The Impact of Hill Training on Specific Endurance and Performance in 1500m Running

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Abstract:

The physiological and physical preparations for the 1500m running event in training programs aim to develop specific endurance and both aerobic and anaerobic energy systems through hill training. Since specific endurance training compensates for the reduction in speed rate during performance, the significance of this research lies in understanding the extent of the impact of hill training (both ascending and descending) on specific endurance (speed endurance - strength endurance) and 1500m running performance, in order to achieve the best possible level of performance. Hence, the research problem is focused through the preparation of special training programs that include hill training and their impact on specific endurance and numerical performance level. The study aimed at preparing running exercises on hills (ascending and descending) and examining their impact on specific endurance (speed endurance - strength endurance) and 1500m running performance. The researcher used the experimental method (single group) on the research population represented by young club athletes (Afaq and Nafr) in middle-distance running aged (18-19) years, totaling (8) players for the sports season (2023 – 2024). The researcher then carried out a homogenization process according to the research variables. The researcher prepared hill exercises (uphill and downhill) to develop specific endurance and 1500m running performance, drawing on the opinions of some experts and specialists in the field of sports training and athletics. The exercises included various intensities of hill training over a period of (8) weeks, with (3) training units per week during the special preparation phase. Through the results, the researcher concluded significant differences between the pre-test and post-test in the study variables. Moreover, the hill exercises ascending led to the development of speed endurance and strength, which contributed to improved 1500m running performance. Based on the conclusions, the researcher recommends the need to prepare training curricula in the general and special preparation phases on hills or slopes to develop the physical and physiological variables for various middle and long-distance running events.

Keywords: Hill Training, 1500m Race Performance, Endurance Running, Running Economy

1 – Research Definition

1 - 1 Introduction and Importance of Research:

Physical preparation is crucial for achieving the best sports performances. The astonishing skill levels and numerical achievements we hear about in various sports are undoubtedly a result of the evolution of various sports and physiological sciences and the coaches' adherence to correct scientific methods in an attempt to maximize human energy utilization. Therefore, athletics training relies on establishing scientific and regulated training programs to develop the athlete's level and reach higher standards.

Each event has its specific characteristics and requirements, including the middle-distance running events such as the 1500m run, which requires the development of certain physical qualities and energy systems to obtain physiological adaptation of the organic systems for effort endurance and performance during the race to achieve the best time. Since the 1500m event falls within the mixed system with a predominance of the anaerobic system over the aerobic system, it requires the development of energy systems to match its distances and high performance intensity and its ability to endure performance due to fatigue occurring during the race. Accordingly, the physical and physiological preparations for the 1500m running event should aim through training programs to develop specific endurance and both aerobic and anaerobic energy systems, affecting physiological variables together to endure and perform the effort during the race and increase muscle efficiency in lactate endurance, which helps delay fatigue onset and maintain speed rate, thus achieving the best performance. Since hill training compensates for the reduction in speed rate during performance, the significance of the research lies in understanding the extent of the impact of hill training (both ascending and descending) on specific endurance (speed endurance - strength endurance) and 1500m running performance, aiming to achieve the best possible level of performance.

1 – 2 Research Problem:

From reviewing many scientific sources and expert opinions in sports training, it has been observed that there is a variation among them in determining which is more important and contributory in the energy production systems within the training programs in developing the physical qualities affecting the 1500m running event, as this event has become one of the fast-paced competitions in terms of speed rate due to the world's achievements. From this standpoint, the research problem has been focused through the preparation of special training programs that include hill training and examining their impact on specific endurance and the numerical performance level, aiming to contribute to achieving and developing the Iraqi numerical level, which is (3:43:76) minutes recorded by the runner Adnan Ta'is at the Asian Championship in China in 2010, compared to the world record of (3:26:00) minutes.

1-3 Research Objectives:

The research aims to:

- Prepare running exercises on hills (ascending and descending).
- Examine the impact of hill training (ascending and descending) on specific endurance (speed endurance - strength endurance) and 1500m running performance.

3 - Research Methodology and Field Procedures:

3-1 Research Method:

The researcher used the experimental method with a single group, suitable for the nature of the research, as experimentation is considered one of the most efficient means to achieve reliable knowledge. This method is the only one that can truly test the hypotheses of causal relationships.

3-2 Research Population and Sample:

The research sample was randomly selected from the research population, which consisted of young athletes from athletic clubs in Al Diwaniyah, specializing in middle-distance running, aged (18-19) years, and totaling (8) players for the sports season (2023

– 2024). Subsequently, the researcher carried out a homogenization process according to the research variables.

3-3 Equipment and Tools Used:

Registration forms.

Manual electronic timing watches (8).

Electronic calculator (Sharp) made in Japan.

3-4 Tests:

Tests are one of the essential tools for evaluating the level reached by the athlete and also indicate the suitability of any training program. Based on this, the researcher decided to evaluate the performance level of the research sample through the study variables in the preliminary and final tests of the experimental group. Then, the tests of the preliminary and final groups were compared to determine the differences between them and which one had a more significant impact on those variables.

3-5 Exploratory Experiment:

The exploratory experiment is a practical training for the researcher to identify the negatives encountered during testing to avoid them. The purpose of the exploratory experiment is to determine the suitability of the tests for the research sample, the sample's response to these tests, the time taken to perform the tests, and to define the duties of the support team. Thus, the exploratory experiment was conducted on a sample of (3) players in middle-distance running, not part of the main research sample. The exploratory experiment was conducted on Sunday, 25/9/2023, to accommodate the times and determine the tests of the study as follows:

First: Speed endurance test.

Second: Strength endurance test.

Third: 1500m running test.

3-6 Specifications of Tests and Measurements Used:

3-6-1 Speed Endurance Test:

The speed endurance is tested by running a (600m) track and timing the duration to the nearest fraction of a second.

3-6-2 Strength Endurance Test:

The test is performed by alternating running and jumping for a minute on the athletics track, and the covered distance in meters is recorded.

3-6-3 1500m Running Test:

- Objective: To measure the performance of 1500m running.
- Tools used: Stadium track, manual timing watches (8), registration forms.
- Performance description: The test begins when the players hear the command "Take your places" from the starting position of standing, followed by the start signal and then running around the track (3 laps and 300m) for a distance of 1500 meters, then recording each contestant’s time on the registration form.

3-**7 Design of Training Programs:**

The researcher prepared exercises on the hills (ascending and descending) to develop specific endurance and performance in 1500m running, relying on his field experience and expertise, and consulting some experts and specialists in the field of

sports training and athletics, in addition to training and physiological scientific sources. These exercises included various intensities of hill training over a period of (8) weeks, with (3) training units per week during the special preparation phase.

Continuing the translation from where we left off:

3-8 Pre-test Measurements and Tests:

The pre-test measurements and tests for the research were carried out by the work team under the supervision of the researcher on the research sample, which took two consecutive days, from 10 - 12 October 2023, as follows:

- Day One: Physical tests (specific endurance) were conducted.
  - Speed endurance
  - Strength endurance
- Day Two:
  - 1500m running test

3-9 Post-test Measurements and Tests:

The post-test measurements and tests were conducted on the research sample in the same manner as the pre-test measurements and tests.

3-10 Statistical Tools:

The statistical package used was SPSS.

- The highest value – the lowest value
- The formula for the rate of improvement = ((highest value - lowest value) / lowest value) × 100

4- Presentation, Analysis, and Discussion of Results:

4-1 Presentation, Analysis, and Discussion of Physical Variable Results:

To verify the objectives related to the research variables and test the hypotheses, differences in these variables between the pre-test and post-test were extracted.

4-1-1 Presentation and Analysis of Speed Endurance Test Results for the Experimental Group:

Table (1) Shows the mean, standard deviation, computed T-value, and table T-value, and significance of differences in the speed endurance between the pre-test and post-test.

Test	Mean (s)	Std. Dev.	Computed T-value	Table T-value	Significance Level*
Pre-test	93	0.365	17.111	2.021	Significant
Post-test	88	0.664			

*Under a degree of freedom of 7 and an error level of 0.05

Table (2) Shows the rate of improvement between the pre-test and post-test in speed endurance.

Pre-test Time (s/d)	Post-test Time (s/d)	Improvement Rate (%)
95	88	7.95

4-1-2 Presentation and Analysis of Strength Endurance Test Results for the Experimental Group:

Table (3) Shows the mean, standard deviation, computed T-value, and table T-value, and significance of differences in strength endurance between the pre-test and post-test.

Test	Mean (meters)	Std. Dev.	Computed T-value	Table T-value	Significance Level*
Pre-test	220	0.365	17.111	2.021	Significant
Post-test	248	0.664			

*Under a degree of freedom of 7 and an error level of 0.05

Table (4) Shows the rate of improvement between the pre-test and post-test in strength endurance.

Pre-test Distance (m)	Post-test Distance (m)	Improvement Rate (%)
220	248	7.31

4-2 Discussion of the Results of the Speed Endurance and Strength Endurance Tests for the Study Sample:

The results from the tables above show clear outcomes between the pre-test and post-test. The researcher attributes this progress in the speed endurance and strength endurance variables to the implementation of the training program, which included training loads based on scientific principles of volume, intensity, and appropriate rest tailored to the capabilities of the research sample. The use of a significant proportion of anaerobic training compared to aerobic training helped improve and develop speed endurance among the athletes in the sample. According to Abu Al-A'la Ahmed Abdel Fattah, speed endurance training performed at an intensity close to maximum effort improves the central nervous system's ability to signal muscles effectively, thereby enhancing muscle response despite the conditions of increased lactic acid accumulation. Furthermore, Mufti Ibrahim Hammad views anaerobic training, which involves performing high-intensity exercises, as increasing the lactic energy production system. He also notes that muscle organizations increase with anaerobic training, allowing higher levels of muscle efficiency and better lactic acid levels, which facilitate the release of oxygen from lactic acid electronically, reducing fatigue. The development of strength endurance was also evident through the use of body resistance exercises such as varied jumping, continuing to output this power for the longest possible period. Mufti Ibrahim Hammad also confirms that the greater the muscle strength, the better the resistance can be overcome, thereby increasing speed.

4-3 Presentation and Analysis of 1500m Running Performance Results for the Study Sample:

Table (5) Shows the mean, standard deviation, computed T-value, and table T-value, and significance of differences in 1500m running performance between the pre-test and post-test.

Test	Mean Time (min/sec)	Std. Dev.	Computed T-value	Table T-value	Significance Level*
Pre-test	4:05.66	0.365	17.111	2.021	Significant
Post-test	4:00.70	0.664			

*Under a degree of freedom of 7 and an error level of 0.05

Table (6) Shows the rate of improvement in the pre-test and post-test for 1500m running performance.

Pre-test Time (min/sec)	Post-test Time (min/sec)	Improvement Rate (%)
4:05.66	4:00.70	4.46

4-3-1 Discussion of the Results of the 1500m Running Performance:

From observing Table (6), it is apparent that there was a significant improvement in the time for running 1500m among the sample, with significant differences favoring the post-test. The researcher attributes this progress to the application of the training program, which consisted of training loads based on scientific principles of volume, intensity, and appropriate rest, matched to the capabilities and physiological and performance variables of the research sample. The training program included both anaerobic and aerobic exercises, as mentioned by Ris'an Khuraibet, who states that "regular and programmed training using calibrated intensity types and optimal rest intervals between repetitions leads to performance improvement." Thus, the progress observed in the sample after implementing the training program led to changes in the physical, chemical, and performance variables, as confirmed by Muhammad Usman, who notes that "regular training leads to changes in the cells of various body tissues, as the changes that occurred after aerobic and anaerobic training improve the muscle's ability to perform work in the presence or absence of oxygen, primarily through an increase in myoglobin and mitochondria (energy houses), in addition to an increase in glycogen storage in muscles and an increase in enzyme activity."

5 - Conclusions and Recommendations

5-1 Conclusions:

From the results, the researcher concludes the following:

- There was a clear effect of the hill training prepared in developing specific endurance and performance.

- Significant differences were observed between the pre-test and post-test variables of the study.

- Hill training ascending led to the development of strength endurance, which contributed to improved performance.

- Hill training descending led to the development of speed endurance, which also contributed to improved performance.

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