (training diaries), the structure of the annual cycle of 12-15 years old sprinters at the stage of initial specialization was determined.

When developing this scheme, the main attention was drawn to the problem of optimal planning of young athletes training, which provided for such an organization of training that would exclude the "forcing" of it. On the basis of the obtained factual material, the following directions in the organization of special physical training of young runners were determined, designed to reduce the likelihood of forced training of those involved.

1. It was planned to slightly increase (by 10-15 %) the volume of general physical training from the training loads of qualified sprinters. At the same time, the exercises to a small extent used by adult sprinters of higher qualifications were widely used. So, it was predominantly carried out to introduce outdoor games, sports games, game exercises, etc. into the educational and training process of young sprinters.

2. The total fulfillment of the volume of the annual load related to the means of special physical training was calculated. The volume of the latter was not more than 40-50 % of the similar training impacts of more qualified sprinters.

3. Organization of the load according to monthly cycles provided the maximum values of the use of training means which were not more than 10 % per mesocycle of the annual volume of training influences. Regarding adult athletes, these load parameters provided for the concentration of unidirectional means of special physical training up to 20 % or more per month of the annual volume.

To implement the developed methodology, the volume of fixed means of preparation was determined and their distribution by months of the macrocycle was made as a percentage of the total annual volume taken as 100 %. Also, it was necessary not only to distribute the means of training, but also to interconnect them with the load of another predominant orientation to a certain extent necessary for the specialized training of sprinters. The average planned annual parameters of the volume of the training load for young sprinters of 12-13 and 14-15 years old are presented in Table 1.

Table 1

The total volume of annual training load means for sprinters of 12-15 years old planned in the pedagogical experiment

Training means	Age	
	12-13 years	14-15 years

Running up to 80 m at a speed of 96-100 %, km	7,3±1,0	12±1,0
Running up to 80 m at a speed of 91-95 %, km	8,0±2,0	14±3,0
Running 100-300 m at a speed of 91-100 %, km	19,5±3,5	30,0±4,0
Running over 300 m at a speed of less than 80 %, km	45,0±7,5	60,0±10,0
Cross-country running, hours	30,0±8,0	40,0±5,0
Strength exercises, t	35,0±5,0	65,0±5,0
Short jumps, number of repulsions	2700±300	6000±600
Long jumping exercises, km	8,0±1,4	10,0±1,0
Sports games, hours	90,0±5,0	52,0±3,5
General developing exercises, hours	80,0±5,0	45,0±3,5

To determine the effectiveness of various options for using the means of speed-strength training in the educational-training process of young sprinters, an ascertaining experiment was carried out in which one group (A, n = 22) performed first speed-strength exercises, and then strength exercises. The second group (B, n = 24) was based on the reverse order of the use of means. Group C (n = 22) systematically applied both speed-strength and strength exercises, successively changing them in adjacent training sessions.

The experiment lasted 11 weeks and during this period 28 trainings were conducted. The groups did not differ from each other regarding age (14-15 years old) and physical fitness level, the volume of training influences was the same in the three groups.

The following speed-strength exercises were used: jumping on two legs, on one leg up stairs and uphill; various multi-hops, with an emphasis on the speed of repulsion; jumping rope, pushing off with one or two legs; jumping up with pulling the knees to the chest; repeated jumping up on two legs from a low squat position without weights and with weights (10-12 kg); jumping from an elevation on one leg, followed by a long and high jump; jumps with a light barbell on the shoulders and moving the barbell forward; jumping up, while reaching a suspended object or a basketball net with your hand; long jump and triple jump; jumps on one leg noting the time and without noting the time, etc.

The following strength exercises were used: extension and flexion of the leg with an external resistance (shock absorber, partner); squats and walking

with a barbell of light weight or with a partner on the shoulders; “Press” the partner’s legs while lying down; lifting the hip with weights (5-10 kg); squats on one leg; jumping with kettlebell; squats and subsequent jumps on one leg, with another leg on an elevation; exercise on simulators, etc. At the beginning and end of the experiment the dynamometric characteristics of the strength of the muscles of the lower extremities manifested in the isometric mode were recorded (Table 2).

Table 2

The changes in the experimental groups of strength and speed-strength indicators of muscles, leg extensors in the knee and hip joints of young runners during the experiment

Groups	Absolute strength		Strength gradient		Strength for 0,1 sec	
	Difference, kg	%	Difference, kg/s	%	Difference, kg	%
A	10,84	14,7	18,15	11,7	10,42	25,1
B	18,89	29,9	40,12	23,5	15, 61	38,3
C	33,97	39,2	71,19	42,3	29,93	74,9

At the beginning of the experiment, there was no statistically significant difference ($p > 0.05$) in the value of the dynamometric characteristics of young athletes of three groups, which made it possible to analyze the change in their indicators during the period of the pedagogical experiment as a result of the training influences used.

It was revealed that the differences in the magnitude of the increase in muscle strength indicators in groups A and B before and after the experiment were statistically insignificant for the 5 % significance level. In group C, the statistically significant ($p < 0.05$) changes were observed, which differ from the changes in the first two groups. The greatest changes in the dynamometric characteristics were noted in the strength shown in 0.1 sec, which characterizes the individual’s ability to quickly manifest effective strength at the beginning of the working muscle tension in sprint.

Based on the stated above, a methodology of training young sprinters of 12-15 years old was developed, which was aimed at the development of special preparedness by play means of training (Tables 3 and 4).

Table 3

Construction of training for young sprinters (12-15 years old) using the game orientation of classes to develop speed and speed-strength abilities

Training means, used during the training	Components of training influences				
	Intensity.	Exercise	The number of	Duration of rest	Type of

process	Heart rate, beats / min	time min.	repetitions, times	intervals, (min, sec.)	rest
General developing exercises	80-90	10-12	-	-	-
Slow running and its types	110-120	8-10	-	-	-
Running exercises	110-120	4-5	3-4	20-40 sec	Passive
Speed-ups	160-170	5-7	3-4	15-20 sec	Passive
10x jumps on one leg	160-170	5-7	4	1 min	Active
Games and game tasks aimed at speed	170-180	18-20	8-10	1 min	Active
Elimination starts	170-180	8-10	4-5	1-2 min	Passive
Exercises for flexibility and coordination	100-120	6-8	4-5	10-20 sec	Passive
Relaxation exercises	80-100	4-5	3-4	10-20 sec	Breathing exercises

Table 4

Construction of training of young sprinters (12-15 years old) using the game orientation of classes on the development of speed endurance and speed-strength abilities

Training means, used during the training process	Components of training influences				
	Intensity. Heart rate, beats/min	Exercise time min.	The number of repetitions, times	Duration of rest intervals, (min, sec.)	Type of rest
General developing exercises	80-90	10-12	-	-	-
Slow running and its types	110-120	8-10	-	-	-
Running exercise	110-120	4-5	3-4	20-40 c	Passive
Speed-ups	160-170	5-7	3-4	15-20 c	Passive
Relay races with overcoming obstacles	170-180	8-10-	4-5	1 min.	Active
“Duck Hunters” Game	160-170	8-10	1-2	1-2 min.	Active
Mini football	160-170	16-18	1	-	-
Exercises for flexibility and coordination	100-120	6-8	4-5	10-20 c	Passive
Relaxation exercises	80-100	4-5	3-4	10-20 c	Breathing exercises

In the first experimental group among 12-13 year old boys, as a result of a one-year training, along with an increase in the result in 100 m running by 1.43 sec, the indices of special physical preparedness significantly improved: the running time of 20 m from the run-up and 60 m from the start improved on average by 0.19 sec and 1.02 sec; the results of the long jump from the spot improved by 0.40 m, of the triple jump from the spot by 1.02 m and the

bottom-forward shotput with two hands (3 kg) by 1.12 m.

The differences in the indices of 60 m running from the start, a triple jump and a two-handed bottom-forward shotput have a high statistical significance ($p < 0.05$). There is a statistically significant ($p<0.01$) increase in strength characteristics – absolute strength, strength gradient and manifestation of strength in 0.1 sec.

In the second experimental group among boys aged 14–15 years, the cumulative effect of a one-year training was expressed in an improvement in performance in running 100 m by 1.13 sec, in running 20 m from the run-up and 60 m from the start, on average by 0.17 sec and 0.22 sec respectively. In the long jump from the spot by 0.30 m, in the triple jump from the spot – by 0.84 m, in the bottom-forward shotput with two hands (3 kg) by 1.65 m. Statistically reliable, for 1 % of the significance level, the strength indicators increased. So, the absolute strength increased by 10.83 kg, the force gradient by 159.18 kg/sec, and the manifestation of force in 0.1 sec by 13.59 kg.

Discussion. The analysis of special literature has shown that the issues related to the speed-strength training of young sprinters are clearly insufficiently considered (Анпилогов и Врублевский, 2011; Балахничев и Зеличенок, 2013; Врублевский и др. 2019) and the means of special strength training have an important place in the system of sports training of sprinters of different ages. This is due to the fact that these means, firstly, are designed to ensure formation of such a structure of the athlete's physical fitness, which would correspond to the specifics of the external relations of his body, and, secondly, should correspond in their effect to the athlete's activity regime in a specialized exercise. At the same time, the functional specialization of the musculoskeletal system of athletes should not be the result of passive adaptation to the conditions of competitive activity. It is necessary, in accordance with the individual biorhythmological predisposition (Бальсевич, 2000, с. 37) of the age-related development of sprinters, to try to achieve specific morphological and functional rearrangements of their musculoskeletal system in advance. This will become the basis for the dynamic growth of sports achievements and can be a potential reserve contributing to the qualitative improvement of the speed-strength preparedness of sprinters.

Failure to carry out all of the stated above leads to the premature implementation of the functional capabilities of young sprinters, their lack of progress when moving to the junior and adult groups. In our opinion, one of the most important reasons for this can be attributed to the lack of specialists' unified approach to the orientation of the training process and physical training

at the stage of initial sports specialization, where the ratio of low-specific training means with a wide training effect and highly directed at various stages of long-term training is not always maintained.

The results obtained by us confirm a number of studies (Балахничев и Зеличенок, 2013; Озолин, 2010; Dasteridis и др., 2011; Wychowański, 2008), indicating that the means of speed-strength training of young sprinters should be selected in such a way as to ensure a positive interaction of the qualities of strength and speed in order to effectively perform the necessary motor task, including the use of outdoor games, sports games and game exercises.

Conclusion. 1. There was observed a more significant effect in changing the dynamometric characteristics of the muscles of athletes with the simultaneous combination of speed-strength and strength means in training young sprinters (alternating the use of such means in related exercises) than with their sequential introduction in the preparatory period of a one-year macrocycle. Such a sequence of speed-strength training organization is the most justified at the stage of initial sports specialization.

2. The greatest effect from the point of view of the interest of those who go in for training work ensuring high physical activity belongs to outdoor games and game exercises. The popularity of such games among children is due, first of all, to the fact that they are close to the mental disposition of the child and are easier to perform in sports training. When conducting any game, the following parameters must be recorded: the sum of the heart rate for 5 minutes of the game, the highest heart rate during the game, the ratio of running and walking during the game, the level of tiredness of children, interest in the game (a desire to continue the game).

3. Testing, carried out at the beginning and at the end of the one-year pedagogical experiment, showed a significant increase in the analyzed indicators among the athletes of the experimental groups, which was reflected in the result of running the main sprint distance – 100 m. The increase in strength indicators among young sprinters can be explained not only by the sensitive period of muscle strength development, but also by the effectiveness of training influences. Moreover, the latter will be more effective as the skill of the athlete grows, if in their orientation they correspond to the mode of the activity in the main specialized exercise. The results of the pedagogical experiment allow certifying the productivity of the methodology of speed-strength training in the annual cycle, developed for sprinters of 12-15 years old, as well as the content of the normative indicators assessing their preparedness.

Prospects for further research are focused on the development of methods for special strength training of short-distance runners of various qualifications in the annual training cycle.

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РЕЗЮМЕ

Хоршидахмед Хайдер, Врублевский Евгений. Методика скоростно-силовой подготовки юных спринтеров 12-15 лет в годичном макроцикле.

Цель исследования – определение результативности методики подготовки юных бегунов на короткие дистанции в годичном макроцикле с использованием подвижных, спортивных игр и игровых упражнений. В результате проведенных исследований определена результативность в тренировочном процессе спринтеров 12-15 лет различных вариантов организации их специальной силовой подготовки, а разработанная методика развития быстроты и скоростно-силовых способностей игровыми средствами тренировки у юных бегунов-спринтеров показала свою

продуктивность. Получил подтверждение тот факт, что средства подготовки бегунов на короткие дистанции должны подбираться таким образом, чтобы обеспечить положительное взаимодействие качеств силы и быстроты с целью эффективного выполнения необходимой двигательной задачи.

Ключевые слова: *юные бегуны, силовые характеристики, годичный цикл, скоростно-силовые способности, показатели, спринт, подготовка, игровые средства.*

АНОТАЦІЯ

Хоршидахмед Хайдер, Врублевський Євген. Методика швидкісно-силової підготовки юних спринтерів 12-15 років в річному макроциклі.

Мета дослідження – визначення результативності методики підготовки юних бігунів на короткі дистанції в річному макроциклі з використанням рухливих, спортивних ігор та ігрових вправ. У результаті проведених досліджень визначена результативність у тренувальному процесі спринтерів 12-15 років різних варіантів організації їх спеціальної силової підготовки, розроблена методика розвитку швидкості і швидкісно-силових здібностей ігровими засобами тренування в юних бігунів-спринтерів показала свою продуктивність. Отримав підтвердження той факт, що засоби підготовки бігунів на короткі дистанції повинні підбиратися таким чином, щоб забезпечити позитивну взаємодію якостей сили і швидкості з метою ефективного виконання необхідного рухового завдання.

Ключові слова*: юні бігуни, силові характеристики, річний цикл, швидкісно-силові здібності, показники, спринт, підготовка, ігрові засоби.*