

METHODOLOGY OF OPTIMIZATION OF THE TEMPO-RHYTHMIC STRUCTURE OF THE RUN-UP OF FEMALE POLE VAULTERS OF 14-16 YEARS OLD

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Анотації:

One of the main problems in maintaining the gained speed in the last steps of the take-off is the incorrect construction of the tempo-rhythm structure of the take-off, which is due to the imperfection of holding, carrying and putting forward the pole. The latter occurs due to a certain underestimation of the role of the run in the pole vault by coaches. The relevance of the work is due to the fact, that a number of coaches lack a clear idea about the correlation of the individual sides of the training process in pole vaulting and the place of each means in the system of annual training of athletes. **The aim of the study** is to develop a methodology of the tempo-rhythm structure of the take-off run for pole-jumpers aged 14–16 years. **Results of the study.** Four sets of exercises were developed (each for a specific stage of the jump), which were used in compiling individual microcycles. This was done taking into account the strengths and weaknesses in the preparation of the girls. Moreover, not previously studied exercises were used to a greater extent. This approach made it possible to make changes in individual stages of the jump due to the study of new auxiliary exercises, and at the same time to form a more advanced skill of a holistic jump, which will subsequently become the basis of individual technique. The complexes consisted of unidirectional exercises with increasing complexity from the first exercise to the final one. The purposeful use of the developed systems has contributed to both the improvement of individual stages of the pole vault and to the increase in the general and special physical fitness of athletes. **Conclusions.** Experimental testing of the methodology for optimizing the tempo-rhythm structure of the run for jumpers with a pole of 14–16 years old has shown its effectiveness as a factor in optimizing the educational process. During the experiment, stabilization of the takeoff run for pole vaulters was achieved, the number of successful competitive attempts increased from 46 to 69%, the coefficient of realization of the takeoff speed of 4 girls increased, which indicates an improvement in the technique of pole vaulting.

Ключові слова:

methodology, pole vaulters, exercise complexes, run-up, tempo-rhythmic structure

Методика оптимізації темпо-ритмової структури розбігу у стрибунів з жердиною 14-16 років

Борова Валентина, Врублевський Євген, Севдалев Сергій

Однією з основних проблем збереження набраної швидкості на останніх кроках розбігу є неправильна побудова його темпо-ритмової структури, що обумовлено недосконалістю тримання, несення і виносу жердини. Останнє пов'язано з деякою недооцінкою тренерським складом ролі розбігу в стрибку з жердиною. Актуальність роботи обумовлена тим, що у ряді тренерів відсутнє чітке уявлення про взаємозв'язок окремих сторін тренувального процесу в стрибках з жердиною та місця кожного засобу в системі річної підготовки спортсменок. **Мета дослідження** – розробити методику темпо-ритмової структури розбігу у стрибунів з жердиною 14-16 років. **Результати дослідження.** Були розроблені чотири комплекси вправ (кожен для певної частини стрибка), які використовувалися при складанні індивідуальних мікроциклів з урахуванням слабких і сильних сторін у підготовці дівчат. Причому, більшою мірою використовувалися вправи, що не вивчалися раніше. Такий підхід давав можливість за рахунок вивчення нових допоміжних вправ вносити зміни в окремі частини стрибка, а разом з цим формувати більш досконалу навичку цілісного стрибка, який згодом стане основою індивідуальної техніки. Комплекси склалися з односпрямованих вправ з підвищуваною складністю від першої вправи до заключної. Цілеспрямоване застосування розроблених комплексів сприяло вдосконаленню окремих частин стрибка з жердиною, підвищенню загальної та спеціальної фізичної підготовленості спортсменок. **Висновки.** Експериментальна апробація методики оптимізації темпо-ритмової структури розбігу у стрибунів з жердиною 14-16 років показала її ефективність як чинника оптимізації навчально-тренувального процесу. В ході експерименту досягнута стабілізація розбігу у стрибунів з жердиною, кількість вдалих змагальних спроб збільшилася від 46 до 69%, коефіцієнт реалізації швидкості розбігу у 4 дівчат збільшився, що свідчить про поліпшення техніки бігу з жердиною.

методика, стрибуні з жердиною, комплекси вправ, розбіг, темпо-ритмова структура

Методика оптимізації темпо-ритмової структури розбігу у прыгунів с шестом 14–16 лет. Борова Валентина, Врублевский Евгений, Севдалев Сергей

Одной из основных проблем сохранения набранной скорости на последних шагах разбега является неправильное построение его темпо-ритмовой структуры, что обусловлено несовершенством держания, несения и выноса шеста. Последнее связано с некоторой недооценкой тренерским составом роли разбега в прыжке с шестом. Актуальность работы обусловлена тем, что у ряда тренеров отсутствует четкое представление о взаимосвязи отдельных сторон тренировочного процесса в прыжках с шестом и места каждого средства в системе годичной подготовки спортсменов. **Цель исследования** – разработать методику темпо-ритмовой структуры разбега у прыгунів с шестом 14–16 лет. **Результаты исследования.** Были разработаны четыре комплекса упражнений (каждый для определённой части прыжка), которые использовались при составлении индивидуальных микроциклов с учётом слабых и сильных сторон в подготовке девушек. Причем, в большей степени использовались упражнения не изучаемые ранее. Такой подход давал возможность за счёт изучения новых вспомогательных упражнений вносить изменения в отдельные части прыжка, а вместе с этим формировать более совершенный навык целостного прыжка, который впоследствии станет основой индивидуальной техники. Комплексы состояли из однонаправленных упражнений с повышающей сложностью от первого упражнения до заключительного. Целенаправленное применение разработанных комплексов способствовало совершенствованию отдельных частей прыжка с шестом, повышению общей и специальной физической подготовленности спортсменок. **Выводы.** Экспериментальная апробация методики оптимизации темпо-ритмовой структуры разбега у прыгунів с шестом 14–16 лет показала ее эффективность как фактора оптимизации учебно-тренировочного процесса. В ходе эксперимента достигнута стабилизация разбега у прыгунів с шестом, количество удачных соревновательных попыток увеличилось от 46 до 69 %, коэффициент реализации скорости разбега у 4 девушек увеличился, что свидетельствует об улучшении техники бега с шестом.

методика, прыгуны с шестом, комплексы упражнений, разбег, темпо-ритмовая структура

Formulation of the problem. It is known, that with an increase of the skill of female athletes, the take-off speed starts to play a leading role in achieving high results in pole vaults [2, 5, 7, 11]. Currently, training aimed at running is carried out in two main ways: the first is to increase the absolute speed of running and the second is to reduce the difference between speed in a “smooth” run and run with the pole in hand [1, 10, 12].

One of the main problems in maintaining the gained speed in the last steps of the take-off is the incorrect construction of the tempo-rhythm structure of the take-off, which is due to the imperfection of holding, putting forward and carrying the pole. The latter occurs due to a certain underestimation of the role of the run in the pole vault by coaches. At the same time, a number of coaches lack a clear idea about the correlation of the individual sides of the training process in pole vaulting and the place of each means in the system of annual training of athletes.

Analysis of recent research and publications. An analysis of literary sources made it possible to single out the main tasks solved by athletes in the run in the pole vault [8, 13, 14, 15, 18]. Jumpers seek:

- to develop maximum controlled speed;
- to form the tempo-rhythmic structure of movements with an increased frequency of running steps at the end of the takeoff. It is characterized by a reduction in the flight phase time and an accentuated lowering of the leg to the support;
- to effectively put the pole at point-blank range and accurately place the foot in the place of repulsion.

In this case, it is important, according to experts, to consider two points. The first point (technical) is the imperfection of holding, putting forward and carrying the pole [1, 5, 6, 14, 18]. The second (methodical) is the lack of a clear understanding of the relationship between individual sides of the training process and the place of each means in the annual training system by coaches, which led to some underestimation of the role of running in the pole vault [7, 9, 11, 15].

When developing a methodology for optimizing the tempo-rhythm structure of the run, we proceeded from the fact that the exercises used were simple and attainable, and also provided for the formation of skills and abilities necessary when performing the basic movements and their meaningful attitude to implementation. Moreover, the main task of such exercises was to develop a sense of time, rhythm and orientation in space.

When considering the duration of targeted pedagogical impact, we relied on the opinion of a number of authors [3, 6, 9] that after 20-25 sessions aimed at improving elements of the technique of movements. According to them, we can get a positive effect from the methodology applied.

The aim of the study is to develop a methodology of the tempo-rhythm structure of the take-off run for pole-jumpers aged 14–16 years.

Material and research methods. The task of the first stage of the pedagogical experiment was to assess the level of development of physical qualities and the correspondence of load parameters to the characteristics of the sexual development of athletes. The studies were carried out at the winter sports day of the Youth and Youth Sports School, Sports School of the Gomel Region (12/23/2016) and the championship of the Gomel Region on 05/05/2017. The strongest pole-vaulters “SCYSOR (Sports children’s youth school of the Olympic reserve) on track and field athletics” (5 people) took part in them.

The objective of the second stage was to evaluate the biomechanical parameters of the pole vault technique. This was done whilst comparing the results of angular measurements with the model characteristic of the run of girls 14-16 years old.

The task of the third stage was the practical verification of the proposed methodology for optimizing the rhythm of the final part of the run for pole vaulters. To form the optimal tempo-rhythm structure of the take-off and improve the technical preparedness of the athletes, we used the special exercise complexes developed by us.

Calculation of mean values and determination of statistically significant differences using Student's T-criterion was performed by automatic calculation of the Microsoft OfficeExcel program.

The results of the study. Four sets of exercises were developed (each for a specific stage of the jump), which were used in compiling individual microcycles. This was done taking into account the strengths and weaknesses in the preparation of the girls. Moreover, not previously studied exercises were used to a greater extent. This approach made it possible to make changes in individual stages of the jump due to the study of new auxiliary exercises, and at the same time to form a more advanced skill of a holistic jump, which will subsequently become the basis of individual technique.

The complexes consisted of unidirectional exercises with increasing complexity from the first exercise to the final one.

COMPLEX 1

Orientation - improving the technique of the start of the take-off:

- 1) holding, carrying and the form of walking and running with a pole - 30 times;
- 2) the start of the take-off (walking through 1 - 2 - 3 steps of the stairs - 30 times;
- 3) walking and running according to the markings (1st step - 4 feet, 5 feet, 6 feet) - 30 times;
- 4) walking and running along the marks with the transition to acceleration - 30 times.

Between repetitions, the grip width and the method of carrying the pole are specified.

Focus - improving the middle part of the run:

- 1) 10 standard steps (walking through 4 stops, running through 6 stops) - 30 times;
- 2) walking 10 steps with lowering the pole and hitting the mark - 30 times;
- 3) 30 m run in the form of an acceleration and lowering the pole at the end of the segment - 30 times;
- 4) run on a run with repulsion (16 - 18 running steps) - 30 times.

COMPLEX 2

Orientation - improvement of take-off technique with transition to hanging:

- 1) jumping into hanging on a crossbeam from three steps, a rope, a gymnastic wall - 30 times;
- 2) placing in a box with a pole bending for 4 steps - 30 times;
- 3) "input of the pole" from 3 to 4 steps - 30 times;
- 4) "input with a pole" from 4 steps, with the transition to hanging on a pole (sand, box) - 30 times.

Between repetitions, the staging of the pole is improved by 4-6 steps;

- 5) the entrances to the sand (grip increases) from 4 - 6 - 8 steps, - 30 times;
- 6) bending the pole (pushing leg on the box with 2 steps, bending the pole (pushing leg on the box 30 - 40 cm) - 30 times;
- 7) jumping into a rope as high as possible from 4 to 6 steps - 30 times;
- 8) "entrances" to the box with 6 - 8 - 10 steps (grip as high as possible) - 30 times.

COMPLEX 3

Orientation - improved coordination of movements in the biomechanics of the running step:

At this stage it is very important to observe the principle of gradualness in increasing the intensity of performing special exercises. Improving coordination abilities begins with exercises on the accuracy of movements, first at a slow, then average, fast and fastest pace. It should be emphasized that the athlete must observe the transition from conscious control of movements to their automatic performance and it is very important to maintain a functional posture.

As is known [4, 13, 16, 17], the implementation of speed-power qualities should not be ahead of technical training in order to avoid the emergence of a "speed barrier". The intensity of performing special running exercises (SRE) and speed running is increased provided that the basic

technique of movements is maintained. Used exercises aimed at creating a sense of rhythm and orientation in space.

1). SRE - the length of the segment is 20-50 m walking with increasing intensity. At the end of the segment the speed is maximum, with the transition to running. For example, a gradual transition from "lifting the heel" to "lifting the knee and thigh" followed by running.

2). Running on segments of 40-120 m with an intensity of 80-90%, the pace is increasing, the rhythm is "1-2", "1-2-3" or "1-2-3-4". The task is to improve the technique of running and rhythm.

3). The same exercises were used as the previous complexes, but in a different modification. For example, a tenfold jump in marks or running through stuffed balls. When performing the exercises, certain conditions were observed (amplitude, sequence, repetition rate, duration, etc.)

COMPLEX 4

Orientation - special training for pole vaulters.

1) SRE and running on a segment with a shortened pole - to form a functional posture.

2) The same, with a lightened pole of normal length - to synchronize the frequency of oscillations of the pole and bct jumper.

3) The same when running on an incline track.

4) Repeated run on segments in the rhythm of the run.

5) Running with a pole of competitive weight and length on the move, with maximum speed.

COMPLEX 5

Orientation - improving the grouping and hanging:

1) holding on to a rope while sitting on the floor, a coup in a grouping - 30 times;

2) jumping to the crossbar from two steps - perform grouping - 30 times;

3) entering, hang, flip - get the pole with your feet from 2 - 4 - 6 steps, - 30 times;

4) performing grouping and staying at the pole from 4 - 6 - 8 steps - 30 times;

Between exercises - the work of the hands in the broach and turn (standing on the ground).

5) the implementation of the "broach" and rotation on the trolley (training simulator) - 30 times;

6) the implementation of the "broach" and rotation on the suspended simulator - 30 times;

7) with a run of 4 to 6 steps, a long jump without turning is 30 times;

8) from 6 to 8 steps of the take-off jump with a pole without a bar - 30 times.

COMPLEX 6

Orientation - combining elements in a jump:

1) lightweight pole, run 6 - 8 steps, jump over the bar - 30 times;

2) a jump from a rope over a bar (standing on a dais) - 30 times;

3) pole vault without turning (get the bar with your feet) - 30 times;

4) entrances on a high grip (in sand, box) with 14 - 16 - 18 take-off steps - 30 times;

Between jumps - imitation of staging and turning on a pole.

5) jumping at an easily overcome height (style formation) - 30 times;

6) jumps from 14 to 16 take-off steps (after 2 jumps, raise the bar) - 30 times;

7) from a sitting position on the ground, bend and hold the pole for 5 s - 30 times;

8) the formation of a competitive jump (run, grip, pole number) - 30 times.

From each complex, 1-2 exercises were included in the training session, then the following exercises were used in the classes. In each training session, physical exercises were included with the goal of eliminating the weakened links and forming muscle topography, which provides the opportunity to master the technique of a universal style of jumping.

A pedagogical experiment was conducted to identify the dependence of the technique of performing a competitive exercise on the level of development of the physical qualities of young pole vaulters, as well as substantiating the effectiveness of the proposed methodology for optimizing the rhythm of the final part of the run for pole vaulters. The experiment was carried out in three stages.

II. Науковий напрям

The task of the first stage of the pedagogical experiment was to assess the level of development of physical qualities and the correspondence of load parameters to the characteristics of the sexual development of athletes.

The survey data, conducted at the first stage, recorded a low level of power and speed-power abilities, which indicates the insufficient use of such exercises in the training process (Table 1).

Table 1

Test results of the experimental group before and after the experiment

Testing steps	Before the experiment	After the experiment	Significance of Differences (p)
Tests			
<i>General physical training</i>			
Running 10 meters, s	1,92±0,083	1,84±0,08	<0,05
Running 5 minutes, m	1295±54	1525±98	<0,05
Running "snake" 10 m, s	2,52±0,05	2,46±0,06	<0,05
Tilt forward, cm	28,2±1,45	32±2	>0,05
Long jump from a place, cm	205,5±2,5	217,5±2,81	>0,05
<i>Special physical training</i>			
Pull-ups on the crossbar, number of times	3,5±0,6	4,3±0,73	>0,05
Five forward somersaults together, s	6,56±0,03	6,03±0,01	<0,05
Five somersaults back together, s	8,21±0,14	7,71±0,23	<0,05
Raising legs on the crossbar, number of times	10,6±1,4	12,8±1,8	>0,05

The objective of the second stage was to evaluate the biomechanical parameters of the pole vault technique. When comparing the results of angular measurements with the model characteristic of the run of girls 14–16 years old (Table 2), inconsistencies were established that indicate insufficient technical readiness of pole jumpers.

Table 2

Biomechanical indicators of pole vaulters 14-16 years old before and after the experiment

Biomechanical indicators	Before the experiment	After the experiment
Official result, m	2.80	3.20
Number of steps	10	12
Speed in the run-up, m/s	6,4-6,6	6,8-7,0
The slope of the pole at the beginning of the run, degrees	71	74
The slope of the pole in the middle of the run-up, degrees	64	64
Setting the pole is performed	4 steps	6 steps
Pace of the last run-up steps, step/s	4	5
Pole setting angle, degrees	40	31
Angle of flexion of the lower grip arm, degrees	81	90
The angle of flexion of the leg, the degree	95	110
Repulsion time, s	0,74	0,66
Pole bending time, s	1,98	2,97
The angle between the torso and thighs in the grouping, degrees	55	51
The maximum distance of the CCM from the pole during "broaching", sm	87	64
The angle between the body and hips at the end of the "broach", degrees	93	120
The angle between the shoulder axis and the bar at the transition, degrees	30	The shoulder axis is parallel to the bar

An assessment was also made of the degree of realization of the speed capabilities of athletes in a competition. It was estimated by the speed realization coefficient (the ratio of the competitive speed on the last 5-meter take-off run to the absolute running speed, in percent).

The degree of implementation of the take-off speed in different stages of the jump was estimated by the coefficient of the take-off speed (the ratio of the competitive result to the speed in the last 5-meter run). There was a lag in the speed realization coefficient from model indicators and the low implementation coefficient of the take-off speed, which indicates the absence of an optimal rhythm of the final part of the take-off for pole-jumpers (Table 3).

Table 3

**The degree of implementation of the speed capabilities of athletes in a competition
(12/23/2016) at the beginning of a pedagogical experiment**

Indicators	Sportswomen				
	K.K.	A.E.	K.D.	I.U.	M.K.
Competitive result, sm	360	340	320	320	280
Running for 10m on the move, s	1,29	1,32	1,29	1,35	1,36
The sales ratio of speed, %	93,8	92,4	88,1	89,7	85,9
Speed on the penultimate 5 m run, m/s	7,11	6,83	6,64	6,55	6,11
Speed at the last 5 m run - up, m/s	7,27	7,01	6,83	6,65	6,31
Coefficient of implementation of the run-up speed, c.u.	0,495	0,485	0,469	0,481	0,444

The task of the third stage was the practical verification of the proposed methodology for optimizing the rhythm of the final part of the run for pole vaulters. To form the optimal tempo-rhythm structure of the take-off and improve the technical preparedness of the athletes, we used the special exercise complexes developed by us. Each complex was repeated twice a week for three weeks, exercises were performed at the end of the main part of the session.

The purposeful use of the complexes contributed to the improvement of individual parts of the pole vault, to the increase of general and special physical fitness.

Discussion. The results of this study relate to pole vaulters 14-16 years old. Only a few authors drew attention to the indicated contingent of students [13, 17], and most studies were conducted on qualified athletes [1, 5, 6, 7, 14, 18]. The methodology for optimizing the tempo-rhythm structure of the run for pole vaulters at the initial specialization stage was proposed for the first time. However, it should be noted, that work with any contingent of athletes has important nuances, which can also be systematized and considered in further observations and studies.

In the course of our experiment, positive dynamics can be traced in general and special physical fitness (see Table 1). Due to the targeted use of strength exercises, athletes experienced a significant increase in strength and speed-strength abilities. Thus, the result in raising legs on the crossbar increased from $10,6 \pm 1,4$ to $12,8 \pm 1,8$ times ($p > 0.05$), and in long jumps from standstill: from $205,5 \pm 2,5$ to $217,5 \pm 2,81$ cm ($p > 0.05$).

The level of development of motor coordination abilities and endurance has also changed. If before the experiment the result in a 5-minute run was 1295 ± 54 m, then after the experiment it was 1525 ± 98 m ($p > 0.05$). The execution time of the five somersaults back and forth increased from $6,56 \pm 0,03$ to $6,03 \pm 0,01$ s and from $8,21 \pm 0,14$ to $7,71 \pm 0,23$ s, respectively. The differences are statistically significant for a 5% significance level.

The purposeful use of the complexes also contributed to the stabilization of the run for pole vaulters. The number of successful competitive attempts increased from 46% in December to 69% in May, the coefficient of realization of the take-off speed of 4 girls increased, which indicates an improvement in the technique of pole vaulting (table 4).

Table 4

The degree of implementation of the speed capabilities of athletes in a competition (05/05/2017) at the end of a pedagogical experiment

	Sportswomen				
	K.K.	A.E.	K.D.	I.U.	M.K.
Competitive result, cm	380	360	340	320	300
Running for 10m on the move, s	1,28	1,30	1,30	1,32	1,34
The sales ratio of speed, %	94,9	93,1	91,2	88,3	86,9
Speed on the penultimate 5 m run, m/s	7,19	7,03	6,78	6,52	6,27
Speed at the last 5 m run - up, m/s	7,41	7,16	7,01	6,69	6,48
Coefficient of implementation of the run-up speed, c.u.	0,513	0,503	0,485	0,478	0,463

All athletes increased speed in the penultimate and last five-meter section before repulsion.

The coefficient of realization of the take-off speed increased in four out of five jumpers, and in two girls it approached the model indicators, which testifies to the high technical running fitness of the athletes and the ability to translate the obtained kinetic run-off energy into repulsion.

Thus, the dependence of the technique of competitive exercises on the level of physical fitness of pole-jumpers aged 14-16 years is confirmed by positive test results and a change in the kinematic and dynamic characteristics of the jump. At the same time, correction of special running training aimed at optimizing the tempo-rhythm structure of the take-off run is a fundamental condition for "minimizing" pedagogical errors and prevents inadequate acceleration and deceleration of the level of performance as sportsmanship grows.

Conclusions. Experimental testing of the methodology for optimizing the tempo-rhythm structure of the run for jumpers with a pole of 14-16 years old has shown its effectiveness as a factor in optimizing the educational process. During the experiment, stabilization of the takeoff run for pole vaulters was achieved, the number of successful competitive attempts increased from 46 to 69%, the coefficient of realization of the takeoff speed of 4 girls increased, which indicates an improvement in the technique of pole vaulting.

The new data obtained broadens and deepens the knowledge about the system of knowledge regarding the directions of optimizing the training of athletes, makes it possible to use the qualitative values of technical readiness indicators in the correction of the training process, and to determine the prerequisites for improving the competitive activity of pole jumpers of various qualifications.

The prospect of further research can be concluded in the development of methods for the tempo-rhythm structure of the take-off run for qualified pole vaulters.

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