



**THE INFLUENCE OF THE LEVEL  
OF SPEED-POWER PREPARATION  
ON THE RESULT IN RUNNING ON  
SHORT DISTANCES OF ATHLETES OF  
DIFFERENT RESULT GROUPS**

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**Annotation**

Means of special strength training are of great importance in the sprinter's sports training system. Such means of training are, firstly, ensure that the formation of a structure of the athlete's physical fitness corresponds to the specificity of the external relations of his body, and, secondly, in their influence, they should correspond to the athlete's mode of activity in the specialized exercise. The problem of choosing rational means of speed-strength training and the peculiarities of their use in training with various contingents of sprinters have not received a satisfactory substantiation and theoretical explanation.

**The aim of the study** is to determine the structure of speed-strength preparedness among sprinters of various qualifications and to reveal its relationship with sports results among runners of various qualifications.

**The set of methods** used to solve the assigned tasks included: theoretical analysis and generalization of scientific and methodological literature data; pedagogical testing and experiment, methods of statistical processing of the obtained material.

**Research results.** It was found that the growth of qualifications of sprinters is largely determined by the level of development of their speed-strength preparedness. This is manifested in an increase in the relationship between athletic performance in the 100 meters running and performance in tests. This is evidenced by the obtained coefficient of multiple correlation ( $R = 0,811$ ), which proves the joint influence of achievements in speed-power indicators on the result in the 100-meter run. Informative tests for assessing the level of speed-strength readiness of short-distance runners were revealed. The use of metrologically grounded tests in practice can help to increase the effectiveness of the educational-training process of runners of this sports qualification.

**Conclusions.** The obtained data of the structure of preparedness of sprinters of various qualifications indicate its change as the skill of athletes grows and confirms a number of studies indicating that the means of speed-strength training of short-distance runners should be selected in such a way as to ensure a positive interaction of the qualities of strength and speed with the aim of effective performing the necessary motor task.

**Key words:** sprint, athletes, qualification, structure, readiness, tests, correlation analysis.

**Анотація**

Засобам спеціальної силової підготовки належить важливе місце в системі спортивного тренування спринтера. Це пов'язано з тим, що вони, по-перше, покликані забезпечити формування такої структури фі-

зичної підготовленості спортсмена, яка б відповідала специфіці зовнішніх відносин його організму, і, по-друге, повинні за своїм впливом відповідати режиму діяльності спортсмена в спеціалізованому вправі. Проблема вибору раціональних засобів швидкісно-силової підготовки, особливості їх застосування в тренуванні з різним контингентом спринтерів, не отримали задовільного обґрунтування і теоретичного пояснення.

**Мета дослідження** - визначити структуру швидкісно-силової підготовленості у спринтерів різної кваліфікації і виявити її взаємозв'язок зі спортивним результатом у бігунів різної кваліфікації.

Сукупність методів, використовуваних для вирішення поставлених завдань, включала: теоретичний аналіз і узагальнення даних науково-методичної літератури; педагогічне тестування і експеримент, методи статистичної обробки отриманого матеріалу.

**Результати дослідження.** Встановлено, що зростання кваліфікації спринтерів від III до I спортивного розряду значною мірою визначається рівнем розвитку їх швидкісно-силової підготовленості. Це проявляється в збільшенні взаємозв'язку між спортивним результатом в бігу на 100 м і показниками в тестах. Про це ж свідчить отриманий коефіцієнт множинної кореляції ( $R = 0,811$ ) доводить спільний вплив досягнень в швидкісно-силових показниках на результат в бігу на 100 метрів. Виявлено інформативні тести для оцінки рівня швидкісно-силової підготовленості бігунів на короткі дистанції III-I спортивних розрядів. Застосування в практичній діяльності метрологічно обґрунтованих тестів може сприяти підвищенню ефективності навчально-тренувального процесу бігунів цієї спортивної кваліфікації.

**Висновок.** Отримані дані про структуру підготовленості спринтерів різної кваліфікації свідчать про її зміну в міру зростання майстерності спортсменів і підтверджують ряд досліджень, що вказують, що засоби швидкісно-силової підготовки бігунів на короткі дистанції повинні підбиратися таким чином, щоб забезпечити позитивну взаємодію якостей сили і швидкості з метою ефективного виконання необхідної рухової задачі.

**Ключові слова:** спринт, спортсмени, кваліфікація, структура, підготовленість, тести, кореляційний аналіз.

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#### Аннотация

Средствами специальной силовой подготовки принадлежит важное место в системе спортивной тренировки спринтера. Это связано с тем, что они, во-первых, призваны обеспечить формирование такой структуры физической подготовленности спортсмена, которая бы отвечала специфике внешних отношений его организма, и, во-вторых, должны по своему воздействию соответствовать режиму деятельности спортсмена в специализируемом упражнении. Проблема выбора рациональных средств скоростно-силовой подготовки, особенности их применения в тренировке с различным контингентом спринтеров, не получили удовлетворительного обоснования и теоретического объяснения.

**Цель исследования** - определить структуру скоростно-силовой подготовленности у спринтеров различной квалификации и выявить ее взаимосвязь со спортивным результатом у бегунов различной квалификации.

Совокупность методов, используемых для решения поставленных задач, включала: теоретический анализ и обобщение данных научно-методической литературы; педагогическое тестирование и эксперимент, методы статистической обработки полученного материала.

**Результаты исследования.** Установлено, что рост квалификации спринтеров от III до I спортивного разряда в значительной мере определяется уровнем развития их скоростно-силовой подготовленности. Это проявляется в увеличении взаимосвязи между спортивным результатом в беге на 100 м и показателями в тестах. Об этом же свидетельствует полученный коэффициент множественной корреляции ( $R = 0,811$ ) доказывающий совместное влияние достижений в скоростно-силовых показателях на результат в беге на 100 метров. Вывявлены информативные тесты для оценки уровня скоростно-силовой подготовленности бегунов на короткие дистанции III-I спортивных разрядов. Применение в практической деятельности метрологически обоснованных тестов может способствовать повышению эффективности учебно-тренировочного процесса бегунов этой спортивной квалификации.

**Выводы.** Полученные данные о структуре подготовленности спринтеров различной квалификации свидетельствуют о ее изменении по мере роста мастерства спортсменов и подтверждают ряд исследований, указывающих, что средства скоростно-силовой 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:** спринт, спортсмены, квалификация, структура, подготовленность, тесты, корреляционный анализ.

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**Introduction.** The motor specificity of a sports exercise, sprint running in particular, offers great requirements for the speed-strength training of runners. This happens because the process of development of speed-strength qualities in a sprinter takes place in close connection with the improvement of other motor qualities (strength, speed, special endurance), general physical fitness in combination with the formation of a rational running technique [1, 7, 11, 13, 16, 21, 31, 35]. Means of special strength training are of great importance in the sprinter's sports training system [3, 5, 9, 10, 18, 22, 33]. Such means of training are, firstly, ensure that the formation of a structure of the athlete's physical fitness corresponds to the specificity of the external relations of his body, and, secondly, in their influence, they should correspond to the athlete's mode of activity in the specialized exercise [4, 17, 20, 24, 30, 38].

High power in high-speed running is associated with a high expenditure of muscle and nervous energy of the athlete. As a result, sprint running belongs to the group of speed-strength sports performed with maximum intensity of working efforts [1, 5, 13, 19, 23, 25, 37]. This requires a high level of development of speed-strength qualities for the continuous growth of sportsmanship. Moreover, the speed-strength nature of work in sprint running begins with the first step, proceeds against the background of the developing acceleration of the body and serves as a means of creating an additional number of movements to the one that already exists [2, 4, 11, 12, 23].

Sprint speed is directly related to the manifestation of another important quality - strength. Hence, there are general reasons that determine the adequacy of the development of these physical qualities in a sprinter. Therefore, as indicated by Y.V. Verkhoshansky [30], the task of today's sport and today's physiology

should be to establish a fundamental relationship between strength and speed and create ways to get the individual characteristics of this connection.

A high level of development of speed-power qualities has a positive effect on the physical and technical preparedness of sportsmen, on their ability to concentrate efforts in space and time [15, 19, 21, 29]. In the process of performing high-speed running, a sprinter repeatedly has to overcome the resistance of body weight. This requires the sprinter to have a great manifestation of special strength in the work of muscles while running [27, 30]. According to many authors, a great place in the sports training of sprinters should be given to the upbringing of speed-power qualities [7, 14, 25, 28].

At present, there has been accumulated a large number of methodological materials on the use of various speed-strength exercises in the training of runners. However, the problem of choosing rational means of speed-strength training and the peculiarities of their use in training with various types of sprinters have not received a satisfactory substantiation and theoretical explanation. The question of how speed-strength exercises affect the preparedness of a sprinter and his result in running 100-200 meters is also covered in the scientific and methodological literature quite insufficiently.

**The aim of the study** is to determine the structure of speed-strength preparedness among sprinters of various qualifications and to reveal its relationship with sports results among runners of various qualifications.

The set of methods used to solve the assigned tasks included: theoretical analysis and generalization of scientific and methodological literature data; pedagogical testing and experiment, methods of statistical processing of the obtained material [26].

The research was carried out

in the year 2018-2019 on the basis of the sports school in Gomel (Belarus). To study the structure of the preparedness of sprinters, 55 sprinters of various qualifications from 15 to 17 years old were examined with the help of control and pedagogical tests. The athletes who passed the examination were conventionally divided into three groups.

The first group (average result 11.07 s) included 12 athletes of the first sports category. The second group (average result 11.56 s) consisted of sportsmen of the second category (n = 18). The third group included athletes of the third sports category (average result 12.49 s) in the amount of eleven people (n = 25).

The examinations of each qualification group were carried out in the competitive period within one day, after a standard warm-up, which included slow running, general developmental exercises, trial attempts, and running from the start. The results in all exercises were determined in conditions close to competitive ones.

Running 30m starting with the maximum speed (the speed gained from running before the starting point). Each athlete was presented with two runs, of which the best was chosen. The result was determined by a hand-held stopwatch.

Triple jump. The jumps were carried out on a rubber track into a sand pit. Each athlete was given one trial and three test attempts. The result was determined by the best attempt and was rounded down to one centimeter.

A 5 kg shotput from the bottom with two hands forward was performed from a segment in a standard shotput sector. Each athlete was given one trial and three test attempts. The result was determined by a metal tape measure (R-20) at the best attempt and rounded up to one centimeter.

Two-handed barbell jerk. Each athlete was given three attempts. Weight was added by 0.5 kg. The

best result was determined by the weight lifted by the athlete.

To determine the correlation structure of speed-strength preparedness among sprinters of various qualifications, their best sports result of the season in the 100-meter race was used.

**Research results.**

The data of pedagogical testing and the subsequent carried out mathematical and statistical analysis of the obtained experimental material made it possible to reveal the differences observed in the course of the formation of sprinters' sportsmanship (Table 1., Fig. 1 and 2).

The analysis of the presented results indicates that the difference observed between the mean values of the recorded indicators in athletes of III-I sports categories is not homogeneous. So, as the result grows in running at the main distance from the III-I sports category, the average values in the barbell jerk with two hands increase by 32%, and in the shotput - by 10%.

Moreover, it is noteworthy that an increase in the qualifications of sprinters from III to II sports categories is accompanied by an increase in the result in a triple jump from a place only by 1,5% ( $p > 0,05$ ), and from II to I sports categories by 9% ( $p < 0,05$ ). It is also significant that a similar difference is characteristic for other indicators as well (see Table 1), which may indicate a more accelerated increase in the result

both in running 100 meters and in fixed tests.

And if the difference in the analyzed indicators between the data of sprinters of the II and III sports categories is basically insignificant for the 5% level of significance, then the statistical differences in the indicators of runners of the I sports category ( $p < 0,05$ ) differ from the indicators of athletes of lower qualifications in all characteristics.

From the comparison of the data in the table, it can be seen that the highest variability (in terms of the coefficient of variation) is observed in athletes of the I sports category, which can be considered as an expansion of the boundaries of individual fluctuations in the values of the analyzed characteristics. Moreover, the greatest heterogeneity of the array of initial values for all groups is observed according to the data of the barbell jerk with two hands, and the smallest spread of indicators in the 100-meter run and 30 meters.

The idea of the structure of athletes' fitness, according to Y.V. Verkhoshanskiy [30] and other authors [2, 12], is extremely important for the organization of training in a particular sport and, in particular, for the selection of effective means, and methods of developing muscle strength. The solution to this issue is impossible without the involvement of modern methods of mathematical and

statistical processing of the data obtained and correlation analysis.

The carried-out correlation analysis made it possible to establish the relationship between the set of tests assessing the motor abilities of athletes and the result in 100m running among sprinters of different sports categories, as well as a change in the structure of speed-strength preparedness as the qualifications of sprinters grow (Fig. 3-6).

As a result of the correlation analysis for all groups of subjects, a high reliable correlation of sports results with the following indicators (Fig. 3) 30 meters running –  $r_1 = 0,939$  was obtained; triple jump from a spot –  $r_2 = -0,775$ ; shotput from the bottom forward –  $r_3 = -0,769$ . The relationship between sports results and the barbell jerk with two hands is somewhat lower ( $r_4 = -0,529$ ).

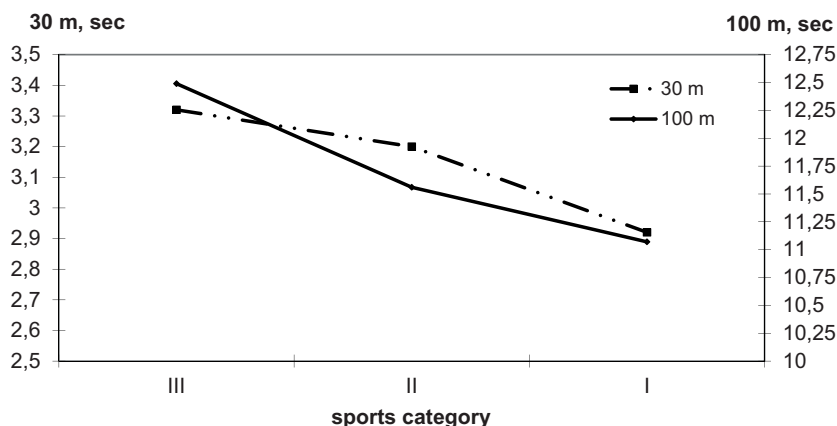
If we consider the structure of speed-power preparedness in relation to the three groups of sports qualifications, it is clear that as the sports result grows, it changes. So, among athletes of the III sports category, the highest correlation of sports results is observed with the result of 30 m running ( $r_1 = 0,719$ ) and with the result of a triple jump from a spot ( $r_2 = -0,810$ ) (Fig. 2).

The correlation coefficient for such indicators as the barbell jerk and the two-handed core throw forward for this group of the sample was statistically insignificant for the

**Average numbers ( $\bar{X}$ ) and coefficients of variation (V) of experimental indicators among sprinters of different result groups (III - I sports categories)**

Table 1

Sports qualification	Statistical indicators	The studied indicators				
		Running 100m, s	30m run, s	Shotput, m	Barbell jerk, kg	Triple jump, m
III sports category	$\bar{X}$	12,49	3,32	12,54	42,5	7,33
	V	0,92	2,91	1,45	7,43	6,32
II sports category	$\bar{X}$	11,56	3,20	13,05	55,0	7,44
	V	1,24	2,12	1,78	5,69	5,58
I sports category	$\bar{X}$	11,07	2,92	13,88	62,0	8,20
	V	2,09	3,18	5,11	14,55	13,66



**Fig.1 Dynamics of average results in 100 and 30 m run of sprinters of various qualifications**

5% significance level.

Approximately the same picture is observed when analyzing the structure of speed-power preparedness among sportsmen of the II sports category (Fig. 5). The differences here from the group of athletes of the III sports category are in the more correlation of the result for the main discipline with the shotput ( $r = -0,590$ ).

The structure of speed-power preparedness among athletes of the I sports category is as follows (Fig. 6). The mentioned group of runners has a high statistically significant

( $p < 0,05$ ) correlation of sports results with all fixing indicators. This which may indicate the need to include all these indicators as means of speed-strength training. One of the reasons for the low correlation with the result at the main distance, such as tests like a two-handed barbell jerk and a two-handed shotput for III-I athletic category runners are, apparently, their relative coordination difficulty. The fulfillment of these exercises requires, in addition, a certain speed-power potential of the athlete's muscles.

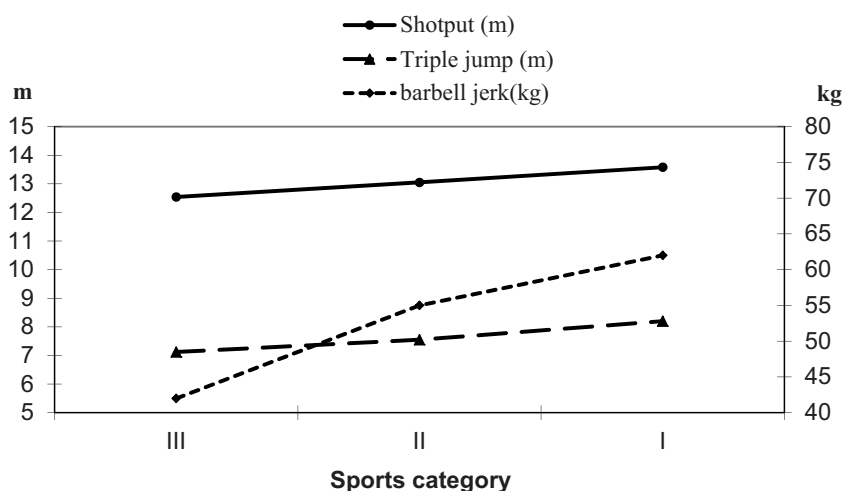
The obtained multiple correlation

coefficient (R), which is 0,811 for the III-I sports category runners, also testifies to the significant cumulative influence of speed-power indicators on the result in 100m running. The obtained coefficient shows that the combined effect of indicators in a triple jump from a standing position (y) and a barbell jerk with two hands (z) on the result in a 100m run (x) is quite significant.

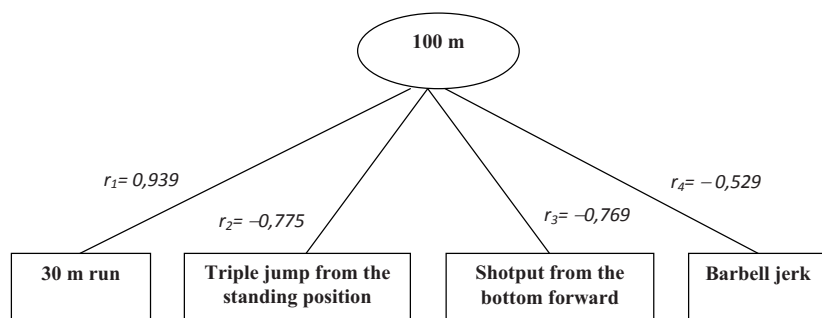
Thus, the correlation analysis confirmed the fact that speed-strength training plays an important role in achieving high sports results in 100 meters running, thanks to which there is a targeted and accelerated improvement of the ability of the leading muscle groups to perform specific work.

A large number of tests are used to determine the fitness level of short-distance runners. However, the choice of informative indicators for assessing speed-strength indicators, despite its practical importance, is one of the most poorly developed issues in the theory of sports [24, 29, 36, 37]. In order to simplify the material presented for the term "test", we accepted the definition proposed by V.M. Zatsiorsky [26]. The term "indicator" was understood as digital material obtained as a result of testing or mathematical calculations. Exercises offered as tests should meet the following requirements: be simple to fulfill and at the same time of a complex type, and the assessment of results should be simple and convenient.

As a result of the study, the tests which carry informational content about the speed-strength qualities of short-distance runners of III-I sports categories were identified and evaluated. Such a test for athletes of the II and III categories is a triple jump from a place, and for runners of the I sports category, informative tests assessing their special strength readiness are the result in a triple jump from a standing position, a barbell jerk with two hands forward and a shotput. The assessment of the reliability of tests by the "test-



**Fig.2 Dynamics of the average results of a shotput from the bottom forward, a barbell jerk and a triple jump from the standing position among athletes of different qualifications**



**Fig. 3 The structure of speed-strength preparedness of runners of I-III sports categories**

retest" method showed that the obtained correlation coefficients are quite high. This indicates their reliability [26].

The use of metrologically grounded tests in the training process can increase the effectiveness of training short-distance runners of a given qualification level.

Discussion. In the process of performing high-speed running, a sprinter repeatedly has to overcome the body weight resistance. This requires a sprinter to have a great manifestation of special strength in the work of muscles while running [2, 25, 31, 33]. According to many authors, a great place in the sports training of sprinters should be given to the development of speed-strength qualities [3, 4, 6, 8, 11, 16, 35]. The studies carried out by us supplement this fact with data obtained from different classes of sprinters [34]. At the same time, experts emphasize that the degree of manifestation of

speed-strength qualities depends on the magnitude of muscle strength and on the athlete's ability to a high concentration of neuromuscular efforts, mobilization of the body's functional capabilities [19, 22, 27, 30, 37], as well as on differences of the sex of the sportsman [32, 35].

So, in his work K.K. Bondarenko [2] divided the runners into groups depending on the ability of the neuromuscular apparatus to adapt to the loads of speed, speed-power, power orientation and to the manifestation of speed endurance. The group of athletes with a good level of adaptation to speed load surpassed the others in the 20 m run by 0,1-0,3 sec; to power - in squatting with weights of 10-20 kg; to speed-power - in a five-time jump of 30-80 cm; to the manifestation of high-speed endurance - in a 300 m run for an average of 1-3 sec.

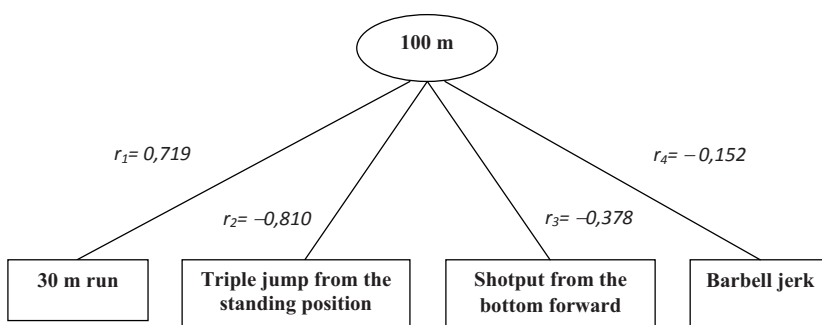
Athletes with a high level of adaptation of the neuromuscular

system to high-speed loads were distinguished by a high starting speed, a relatively lower level of special endurance, and slower recovery after power and speed-power loads in trainings. Those with a high level of adaptation of the neuromuscular apparatus to power loads excelled others in power indicators, had an average level of special endurance and showed a slowed down recovery after high-speed loads.

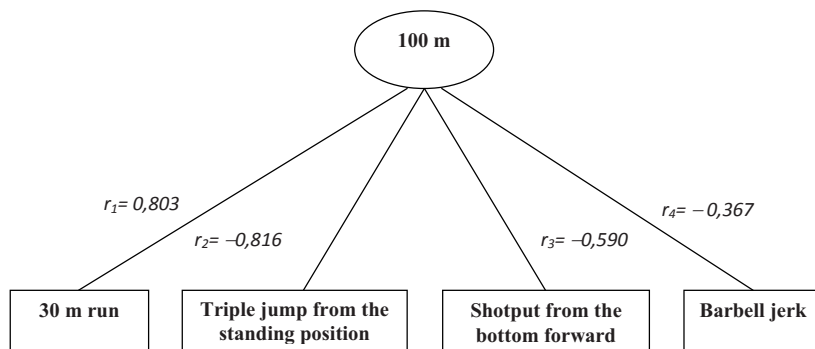
The athletes who have a high level of adaptation of the neuromuscular apparatus to speed-power loads, according to experts [3, 5, 8, 25, 29], are distinguished by the dominant indicators of power, speed, speed-power preparedness and rapid recovery after loads of different directions.

According to D.L. Mironova, V.N. Egorova, E.M. Popova [17] a large amount of jump work, during which the set to perform fast take-off in each jump is implemented, is a more effective means of increasing an athlete-sprinter's speed capability at the initial stage of training. Research results of A.D. Faigenbaum and his co-workers [8] showed that strength characteristics, assessed by the results in the press of the weight with the legs and the height of the jump up from the spot, especially increase during puberty of young athletes. Considering the fact that young men of 15-17 years old participated in our experiment, a similar fact may have taken place.

A high level of speed-strength preparedness is expressed in the results of jumping tests, which are given by specialists. So, according to E.S. Ozolina [19] a sprinter, having a result of the level of the second sports results category, should jump 260 cm from the standing position, his triple jump from the standing position should be of 760 cm, and a tenfold jump of 27 meters. Indicators in the same tests for a first-class athlete are respectively 0,2-0,5 and 4 meters higher. And the outstanding sprinter



**Fig. 4 The structure of speed-strength preparedness of runners of III sports category**



**Fig. 5 The structure of speed-strength preparedness of runners of the II sports category**

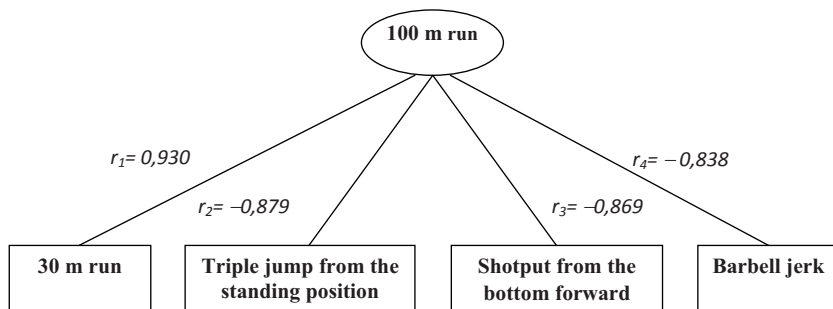
V. Borzov could do a triple jump from the standing position up to 10 meters and a tenfold jump up to 36-37 meters [1].

Long jumps, triple and tenfold jumps from the standing position are closely related to the speed of running at various segments of the hundred-meter distance [2, 16, 17, 33]. Moreover, according to some experts [5, 6, 15, 27] long jump from the standing position has a greater data content in comparison with other types of jumps. Running speed in the initial sections of the distance equally depends on the performance in the listed exercises. In the second half of the distance, it becomes more dependent on the results in jumping exercises with several take-offs [3, 11, 16, 33].

The end result of 100m runners depends more on the level of explosive development than on absolute strength [4, 13, 34]. Therefore, in order to increase the

special power and speed-power preparedness of sprinters at the stage of the initial specialization and in-depth training, it is recommended to use mainly a variety of running and jumping exercises with an emphasis on speed of execution with an insignificant general strength background. This statement stands in one line with our research about young athletes. According to Chelly M., Hermassi S., Shephard, R. [5] the use of jumps over low barriers and various jumping exercises increases the running speed both from the start and along the distance. At the same time, exercises aimed at static stress impair sprint performance of young athletes [36].

Interestingly, the use of half-squats with a barbell or with a partner on the shoulders for 12 weeks, as found by M. Vanderka et.al [29], contributes to a statistically significant increase in speed abilities of athletes. And



**Fig. 6 The structure of speed-strength preparedness of runners of the I sports category**

according to another group of specialists [14], combined trainings with alternating speed-strength exercises and sprint running give better results in increasing the speed of smooth running than only speed-strength exercises or only training effects using smooth high-speed running. Similar data were obtained by other researchers [3].

The effectiveness of running and jumping exercises which are similar in structure to the competitive ones is a consequence of the fact that they not only accentuate the speed-power characteristics of the most significant muscle groups in sprint running, but also contribute to the formation of a rational technique of high-speed running movements. So, L. Cunha et.al [6] propose to use jumping exercises from the spot to assess the speed-strength abilities of sprinters, which is consistent with our data. They also recommend using a jump up from a spot.

Thus, experts believe that speed-strength training plays an important role in achieving high results in sprint running at all stages of long-term improvement, and it must be given a large place in the training process of runners.

#### Conclusions.

1. It was revealed that an increase in the skills of sprinters is accompanied by a more accelerated increase in the recorded indicators. This comes as the result improves to the level of a higher result category (I sports category). Thus, if the difference in the analyzed indicators between the data of the sprinters of the II and III sports categories is mainly unreliable for the 5% level of significance, then the indicators of the runners of the I sports category are statistically significantly ( $p < 0.05$ ) differ from the indicators of athletes of lower qualifications in all characteristics. Moreover, for runners of the I sports category, a higher variability of the analyzed characteristics is essential.

2. It was found that the growth of qualifications of sprinters

from III to I sports category is largely determined by the level of development of their speed-power preparedness. This is manifested in an increase in the correlation between athletic performance in 100 meters running and indicators in a two-handed shotput ( $r$  from  $-0,378$  to  $-0,869$ ) and a barbell snatch ( $r$  from  $-0,152$  to  $-0,838$ ). This is also evidenced by the obtained coefficient of multiple correlation ( $R = 0.811$ ), which proves the joint influence of achievements in speed-strength tests on the result in running 100 meters.

3. The obtained data regarding the structure of preparedness of sprinters of various qualifications

indicate its change as the skill of athletes grows. The data also confirms a number of studies indicating that the means of speed-strength training of short-distance runners should be selected in such a way as to ensure a positive interaction of the qualities of strength and speed with the aim of effectively performing the necessary motor task.

4. As a result of the study, the informative tests for assessing the level of speed-strength readiness of short-distance runners of III-I sports categories were revealed. Such tests for sprinters of the II and III sports categories are a triple jump from the standing position. As for runners of

the I sports category, informative tests assessing their special strength preparedness can serve as indicators in a triple jump from the standing position, a barbell jerk and a shotput with two hands from below. The use of metrologically grounded tests in practice can help to increase the effectiveness of the educational-training process of runners of a given sports qualification.

**Prospects for further research** are related to the development of a methodology for special speed-strength training of runners at the stage of in-depth specialization.

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