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METHODOLOGY FOR PREPARING HURDLE RUNNERS IN TRAINING GROUPS FOR COMPETITIONS ACROSS ANNUAL PREPARATION STAGES

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Abstract
This article presents a modern pedagogical methodology for preparing 15–17-year-old hurdle runners (competing in 100m, 110m, and 400m events) within the training groups of sports schools and Olympic reserve centers. The study focuses on athletes in their second or third year of training. Mechanisms were developed to optimize the balance between general physical preparation (GPP), special physical preparation (SPP), and technical-tactical elements throughout the four stages of the annual training macrocycle: general preparation, special preparation, pre-competition (including the main competition phase), and the transition phase. In the pedagogical experiment, the efficiency coefficient of hurdling technique ($\Delta t = t_{hurdle} - t_{flat}$), the stability of the three-stride rhythm between hurdles, and the growth dynamics of speed-strength indicators were evaluated using the Brody formula and Student's t-test. In the experimental group, the technical index improved from 1.82 ± 0.09 seconds to 1.44 ± 0.07 seconds ($p < 0.01$), while performance in the 110m hurdles improved by an average of 6.04%.

Keywords: Track and field (athletics), hurdling, training group, annual macrocycle, periodization, pre-competition mesocycle, technical efficiency coefficient, hurdle rhythm, speed-strength qualities.

Introduction

O‘QUV-MASHG‘ULOT GURUHI G‘OVLAR OSHA MUSOBAQALARGA YILLIK TAYYORGARLIK BOSQICHLARI BO‘YICHA TAYYORLASH TEXNOLOGIYASI

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Annotatsiya
Maqolada sport maktablari va olimpiya zaxiralari markazlarining o‘quv-mashg‘ulot guruhlarida shug‘ullanuvchi 15–17 yoshli g‘ovlar osha yuguruvchilarni (100 m, 110 m va 400 m) yillik makrosikl bosqichlarida musobaqalarga tayyorlashning zamonaviy pedagogik texnologiyasi asoslab berilgan. Tadqiqot o‘quv-mashg‘ulot bosqichining 2–3-yillaridagi sportchilarni qamrab olgan. Yillik tayyorgarlikning to‘rt bosqichli tuzilmasida, ya’ni umumiy tayyorgarlik, maxsus tayyorgarlik, musobaqa oldi hamda asosiy musobaqa va o‘tish bosqichlarida umumiy jismoniy tayyorgarlik (UJT), maxsus jismoniy tayyorgarlik (MJT) va texnik-taktik vositalar nisbatini optimallashtirish mexanizmlari ishlab chiqildi. Pedagogik tajribada g‘ovlar osha yugurish texnikasi samaradorlik koeffitsiyenti ($\Delta t = tg/o - ttekis$), g‘ovlar orasidagi 3 qadamli ritm barqarorligi va tezkor-kuch ko‘rsatkichlarining o‘sish dinamikasi Brody formulasi hamda Styudentning t-mezoni yordamida baholandi. Tajriba guruhida texnik indeks $1,82 \pm 0,09$ soniyadan $1,44 \pm 0,07$ soniyagacha yaxshilandi ($p < 0,01$), 110 m g‘ovlar osha yugurish natijasi esa o‘rtacha 6,04% ga oshdi.

Kalit so‘zlar: yengil atletika, g‘ovlar osha yugurish, o‘quv-mashg‘ulot guruhi, yillik makrosikl, davriylashtirish (periodizatsiya), musobaqa oldi mezotsikli, texnik samaradorlik koeffitsiyenti, g‘ovlar ritmi, tezkor-kuch sifatlar.

Introduction

Hurdling is a technically complex discipline within modern track and field that demands a high degree of coordination. It encompasses the 100m event for women, as well as the 110m and 400m events for men [1]. To achieve high-level results, an athlete must possess maximum sprinting speed and speed-strength endurance; they must clear standard-height hurdles (ranging from 0.762 m to 1.067 m) while maintaining high horizontal velocity and minimal vertical displacement, all while adhering to a precise rhythmic structure between the hurdles [6, 5].

In the Republic of Uzbekistan, the reform of the physical education and sports system—specifically the identification and targeted training of talented youth within sports schools and centers for Olympic and Paralympic preparation—has been established as a priority of state policy. At the "training group" (TG) stage, athletes aged 15–17 transition from foundational technical skills toward in-depth specialization and the ability to perform at high competitive speeds. During this

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period, the improper distribution of annual training loads—for instance, forcing preparation too early or creating an imbalance between flat-sprinting and hurdling technique—can lead to the emergence of a "speed barrier" and the entrenchment of technical errors [2, 4].

An analysis of current practice reveals that many coaches, when planning for training groups, focus primarily on increasing the total volume of running. In doing so, they often fail to adequately integrate key elements during the pre-competition phases: the biomechanics of hurdling (specifically the movements of the lead and trail legs), the trajectory of the athlete's center of gravity while clearing the hurdle, and methods for simulating the competitive rhythm [3]. Consequently, there is significant scientific and practical value in developing and empirically testing a scientifically grounded methodology for preparing hurdlers for competition throughout the annual training cycle.

Literature Review

Numerous fundamental studies have been conducted by both domestic and international scholars regarding the theory of periodization in sports training and the methodology for teaching track and field.

L.P. Matveyev, V.N. The perspectives of Platonov and T. Bompa regarding classical and block periodization of sports training, along with research on the periodization of modern sprint and hurdle events [9], indicate the necessity of dividing the annual cycle into preparatory (general and specific), competitive (early and main events), and transitional phases. In sprint and hurdle events, a dual-peak macrocycle model encompasses both the indoor winter season and the outdoor summer season. This model enables athletes in training groups to reach an optimal peak of athletic form twice throughout the year.

The stages of teaching hurdle-running technique are described in the works of specialists from Uzbekistan: R. Qudratov [2], M.J. Abdullayev, M.S. Olimov, N.T. To‘xtaboyev [1], U.R. Radjapov [3], and M.A. Fatullayeva [4]. These works cover the approach run from the start to the first hurdle (typically 7–8 strides), the angle of attack on the hurdle, and the development of a specific stride rhythm—3 strides between hurdles for sprint hurdles, and 13–17 strides for the 400m hurdles. However, for athletes at the training-group stage, there is no systematic framework for the

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quantitative distribution of specialized plyometric, eccentric, and technical-rhythmic loads across annual mesocycles.

Biomechanical and force-velocity factors in hurdling. The biomechanics of clearing hurdles have been analyzed in World Athletics publications and various international research studies [6, 5, 7]. Furthermore, materials from the UKSCA (United Kingdom Strength and Conditioning Association) address the strength conditioning of hurdlers [8]. Elite-level hurdlers typically take off 1.95–2.15 meters before the hurdle and land 1.05–1.25 meters beyond it. The support phase duration is 0.10–0.12 seconds. For adolescent and young hurdlers, the targeted development of eccentric and reactive strength in the hamstrings and the ankle joint is essential for achieving a technique that allows them to "run over" the hurdles—rather than "jumping over" them—at competitive speeds [8].

Scientific Problem and Research Hypothesis. Periodizing specialized physical and technical training tools—based on a four-stage block-modular framework—within the annual training plan for hurdlers, combined with the use of a "variable hurdle spacing and height" method during the pre-competition mesocycle, will reduce the athletes' technical efficiency index (Δt) by 0.30–0.40 seconds and ensure consistent improvement in competitive performance.

Research Objective, Tasks, and Methodology. The objective of this study is to develop a block-modular pedagogical technology for preparing 15–17-year-old hurdlers (in the training group) for competitions throughout their annual training cycle, and to empirically validate its effectiveness. Research objectives: To analyze the distribution of the volume and intensity of training means across the stages of the annual macrocycle for hurdlers in a training group.

To develop a preparation methodology—encompassing blocks for specialized physical conditioning, technical-rhythmic training, and pre-competition modeling—tailored for the four main stages of the annual cycle.

Determining the impact of the developed technology on the physical and technical preparation indicators of athletes through a pedagogical experiment.

Research methods and organization. The study employed the following methods: analysis of scientific and methodological literature, pedagogical observation, chronometry (timekeeping) and video-biomechanical analysis, pedagogical testing, a pedagogical experiment, and mathematical-statistical analysis. For the pedagogical experiment, 24 hurdlers aged 15–17—holding youth ranks II and I, as well as the

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adult rank III—were divided into two equal groups. The athletes practiced the 110-meter hurdles; for the youth category, the hurdle height was 0.914 m, and the distance between hurdles was 9.14 m.

The control group (CG, n = 12) trained according to the traditional curriculum used in sports schools. The experimental group (EG, n = 12) followed a training program based on a proprietary block-modular annual preparation and competition-focused preparation technology.

Evaluation criteria and mathematical-statistical apparatus. To evaluate the technique of hurdling, the following integral indicator was used:

$$Ktex = \Delta t = t110m_hurdles - t110m_flat \quad (1)$$

Here, t110m_hurdles is the time taken to run 110 meters over 10 standard hurdles (s), and t110m_flat is the time taken to run 110 meters on a flat track (s)—determined either by calculating t100m × 1.10 or by direct measurement. A smaller value for Δt indicates a lower loss of horizontal velocity when clearing the hurdles [1, 5].

The relative growth rate of the indicators during the experiment was calculated using V. Brody's formula:

$$W = 100 \times |V2 - V1| / [0.5 \times (V1 + V2)] (\%) \quad (2)$$

Where V1 is the arithmetic mean at the beginning of the experiment ($\bar{X}1$), and V2 is the arithmetic mean at the end of the experiment ($\bar{X}2$). The statistical significance of differences between groups was assessed using Student's t-test at the $p < 0.05$ and $p < 0.01$ levels.

Results and Discussion: Annual training technology and the effectiveness of the experimental approach regarding the distribution of training loads across the stages of the annual macrocycle.

For hurdlers in the training group during their 2nd–3rd year of study, the annual macrocycle was divided into four interconnected methodological stages. The macrocycle spanned 52 weeks, totaling 624 training hours, with 5–6 training sessions conducted per week (Table 1). In accordance with modern periodization principles [9, 8], the volume of the training load was reduced in a wave-like pattern from the general preparatory stage toward the competitive stage; meanwhile, the intensity of movement and the degree of proximity to the competitive rhythm were gradually increased to 95–100%.

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Table 1. Distribution of training loads across the stages of the annual macrocycle for hurdlers in the training group (program for the experimental group)

Load Indicators and Means	**I. General preparation (16 weeks)**	**II. Specialized preparation (14 weeks)**	**III. Competition Phase (16 weeks)**	**IV. Transition Phase (6 weeks)**	**Total annual average**
Training days / hours (hours)	88 / 200	78 / 180	84 / 196	24 / 48	274 / 624
General Physical Preparation (GPP) (%)	50%	30%	15%	65%	35,6%
Special Physical Preparation (SPP) (%)	30%	40%	35%	20%	33,7%
Technical-tactical and competitive preparation (%)	20%	30%	50%	15%	30,7%
Special hurdle exercises (number of hurdle clearances, in thousands)	2,8	3,6	4,2	0,4	11,0
High-intensity (90–100%) sprinting (km)	4,5	9,2	12,8	0,8	27,3
Rhythm modeling (over 3–10 hurdles from the start, number of repetitions)	45	110	185	10	350
Jumping and plyometric exercises (number of take-offs, in thousands)	4,2	3,8	2,4	0,6	11,0
Control and official competitions (number of starts)	2–3	4–5	10–12	—	16–20

Block-modular technology for competition preparation, broken down by stages

The technology developed for the experimental group consisted of four technological modules, each aimed at addressing specific biomechanical and physiological objectives within a given stage of preparation (Table 2).

Module I. Foundational functional training and joint-muscle mobilization (general preparation stage: November–early February / March–April). This stage focused on increasing hip joint mobility, strengthening the eccentric endurance of the posterior thigh muscles (biceps femoris) [8], and automating the technique for clearing low hurdles (0.65–0.76 m) using 1-step and 3-step rhythms.

Module II. Development of speed-strength and specialized rhythm (specialized preparation stage). A method involving "variable hurdle spacing and height" (discounted hurdles) was implemented. To foster a high stride frequency and build a

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speed reserve, the distance between hurdles was reduced from the standard 9.14 m to 8.50–8.80 m; conversely, to develop a powerful takeoff, the spacing was extended to 9.30 m. These variations were applied alternately.

Module III. Pre-competition modeling and tapering (2–3 weeks before the competition) [10]. During the 14–21 days leading up to the main competition, the total training volume was reduced by 35–40%, while intensity was maintained at 96–100%. Training sessions included starts from starting blocks (triggered by an electronic signal) followed by clearing 1–5 or 1–8 standard hurdles, executing a 20-meter acceleration toward the finish line after the final hurdle, and exercises designed to model psychological stability—specifically, maintaining rhythm while in close proximity to a competitor in an adjacent lane.

Module IV. Management of inter-competition microcycles and recovery. Between consecutive competitions, a "3:1" or "2:1" load-to-recovery ratio (wave pattern) was applied. Forty-eight hours prior to the start, athletes performed short, submaximal-speed repetitions over 3–4 hurdles to stimulate the central nervous system.

Table 2. Structure and training means of the weekly microcycle during the pre-competition mesocycle (3-week tapering block)

Day of the week	Main focus and specialized training tools for the session	**Intensity (%)**	**Microcycle volume**
Monday	Start reaction and speed-technique block: 3 × (1–3 hurdles) from starting blocks; 3 × (1–5 hurdles) with shortened spacing (8.80 m); light plyometrics (3 × 6 hurdle jumps).	95–98%	O'rtacha (75%)
Tuesday	Specialized flexibility and active recovery: 15-minute cross-country run (jogging), a complex of static-dynamic stretching exercises using hurdles, 4 × 60 m rhythmic running, physiotherapy.	65–75%	Past (45%)
Wednesday	Simulation of race distance: 2 × 8 hurdles from starting blocks (standard height and spacing, with full recovery of 12–15 minutes); 2 × 120 m for speed endurance.	96–100%	Yuqori (85%)
Thursday	Rest or recovery session: swimming/massage, ideomotor (mental visualization) practice of hurdle clearance, and video analysis.	50–60%	Minimal (30%)
Friday	Pre-competition activation (priming): warm-up, 3 × 30 m starts, 2 × (1–2 hurdles) at race pace.	90–95%	Past (40%)
Saturday	Control session or official competition: 110 m / 100 m hurdles (heats and finals, with kinematic timing/analysis).	100%	Musobaqa yuklamasi

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Results of the pedagogical experiment and statistical analysis

At the conclusion of the year-long pedagogical experiment, a comparative analysis was conducted on the physical and technical preparation indicators of 15–17-year-old athletes in the control group (CG) and the experimental group (EG) (Table 3).

Table 3. Dynamics of physical and technical indicators in hurdlers from the experimental and control groups during the annual training cycle (n1 = 12, n2 = 12)

Control tests and biomechanical indicators	Group	Beginning of the experiment ($X^{-} \pm \sigma$)	End of experiment ($X^{-} \pm \sigma$)	Growth (W, %)	t-criterion	p value
30 m sprint from a crouch start (s)	NG	4,38 ± 0,11	4,29 ± 0,10	2,08%	2,10	p > 0,05
30 m sprint from a crouch start (s)	TG	4,39 ± 0,12	4,16 ± 0,08	5,38%	5,52	p < 0,01
30 m sprint with a running start (flying start) (s)	NG	3,42 ± 0,09	3,34 ± 0,08	2,37%	2,30	p < 0,05
30 m sprint with a running start (flying start) (s)	TG	3,44 ± 0,10	3,21 ± 0,07	6,92%	6,53	p < 0,01
Standing long jump (m)	NG	2,48 ± 0,08	2,56 ± 0,07	3,17%	2,61	p < 0,05
Standing long jump (m)	TG	2,47 ± 0,09	2,68 ± 0,06	8,16%	6,73	p < 0,01
Standing triple jump (m)	NG	7,62 ± 0,22	7,85 ± 0,20	2,97%	2,68	p < 0,05
Standing triple jump (m)	TG	7,60 ± 0,24	8,18 ± 0,18	7,35%	6,70	p < 0,01
110 m flat sprint (s)	NG	13,84 ± 0,28	13,56 ± 0,25	2,04%	2,58	p < 0,05
110 m flat sprint (s)	TG	13,86 ± 0,30	13,32 ± 0,21	3,97%	5,11	p < 0,01
110 m hurdles (h = 0.914 m, s)	NG	15,68 ± 0,34	15,24 ± 0,30	2,85%	3,36	p < 0,01
110 m hurdles (h = 0.914 m, s)	TG	15,68 ± 0,35	14,76 ± 0,22	6,04%	7,71	p < 0,01
Technical proficiency index (Δt = t_hurdles − t_flat, s)	NG	1,84 ± 0,10	1,68 ± 0,09	9,09%	4,12	p < 0,01
Technical proficiency index (Δt = t_hurdles − t_flat, s)	TG	1,82 ± 0,09	1,44 ± 0,07	23,31%	11,55	p < 0,01
Time from start to the 1st hurdle (s)	NG	2,74 ± 0,08	2,67 ± 0,07	2,59%	2,28	p < 0,05
Time from start to the 1st hurdle (s)	TG	2,75 ± 0,08	2,56 ± 0,05	7,16%	6,98	p < 0,01
Average time for one cycle between hurdles (3 strides + hurdle clearance) (s)	NG	1,24 ± 0,05	1,20 ± 0,04	3,28%	2,16	p < 0,05
Average time for one cycle between hurdles (3 strides + hurdle clearance) (s)	TG	1,24 ± 0,05	1,13 ± 0,03	9,28%	6,53	p < 0,01

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Explosive power and starting acceleration. In the experimental group, the time for a 30-meter sprint from a low start improved from 4.39 s to 4.16 s—an improvement of 5.38% ($p < 0.01$). The time taken to cover the 13.72-meter distance from the start to the first hurdle improved from 2.75 s to 2.56 s, representing a 7.16% gain. These results confirm the high effectiveness of reactive acceleration exercises—performed over the first 1–3 hurdles—during the pre-competition phase.

Reduction in the technical efficiency index (Δt). The value Δt (calculated as the difference between the time for a 110m hurdle race and the time for a 110m flat sprint)—a key criterion for a hurdler's proficiency—decreased by 0.16 s in the control group (from 1.84 s to 1.68 s). In the experimental group, this indicator decreased by 0.38 s, reaching 1.44 ± 0.07 s ($W = 23.31\%$, $t = 11.55$, $p < 0.01$). By spending an average of 0.144 s to clear each of the 10 hurdles, the athletes in the experimental group moved closer to the technical model required for the "First-Class Athlete" and "Candidate for Master of Sports" qualification standards [1, 5].

Competition performance and rhythm stability. In the experimental group, the average performance in the 110m hurdles improved from 15.68 ± 0.35 s to 14.76 ± 0.22 s. This represents a difference of 0.92 s, or 6.04%; in the control group, the improvement was 0.44 s (2.85%). Over the distance between the 3rd and 8th hurdles, the average duration of a stride cycle decreased from 1.24 s to 1.13 s, and the decline in speed during the second half of the distance was minimized.

Conclusions **and practical recommendations.** Based on the results of the scientific-pedagogical research, the following conclusions and practical recommendations for coaches have been formulated:

For 15–17-year-old hurdlers in training groups, organizing preparation for competitions throughout the annual training cycle—using a four-stage block-modular technology based on a specific ratio of general physical training (GPT), specialized physical training (SPT), and technical-rhythmic exercises (35.6% : 33.7% : 30.7%)—ensures that the athletes' peak form is precisely aligned with the competitive period. During the specialized preparation and pre-competition phases, the use of "variable hurdle spacing" (8.50–8.80 m and 9.14–9.30 m) combined with a block of eccentric-plyometric exercises accelerates the 3-stride rhythm cycle between hurdles by 9.28%. The technical efficiency index for hurdle clearance (Δt) improves from 1.82 s to 1.44 s ($p < 0.01$).

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Implementing a 2–3 week "tapering" mesocycle prior to major competitions—characterized by a 35–40% reduction in training volume while maintaining simulated runs over 5–8 hurdles at competition speed (96–100%)—enables athletes in specialized training groups to improve their 110m hurdles performance by an average of 0.92 s (6.04%) over the course of the year.

Coaches at sports schools and Olympic reserve centers are advised to consistently monitor the Δt index (calculated as the time taken to clear a hurdle minus the time taken for an equivalent flat-sprint distance) at the end of each preparatory mesocycle, as well as the difference in timing between the start and the first hurdle versus the intervals between the 4th and 8th hurdles. If $\Delta t > 1.70$ s, the focus in training should be on increasing the contribution of technical-rhythmic elements and hurdle clearance; if $\Delta t < 1.45$ s, priority should be given to developing flat-sprint speed.

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