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The Effect of Hypoxic Training on Blood Lactate And Level of Performance For 1500m Runners

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Abstract

The research aims to investigate the effect of hypoxic training on blood lactate concentration (rest-exercise) and the performance level of 1500 m. runners. The researchers employed the experimental method using a single experimental group comprising six athletes from the 1500-meter running team of the Athletics National Team of University of Sadat City at (2023-2024). The research sample underwent physical training using a training mask (hypoxic training) as part of the training program for 12 weeks, with three training sessions per week, totaling 36 training sessions. Each session lasted 90 minutes. The results indicated that the training program using hypoxic training with a training mask positively affected the participants, showing statistically significant differences between pre- and post-measurements in favor of the post-measurements in blood lactate concentration (rest-exercise) and the performance level of 1500-meter runners. The researchers recommended the use of hypoxic training to improve blood lactate concentration (rest-exercise) and the performance level of 1500 m runners. scientific and technological fields is the result of modern scientific research and inventions across different areas that serve humanity.

Keywords: *Hypoxic training , Blood lactate , 1500 m level of performance*

Introduction

Modern sports training is a planned process based on sound scientific principles aimed at achieving holistic athletic performance. This, in turn, helps athletes reach advanced standings through the attainment of optimal achievements. Achieving this goal requires coaches to plan their athletes' physical, physiological, technical, tactical, and psychological abilities in a unified framework to reach an exceptional athletic level, especially during competitions.

Blagrove et al. (2018) point out that middle-distance running performance is the result of a complex interaction of physical, physiological, mechanical, psychological, and tactical factors. Certain cardiovascular variables associated with aerobic energy

production can account for a significant proportion of the differences in performance among athletes (Blagrove et al., 2018, p. 1118).

Hong Young et al. (2018) and Schiff et al. (2004) suggest that exposing body tissues and cells to hypoxia by holding one's breath or controlling breathing (reducing the frequency of breaths) during regular and short-duration exercises in training programs has a positive and effective impact. It reduces lactic acid concentration in blood and muscles, accelerates the elimination of accumulated lactic acid, enhances the body's ability to sustain high-intensity muscle performance in oxygen debt conditions, and improves overall body efficiency (Hong Young et al., 2018, p. 52; Schiff et al., 2004, p. 86).

Bukhari et al. (2016) and Sirkan Onsen and Salih Binar (2018) add that the training mask is a modern training tool that simulates high-altitude training by altering the partial pressure of oxygen. It consists of three differently designed valves that control air intake and exhalation through the nose and mouth at varying altitudes. The training mask is designed to improve breathing efficiency, making it an excellent tool for cardiovascular training. It enhances oxygen uptake efficiency, increases the body's energy levels, and ultimately elevates physical performance (Bukhari et al., 2016, p. 379; Sirkan Onsen & Salih Binar, 2018, p. 7).

Using hypoxic training methods requires caution by adhering to certain conditions, which are outlined as follows: The proportion of hypoxic training should range between 25% and 50% of the total duration of the training session, Severe oxygen deprivation should be avoided to prevent fainting, If a headache occurs during training and persists for more than ten minutes, the oxygen level should be increased by adjusting the three mask settings. The principle of gradual load increase should always be observed, Hypoxic training should not negatively impact the technical performance of the competition, Finally, Hypoxic training is a highly demanding physical load on the body, so it should not be continued for an extended period during training competitions. (Mohamed Hassan Allawi & Abu Alaa Abdel Fattah, 2004, p. 92).

Raisin Khirbet and Abu Alaa Abdel Fattah (2016) state that lactic acid plays a role in anaerobic adenosine triphosphate (ATP) regeneration through glycolysis, a process involving glucose breakdown in the absence of oxygen. Lactic acid is the final product of anaerobic glycogen consumption in muscle cells, leading to temporary muscular fatigue. Reducing its concentration in blood and muscles is crucial for recovery and returning athletes to their normal state (Raisan Khreibet & Abu Alaa Abdel Fattah, 2016, p. 147).

Baha Uddin Salama (2005) highlights that active muscles are the primary source of lactic acid production in the blood, while inactive muscles contribute significantly to lactic acid clearance. This occurs within their capacity to extract acid from the circulating

blood. The enzyme lactate dehydrogenase (LDH) plays a role in metabolizing lactic acid. Any increase in the activity of this enzyme is accompanied by changes in lactic acid concentration (Baha Uddin Salama, 2005, p. 43).

The researchers observed a decline in the performance level of 1500-meter runners from the University of Sadat City team compared to the recorded results in the Egyptian Universities Championship. This observation prompted the researchers to design a training program using hypoxic training to examine its effect on blood lactate and the level of performance for 1500 m runners.

The researcher used the Phantom Athletics training mask, an innovative mask for training the respiratory muscles and improving fitness during exercise. It prevents early feelings of fatigue and lowers the heart rate. It features the patented Phantom breathing regulation system for individual difficulty adjustment with 4 levels, anatomical fit for providing the perfect size, and includes a good ventilation strip and sweat absorption.

The research aims to investigate the impact of a training program using hypoxic training on blood lactate levels for 1500 m runners and level of Performance for 1500 m. runners.

Method

The researchers utilized the experimental approach, employing a one-group experimental design.

Participants

The research sample was selected from the athletics team University of Sadat City at (2023/2024), consisting of (6) participantsK, The training age of the basic research sample ranges from 5 to 10 years the average age (20,333 ± 1.033 years) , Height (177.00 ± 4.382 cm) and the Weight (72.333 ± 5.574 kg).

Procedures

Pre- measurements

The researchers conducted the pre-test for the main sample of the research from 9/9/2024 to 10/9/2024.

Training Program

The researchers implemented the proposed training program on the research sample from 1/10/2024 to 22/12/2024, for a period of 12 weeks, with 3 training sessions per week, "This training program consists of 12 weeks, comprising 36 training units, each lasting 90 minutes. The intensity levels are:

- Month 1: 70%
- Month 2: 80%

- Month 3: 90%

1- Program Objective:

The training program utilizing hypoxic training aims to enhance blood lactate concentration levels and improve the performance times of 1500m runners.

2- Basis for Program Design:

When designing the program, the researcher adhered to the following scientific principles:

- Ensuring that hypoxic training achieves the intended objective.
- Referring to similar training programs that have incorporated hypoxic training.
- Aligning the program content with its objectives and the sample's level.
- Gradually increasing the training load according to the age group and level of the research sample.
- Considering individual differences among athletes.
- Emphasizing stretching and flexibility exercises in the warm-up phase of each training session.
- Allowing sufficient flexibility in the proposed program during its implementation.
- Ensuring safety and security measures are in place during training.
- Taking into account movement levels and mechanics.

3- Training Methods Used in the Program:

- Continuous Training
- Low-Intensity Interval Training
- High-Intensity Interval Training.

Post measurements

The researchers conducted the post-test for the research sample from 22/12/2024 to 23/12/2024, ensuring that the same conditions and procedures as in the pre-test were followed.

Tools and devices

1. Stopwatch for measuring time.
2. Different height cones.
3. Whistle.
4. Medical scale to measure weight in kilograms.
5. Rastameter device to measure height in centimeters.
6. Hypoxic training mask

Statistical Analysis

According to the objectives and hypotheses of the study, the author calculated the Mean, Standard deviation, Skewness, Mann-Whitney, and improvement percentage of the output data.

Results

The results of the table indicate the mean and standard deviation for the lactate concentration in the blood (rest-effort) for both the pre-test and post-test of the experimental sample.

Table (1) Lactate Concentration in the Blood (Rest-Effort) in the Pre-Test and Post-Test for the Experimental Sample (N=6)

Tests		Units	pre-test Standard Deviation	Post-test Mean	Post-test Standard Deviation	Pre-test Mean
Lactate Concentration	Rest	mmol/L	0.414	2.305	0.120	2.852
	Effort	mmol/L	0.696	9.420	0.568	10.838

The results of the table indicate that there are statistically significant differences between the pre-test and post-test, favoring the post-test in lactate concentration in the blood (rest-effort) for the experimental sample.

Table (2) Statistical Significance of the Differences Between the Pre-test and Post-test for Lactate Concentration in the Blood (Rest-Effort) (N=6)

Tests	Direction	Number	Mean Ranks	Sum of Ranks	Z-Value	Significance
Lactate Concentration	Rest	-	6	3.50	21.00	*2.201
		+	0	0.00	0.00	
		=	0			
	Effort	-	6	3.50	21.00	*2.201
		+	0	0.00	0.00	
		=	0			

The results of the table indicate the average pre-test and post-test values for lactate concentration in the blood (rest-effort) for the experimental sample.

Table (3) Rate of Change in Lactate Concentration in the Blood (Rest-Effort) in the Post-test Compared to the Pre-test for the Experimental Sample

Tests	Pre-test Mean	Post-test Mean	Rate of Change (%)
Lactate Concentration	Rest	2.852	2.305

	Effort	10.838	9.420

The results of the table indicate the mean and standard deviation for the numerical level in the pre-test and post-test for the experimental sample.

Table (4) Mean and Standard Deviation of the Numerical Level in the Pre-test and Post-test for the Experimental Sample (N=6)

Variables	Unit	Pre-test Mean	Pre-test Standard Deviation	Post-test Mean	Post-test Standard Deviation
Numerical Level	Seconds	264.333	4.844	259.167	5.845

The results of the table indicate that there are statistically significant differences between the pre-test and post-test, favoring the post-test in the numerical level for the experimental sample.

Table (5) Statistical Significance of the Differences Between the Pre-test and Post-test for the Numerical Level of the Experimental Sample (N=6)

Variables	Direction	Number	Mean Ranks	Sum of Ranks	Z-Value	Significance
Numerical Level	-	6	3.50	21.00	2.226*	0.026
	+	0	0.00	0.00		
	=	0				

*Z-Value at a significance level of 0.05 is 1.96

The results of the table indicate the rate of change in the physical tests used in the research between the post-test and pre-test for the experimental sample.

Table (6) Rate of Change in the Numerical Level in the Post-test Compared to the Pre-test for the Experimental Sample

Variables	Pre-test Mean	Post-test Mean	Rate of Change (%)
Numerical Level	264.333	259.167	1.95%

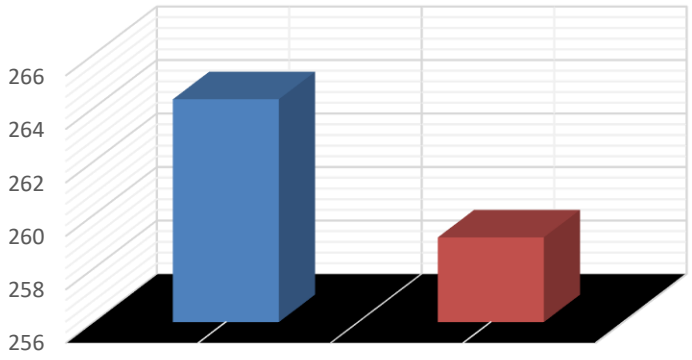

Figure (1) Average pre-test and post-test scores of the numerical level for the experimental sample.

Let me know if you'd like further clarification or adjustments.

Discussion

Table (1) shows statistically significant differences between the pre-test and post-test means in blood lactate concentration, favoring the post-test.

Table (2) also indicates statistically significant differences between the pre-test and post-test in the blood lactate concentration, favoring the post-test.

Table (3) the improvement rates between the pre-test and post-test means in blood lactate concentration, with all showing improvements in the post-test.

The researcher attributes this improvement in blood lactate concentration to the effectiveness of the hypoxic training, which involved a variety of exercises, as well as careful adjustment of training loads to match the participants' levels.

This result is consistent with the findings of Hon Yong et al. (2018) and Shif et al. (2004), who state that subjecting body tissues and cells to oxygen deficiency through breath-holding or breathing control (reducing breathing frequency during short, regular exercises in training programs) has a positive and effective effect on reducing blood lactate concentration, accelerating lactate removal, increasing the body’s ability to tolerate high-intensity exercise, and improving overall body functional efficiency.

This result also aligns with the findings of studies by Ahmed Kawah (2018) The researcher benefited from this study that hypoxic exercises using a training mask contribute to improving the concentration of lactic acid in the blood of 1500-meter runners . and Hamdy El-Sayed El-Nawasery (2022) on the effectiveness of hypoxic training in reducing blood lactate concentration in 1500 -m runners.

Thus, the first hypothesis, which states, "There are statistically significant differences at the 0.05 significance level between the pre-test and post-test means for the experimental group in blood lactate concentration (rest-exercise), favoring the post-test," was confirmed.

Table (4) shows statistically significant differences between the pre-test and post-test means for the 1500m runners' performance levels, favoring the post-test.

Table (5) also shows statistically significant differences between the pre-test and post-test in the performance levels of the 1500m runners, favoring the post-test.

Table (6) the rate of change in performance levels from pre-test to post-test for the experimental group, where the change rate was 1.95%.

Michel Clarke et al. (2012) emphasized that coaches must be familiar with the latest methods and techniques in sports training that help athletes improve their physical abilities and performance levels.

Francimara (2011) that the physical and functional preparation of middle-distance runners, especially in the 1500m race, depends on enhancing both aerobic and anaerobic energy systems, as anaerobic energy development requires a solid foundation of aerobic energy.

This finding is also in line with the studies of Rahim Habib (2019) The researcher benefited from this study on the effectiveness of endurance training using the altitude method in improving the performance rates of 1500-meter runners.and Ahmed Salem (2021), which emphasize the effectiveness of hypoxic training in improving performance levels in 1500m runners.

The hypoxic training had a significant positive effect on improving performance levels for 1500m runners by helping improve lactate concentration in the blood, thus delaying fatigue onset, which ultimately helped improve performance levels.

Thus, the second hypothesis, which states, "There are statistically significant differences at the 0.05 significance level between the pre-test and post-test means for the experimental group in performance levels, favoring the post-test," was confirmed.

Conclusion

Based on the research problem, research objectives, and the findings derived from the sample and procedures, the researchers concluded the following:

1. The proposed training program improves blood lactate levels (rest-exercise) in the 1500m runners in the experimental group.

2. The proposed training program improves the performance levels of the 1500m runners in the experimental group.

Recommendations

1. Utilizing the proposed training program to improve lactic acid levels in 1500-meter runners.
2. Incorporating hypoxic training exercises in the training programs for 1500-meter runners to enhance their performance and mprove their timing.
3. Conducting further similar studies on other track and field events.

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