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DYNAMICS OF THE FORMATION OF TECHNICAL PREPARATION IN MIDDLE-DISTANCE RUNNERS

B.A. Djumanov
Independent Researcher
Associate Professor, Karakalpak State University
E-mail: djumanovbarlikbay1988@gmail.com
Nukus, Uzbekistan

ABOUT ARTICLE

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Abstract: This article presents the dynamics of technical training development for track and field athletes specializing in middle-distance running, assessed through pedagogical tests, and the effectiveness of the applied research methods. Suggestions and recommendations are provided for improving the technical training of middle-distance runners in the training group from the Aral Sea region of Karakalpakstan. A comparative analysis of the special physical training results for the experimental and control groups at the beginning of the study is presented, and scientific conclusions are formulated based on the obtained data.

Introduction. Middle-distance running is one of the most competitive disciplines in the athletics system, requiring high levels of speed endurance. The continuous growth of results in international competitions demands from athletes not only a high level of physical development but also perfectly formed running technique and continuous improvement of training components.

This is because, during middle-distance running, each technical element—such as stride length and rhythm, duration of the support phase, body posture, and arm movements—directly determines the overall running efficiency of the athlete.

Scientific study of the dynamics of the formation of running technique is of great importance for coaches in optimizing the training process, eliminating individual technical shortcomings, and developing new effective models for competition preparation.

Furthermore, the technical preparedness of middle-distance runners develops progressively across different age stages. A detailed analysis of the step-by-step dynamics of this process, as well as identifying the interrelationship between technical indicators, functional condition, physical qualities, and competition loads, makes it possible to train athletes effectively while adapting them to climatic conditions.

At present, modern technical tools such as video analysis, digital biomechanical diagnostics, and monitoring programs make it possible to deeply assess athletes' technique. However, there is still a strong need to develop conceptual and methodological foundations for their effective use in improving running technique.

In addition, studying the dynamics of technical preparedness of middle-distance runners under the specific climatic conditions of Karakalpakstan provides new scientific conclusions for practical application.

In addition to the high-level development of general and special physical preparedness, improving functional preparedness plays a significant role in enhancing the performance of middle-distance runners [2]. The effective use of these capabilities depends primarily on speed endurance and technical preparedness.

An athlete must understand the laws of movement and be able to apply methods according to their individual characteristics. This is because a middle-distance runner is well aware of their strengths and weaknesses.

Therefore, correct execution of running technique allows:

- economical running
- rational distribution of effort throughout the distance

This increases the athlete's ability to achieve high performance in competitions [1]. Moreover, this issue is considered highly relevant both theoretically and practically.

Purpose of the Study

To scientifically investigate the dynamics of the formation of technical preparedness in middle-distance runners.

Research Objectives

- To analyze scientific and methodological sources related to the technical preparedness of middle-distance runners and generalize existing approaches and scientific views

- To identify the structural components of running technique, including:
  - stride length
  - step frequency
  - cadence
  - energy expenditure
  - arm movement
  - body posture
- To analyze the dynamics of technical preparedness under the climatic conditions of Karakalpakstan, study influencing factors, and develop recommendations

Methodology

- analysis of scientific-methodological literature
- pedagogical observation
- organization of the research
- instrumental methods
- pedagogical experiment
- mathematical-statistical methods
- analysis of obtained results

Climate Analysis

Analysis of meteorological data across Asia shows that in Uzbekistan, especially in the Aral Sea region, temperatures are rising and the climate is becoming increasingly arid.

Climate change is expected to transform dry and semi-desert areas into even hotter and more arid regions. Therefore, it can be predicted that drought seasons in Central Asia will become longer and more severe in the future.

The severity or rarity of weather phenomena is usually determined by how frequently they occur. Although climate traditionally refers to norms that change slightly over relatively short periods (e.g., 10 years), humanity is currently rapidly altering the climate and creating "new norms."

For example, storms that used to occur once every 100 years now occur every 10 years [4].

Such rapid climate change imposes new tasks on athletics specialists and coaches. Therefore, organizing training sessions for middle-distance runners while considering climatic conditions allows for more effective preparation for competitions.

Training in Autumn–Winter Season

In the Aral Sea region of Karakalpakstan, the climate during autumn and winter is cold, windy, and humid. Therefore, it is very important to schedule training sessions at the safest and most physiologically favorable times.

Based on scientific-methodological sources and sports meteorology principles, the following recommendations were proposed:

- 14:00–17:00 → optimal for general and special endurance training
  - highest daytime temperature
  - reduced wind compared to early morning
  - lower risk of cold-related injuries
  - less impact of cold air on respiration
- 11:00–13:00 → suitable for technical training and light exercises
  - moderate warming of air
  - sunlight improves immunity
  - suitable for low-intensity exercises
- 09:00–10:00 → morning training indoors
  - suitable only for light running

Not recommended:

- intense training early morning (before 07:00)
  - temperature: –6°C to –15°C
  - strong wind
  - increased risk of illness
  - respiratory constriction

Additional rules:

- avoid speed exercises below –10°C
- move training indoors during strong wind
- breathe through the nose, not mouth
- wear 3-layer sports clothing (increased energy expenditure)

Thus, the best time for training in winter is 14:00–17:00, when conditions are milder and injury risk is lower.

Training in Spring–Summer Season

In the Aral Sea region, spring and summer are extremely hot and dry (up to 40–45°C). Therefore, it is crucial to conduct training at safe and physiologically optimal times.

Recommended:

- 06:00–08:00 → main training

- temperature: 20–26°C
- optimal body condition
- high energy availability
- low risk of heat stroke

• 19:00–21:00 → evening training

- cooler air
- better breathing conditions
- muscles already warmed up

• 18:00–19:00 → technical drills and light running

Not recommended:

• 11:00–17:00

- temperature: 35–45°C
- high risk of heat stroke, dehydration, cardiovascular strain

Additional recommendations:

• drink 300–500 ml water before training

• drink small amounts every 15–20 minutes

• wear light, breathable clothing

• avoid direct sun warm-ups

• monitor breathing and heart rate

Thus, optimal summer schedule:

• 06:00–08:00 → endurance training

• 18:00–19:00 → technique

• 19:00–21:00 → intensive training

Results and Discussion. We compared the dynamics of technical preparedness indicators of athletes in the control group (n=14) and experimental group (n=14) during the pedagogical experiment.

Experimental Group (Initial Stage)

• Stride length: 174.64 ± 12.99 cm

• Cadence (1 min): 110.93 ± 11.96 steps

• 30-sec running-in-place: 114.57 ± 12.97 steps

• Energy expenditure (1500 m): 366.71 ± 11.99 kcal

• Time (1500 m): 305.57 ± 13.96 sec

Control Group (Initial Stage)

• Stride length: 176.79 ± 12.60 cm

- Cadence: 113.07 ± 11.63 steps
- 30-sec test: 111.93 ± 12.59 steps
- Energy expenditure: 362.50 ± 11.60 kcal
- Time: 310.86 ± 13.59 sec

At the beginning of the study, analysis showed that the indicators in both groups were equal, which allowed the continuation of the experiment.

Table 1

Comparison of the dynamics of changes in the main statistical characteristics of technical preparedness indicators of athletes in the control (n=14) and experimental (n=14) groups during the pedagogical experiment

Indicator	**Group**	**Beginning of Experiment (Mean ± SD)**	**CV (%)**	**End of Experiment (Mean ± SD)**	**CV (%)**	**Absolute Change**	**Relative Change**	**t**	**P**
Stride length (cm)	EG	174.64 ± 22.69	12.99	202.93 ± 24.62	12.13	28.29	16.20	2.93	<0.01
	CG	176.79 ± 22.27	12.60	193.50 ± 24.21	12.51	16.71	9.45	1.76	>0.05
Cadence per minute (steps)	EG	110.93 ± 13.27	11.96	133.64 ± 14.83	11.10	22.71	20.48	3.95	<0.001
	CG	113.07 ± 13.15	11.63	124.86 ± 14.36	11.50	11.79	10.42	2.10	<0.05
Number of steps in 30 s running in place	EG	114.57 ± 14.86	12.97	139.79 ± 16.97	12.14	25.21	22.01	3.87	<0.001
	CG	111.93 ± 14.09	12.59	124.57 ± 15.56	12.49	12.64	11.30	2.09	<0.05

Indicator	Group	Beginning of Experiment (Mean ± SD)	CV (%)	End of Experiment (Mean ± SD)	CV (%)	Absolute Change	Relative Change	t	P
Energy expenditure (kcal)	EG	366.71 ± 43.97	11.99	424.07 ± 51.45	12.13	57.36	15.64	2.94	<0.01
	CG	362.50 ± 42.04	11.60	393.79 ± 45.31	11.51	31.29	8.63	1.75	>0.05
1500 m running time (seconds)	EG	305.57 ± 42.67	13.96	258.79 ± 33.91	13.10	46.79	15.31	2.97	<0.01
	CG	310.86 ± 42.23	13.59	282.36 ± 38.08	13.49	28.50	9.17	1.74	>0.05

Average values

Group	Absolute Change	Relative Change
Experimental Group (EG)	36.07	17.93
Control Group (CG)	20.19	9.79

Note:

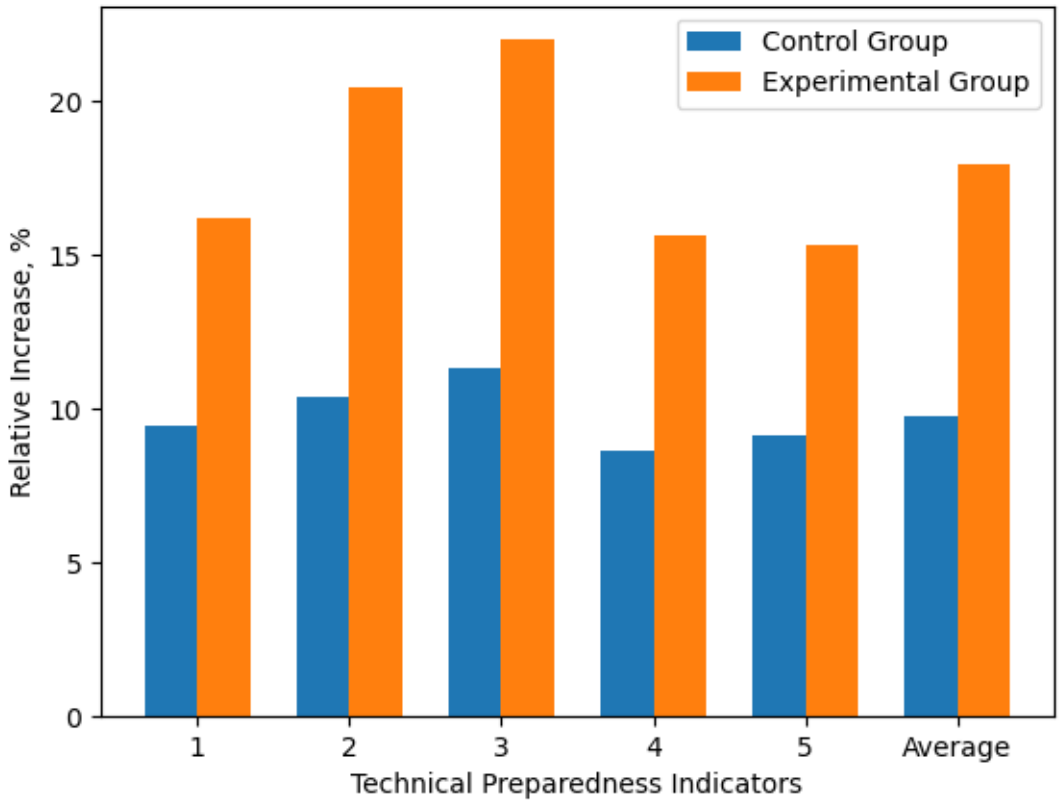
EG – Experimental group

CG – Control group

Results Description

At the end of the study, the athletes in the experimental group demonstrated the following results:

- Stride length increased to 202.93 ± 12.13 cm
- Cadence per minute increased to 124.86 ± 11.50 steps
- In the 30-second running-in-place test, the number of steps reached 139.79 ± 12.14
- During the 1500 m run, energy expenditure increased to 424.07 ± 12.13 kcal
- After applying the proposed methodology, the time for completing the 1500 m distance improved to 258.79 ± 13.10 seconds



At the end of the study, the athletes in the control group demonstrated the following results. In the stride length test, the value increased to 193.50 ± 12.51 cm, while cadence per minute increased to 124.86 ± 11.50 steps. In the 30-second running-in-place test, the number of steps reached 124.57 ± 12.49. During the 1500 m run, the control group athletes expended 393.79 ± 11.51 kcal of energy and completed the distance in 282.36 ± 13.49 seconds.

Conclusion. In this scientific study, the dynamics of the formation of technical preparedness of middle-distance runners were comprehensively investigated, particularly the specific features of the development of technical indicators under the sharply continental climatic conditions of Karakalpakstan. During the research, modern scientific methods such as video analysis, biomechanical assessment, pedagogical observation, and statistical analysis were applied. The obtained results revealed the interrelationship between climate, functional condition, and physical preparedness in improving middle-distance running technique.

The comparative analysis between the experimental and control groups showed that the specially developed methodology, taking into account the climatic conditions of the Aral Sea region of Karakalpakstan, had a significant positive impact on the technical preparedness indicators of athletes. In the experimental group, statistically significant improvements ($P < 0.01$; $P < 0.001$) were observed in stride length, cadence, running rhythm, energy expenditure, and 1500 m performance time. In particular, stride length increased by 28.29 cm, and cadence

improved by 22.71 steps per minute. These changes indicate that the overall rate of development in the experimental group was 1.8 times higher than in the control group.

The research findings demonstrate that planning training sessions in accordance with seasonal and climatic conditions (winter: 14:00–17:00; summer: 06:00–08:00 and 19:00–21:00) ensures optimal physiological conditions for muscle activity, respiratory function, cardiovascular load, and thermoregulation. Furthermore, under conditions of climate change, regular monitoring of technical preparedness, analysis of biomechanical indicators, and the application of individualized methodological approaches are key factors in improving athletic performance.

1. The climate of the Aral Sea region of Karakalpakstan directly influences middle-distance running technique, and adapting training to climatic conditions increases training effectiveness.

2. A comprehensive study of the dynamics of technical preparedness allows for the identification and correction of individual technical deficiencies, significantly improving running efficiency.

3. Improvements in biomechanical indicators (stride length, rhythm, energy expenditure) are decisive factors in enhancing performance in the 1500 m distance.

4. The proposed specialized methodology ensured statistically significant improvements in technical preparedness indicators in the experimental group and is recommended for practical implementation.

In general, this study scientifically substantiates the importance of climatic conditions, biomechanical analysis, and individualized training models in improving middle-distance running technique. The research results have practical value for coaches, sports education institutions, national teams, and sports research organizations, serving as an important resource for optimizing the preparation of highly qualified athletes.

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