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The effect of aerobic and anaerobic exercises on maximum oxygen consumption and specific speed according to the target time for 1500m runners

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***Abstract*---**This study aimed to understand the effect of aerobic and anaerobic exercises on maximum oxygen consumption and specific speed according to the target time for 1500m runners. The researchers conducted an experimental study on a sample of 16 young athletes active in the Provincial Athletics League in Jijel province. They used a set of physical tests appropriate for the nature of the study. The study concluded that anaerobic and aerobic training, according to their targeted time, has a significant effect on maximum oxygen consumption and effectively improves specific speed, speed endurance, special performance endurance, and also enhances the time to cover the 1500m distance.

***Keywords*---**aerobic, anaerobic exercises, maximum oxygen consumption, specific speed, target time, 1500m runners.

Introduction

The world is currently witnessing developments and advancements in numerical achievements in global and Olympic championships, as well as African championships across various events and games. Most countries have adopted strategies to keep up with modernity by providing the means to elevate the sports level using advanced scientific methods. This has enabled athletes to reach top levels and win titles at international and Olympic competitions, not by improvisation but as a result of using modern scientific methods in continuous planning and training.

Laures (2009) mentions that aerobic exercises are aerobic work activities consisting of physical movements performed when there is sufficient oxygen supply in the body to produce the necessary energy. Muscles need oxygen to function, and their need increases with work. These exercises depend on the work of the circulatory and respiratory system and are performed continuously for a duration ranging between 15-30 minutes with a heart rate of 130-160 beats per minute for adults. (Laures, 2009, p. 4)

In this context, Yasser Mohamed Abdel Warikat and Samira Mohamed Ahmed Arabi (2019) indicate that regular aerobic exercises have positive physiological effects, such as increased levels of endorphin hormone in the blood, improved aerobic capacity, improved heart rate, enhanced cardiac fitness, and respiratory fitness. (Abdel Warikat, Arabi, 2019, p 89-105)

Mathews and Fox (2009) point out that anaerobic power training is characterized by increasing an individual's efficiency in activities that depend on anaerobic work for energy production. This is due to increased capacity for anaerobic energy production through the enhanced ability of the ATP-PC system and increased capacity for anaerobic energy production due to anaerobic glucose combustion (lactic acid). Training has been found to increase the activity of key enzymes that control glucose combustion. (Mathew & Fox, 2009, p. 273)

Oxygen is key to continuing training. When an athlete cannot obtain enough oxygen, they are forced to use anaerobic methods and limited energy sources. (Bounab & Benkara, 2020, p 466-485). Most scientific opinions confirm that the maximum oxygen consumption, as defined by Salama (2003), is the maximum volume of oxygen consumed per minute relative to body weight in kilograms. (Adda, 2003, p 217)

Kamash & Saad (2006) emphasize that maximum oxygen consumption is considered the best physiological indicator of the ultimate capabilities of the circulatory and respiratory system and a good indicator of the level of physical fitness, expressed as maximum aerobic capacity. (Kamash, Saad, 2006, p179) The 1500m event is one of the athletics competitions in which Algeria has won gold medals at the global, Olympic, and African levels. From this platform, the need arises to study some aspects of training this event in order to keep up with the tremendous progress in this competition. This includes studying the special abilities that characterize this event, especially the specific speed which has proven its importance through the record numbers achieved in this competition.

The competition continues to break records and achieve higher levels of achievement, including surpassing the still-standing record of Hicham El Guerrouj.

Problem Statement

The preparation and training for middle-distance running in athletics, specifically the 1500m race, and the remarkable results achieved recently, make it worthy of research and study. This is due to the ongoing attempts to break the record in recent years at the Olympic and global levels. These attempts are not coincidental but are a result of advancements in the use of standardized training methods and modern technology in training. Drawing from the field experience of the researchers as former runners and coaches of some clubs, a lack of attention by coaches in developing this event was observed. There has been a decline in the performance of Algerian athletes recently, as well as a scarcity of research focused on the target time in the 1500m event for juniors.

This was evident through attending some national training camps organized by the Algerian Athletics Federation and experiencing various regional and national championships. Therefore, we aimed to study this issue by developing a training methodology for aerobic and anaerobic exercises and exploring their impact on developing the specific speed of running (1500m) according to the target time for junior category runners, by setting a target time for achievement.

The use of aerobic and anaerobic training according to the targeted time presents the researcher with questions related to such a fundamental problem. Achieving top levels in training and observation alone requires diversification in training methods and approaches, including recovery methods and the incorporation of modern technology in training, to respond to the functional adaptation of the athlete's body through training load according to the target time.

In this study, the researchers for the first time used aerobic and anaerobic exercises according to the target time in varying environmental and weather conditions at an altitude of 1250 meters above sea level to develop specific physical capabilities in the 1500m event for juniors, contributing to the advancement in athletics.

Study Hypotheses

- There are statistically significant differences between the pre-test and post-test measurements in maximum oxygen consumption and specific speed for the control group, favoring the post-test.
- There are statistically significant differences between the pre-test and post-test measurements in maximum oxygen consumption and specific speed for the experimental group, favoring the post-test.
- There are statistically significant differences between the post-test measurements in improving maximum oxygen consumption and specific speed endurance for both experimental and control groups, favoring the post-test for the experimental group.

Study Concepts
Anaerobic exercises

These are exercises where the output of power is high and occur without significant contribution from the aerobic system. (Al-Basiti, 2001, p 84)

- Operational Definition: A set of exercises that rely on the absence of oxygen according to the requirements of the energy production systems.

Aerobic exercises

These are aerobic exercises which require oxygen. (Jamal, 2022, p 91-98)

- Operational Definition: Physical exercises that lead to the consumption or burning of oxygen in the body.

Maximum oxygen consumption

It is the largest amount of oxygen an individual consumes during aerobic work per unit time and is measured in liters or milliliters per minute (Foxe, 2009). Carbovich and Sinning, 1981, define it as the maximum rate of oxygen consumption in liters/minute (Abu sari', 2021, p1-16).

- Operational Definition: The maximum amount of oxygen (in milliliters) that the body can consume per minute per kilogram of body weight when it reaches its maximum performance.

Speed

Charles A. Bucher believes that speed is the ability of an individual to perform sequential movements of the same type in the shortest possible time (Adel Abdul Basir, 1999, p 105). Weineck (1996) defines speed as the human capacity to employ rapid and regular release processes of neural-muscular system commands, which work to complete muscle contractions with high coordination for the purpose of executing voluntary movements in the shortest possible time periods. (Thamer Al-Dawoodi, 2019)

- Operational Definition: The ability to perform certain movements in the least possible time.

Target time

It is an assumption of a maximum expected achievement time for the competition, which the researchers work to achieve for the research sample through training with specific intensity according to this time and for training distances specific to the stages of the race. (Hussein Ali Hassan Al-Ali, Ahmed Bahaa El-Din Ali, 2014, p211-224)

- Operational Definition: A hypothetical numerical predictive process for the runner's time according to their functional, physical, and bodily capabilities in order to determine the goal and the designed course for the race.

1500 meters

It is a distance that competitors cover in three and a half laps around the stadium, and 1500 meters falls within the middle distances (Monaco, 2015).

Youth

Amr Abu Al-Majd and Jamal Ismail define the youth as "equivalent to one of the age stages of the players, which is very complex. Working with youths and juniors requires full knowledge of characteristics, traits, readiness, capabilities, attitudes, and knowledge of where to start, how to continue, and how to develop. This clear knowledge of landmarks and organized goals allows, in the end, to bring the youth to the highest level in the sports field." (Sarayia, 2023, p310-320)

Literature Review

First Study: Amjad Zakaria Ahmed Abdel Aal and others, 2023
Title: The Effect of Specific Anaerobic Exercises on Some Special Physical Abilities of Kumite Players

The researchers used an experimental method and selected a sample of junior athletes aged 15-17 from the Eastern region. The sample size was 34, with 24 main participants. The study aimed to improve the special physical abilities and maximum anaerobic capacity of Kumite players using a training program. The results showed that specific anaerobic exercises significantly improved physical variables (speed-specific strength, performance speed, strength endurance, speed endurance, performance endurance, and special agility) and maximum anaerobic capacity.

Second Study: Sudad Fadel Mohamed Jamal, 2022
Title: The Effect of Aerobic Exercises on Respiratory Efficiency and Pulmonary Ventilation in Obese Individuals

The researcher used an experimental method and selected a sample of non-athletic women aged 35-40, totaling 10 individuals. The research aimed to develop aerobic exercises for obese individuals, explore the effects of these exercises on the study variables, and understand the nature of differences in these variables among obese women. The results indicated that the aerobic exercise training program improved the vital capacity of obese women, as well as their performance in the Queens test and the PWC170 test, and also enhanced maximum oxygen consumption.

Third Study: Ahmed Abdel Salam Atito, Faisal Mufreh Bani Al-Anzi, 2017
Title: The Effect of Aerobic and Anaerobic Exercises Using Aquatic Environment on Some Physical and Physiological Variables of 3000m Steeplechase Athletes in Kuwait.

The researchers used an experimental method on a single group composed of all registered 3000m steeplechase athletes in the Kuwait Athletics Federation, totaling 15 athletes for the 2015-2016 season. The sample of 6 athletes from the Kuwaiti national team, aged between 20-25, was chosen purposefully. The study aimed to design aerobic and anaerobic exercises using an aquatic environment to enhance the physical and physiological efficiency of 3000m steeplechase athletes, improve some components of physical fitness (endurance speed, strength), and improve certain physiological aspects (capacity, pulse, maximum oxygen consumption). The results showed that the training program using the aquatic environment improved the physiological and physical variables studied, which could reflect on the athletes' performance levels.

Fourth Study: Marouf Said, 2019.
Title: The Use of Anaerobic Exercises According to Training Zones and Their Effect on Developing Speed Endurance and Recovery Ability of Soccer Players.

The researcher used anexperimental method on a community and sample of soccer players under 19 years of age, with 300 players for the 2017-2018 sports season. The research sample was purposefully chosen from the Rapid Ghilizan team, consisting of 20 players. The research goals were to discover the impact of using anaerobic exercises according to training zones on developing speed endurance, to identify the effect of these exercises on developing recovery ability, and to determine the most suitable training zones that influence the development of speed endurance and recovery ability.

The researcher concluded that there are statistically significant differences between the two experimental groups (01 and 02) in the post-tests for the variable of speed endurance in soccer players, favoring the experimental group 02. There were also significant differences between the two experimental groups in the post-tests for the variables of speed endurance and recovery ability, favoring experimental group 02. Lastly, significant differences were found between the two groups in the improvement rate between the average scores in tests of speed endurance and recovery ability.

Fifth Study: Inas Yasin Abd, 2009.
Title: The Effect of Anaerobic and Aerobic Exercises at Two Different Altitudes Above Sea Level on Some Physical Abilities and Functional Variables in 1500m Elite Female Runners.

The researcher used an experimental method and selected a sample of 12 female 1500m runners by purposeful sampling. The study aimed to prepare a proposed methodology for aerobic and anaerobic exercises at two different altitudes above sea level for elite 1500m female runners, to identify the differences between pre- and post-tests for the two experimental groups influenced by aerobic and

anaerobic exercises at different altitudes, and to explore the differences in the post-tests between the two experimental groups in the research variables. The research found that training at high altitudes with low atmospheric pressure (2464 meters, 561 mmHg) improves the hemoglobin levels and red blood cell count. Resting blood pressure rates were not affected by high-altitude training. Training at high altitudes improved maximum oxygen consumption and did not affect blood acidity levels post-effort. Additionally, high-altitude training enhanced the functional efficiency of 1500m female runners.

Research Methodology and Field Procedures
Research Method

The research method is the art of correctly organizing a series of ideas either to discover a truth unknown to others (Tamatousin, 2023, p214-232). The researchers used the experimental method as it was suitable for the nature of the research problem. The experimental method involves investigating the causal relationships between variables responsible for forming a phenomenon or event or influencing them directly or indirectly. This is done with the aim of understanding the impact and role of each of these variables in this field. (Khoja et al., 2023, p343-363)

Research Population and Sample

The researchers purposefully selected a sample from a group of athletes from Jijel province in athletics. The total population was 28 athletes aged 16-18 years, registered in the Algerian Athletics Federation for the 2022-2023 season. The research sample consisted of 16 runners representing the future of Jijel athletics. Eight athletes were chosen for a preliminary study, leaving a primary research sample of 16 athletes, divided into two equal groups, one experimental and the other control, each consisting of 8 runners.

Table 1: Specifications of the Research Sample in Terms of Height, Weight, Chronological Age, and Training Age

No.	Name	Date of Birth	Training Age	Weight	Height
1	Soukou Fadi	2006	5 years	59 kg	1.68 m
2	Fenousha Ishaq	2007	4 years	52 kg	1.57 m
3	Soukou Mohamed Lamine	2007	5 years	58 kg	1.72 m
4	Soukou Chihab	2006	5 years	58 kg	1.72 m
5	Ben Aziza Ayman	2007	4 years	57 kg	1.66 m
6	Bellout Sidi Ahmed Diaa Eddine	2007	4 years	54 kg	1.58 m
7	Boualmdaoud Mohamed Alaa Eddine	2006	4 years	56 kg	1.58 m
8	Soukou Karim	2006	5 years	55 kg	1.62 m

Homogeneity of the Research Sample

The researcher conducted a homogeneity test for the sample members in terms of height, weight, age, and training age.

Table 2: Homogeneity Coefficients of the Research Sample in Height, Age, Training Age, and Weight

No.	Statistical Parameters / Variables	Measurement Unit	Mean	Mode	Standard Deviation	Skewness Coefficient	Significance Type
1	Height	m	1.64	1.72	0.07	-0.86	Homogeneous
2	Age	years	16.5	16	0.52	0.63	Homogeneous
3	Training Age	years	4.5	5	0.55	-0.91	Homogeneous
4	Weight	kg	56.13	58	2.48	-0.47	Homogeneous

From Table 2 above, it is observed that the skewness values range between (± 3), indicating homogeneity of the sample members in these variables. The researchers then established equivalence for variables related to maximum oxygen consumption, specific speed, and completion time under study, and the results are shown in Table 3 as follows:

Table 3: Homogeneity of the Research Group Sample in Variables Under Study

No.	Statistical Parameters / Variables	Unit of Measurement	Mean	Standard Deviation	Median	Skewness Coefficient	Type of Significance
1	Vo2max	ml/kg	62.04	3.70	63.53	-1.21	Homogeneous
2	100m	Seconds	13.43	0.28	13.22	2.25	Homogeneous
3	400m	Seconds	57.35	3.09	57.8	-0.43	Homogeneous
4	1200m	Seconds	195.7	1.65	195.8	-0.18	Homogeneous
5	1500m	Seconds	247.1	4.84	246.97	0.08	Homogeneous

From Tables 2 and 3, it is clear that all values of the skewness coefficient ranged between (±1), which is within the limit of (± 3), indicating that the research sample falls within the normal distribution curve for these variables. This signifies the homogeneity of the sample members, and the distribution was moderate for all group members.

Preliminary Experiment

The researcher conducted the preliminary experiment on February 19, 2023, at 3:00 PM at the athletics track in the municipality of Qaous, Jijel province. This was done to identify the positives and negatives that might be encountered during the main experiment to avoid them. The sample for the preliminary experiment consisted of 8 runners from the Future Jijel Athletics team, specializing in middle-distance running. This was to identify the problems that the researcher might face during the main experiment, the suitability of the devices and tools, the appropriate time for conducting the main experiment, how to perform the physical tests, and to understand the obstacles faced by the researchers when implementing the tests and measurements.

Post-Tests

After completing the training program for the research group, the post-tests were conducted over two days, similar to the pre-tests, which were conducted from June 1st to June 2nd, 2023, under the same temporal and spatial conditions as the pre-tests.

Statistical Tools

The SPSS statistical software was used to obtain the research results using statistical formulas such as mean, standard deviation, skewness coefficient, and T-test for correlated samples.

Scientific Foundations of the Tests

Validity of the Tests: To ensure the validity of the tests, the researcher relied on face validity by presenting the tests to a group of experts and specialists in the field of sports training, specializing in athletics and physical preparation. They determined the suitability of the tests for measuring the intended purpose and agreed that they were appropriate for what they were designed for.

Table 4: Agreement Percentage of Experts and Specialists for the Tests

Test Name	Purpose of the Test	Measurement Unit	Number of Experts	Agreement Percentage
Cooper Test	Measuring maximum oxygen uptake	ml/min	5	71.43%
100m Sprint	Specific speed	Seconds	6	85.71%
400m Run	Speed endurance	Seconds	6	85.71%
1200m Run	Special performance endurance	Minutes	5	71.43%
1500m Run	Measuring effectiveness of 1500m run	Minutes	7	100%

Tests Reliability

The researchers chose the retest method for all the tests in the same manner. All tests were repeated in the same way to extract the reliability of the tests on a pilot sample of 8 players, on February 19, 2023, at 3:00 PM at the athletics field in the municipality of Qaos. The tests were repeated again under the same conditions after 9 days, on Saturday, February 27, 2023, at the same time and track. The researcher calculated the Pearson simple correlation coefficient between the test results and found that they have a strong correlation degree, as shown in Table (5).

Tests Objectivity

The tests used in this research are based on simple, clear, and easily understandable elements, far from subjective assessment and discretion. The recording is done using units (distance and time), making the tests used highly

objective. Furthermore, the correlation coefficient between the measurements of the first and second judges was used. After statistically treating the results and extracting the Pearson simple correlation coefficient between the results of the two judges (evaluators), as shown in Table (4).

Table 5: Reliability and Objectivity Values for the Tests

Test Name	Measurement Unit	Reliability Coefficient	Objectivity Score
Cooper Test	Minutes	0.93	0.97
100m Sprint from High Start	Seconds	0.88	0.93
400m Run from High Start	Minutes	0.85	0.91
1200m Run from Standing	Minutes	0.87	0.90
1500m Run from Standing	Minutes	0.85	0.89

Presentation, Analysis, and Discussion of Results

Table 6: Mean Values, Standard Deviations, Improvement Ratios, and Calculated T-Values Between the Pre-Test and Post-Test for the Control Group in Maximum Oxygen Consumption, Specific Speed, and 1500m Performance.

Statistical Treatment / Tests	Pre-Test		Post-Test		Calculated T-Value	Improvement Ratio	Error Level
	Mean	Std Dev	Mean	Std Dev			
Max Oxygen Consumption	62.04	3.70	64.45	6.27	2.87	3,88%	0,001
Maximum Speed	13.43	0.28	12.98	0.27	3.48	3,46%	0,037
Special Speed Endurance	57.35	3.09	56.89	1.42	3.02	0,80%	0,028
Special Performance Endurance	195.7	1.65	194.43	1.54	3.42	0,65%	0,003
1500m Performance	247.1	4.84	240.7	5.00	6.85	2,65%	0,019
Table t-value = 2.57- Significance level = 0.05 - Degrees of freedom = 5- N = 6							

Table (06) indicates that the mean value for the control group in the pre-test for measuring maximum oxygen uptake was (62.04) with a standard deviation (SD) of (3.70). In the post-test, the mean value was (64.45) with an SD of (6.27), showing an improvement rate of 3.88%. The calculated t-value was (2.87) at a significance level of (0.05) and degrees of freedom of 5, with a sig value of (0.01), which is less than (0.05). This indicates significant differences between the pre-test and post-test in favor of the post-test.

In specific speed, the pre-test mean was (13.43) with an SD of (0.28), while the post-test mean was (12.98) with an SD of (0.27). The improvement rate was 3.46%. The calculated t-value was (3.48) at a significance level of (0.05) and degrees of freedom of 5, with a sig value of (0.03), indicating significant differences between the pre-test and post-test in favor of the post-test.

In the specific speed endurance test, the pre-test mean for the control group was (57.35) with an SD of (3.09), and the post-test mean was (56.89) with an SD of (1.42). The improvement rate was 0.80%. The calculated t-value was (3.02) at a

significance level of (0.05) and degrees of freedom of 5, with a sig value of (0.02), indicating significant differences between the pre-test and post-test in favor of the post-test.

For the special performance endurance variable, the pre-test mean was (195.7) with an SD of (1.65), while the post-test mean was (194.43) with an SD of (1.54). The improvement rate was 0.69%. The calculated t-value was (3.42) at a significance level of (0.05) and degrees of freedom of 5, with a sig value of (0.04), indicating significant differences between the pre-test and post-test in favor of the post-test.

In the 1500m performance measurement, the pre-test mean was (247.1) with an SD of (4.84), while the post-test mean was (240.7) with an SD of (5). The improvement rate was estimated at 2.65%. The calculated t-value was (6.85) at a significance level of (0.05) and degrees of freedom of 5, with a sig value of (0.01), indicating significant differences between the pre-test and post-test in favor of the post-test.

The researchers attribute the improvement in maximum oxygen consumption and specific speed for 1500m runners to the fact that the program applied to the control group by the coach was the same as that applied to the experimental group, with the exception of the part concerning aerobic and anaerobic exercises according to the targeted time implemented on the experimental group. This training was in preparation for participation in provincial and national competitions, thereby developing various special physical abilities.

Abu Al-Alaa Abdel Fattah (2012) points out that any form of training positively affects most physical abilities, and changes in behavior occur as a result of training and practice. This led to the athletes' resistance and improvement and delayed fatigue when covering various distances, which consist of specific distances and special physical abilities. Most coaches and experts agree that these special physical abilities, which impact the achievement of this activity, involve "increasing the body's ability to tolerate oxygen deficiency during performance and the accompanying accumulation of lactic acid at high concentrations in the muscles and blood, and a change in the blood pH value, which becomes more acidic (Jabbar, 2007, p. 199)."

Additionally, the use of various speed exercises, weight training, coordination and flexibility exercises, and progressive speed training helped in the development of speed endurance and performance through interval and repetitive training with maximal and medium intensity. This aligns with what was indicated by both Bashtawisi Ahmed (1999), the International Federation (2003), and Mohamed Othman (1990), that the development of speed is through training on coordination and flexibility due to the strong association of speed with strength characterized by speed, which helps in developing transitional speed. Speed development involves using progressive speed exercises, weight training, and different one-legged and two-legged vertical jump exercises (strength exercises characterized by speed) (Abu Sari, 2021, p1-16).

Most of the energy produced during the training is produced anaerobically, which must correspond with the training intensity, affecting the muscles' ability to produce energy through blood-dissolved oxygen (Abdel Khaleq, 1999, p. 150). "No activity can be accomplished without the development and integration of special endurance, which affects the development of organic systems and their readiness to perform at distinguished rates, and endurance capacity is associated with maintaining the appropriate high level during performance" (Al-Fadli, 2012, p. 257).

These results are consistent with the findings of studies by Amjad Zakaria Abdel Aal and others (2023), Ahmed Abdel Salam Atitou, Faisal Mufrah Bani Al-Anzi (2017), Marouf Said (2019), (Abu Al-Noor,2015), and (Radi, 2020). These studies showed statistically significant differences between the pre-test and post-test measurements for the control group, due to the regularity of the control group's training and the repeated performance of traditional exercises and programs, which indirectly led to the improvement of some variables.

Thus, the first research hypothesis is verified, which states, "There are statistically significant differences between the results of both the pre-test and post-test in maximum oxygen consumption and specific speed according to the targeted time for 1500m runners in the control group, in favor of the post-test measurement."

Table 7: Mean Values, Standard Deviations, Improvement Ratios, and Calculated T-Values Between the Pre-Test and Post-Test for the Experimental Group in Maximum Oxygen Consumption, Specific Speed, and 1500m Performance

Statistical Treatment / Tests	Pre-Test		Post-Test		Calculated T-Value	Improvement Ratio	Error Level
	Mean	Std Dev	Mean	Std Dev			
Max Oxygen Consumption	60,97	17,82	69,26	58,46	3,98	13,59%	0,04
Maximum Speed	13,94	0,78	12,48	0,34	7,72	11,69%	0,03
Special Speed Endurance	58,49	0,66	56,05	0,87	4,13	4,35%	0,02
Special Performance Endurance	194,9	3,94	190,1	4,23	7,51	2,52%	0,01
1500m Performance	247,96	8,56	232,8	208,08	3,05	6,51%	0,01
Table t-value = 2.57- Significance level = 0.05 - Degrees of freedom = 5- N = 6							

From Table 07, it can be seen that the mean value in the pre-test for the experimental group for maximum oxygen consumption was (60.97) with a standard deviation (SD) of (17.82). In the post-test, the mean value was (69.26) with an SD of (58.46), showing an improvement rate of 13.59%. The calculated t-value was (3.98) at a significance level of (0.05) and degrees of freedom of 5, with a sig value of (0.04), which is less than (0.05). This indicates significant differences between the pre-test and post-test in favor of the post-test.

In the specific speed test, the pre-test mean was (13.94) with an SD of (0.78), while the post-test mean was (12.48) with an SD of (0.34). The improvement rate was 11.69%. The calculated t-value was (7.22) at a significance level of (0.05) and

degrees of freedom of 5, with a sig value of (0.03), indicating significant differences between the pre-test and post-test in favor of the post-test.

In the speed endurance test, the pre-test mean for the experimental group was (58.49) with an SD of (0.66), and the post-test mean was (56.05) with an SD of (0.87). The improvement rate was 4.35%. The calculated t-value was (4.13) at a significance level of (0.05) and degrees of freedom of 5, with a sig value of (0.02), indicating significant differences between the pre-test and post-test in favor of the post-test.

For the special performance endurance variable, the pre-test mean was (194.9) with an SD of (3.94), while the post-test mean was (190.1) with an SD of (4.23). The improvement rate was 2.52%. The calculated t-value was (7.51) at a significance level of (0.05) and degrees of freedom of 5, with a sig value of (0.01), indicating significant differences between the pre-test and post-test in favor of the post-test.

In the 1500m performance measurement, the pre-test mean was (247.96) with an SD of (8.56), while the post-test mean was (232.8) with an SD of (208.08). The improvement rate was estimated at 6.51%. The calculated t-value was (3.98) at a significance level of (0.05) and degrees of freedom of 5, with a sig value of (0.04), indicating significant differences between the pre-test and post-test in favor of the post-test.

The researchers' training program, which focused on speed and effort distribution throughout the race distance, contributed to the superior performance of the experimental group in the tests. This emphasis on speed control and effort distribution aligns with the importance of these factors in the success of a 400-meter race, as emphasized by Qasim Al-Mandlawi (1990), who states that an athlete's ability to control their speed and effort is crucial for a successful 400-meter race. "Controlling the runner's speed at a consistent and calculated pace and distributing effort are essential factors" (Al-Mandlawi, 1990, p. 166).

The improvement observed in the experimental group's performance can be attributed to the aerobic and anaerobic training sessions tailored to the targeted time frame, which aimed to enhance specific performance endurance. This type of training helps athletes resist and overcome fatigue and allows them to produce energy in low-oxygen conditions. This, in turn, enhances their capabilities and potential to overcome challenges in training and competition, ultimately achieving better results, as noted by Walid Ahmed Awad (2011), citing the effectiveness of high-intensity training sessions. Walid Ahmed Awad (2011) also mentions that intense physical effort indicates maximum effort to cover a distance in the shortest possible time, which results from effective training based on scientific principles. "One of the methods of training for special speed is precision in determining intensity" (Fitzgerald, 1991, p. 20-45).

The training regimen that combines aerobic and anaerobic exercises has proven effective in improving performance, maximum oxygen consumption, specific speed, speed endurance, and performance endurance in the 1500 meters. The researchers believe that determining intensity for 1500 meters running training

according to the targeted time frame and dividing it into segments has a significant impact on improving the specific 100-meter speed, as well as the development of 400-meter speed and improved overall time.

This aligns with the results of various studies conducted by researchers such as Afifi (2023), Sudad Fadel Mohammed Mal (2022), Ali Hussein Banyan Al-Khalidi (2021), Marouf Saeed (2019), Enas Yassin Abdel (2009), Ahmed Abdel Salam Attiatu (2017), and Faisal Mufarrah Bani Al-Anzi (2017). These studies collectively support the notion that tailored training programs, combining aerobic and anaerobic exercises, have a positive impact on improving the performance of middle-distance runners in events like the 1500 meters.

Thus, the second hypothesis, which states the existence of statistically significant differences between pre-measurement and post-measurement in maximum oxygen consumption and specific speed according to the targeted time for 1500 meters runners in the experimental group, is confirmed.

Table 8: Mean Values, Standard Deviations, Improvement Percentages, and Calculated T-values for Post-Tests in Maximum Oxygen Consumption, Specific Speed, and 1500m Performance for Both the Experimental and Control Groups

Statistical Treatment / Tests	Pre-Test		Post-Test		Calculated T-Value	Improvement Ratio	Error Level
	Mean	Std Dev	Mean	Std Dev			
Maximum Oxygen Consumption	69.26	58.46	64.45	6.27	3.46	9.71%	0.021
Specific Speed	12.48	0.34	12.98	0.27	2.56	8.23%	0.004
Speed Endurance	56.05	0.87	56.89	1.42	3.35	3.53%	0.012
Special Performance Endurance	190.1	4.23	194.43	1.50	4.43	1.87%	0.033
Achievement	232.8	208.08	240.7	5.00	3.32	3.86%	0.006

Table t-value = 2.22- Significance level = 0.05 - Degrees of freedom = 10- N = 12

From Table (8), it is evident that the mean for the experimental group in the post-test for measuring the maximum oxygen consumption was 69.26, with a standard deviation of 58.46. As for the control group, the mean was 64.45, with a standard deviation of 6.27. The improvement percentage was 9.71%. After calculating the t-value for independent samples, which was 3.46, at a significance level of 0.05 and degrees of freedom equal to 10, the p-value (sig) was 0.021, which is smaller than 0.05. This means that there is a statistically significant difference in favor of the experimental group.

In the specific speed test, the mean for the experimental group was 12.48, with a standard deviation of 0.34. For the control group, the mean was 12.98, with a standard deviation of 0.27. The improvement percentage was 8.23%. The calculated t-value was 2.56 at a significance level of 0.05 and degrees of freedom equal to 10. The p-value (sig) was 0.004, indicating a statistically significant difference in favor of the experimental group.

In the speed endurance test, the mean for the experimental group was 56.05, with a standard deviation of 0.87. For the control group, the mean was 56.89, with a standard deviation of 1.42. The improvement percentage was 3.53%. The calculated t-value was 3.35 at a significance level of 0.05 and degrees of freedom equal to 10. The p-value (sig) was 0.012, indicating a statistically significant difference in favor of the experimental group.

Regarding the specific performance endurance test, the mean for the experimental group was 190.1, with a standard deviation of 4.23. For the control group, the mean was 194.43, with a standard deviation of 1.50. The improvement percentage was 1.87%. The calculated t-value was 4.43 at a significance level of 0.05 and degrees of freedom equal to 10. The p-value (sig) was 0.033, indicating a statistically significant difference in favor of the experimental group.

In the achievement test for the effective 1500 meters, the mean for the experimental group in the post-test was 232.8, with a standard deviation of 208.08. For the control group, the mean was 240.7, with a standard deviation of 5.00. The improvement percentage was 3.86%. The calculated t-value was 3.32 at a significance level of 0.05 and degrees of freedom equal to 10. The p-value (sig) was 0.006, indicating a statistically significant difference in favor of the experimental group.

The researchers attribute this development, especially in the experimental group, to the positive impact of the training program prepared by the researchers. This program involved the implementation of both aerobic and anaerobic exercises according to the targeted timing to enhance maximum oxygen consumption and specific speed for 1500 meters runners. It achieved this by progressively increasing training loads at an altitude of 1250 meters above sea level. The training program also emphasized the importance of diversifying and regulating training loads to induce adaptational changes in the body.

According to Mohammed Sudad (2022), Training contributes to improving pulmonary ventilation and increasing oxygen consumption, which leads to a reduction in lactic acid content in the blood during physical exertion compared to untrained individuals (Sudad, 2022, pp. 91-99).

This development was the result of meticulously dividing the distances, which closely simulates a significant part of training units. The training followed a system of phosphagenic and lactic energy, executed by the members of the experimental group during the training regimen. This was done while considering the target time and heart rate. It significantly contributed to determining rest times and repetitions, thereby accounting for individual differences among runners by adjusting heart rate for varying physiological capabilities.

This concept is in line with what Qassim Hassan Hussein (1998) referred to as follows: "One of the most notable practical examples is the reliance of coaches and athletes on heart rate measurements during training to determine the type of physiological response accompanying physical effort, aiding in regulating training load components" (Qassim, 1998, p. 239).

Furthermore, achieving a high level in athletics, especially in the youth category, is accomplished through adjusting intensity, volume, and rest to develop various functional systems. This is affirmed by Mufti Ibrahim (2010), who stated that adjusting sports training loads and rest duration, either by increasing or decreasing, aims to reach the appropriate level required for players' improvement. This is reflected in the results of reduced heart rate during rest (Mufti, 2010, p. 103).

One of the factors that contributed to this development was the training location of the experimental group compared to the control group, which trained at sea level. Abu Alaa Abdel Fattah (2000) confirmed that athletes retain a high level of efficiency for some time after returning from high altitudes due to a significant improvement in international record numbers after training at high altitudes. This improvement is a result of increased functional capacity of athletes in terms of economy and efficiency in oxygen utilization for energy production (Abdel Fattah, 2000, p. 125).

In the study, special attention was given to improving specific capabilities and the time associated with the 800m distance in order to enhance personal records for the 1500m distance. This was aimed at increasing oxygen debt endurance and maintaining specific speed, as well as optimizing effort distribution. Ibrahim Mohamed (2008) states that 'the body's capacity to endure oxygen debt increases, along with the specific requirements for the 800m event (such as speed, endurance, control, respiratory-circulatory system capability, effort distribution, physiological adaptation, willpower, perseverance, intelligence).

The physical requirements for this event depend on acquiring both aerobic and anaerobic energy' (Ibrahim, 2008, p 9). The 800m event is known to fall within the anaerobic energy systems and the lactic acid (mixed) system. Training in the anaerobic energy system and the lactic acid system enables the athlete to operate at maximum capacity, thereby increasing lactic acid as well as enhancing the efficiency of the biological systems simultaneously, leading to faster elimination of lactic acid. As these physiological capacities improve, the athlete is able to perform maximal muscle work for a longer duration using the lactic acid system (Abdel Fattah & El-Sayed, 2003, p 337). Furthermore, increased activity of the enzymes involved enhances this system's capability to develop specific physical abilities like speed endurance (Training Course, 2006, p 66).

For the control group, despite some improvement, the progress was minimal due to the accumulation of training for this sample compared to the experimental group. The researchers attribute this to the lack of compatibility in the composition of the training load in terms of intensity and the volume of training, as well as a lack of knowledge about modern methods and tools that clearly facilitate and improve coaches' work. 'Expert opinions, regardless of their scientific and practical cultural backgrounds, unanimously agree that the methodology inevitably leads to performance improvement' (Al Ali & Bahaa El-Din, 2014, p 211-234).

The researchers also attribute the improvements in various tests for the control group to the anaerobic exercises that contributed to muscle efficiency and the

elimination of lactic acid. This is corroborated by Rissan Khreibit and Abu Al-Ela Abdel Fattah (2016), who state 'the individual's efficiency in performing activities that rely on anaerobic work for energy production improves as a result of increased anaerobic energy production capacity, which is reflected in increased activity of adenosine triphosphate (ATP) and creatine phosphate (PC) for energy production, as well as enhanced muscle efficiency in eliminating lactic acid byproducts' (Khreibit & Abdel Fattah, 2016, p 22).

These results align with the findings of: Afifi, (2023), Sudad, (2022), Al-Khaldi, (2021), Marouf (2019), Inas Yassin Abd (2009), Ahmed Abdel Salam Atito, Faisal Mufrah Bani Al-Anzi (2017), that both aerobic and anaerobic exercises have a positive impact on maximum oxygen consumption and specific speed according to the targeted time for 1500m runners.

Thus, the third hypothesis is confirmed: there are statistically significant differences between the post-test measurements in maximum oxygen consumption and specific speed according to the targeted time for 1500m runners, favoring the post-test measurement for the experimental group.

Conclusions

- ✓ Aerobic and anaerobic training according to the targeted timing have a significant impact on the maximum oxygen consumption for 1500-meter runners.
- ✓ Aerobic and anaerobic training according to the targeted timing effectively improve specific speed, speed endurance, and performance endurance for 1500-meter runners.
- ✓ Training according to the targeted timing significantly enhances the achievement time for the 1500-meter distance.
- ✓ Improving achievement in the 1500-meter race is associated with several fundamental variables, including specific endurance, speed rate, and performance endurance.

Recommendations

- ✓ It is advisable to incorporate aerobic and anaerobic training according to the targeted timing as they have a positive impact on performance for the 1500-meter race.
- ✓ Diversify the intensity of training in aerobic and anaerobic exercises for their effective impact.
- ✓ Conduct research on aerobic and anaerobic training according to the targeted timing for adolescent athletes and explore other variables.
- ✓ Coaches in middle-distance running should use specialized training exercises to improve specific speed according to the targeted timing.
- ✓ Emphasize the use of the targeted timing for athletes to develop their training capabilities in alignment with their personal timings.
- ✓ Conduct further studies on middle-distance or long-distance races based on the results of this study.

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