

An Original Pedagogical Programme of Speed and Power Performance Training for 16-17-year-old Sprinters

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Abstract. The paper presents the results of implementation of the authors’ training programme aimed at enhancing speed and power performance of 16-17-year-old sprinters realized from September 2018 – June 2019. The pedagogical study was conducted in three stages. At the first stage we analyzed 16 options for building a six-month cycle workout programme for sprinters of different qualifications. Using a series of pedagogical control tests, we tested 24 athletes of the third and second sports category to find their speed and power level. Then they were divided into two groups of 12 athletes: a control group and an experimental group. At the second stage we conducted a formative experiment in one of the groups to find the effectiveness of the training programme we had designed for the advanced specialization stage (n = 12). The third stage comprised data analysis and interpretation. The results showed that there was no connection between 30-meter-distance bounds and sports result. It was found that the programme designed for the experimental group leads to positive shifts during the competition period and has a positive effect on the physical development of young sprinters. The designed pedagogical programme aimed at tailoring a 6-month cycle of speed and power training for 16-17-year-old sprinters will reduce the time of mastering the sports technique.

1 Introduction

To build a proper foundation for developing sprinters’ skills it is necessary to use a sequence of basic training tools to cover the distance, taking into account individual development at a given age period.

The main morphological parameters that determine physical development are longitudinal dimensions of the body (height, length of upper and lower limbs), body weight, and body width. The most informative morphometric factor is the athlete’s height to weight index (which is reciprocal to Quetelet index). The functional capabilities of the muscular system of young men aged 15-16 make up 92% of the full capacity of adults, but their efficiency is only 65-70% [1, 2]. The sensitive periods in the development of strength, agility, speed and power qualities belong to the age of 15-17. To make sprinters’ training highly effective, we should take into account the athlete’s body characteristics at the given age.

2 Method

To substantiate a differentiated 6-month cycle workout programme of speed and power training for sprinters aged 16-17 from September 2018 to June 2019 we conducted a pedagogical experiment which consisted of three stages.

At the first stage we analyzed 16 options for building a six-month cycle workout programme for sprinters of different qualifications to find the quantitative parameters

of the basic training tools and ways to organize them. Using a series of pedagogical control tests, we tested 24 athletes of the third and second sports category to find their speed and power level. After the tests they were divided into two groups of 12 athletes: a control group and an experimental group. The difference in the test results of the average initial data in the experimental and control groups is not statistically significant, which proves the homogeneity of the test group (Table 1). The jumps were measured with a measuring tape (20-meter long) accurate to 0.01 m. The following tests were used to determine the level of special skills: a 20-meter race (from crouch start and standing start) and a 100-meter race.

Table 1. Average initial data of the control and experimental groups of sprinters aged 16-17 (n = 24)

Control pedagogical tests	Control group	Experimental group	p
	Initial data	Initial data	
Standing long jump, cm	254.40	258.70	>0.05
Standing triple jump, cm	765.70	789.50	>0.05
Bounds, 30 m, conditional units	17.53	17.30	>0.05

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20-m race from standing start, sec.	2.16	2.21	>0.05
20-m race from crouch start, sec.	2.76	2.80	>0.05
Hopping on the right leg, 20 m, sec.	3.65	3.46	>0.05
Hopping on the left leg, 20 m, sec.	3.69	3.50	>0.05
100-meter race result, sec.	12.44	12.47	>0.05

At the second stage we conducted a formative experiment in one of the groups to find the effectiveness of the training programme we had designed to differentiate the workouts of 16-17-year-old sprinters at the advanced specialization stage (n = 12).

The experiment was conducted in the natural environment of the training process. The aim of the pedagogical experiment was to test the effectiveness of the speed and power training programme we had designed specially for this group of athletes.

The athletes of the experimental group were trained according to the designed original workout programme for speed and power training, taking into account the distribution of the workout load in the macrocycle. The athletes of the control group were trained according to the traditional training programme for youth sports schools.

The third stage comprised data analysis and interpretation. Data validity for the representative sample was assessed using Student's t-test for independent samples (n = 24; p > 0.05 to compare control and experimental groups) and for dependent samples (n = 24; p < 0.05 to compare the same group at the beginning and at the end of the experiment). The familywise error rate was controlled using Bonferroni correction, the significance level was 0.011. Pearson correlation coefficient was used to measure the correlation between the tested parameters (significant correlation $r_{xy} \geq 0.6$ at $p \leq 0.05$).

3 Original training programme

The basic tools for sprinters' workouts include the following drills and their intensity:

- Race up to 80 m, intensity 96-100%.
- Race 100-300 m, intensity 91-100%.
- Race 100-300 m, intensity 80-90%.
- Race over 300 m, intensity less than 80%.
- Exercises with weights.
- Jumping exercises.

The designed training programme was based on the phases of a six-month cycle and included three blocks in the preparatory period [3, 4]:

Entering or recovery block (February) included: entering with low load; entering with middle load; developing with significant load; recovery with low load.

The block of special (basic) training (March –April) included: a basic mesocycle; intensive with heavy load; developing with significant load; intensive with heavy load; recovery with low load; a special preparatory mesocycle; intensive with heavy load; developing with significant load; stabilizing with average load.

"Technique and recovery block" (May).

Entering mesocycle is aimed at preparing the body for intensive training.

Developing mesocycle is characterized by a fairly heavy load which causes a supercompensation effect and performance growth in different aspects of training. However, the intensity of training does not reach the maximum yet.

Speed and power and speed skills are developed in the basic microcycles by using a complex load with a sequence of exercises which put into use the main set of muscles for sprint, such as exercises with weights (barbell, kettlebell, "long" jump exercises, "short" jump exercises, etc.)

The intensive mesocycle is characterized by the total load close to maximum and the maximum total load and is the basis for the preparatory period.

The stabilizing mesocycle is used to keep the performance characteristics at the achieved level by reducing the volume while maintaining high intensity.

During the "technique and recovery block" the athletes performed the offered set of technique drills using a special pattern (Table 2). The principal goal of this block was to make a transition from the power and speed and power tools to speed tools by focusing on the technique to reach the balance between the physical and technique training. To make the drills more effective, they should be alternated with aerobic and mixed (aerobic-anaerobic) running for 200-300 meters, where running technique should be controlled. The rest before repeating the drill should be so long as to allow the athlete not to lose speed doing the drill.

Table 2. “Technique and recovery block” pattern (n = 12)

Weeks	Set of exercises with blocks		Set of exercises with an elastic band		Running intensity at the distance of 250-300 m, %
	Number of workouts	Load	Number of workouts	Load	
1	6	1 (40%/15)			65%
2	5	2 (35%/15)			70%
3			3	2x20	75%
4			4	3x20	80-85%

Thus, the blocks are mainly aimed at creating a functional framework for further development of speed skills and mastering the technique of young athletes by using special methods.

The correspondence between the real and the expected dynamics of the athlete’s performance is controlled by systematic (twice a month) comparing special training characteristics of 16-17-year-old sprinters, and, in case they are inconsistent (3-4%), by correcting the training process [5, 6].

4 Analysis of the study results

At the end of the six-month cycle of the forming experiment we obtained reliable changes in most control performance values in the experimental group (Table 3), such as the increase in absolute values and individual values of the initial and control data.

At the end of the summer competition period the results in 20-meter hops improved by an average of 7.3%. In all the other control values the results were improved by an average of 4%.

The control group showed reliable changes in the 20-meter race from crouch start. This is the result of technique-oriented training. At the same time, the downside of the process was an average 1.4% deterioration in the 20-meter race from standing start. Although these changes do not have a reliable character, we assume that they resulted in a small increase of the result in the competition exercise (1.9 %). The experimental group showed the increase in the sport result by 0.7 sec or 5.2%, with $p < 0.05$.

Table 3. Comparative analysis of the increase of values in control pedagogical tests (spring-summer preparatory and summer competition stages 2018–2019, n = 24)

Control pedagogical tests	Control group		Experimental group	
	Relative increase, %	p	Relative increase, %	p
Standing long jump	0.1	>0.05	3.3	>0.05

Control pedagogical tests	Control group		Experimental group	
	Relative increase, %	p	Relative increase, %	p
Standing triple jump	0.4	>0.05	3.1	<0.05
Bounds, 30 m	1.3	>0.05	4.1	>0.05
20-m race from standing start	-1.4	>0.05	4.0	>0.05
20-m race from crouch start	5,9	<0.05	4.8	>0.05
Hopping on the right leg, 20 m, sec.	0.3	>0.05	4.9	<0.05
Hopping on the right leg, 20 m, sec.	0.3	>0.05	4.7	<0.05
100-meter race result	1.9	>0.05	5.2	<0.05

The dynamics of the competition exercise results leads us to the conclusion that the proposed programme of the tailored speed and power performance training of 16-17-year-old sprinters is an effective and reasonable alternative for sprinters.

5 Conclusions

1. The results showed that there was no connection between 30-meter bounds and sports result, which could be explained by insufficient body development of young athletes. At this age, the stride length of young athletes is considerably lower than that of adult sprinters, although they have the same rate of movement.
2. The formative experiment proves that the designed programme for the experimental group leads to positive changes in the considered performance characteristics during the competition period and has a positive effect on the physical development of young sprinters. Increasing the effort at the jump-off phase by using a selective force application made a more rapid transition from the yielding to the overcoming effort.
3. To achieve outstanding sports results at the given

age it is necessary to develop special speed and power capacity, which constitutes the base for further increase in the special physical training.

4. The designed pedagogical programme for the tailored special speed and power training of 16-17-year-old sprinters during a six-month cycle will decrease the time needed to master the sports technique.

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