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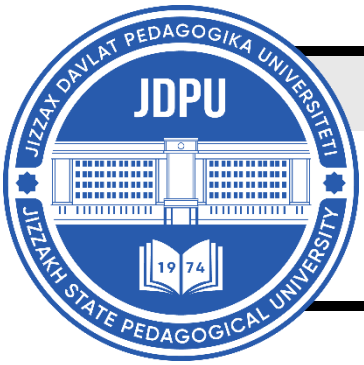

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OPTIMIZING SPEED ENDURANCE DEVELOPMENT IN YOUNG TRIATHLETES UNDER THE AGE 15–16

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ABOUT ARTICLE

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Abstract: This research aimed to develop and experimentally validate a specialized training methodology for enhancing speed endurance in young triathletes aged 15–16. Speed endurance is a critical physical quality in triathlon, determining the athlete's ability to sustain high-intensity efforts across swimming, cycling, and running segments. The research employed an eight-week pedagogical experiment involving two groups—control (traditional training) and experimental (specialized methodology)—each consisting of ten athletes. The experimental program integrated circuit training, interval work, plyometrics, and technical-tactical exercises, with progressively reduced rest intervals to induce pronounced fatigue. Pre- and post-test assessments included 400 m swim time, 20 km cycling time, 3 km and 5 km run times, stroke/step frequency, and overall endurance scores. Results indicated that the experimental group showed significantly greater improvements in speed endurance indicators compared to the control group, with notable gains in swimming, cycling, and running performance, as well as enhanced muscular endurance and movement efficiency. The

findings confirm that a structured, fatigue-based circuit training approach effectively develops speed endurance and specialized physical preparedness in young triathletes. The study provides practical recommendations for coaches to optimize training programs during this sensitive developmental period.

Relevance of the research. The development of speed endurance in young triathletes constitutes one of the key factors for enhancing the effectiveness of their competitive performance. This physical quality characterizes an athlete's ability to perform motor actions at the highest possible speed over a specific time interval while maintaining high work capacity. Within the context of triathlon, which comprises three sequentially performed cyclic disciplines—swimming, cycling, and running—speed endurance directly determines the stability of pace, the efficiency of technique, and the ability to maintain competitive intensity at each stage of the distance.

The relevance of the research is due to the fact that athletes aged 15–16 undergo intensive development of the body's functional systems, refinement of energy supply mechanisms, and increased sensitivity to specific training stimuli. During this period, it is particularly important to implement scientifically based, age-appropriate, and sports readiness level-specific methodologies for developing speed endurance. These methodologies must ensure a gradual and safe increase in training loads.

Modern approaches to developing this physical quality involve not only enhancing the physical capabilities of young triathletes but also integrating technical, tactical, and coordination components into their training. The complex nature of the training process contributes to the development of resilience to speed loads under conditions of mounting fatigue, optimizes motor activity, and improves athletic performance.

Therefore, the development and scientific substantiation of effective methodological approaches for enhancing speed endurance in triathletes aged 15–16 represents a pertinent objective within contemporary theory and methodology of sports training.

The objectives of the research

The objective of this research is to identify and experimentally substantiate effective methodological approaches for developing speed endurance in young triathletes aged 15–16. Additionally, the study aims to assess the impact of the developed methodologies on their level of physical preparedness and competitive performance. The fulfillment of this objective is

intended to optimize the training process and enhance the effectiveness of triathletes' performances at competitions of various levels.

The tasks of the research are as follows:

- to identify the primary factors influencing the development of speed endurance in young triathletes aged 15–16.
- to determine and experimentally substantiate the effectiveness of various training methods aimed at developing speed endurance within the sports training process.
- to develop practical recommendations and a training methodology based on the obtained data for optimizing the development of speed endurance in athletes of the specified age.

Results and discussion of the research

Specialized physical preparation is a key structural component of the triathlete's training process and plays a determining role in the successful execution of competitive performance across all stages of the distance. Regardless of the athlete's specialization (sprint, standard, half-Ironman), specialized preparation should be aimed at developing motor skills and physical qualities corresponding to the specific demands of triathlon.

The results of this study confirm that the targeted development of speed endurance contributes to an increased level of functional readiness in young triathletes, improved resistance to fatigue, and an enhanced ability to maintain a high pace across all stages—swimming, cycling, and running. The formation of specialized physical preparedness involves the integration of key physical qualities such as speed, endurance, strength, speed-strength capabilities, and movement coordination, which directly determine the effectiveness of competitive performance in triathlon.

Of particular significance is the fact that, in accordance with the requirements of current sports training standards, physical qualities and the level of specialized performance capacity are determining indicators of athletic results. The obtained data demonstrate that the developed training methodology, focused on developing speed endurance, positively impacts the pace of completing individual stages of the triathlon distance, reduces fatigue indicators, and contributes to an enhanced overall level of specialized physical preparedness in athletes aged 15-16.

In triathlon, competitive performance and athletes' results are directly dependent on their level of specialized physical preparedness. This preparation must be aimed at developing motor capabilities specific to the discipline and should ensure the improvement of speed endurance as one of the key factors for successful performance.

An important condition for increasing the effectiveness of a triathlete's competitive activity is the harmonious development of speed and endurance, as their interrelation determines the athlete's ability to maintain a high work pace throughout all three stages—swimming, cycling, and running. The optimal combination of these physical qualities contributes to increased resistance to fatigue, refinement of technique, movement economy, and, consequently, improvement of the final competitive result.

Each age period possesses specific characteristics of bodily growth and development. The existence of sensitive (critical) periods for the development of conditioning and coordinative physical qualities allows a coach to purposefully plan training stimuli, taking into account the athlete's age-related capabilities, and to rationally dose loads of varying nature. Each physical quality in ontogeny has a most favorable period for development, during which the greatest improvement in indicators is observed under adequate training stimulus. The manifestation of these qualities is determined by individual characteristics and hereditary factors.

The age of 15–16 years represents a sensitive phase for the development of speed, precision of motor reactions, the ability to anticipate competitive situations, speed of information processing, spatial perception, attentional stability, and the level of cognitive operations. For young triathletes, this age period is particularly significant, as the formation of psychomotor and perceptual skills is directly linked to effective movement control, coordination, and tactical decision-making within the multifaceted context of competitive activity.

In this regard, it is essential for the coach to structure the training process with consideration for age-related sensitive periods, directing training means towards the development of psychomotor abilities, sensorimotor coordination, reaction speed, and cognitive functions that underpin successful competitive performance in triathlon.

The summarized results of the study indicate that by the age of 15-16, young athletes have largely developed key psychomotor qualities, including indicators characterizing the speed and accuracy of motor reactions, as well as cognitive and perceptual functions. According to triathlon sports training standards, this age corresponds to the stage of sports mastery refinement. Modern triathlon, characterized by high-intensity competitive activity, imposes heightened demands on athletes not only in terms of their general physical preparedness but also their specialized physical preparedness.

Organizing the training-educational process based on a rational balance between means of general and specialized physical preparation is a key condition for achieving high athletic

results. For triathletes aged 15-16, the determining factor for successful performance is a high level of speed and specialized endurance, ensuring the ability to maintain the required competitive pace across all three stages of the distance.

The targeted development of these physical qualities through the application of interval and circuit training, based on the principle of performing exercises until pronounced fatigue, contributes to a significant increase in the level of specialized physical preparedness of young triathletes and an improvement in their competitive performance.

Analysis of the competitive activity of young athletes revealed that the determining physical quality ensuring success in triathlon is speed endurance—the ability of muscles to maintain high speed and power output under conditions of prolonged load. In order to determine the optimal training regimen for developing specialized physical qualities, an eight-week pedagogical experiment was conducted.

Two groups of ten individuals each were formed—a control group and an experimental group, comparable in age (15-16 years) and level of preliminary preparedness in the course of the study. Athletes in the control group trained using a traditional methodology corresponding to the current triathlon sports training program. In contrast, the training process of the experimental group incorporated a methodology developed by the authors, aimed at the targeted development of speed endurance.

Both groups conducted training sessions three times a week, each session lasting two hours (see Table 1).

Table 1

Structure of the Training Process in the Experimental and Control Groups (Ages 15-16)

Week Training Days Introductory Part (15–20 min) Main Part (80–90 min) Concluding Part (10–15 min)

1–2 Monday, Wednesday, Friday Light running, general physical training (GPT) exercises, stretching • Swimming technique (20 minutes)

- Interval training on the bicycle (2 sets: 1 min work + 3 min rest)
- Additional exercises (medium intensity) Stretching, breathing exercises (10-15 minutes)

3–4 Monday, Wednesday, Friday General physical exercises, stretching (15-20 minutes) • Swimming and cycling technique (20 minutes)

- Interval running (2-3 sets: 1 min work + 2.5 min rest)
- Plyometric exercises (advanced) Recovery exercises (10-15 minutes)

5–6 Monday, Wednesday, Friday Light running, speed exercises, stretching (15-20 minutes) • Technical-tactical triathlon exercises (20 minutes)

- Combined interval training (3 sets: 1 min work + 2 min rest)
- Additional exercises (jumps, short accelerations, high intensity) Breathing exercises, relaxation (10-15 minutes)

7–8 Monday, Wednesday, Friday

Dynamic exercises, stretching, short starts (15-20 minutes) • Transition zone practice at race pace (20 minutes)

- Interval training (3 sets: 1 min work + 1.5 min rest)
- Additional exercises (intensity near competition level) Transition zone, recovery exercises (10-15 minutes)

The eight-week training program developed for triathletes aged 15-16 was implemented three times a week (Monday, Wednesday, Friday). The training sessions consisted of three parts: an introductory segment (15–20 minutes), a main segment (80–90 minutes), and a concluding segment (10–15 minutes).

The program involved a sequential combination of general and specialized physical preparation. In the initial weeks, emphasis was placed on refining movement technique and performing exercises in a circuit format consisting of two cycles. In subsequent stages, combined exercises, plyometric tasks, and high-intensity circuit training were employed.

Beginning with the fifth week, the sessions included elements of technical and tactical preparation, as well as short high-intensity runs and jumping exercises. During the final stage, conditions were created that closely simulated competition, involving the execution of complex exercises and the imitation of competitive activity.

Circuit training, where exercises were performed until a state of pronounced fatigue was reached, occupied a central place in the program. Rest intervals at the initial stages were 3 minutes and were gradually reduced to 1.5 minutes. This approach ensured the targeted development of athletes' speed and speed-endurance qualities.

The research methodology stipulated that after each training session, exercises in a circuit format were to be performed. These were aimed at achieving a state of complete fatigue at each of the five workstations, with recovery intervals of three minutes set between them.

To assess the impact of the methodology on the development of speed endurance, control tests of physical preparedness were conducted in both groups at the beginning and end of the experiment (Tables 2, 3, and 4).

Table 2

Results of Special Tests for Athletes in the Triathlon Control Group Before and After the Experiment

Control exercises	*400 m swimming (s)*		*20 km cycling (min)*		*3 km run (min)*		*Pedal strokes/min*		*Arm strokes/min*		*Running steps/min*		*Total score*	
	BE	**AE**	**BE**	**AE**	**BE**	**AE**	**BE**	**AE**	**BE**	**AE**	**BE**	**AE**	**BE**	**AE**
MLI	8:49	8:25	38,7	36,9	13,4	12,7	91	95	70	74	203	210	203	210
SAI	8:53	8:27	39,0	37,2	13,5	12,8	95	101	66	70	212	219	212	219
HPI	8:47	8:23	38,2	36,5	13,2	12,6	92	97	68	72	204	213	204	213
SAI	8:48	8:24	38,5	36,8	13,3	12,7	90	94	70	73	204	213	204	213
PDI	8:50	8:25	38,8	37,0	13,4	12,8	91	95	69	73	202	211	202	211
SCI	8:52	8:26	39,0	37,1	13,5	12,9	92	97	6	69	207	214	207	214
SAI	8:48	8:23	38,4	36,7	13,3	12,6	91	96	66	70	210	217	210	217
TAI	8:47	8:22	38,3	36,6	13,2	12,6	90	95	63	67	213	220	213	220
EAI	8:50	8:26	38,9	37,2	13,4	12,8	92	97	67	71	213	220	213	220
ELI	8:54	8:29	39,1	37,4	13,6	12,9	93	97	70	74	210	220	210	220

Table 3

Results of Special Tests for Athletes in the Triathlon Experimental Group Before and After the Experiment

Control exercises	*400 m swimming (s)*		*20 km cycling (min)*		*3 km run (min)*		*Pedal strokes/min*		*Arm strokes/min*		*Running steps/min*		*Total score*	
	BE	**AE**	**BE**	**AE**	**BE**	**AE**	**BE**	**AE**	**BE**	**AE**	**BE**	**AE**	**BE**	**AE**
BLI	8:45	8:21	38,5	36,7	13,2	12,6	92	97	58	62	178	191	205	217
BEI	8:39	8:18	37,9	36,2	13,0	12,4	94	98	59	64	180	193	207	219
ALI	8:57	8:28	39,2	37,0	13,5	12,7	90	95	56	61	175	187	203	214
ELI	8:52	8:23	38,8	36,9	13,3	12,5	91	96	58	63	177	190	204	216
PLI	8:49	8:25	38,6	36,8	13,4	12,6	92	97	59	64	179	191	206	218
EAI	8:55	8:29	39,1	37,2	13,6	12,8	90	95	57	62	176	188	204	215

SAI	8:43	8:17	38,0	36,3	13,1	12,4	93	98	60	65	181	194	208	220
MLI	8:47	8:22	38,3	36,5	13,2	12,5	92	97	58	63	178	190	205	217
ALI	8:50	8:26	38,7	36,9	13,4	12,6	91	96	59	64	179	192	206	218

The results of the conducted control exercises showed a steady increase in performance indicators for both combined and individual actions performed by the athletes. Specifically, the number of combinations consisting of two straight hand strikes and a side kick executed within one minute, at the initial stage, averaged 50.40 ± 2.72 times in the control group, while in the experimental group this indicator was 49.60 ± 3.34 times. Upon completion of the experiment, the average value for the control group reached 54.80 ± 2.82 times, and for the experimental group—54.00 ± 3.33 times. The obtained data indicate a consistent increase in the efficiency of motor action execution in both the control and experimental groups.

The number of maximum side hand strikes performed in one minute, at the initial stage, was 201 ± 6.18 times in the control group and 197.9 ± 9.09 times in the experimental group. At the final stage, this indicator increased to 208.2 ± 6.12 and 204.8 ± 8.63 times respectively, indicating positive changes in speed and endurance during the execution of motor actions.

Table 4

Comparison of Growth Indicator Dynamics in Athletes of the Control and Experimental Groups at the End of the Study (Triathlon)

Control Exercises	**Control group**		**Experimental group**	
	BE	**AE**	**BE**	**AE**
400 m swim (s)	320,4±6,1	312,7±5,9	321,9±5,8	309,4±6,0
20 km cycling (min)	37,6±1,4	36,9±1,2	38,1±1,3	35,8±1,1
5 km run (min)	23,9±0,9	22,8±0,8	24,1±0,8	22,0±0,7
General endurance (points)	66,9±2,4	70,1±2,3	67,1±2,1	71,9±1,8
Total score (points)	208,3±6,2	213,7±6,1	207,9±6,3	214,7±5,9

The number of maximum side kicks (dollyo chagi) performed in one minute initially stood at 91.6 ± 4.03 times in the control group and 92.2 ± 3.36 times in the experimental group. By the end of the experiment, these indicators reached 97.30 ± 4.37 and 97.20 ± 3.36 times, respectively, indicating an improvement in the efficiency and serial execution of motor actions in athletes of both groups.

Analysis of the presented results from the control exercises demonstrated that during the experiment, the dynamics of motor activity indicators underwent positive changes. Although athletes from both groups exhibited steady performance growth, representatives of the experimental group demonstrated a higher rate of improvement in a number of indicators. This points to a progressive development of speed and endurance qualities in the muscles of the upper and lower extremities. The data obtained upon completion of the study confirm the effectiveness of specialized training means aimed at developing speed endurance in triathletes.

Conclusion. The conducted eight-week experimental study confirmed the effectiveness of circuit training, based on the principle of performing exercises to a state of pronounced fatigue, in enhancing the specialized physical preparedness of triathletes aged 15-16. Athletes in the experimental group exhibited a significant increase in the speed and speed endurance of both upper and lower limb muscles compared to the control group. This ensured the sustained execution of high-intensity motor actions during competitive performance.

Furthermore, the gradual reduction of rest intervals contributed to an acceleration in the athletes' adaptation to physical loads and an improvement in the functional capabilities of their bodies.

Based on the obtained results, it can be concluded that within triathlon, the developed methodology aimed at cultivating speed endurance is an effective means of elevating the level of specialized physical preparedness. It can be recommended for integration into the training process of athletes aged 15-16 with the aim of achieving high athletic results.

References:

1. Одилов.И.И. Развитие скоростной и силовой выносливости триатлетов 14-15 лет с использованием беговых тренировок. Fan sportga – 2025. 51 p.
2. Triatlon [Darslik] - I.B. Bobomuratov., Chirchiq: O‘zDJTSU, 2022. -274p
3. Friel Joe //The Triathlete’s Training Bible. USA: Sport - VEP – lag, 2009,594p.
4. И.И. Одилов – Содержание средств беговой подготовки юных триатлонистов. Fan sportga – 2025. 69 p
5. Ниязова Р.Р., Лозовой Д.А. Особенности развития физических качеств в триатлоне. Метод. пособие. Издательство при УГУФКиС. Ч.:-2022-80p