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The enzymatic responses to varying levels of physical stress in 800-meter runners differ

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Abstract: The aim of this study was to identify the enzymatic responses to varying levels of physical stress in 800-meter runners differ. The researchers used the experimental methods on a sample of six male track and field players' ages 18-22 years, measurements used in this study at rest and after exercise on treadmill CPK, LDH, SGOT, SGPT. The following conclusions were reached:

1. Utilize the study's results as indicators for regulating different physical loads (maximum load, submaximal load, and moderate load) in the 800-meter race competition.
2. Incorporate the study's findings in the selection of athletes based on enzymatic responses and varying physical loads (maximum load, submaximal load, and moderate load).
3. Develop a guidance model by the International Association of Athletics Federations (IAAF) in Saudi Arabia, including the enzymatic variables under study, to guide the development of training programs of different intensities for various athletic levels in the 800-meter race.
4. Employ enzymatic variables as essential indicators of the training status of 800-meter race track athletes.

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Introduction

The rapid evolution and continuous progress in the realm of sports training have been driven by the constant accumulation of knowledge, particularly in the field of athletic training. In recent years, there has been a significant breakthrough in sports training, aimed at achieving high athletic levels, enhancing sports performance, and breaking records in various sports disciplines. Central to this endeavor is the meticulous planning of training programs. As the primary objective of sports training is to maximize the potential of athletes, several scientific theories in the field of training have emerged. These theories have provided insights into various aspects of training, offering valuable solutions and contributing to the overall improvement of athletes' performance.

Numerous factors influence sports training and regulate the intensity, duration, and volume of the training load. Among these factors, the intensity of training plays a crucial role. Additionally, the duration of physical activity and the extent of static muscular work involved in the activity are pivotal. Different training loads have a distinct impact on all bodily organs and systems. Moreover, physiological and chemical responses vary among athletes during periods of rest and during physical exertion.

In recent times, field and track competitions have witnessed a remarkable development in breaking athletic records, reaching unprecedented levels of achievement. The improvement of athletic performance depends on various factors, including the enhancement of the functional capacity of the athletic body. This is achieved through the development of training methods aimed at improving results and achieving peak performance. Training methods play a vital role in realizing the objectives of the training process. However, the physical and general functional preparation of middle-distance runners relies to varying degrees on aerobic and anaerobic energy systems.

Numerous scientific studies suggest that measuring the levels of serum enzymes in athletes reflects the effects of training on cellular metabolic changes, recovery periods' efficiency, and provides an indicator for detecting adverse effects of training on skeletal muscles, cardiac muscles, brain tissues, and liver functions (Staron & Hikida, 2000; Robergs & Roberts, 2000; Mc Ardle et al., 2015).

One of the serum enzymes, Creatine Phosphokinase (CPK), stimulates biochemical reactions that produce adenosine triphosphate (ATP) anaerobically. This supports the high-energy demands of short-duration, high-intensity training (Abdelfattah, 2003; Sherwood, 2001; Viru, 2000).

On the other hand, the enzyme Lactic Dehydrogenase (LDH) catalyzes reactions converting pyruvate into lactate to produce ATP through anaerobic glycolysis, providing the necessary energy for sustained high-intensity training over relatively longer periods (Robergs & Roberts, 2000; Foss & Keteyian, 1998).

Additionally, the amino acid transport enzymes (SGPT, SGOT) play a significant role in protein metabolism and the citric acid cycle, thereby supporting both aerobic energy systems and anaerobic glycolysis (Vander et al., 1998; Maughan et al., 1998).

Consequently, serum enzymes are crucial in biochemical reactions that stimulate energy production during physical performance and serve as important indicators of athletes' training status.

Problem Statement

Undoubtedly, the remarkable progress in achieving digital excellence in all track and field competitions reflects an immense wealth of scientific knowledge and information that contributes to a significant breakthrough in the training process. The scientific approach is the correct path to achieving progress that aligns with global advancements. However, the utilization of modern technology is the only way to overcome the substantial shortcomings in achieving digital excellence in track and field competitions.

Through educational observations and a review of literature, scientific studies, and tracking championships and competitions, and monitoring the performance records of 800-meter runners, it has been observed that signs of fatigue quickly manifest in these athletes. Consequently, their ability to control speed rates during the final stages of the race is affected, leading to a sharp decline in performance speed. This underscores the deviation of Saudi runners from achieving optimal race performance. The reason for this discrepancy can be attributed to a problem with the training programs adopted by coaches.

Training programs primarily rely on the principles of energy production systems development based on the type and nature of the practiced activity. These principles encompass training methods, objectives, athlete fitness assessments, dietary recommendations, weight maintenance, and the planning of training loads in accordance with energy source replenishment periods. All these fundamental processes on which training is built fundamentally depend on the applied understanding of energy production systems and the biochemical changes occurring within cells. In this context, enzymes, especially serum enzymes, play a significant role in their reactions and in stimulating energy production during physical performance.

Hence, the importance of serum enzyme markers in detecting the acute changes in the body resulting from training becomes evident. Attempting to uncover the accompanying effects of training on certain biochemical aspects contributes to adding a new dimension that can be relied upon in assessing, guiding, and formulating training programs for 800-meter runners. Therefore, investigating the enzymatic responses to varying levels of physical stress in these athletes aligns with physical development aspects and provides a new dimension for assessing speed endurance among 800-meter runners. This prompted the researcher to study the enzymatic responses to different levels of physical stress in 800-meter track and field athletes and to present an applied model of serum enzyme activity during rest periods, during exertion, and post-exertion for varying physical stress levels among these athletes.

Study Objective

The objective of this study is to determine the enzymatic responses to varying levels of physical stress in 800-meter track and field athletes.

Study Hypotheses

The study postulates the following hypotheses:

1. There are statistically significant differences between pre-measurement and post-measurement in the enzymatic responses of 800-meter track and field athletes according to the intensity of physical load.
2. There is variation in the enzymatic responses of 800-meter track and field athletes across different levels of physical stress.

Study Terminology

1. **Enzymes**: Enzymes are protein molecules that act as biological catalysts to increase the rate of biochemical reactions within living cells by controlling metabolic pathways without being altered or consumed in the reaction (Robergs & Roberts, 2000).
2. **Creatine Phosphokinase (CPK)**: CPK is an enzyme that catalyzes the phosphorylation of adenosine diphosphate (ADP) in the presence of creatine phosphate to form adenosine triphosphate (ATP) (Foss & Keteyan, 1998).
3. **Lactate Dehydrogenase (LDH)**: LDH is an enzyme that catalyzes the conversion of pyruvate into lactate (Foss & Keteyan, 1998).
4. **Glutamic Oxaloacetic Transaminase (SGOT) or Aspartate Amino Transferease (AST)**: SGOT is an enzyme that catalyzes the transfer of an amino group from aspartate to α-ketoglutarate, forming oxalacetate and glutamate. It plays an

essential role in protein metabolism and the citric acid cycle (Maughan et al., 1998).

5. **Glutamic Pyruvic Transaminase (SGPT) or Alanine Amino Transferease (ALT)**: SGPT is an enzyme that catalyzes the transfer of an amino group from alanine to α-ketoglutarate, forming pyruvate and glutamate (Pas Sett JR, How Ley ET, 2000).
6. **International Unit (IU)**: An IU is the amount of enzyme required to convert one micromole (μM-mol) of substrate into product per minute under specific reaction conditions (Mckee T, Mckee J, 1996).

Previous Studies

1. **Abu Jameel and Faraj (2003)** conducted a study titled "The Effect of Using Fins During Muscular Endurance Exercises in Some Aquatic Sports on Creatine Phosphokinase, Lactate Dehydrogenase, Alanine Transaminase Enzymes, Free Radicals Level, and Digital Level of Swimmers in 50m and 100m Freestyle." They employed an experimental approach with a purposive sample of 14 healthy athletes in aquatic sports. The study revealed that inhibiting blood flow to and from the muscles during muscular endurance exercises, with the use of fins as an intervention, positively affected the enzyme levels of LDH and CPK and increased the production of free radicals in the body.
2. **Qutb (2002)** conducted a study titled "Enzymatic Responses Associated with the Development of Special Endurance and Its Components (Strength Endurance – Speed Endurance) for Some Leg Wrestling Movements." The study used an experimental approach and included 40 healthy male wrestlers in different training groups. The results demonstrated the effectiveness of training programs in developing special endurance for leg wrestling and improving the associated enzymatic responses.
3. **Dorofeyeva (2004)** conducted a study titled "Biochemical and Periodic Abilities of Physical Training and Supplementary Nutrition Using Amino Acids." Employing an experimental approach, the study had a sample of 60 cyclists and swimmers. The athletes were divided into two groups, one receiving amino acid supplementation and the other receiving a placebo. The study found significant differences in the concentration of enzymes in the athletes' serum, including IL10, IL6, and LDH, due to the amino acid supplementation.
4. **Fufh et al. (2002)** conducted a study on "Rapid Changes in Selected Blood Serum Enzymes and Metabolic Concentrations in Athletes Aged 12-14 Years after 100m Speed Swimming." Using an experimental approach, the study examined 23 competitive swimmers. The results indicated significant differences in serum CPK concentration at rest (pre-test) and significant differences in LDH and CK levels after 100m high-speed swimming. Differences were also found in serum GOT and glucose levels after 100m fast swimming.
5. **Khalifa (2015)** conducted a study titled "The Effect of Varied Intensity Physical Loads on Some Enzymatic and Functional Responses in Athletes." The research aimed to investigate the impact of different physical loads (maximum, sub-maximum, and moderate) on enzymatic and functional responses in athletes. Using an experimental approach, the study included 12 male runners. The results revealed significant differences between pre-test and post-test measurements in some enzymatic and functional responses for athletes in the 100m sprint, 800m run, and 5000m run, depending on the intensity of physical loads.
6. **Dwaidar (2020)** conducted a study titled "The Effect of Varied Intensity Physical Effort on Some Physiological and Enzymatic Responses in Swimmers." The study aimed to investigate the impact of varying physical loads (sub-maximum and maximum) on physiological and enzymatic responses in competitive swimmers. Using an experimental approach, the study included 15 male swimmers aged 16-18. The results indicated statistically significant differences in physiological and enzymatic responses between athletes engaged in aerobic and anaerobic activities following varying physical loads.

These previous studies collectively contribute to our understanding of how different types and intensities of physical exercise can influence enzymatic and physiological responses in athletes across various sports and age groups.

Commentary on Previous Studies:

The presentation of previous studies highlights that the majority of research has focused on investigating the impact of various enzymatic concentrations during physical activities, with an emphasis on different types of sports and the age groups of the athletes. Furthermore, these studies have demonstrated that the concentration levels of enzymes vary across different types of physical activities, and so do the physiological responses of athletes during these activities. This variation is influenced by the nature and type of the sporting activity under investigation.

Research Scope:

Human Domain:

The current study focuses on high-level athletes who are registered with the Saudi Arabian Athletics Federation and specialize in the 800-meter track event.

Spatial Domain:

The research was conducted at the Exercise Physiology Laboratory within the Department of Physical Education and Sports Sciences at Taibah University.

Temporal Domain:

Data collection for the study occurred in February 2022.

Study Procedures:

Research Methodology:

The researcher employed an experimental research methodology for a single experimental group. This approach involved both pre-test and post-test measurements to align with the specific nature of the study. The study aimed to investigate the enzymatic and physiological responses of the selected high-level athletes in the 800-meter track event before and after the physical activity under investigation.

Study Sample:

The study was conducted on a sample comprising 6 male track and field athletes, all of whom are classified as first-degree competitors. Their ages ranged from 18 to 22 years. The participants were selected randomly from among registered athletes in the records of the Athletics Association in Al-Madinah Al-Munawwarah, specifically from the clubs "Ahad" and "Al-Ansar."

Table 1 provides an overview of the characteristics of the study sample, which consists of athletes specializing in the 800-meter track and field event.

Table 1: Characteristics of the Study Sample

Statistical Significance / Measurements	Measurement Unit	800-meter	
		S	D±
Age	**Years**	19.67	1.63
Height	**cm**	172.50	2.17
Body Weight	**kg**	69.00	0.84
Body Mass Index	**kg/m^2**	23.19	0.31
Body Surface Area	**m^2**	1.82	0.02
Training Age	**Years**	4.67	1.21

The tools and devices used in the study are as follows:

- Test tubes for storing blood samples prior to separation and analysis (Plastic Tubes).
- Tube holder.
- White alcohol for sterilization.
- Plastic syringes.
- Medical cotton.
- Blood transport container (Ice Tank).
- Centrifuge machine for blood sample separation.
- Treadmill for determining various levels of physical stress:

Measurements used in the study

First: Basic measurements:

- Age: Calculated to the nearest month at the start of the pre-measurement.
- Total body length: Measured to the nearest centimeter using a stadiometer.
- Body weight: Measured to the nearest half kilogram using a calibrated medical scale.
- Training age.
- Body Mass Index (BMI): BMI = Mass (kg) ÷ Height squared (m2):
- (Al-Hazzaa, 2010), (Sherwood, 2001), (Baumgartner & Jackson, 1999).
- Calculation of Body Surface Area (Mosteller equation).

$$\text{BSA } (m^2) = \sqrt{([\text{Height (cm)} \times \text{Weight (kg)}]\ /3600}$$

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Secondly, enzymatic laboratory measurements were conducted as follows (during rest and after exercise):

• Creatine Phosphokinase enzyme (CPK).
• Lactate Dehydrogenase enzyme (LDH).
• Glutamic Oxaloacetic Transaminase enzyme (SGOT).
• Glutamic Pyruvic Transaminase enzyme (SGPT).

Normality of the distribution of study measurements:

The normality of the measurements specific to the study was assessed to ensure that the sample was free from non-random non-normal distribution defects for the

quantitative data under study. The researcher performed statistical description of these data through the following:

Normality of the distribution of basic measurements:

Table (2) Statistical Significance of Basic Variables for the Study Sample

Statistical Significance / Standard Measurements	Measurement Unit	Mean	Standard Deviation	Skewness Coefficient	Kurtosis Coefficient
Age	**Years**	19.67	1.63	0.38	-1.48
Height	**cm**	172.50	2.17	0.27	-2.21
Body Weight	**kg**	69.00	0.84	0.38	-1.79
Body Mass Index	**kg/m^2**	23.19	0.31	-0.14	-2.68
Body Surface Area	**m^2**	1.82	0.02	0.31	-2.19
Training Age	**Years**	4.67	1.21	1.95	3.66

It is evident from Table (2) that the basic data of the study sample follows a normal distribution (the normality curve). The skewness coefficient ranges from -0.14 to 1.95, with these values being close to zero. This directly indicates that the sample represents a normally distributed population, implying the absence of non-normal distribution defects in the sample.

The normality of the distribution of enzymatic measurements.

Table (3): Statistical Significance of Enzymatic Measurements

Statistical Significance / Enzyme Measurements	Measurement Unit	Mean	Standard Deviation	Skewness Coefficient	Kurtosis Coefficient
CPK	U / L	337.50	132.13	-0.24	-1.04
LDH	U / L	342.50	34.41	0.34	-0.95
SGOT	U / L	27.33	10.07	0.22	-1.71
SGPT	U / L	29.17	7.63	0.75	1.12

The Implementation Phase (The Basic Study):

The actual study was conducted in February 2022, at the laboratory of the Department of Physical Education and Sports Sciences, College of Education, Taibah University. Blood samples were taken from the participants both at rest and during periods of rest. Subsequently, each participant underwent physical exertion on a treadmill (Tride Mail). The speed was gradually increased at fixed intervals of every two minutes across three different levels of physical stress. There were intermittent periods to ensure the athlete's return to their natural state, followed by the application of the next load, which was less than the maximum. Blood samples were taken after the completion of each physical exertion.

Method of Determining Physical Stress Levels:

Different levels of physical stress were determined using a treadmill. The maximum load for each player was individually determined using progressive loading until reaching the maximum stress level. At this point, the athlete's maximum heart rate was recorded using a heart rate monitor (Polar watch) or a chest strap for heart rate measurement.

Calculation of Maximum Load: (Intensity Level: 90% - 100%)

With knowledge of the maximum heart rate, the maximum load for each player was determined using the following equation:

Target Heart Rate = Heart Rate Reserve × Desired Intensity + Resting Heart Rate.

After determining the target heart rate for the maximum load, the load was applied on the treadmill as described earlier.

Calculation of Submaximal Load: (Intensity Level: 75% - 90%)

Using the same equation as above, with knowledge of the maximum heart rate, the submaximal load for each player was determined. Players began running on the treadmill while maintaining their performance within the target heart rate range for this intensity level. The duration of performance for each

player was calculated once the player's heart rate exceeded the target heart rate for this intensity level.

Calculation of Average Load: (Intensity Level: 50% - 75%)

The average load was calculated using the same steps as for the maximum and submaximal loads, with a different target heart rate determined for this intensity level. The target heart rate was calculated using the same equation mentioned above. The running speed remained the same, and performance time ended when the player's heart rate exceeded the target heart rate for the average load intensity.

Blood samples (4 times) were collected for each participant as follows:

Once during the rest period (before physical exertion).

After each of the following: maximum load, submaximal load, and average load, immediately following the physical exertion.

Blood samples were collected by a specialist doctor from the venous blood in the visible vein at the elbow (the median cubital vein, either right or left) and on the back surface of the hand (the hand dorsum vein).

Statistical Analysis:

The researcher employed various statistical analyses using the SPSS20 software (Statistical Package for the Social Sciences) to achieve the study's objectives. These analyses included:

1. Mean.
2. Standard Deviation.
3. Skewness.
4. Kurtosis.
5. Paired T-test.
6. One-way Analysis of Variance (ANOVA).
7. Least Significant Difference (L.S.D) test.

Presentation and discussion of the results:

Table (4): Statistical implications of enzymatic responses between pre and post measurements during the maximum load of 800 meters running race n=6.

Statistical Significance / Enzyme Measurements	Unit	800m Race				Average Differences	Value (t)	Percentage Change (%)
		Measurement Before		Measurement After				
		S	±D	±D	±D			
CPK	U / L	337.50	132.13	480.00	18.97	142.50	*2.66	42.22
LDH	**U / L**	342.50	34.41	441.83	32.62	99.33	*5.10	29.00
SGOT	**U / L**	27.33	10.07	40.17	10.68	12.83	*2.812	46.94
SGPT	**U / L**	29.17	7.63	35.33	8.98	6.17	*6.52	21.15

The tabulated (t) value at (0.05) = 2.477.

It is evident from Table (4) that there are statistically significant differences between pre-measurement and post-measurement in favor of post-measurement for the enzymes (CPK, LDH, SGPT, SGOT) at a significance level of (0.05).

Table (5): Presents the statistical significance of enzymatic responses between pre-measurement and post-measurement during submaximal load among 800-meter race participants, with n = 6

Statistical Significance / Enzyme Measurements	Unit	800m Race				Average Differences	Value (t)	Percentage Change (%)
		Measurement Before		Measurement After				
		S	±D	±D	±D			
CPK	**U / L**	337.50	132.13	397.00	72.62	86.38	*3.70	25.95
LDH	**U / L**	342.50	34.41	382.67	26.43	40.17	*3.24	11.73
SGOT	**U / L**	27.33	10.07	43.17	43.17	15.83	*3.27	57.92
SGPT	**U / L**	29.17	7.63	29.83	29.83	0.67	0.20	2.30

The tabulated (t) value at (0.05) is equal to 2.477.

Statistically significant differences in favor of post-measurement are evident in Table (5) between pre-measurement and post-measurement for the enzymes (CPK, SGOT, LDH). However, there are no statistically significant differences observed for the enzyme (SGPT) at a significance level of (0.05).

Table (6): Presents the statistical significances of enzymatic responses between pre-measurement and post-measurement during moderate load among 800-meter race participants, with n = 6

Statistical Significance / Enzyme Measurements	Unit	800m Race				Average Differences	Value (t)	Percentage Change (%)
		Measurement Before		Measurement After				
		S	±D	S	±D			
CPK	U / L	337.50	132.13	357.00	111.16	19.50	2.02	5.78
LDH	U / L	342.50	34.41	372.77	41.15	30.17	2.04	8.81
SGOT	U / L	27.33	10.07	47.00	7.24	19.67	*3.76	71.97
SGPT	U / L	29.17	7.63	33.83	8.64	4.67	*3.80	16.01

The tabulated (t) value at a significance level of 0.05 is equal to 2.477.

It is evident from Table (6) that there are statistically significant differences in favor of post-measurement for the enzymes (SGOT, SGPT). However, no statistically significant differences are observed for the enzymes (CPK) and (LDH) at a significance level of 0.05.

It is evident from Table (7) that there are statistically significant differences among the three physical loads in enzymatic responses for variables (CPK, LDH), where the (F) value was statistically significant at the 0.05 significance level. However, there are no statistically significant differences observed for variables (SGOT, SGPT), where the (F) value was not significant at the 0.05 significance level.

Table (7) presents the one-way analysis of variance (ANOVA) for enzymatic responses in the percentage change between post-measurements among 800-meter race participants across three different physical loads.

NO.	Statistical Significance / Enzyme Measurements	Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Value	Significance Level
1	CPK	Between Loads	2	47236.00	23618	3.511*	0.053
		Within Loads	15	100898.00	6726.533		
		Total	17	148134.00			
2	LDH	Between Loads	2	16769.44	8384.722	7.278*	0.006
		Within Loads	15	17281.50	1152.1		
		Total	17	34050.94			
3	SGOT	Between Loads	2	140.78	70.389	0.854	0.445
		Within Loads	15	1235.67	82.378		
		Total	17	1376.44			
4	SGPT	Between Loads	2	97.00	48.5	0.88	0.435
		Within Loads	15	827.00	55.133		
		Total	17	924.00			

The tabulated (F) value at a significance level of 0.05 is equal to 3.20.

Table (8): Represents the significance of differences among the three physical loads between pre-measurement and post-measurement enzymatic responses for 800-meter race track athletes, utilizing the Least Significant Difference (LSD) test.

Enzyme Measurements	Loads	Average Load	Differences in Averages		
			Maximum Load	Less Than Maximum Load	Average Load
CPK	**Maximum Load**	480.00		**83.00**	**123.00***
	Less Than Maximum Load	397.00			**40.00**
	Average Load	357.00			
LDH	**Maximum Load**	441.83		**59.17***	**69.17***
	Less Than Maximum Load	382.67			**10.00**
	Average Load	372.67			
SGOT	**Maximum Load**	40.17		**3.00**	**6.83**
	Less Than Maximum Load	43.17			**3.83**
	Average Load	47.00			
SGPT	**Maximum Load**	35.33		**5.50**	**1.50**
	Less Than Maximum Load	29.83			**4.00**
	Average Load	33.83			

In favor of the group, it becomes evident from Table (8), which employs the Least Significant Difference (LSD) test, that there are statistically significant differences among the three physical loads in the enzymatic variables (CPK, LDH) in the direction of maximum load. However, no statistically significant differences are observed among the three physical loads in all enzymatic responses (SGOT, SGPT).

Discussion of the Results:

It is evident from the numerical tables (4, 5, 6) on enzymatic responses during maximal, sub-maximal, and moderate exercise in 800m runners (lactic acid system) that there are statistically significant differences favoring dimensional measurement in maximal exercise for enzymes (CPK, LDH, SGOT, SGPT). Also, in sub-maximal exercise for enzymes (CPK, SGOT, LDH), as well as in moderate exercise for enzymes (SGPT, SGOT), there were significant differences. However, no statistically significant differences were found in sub-maximal exercise for SGPT enzyme and in moderate exercise for LDH and CPK enzymes. The results indicate a positive impact of physical loads (maximal - sub-maximal) on enzymes (CPK), (LDH), and (SGOT). Additionally, for moderate exercise, there was a positive impact on enzymes (SGOT), (SGPT). These closely aligned statistical significances suggest a distinct nature of this competition. It combines both anaerobic and aerobic systems, hence termed the lactic acid system.

This study reveals that the competition heavily relies on amino acid carrier enzymes and other enzymes involved in the anaerobic energy system, such as CPK. This was evident from the competition results. The researcher interprets these results as indicating a convergence in the level of physical effort exerted during the three physical load tests. This necessitated the assimilation of enzyme activities necessary for the biological processes associated with energy production during performance. It does not involve enzymatic adaptations, attributed to the nature of adaptations specific to these enzymes resulting from the applied training programs on this 800-meter running group. The enzymes reached an optimal state due to enhanced efficiency in stimulating the biochemical processes essential for energy production, ensuring sustained performance during running tests. Moreover, there was a decrease in harmful effects accompanying muscle training and internal organs in the runner's body. Viru A, Viru M (2000) mentioned that enzymatic adaptations lie not in increasing the enzyme particles but in raising the enzymes' sensitivity for Rapidly Renewing effects of training. Thus, training that heightens the enzymes' sensitivity reflects its response through decreased enzymatic concentration with increased efficiency.

These results are consistent with Sumida et al (1995), who stated that eight weeks of endurance training led to a decrease in LDH levels in sub-maximal and moderate exercise, attributed to muscle adaptations and Down Regulation enzymatic component.

Sherwood (2001) and Foss & Keteyian (1998) added that the increase in hydrogen ion concentration (H+) due to lactic acid accumulation in muscles during sub-maximal and moderate exercise leads to Down

Regulation of glycolytic enzymes and a decrease in LDH levels and pyruvate dehydrogenase (PDH).

Tables (7, 8), analyzing the one-way analysis of variance and significance of differences using the least significant difference test among the three physical loads (maximal - sub-maximal - moderate) in enzymatic responses for 800m runners, indicate statistically significant differences in the maximal exercise direction for the enzyme (CPK). The researcher attributes these aforementioned results to the variation in shape and nature of each enzyme individually, depending on the competition's nature. This perspective has been endorsed by various scientists and researchers. They explain the decrease in enzyme levels and the increase in their catalytic efficiency during biological processes. According to (Maughan et al, 1998) ((Mc Ardle et al, 2015 (Mckee T, Mckee J, 1996) hormonal activity can alter enzymatic shape and function through Allosteric Regulation, leading to an increase or decrease in enzyme effectiveness as a catalyst, or activation of inactive forms to active forms. Serum enzymes are crucial in biochemical reactions.

Conclusions:

Based on the study's objectives, procedures, and statistical analyses of the data, the following conclusions can be drawn:

1. Maximum load leads to statistically significant changes in the enzymatic activity of CPK (22.42%), LDH (0.29%), SGPT (94.46%), and SGOT (15.21%) among 800-meter race track athletes.
2. Submaximal load results in statistically significant changes in the enzymatic activity of CPK (95.25%), LDH (73.11%), and SGOT (92.57%) among 800-meter race track athletes.
3. Moderate load induces statistically significant changes in the enzymatic activity of SGOT (71.17%) and SGPT (16.01%).
4. Maximum load differs significantly from moderate load in CPK activity, while maximum load differs from both submaximal and moderate loads in LDH activity.

Recommendations:

In light of the study's conclusions, the following recommendations are suggested:

1. Utilize the study's results as indicators for regulating different physical loads (maximum load, submaximal load, and moderate load) in the 800-meter race competition.
2. Incorporate the study's findings in the selection of athletes based on enzymatic responses and varying physical loads (maximum load, submaximal load, and moderate load).
3. Develop a guidance model by the International Association of Athletics Federations (IAAF) in Saudi Arabia, including the enzymatic variables under study, to guide the development of training programs of different intensities for various athletic levels in the 800-meter race.
4. Employ enzymatic variables as essential indicators of the training status of 800-meter race track athletes.

References:

[1]. Al-Hazaa, H. (2010). The Physiology of Physical Effort-Theoretical Foundations and Laboratory Procedures for Physiological Measurements, Part One. Scientific Publishing and Printing Department, King Saud University.

[2]. Dweidar, A. (2020). The Effect of Variable-Intensity Physical Efforts on Some Physiological and Enzymatic Responses in Swimmers. Scientific Journal of Physical Education and Sports Science, 88(1), 1-38, Helwan University.

[3]. Khalifa, S. (2015). The Effect of Various Intensity Physical Loads on Some Enzymatic and Functional Responses in Athletes. Unpublished Doctoral Dissertation, Faculty of Physical Education for Boys, Alexandria University.

[4]. Abdel-Fattah, A. (2003). Physiology of Sports Training - Series of References in Physical Education and Sports (3rd ed.). Arab Thought Publishing House.

[5]. Qutb, S. (2002). Enzymatic Responses Associated with the Development of Special Endurance and Its Components (Strength Endurance – Speed Endurance) for Some Ground Wrestling Movements. Unpublished Doctoral Dissertation, Faculty of Physical Education for Boys, Alexandria University.

[6]. Abu Jameel, A., & Farag, A. (2008). The Impact of Using Resistance Bands during Muscle Strength Exercises in Some Aquatic Sports on Creatine Phosphokinase, Lactate Dehydrogenase, Alanine Aminotransferase Enzymes, Free Radicals, and Digital Levels of Swimmers in 50m and 100m Freestyle. Scientific Journal Specialized in Physical Education and Sports Sciences, Theories and Applications, Faculty of Physical Education for Boys, Alexandria University.

[7]. Baumgartner TA, Jackson AS. 1999. Measurement for Evaluation in Physical Education and Exercise Science, 6th ed. MGraw - Hill Publishing Co: New York,

[8]. Dorofeyeva EE, Dorofeyev AE 2004; Biochemical and heart adaptation to physicaltraining and supplementation with amino acids, department of medical Donetsk state Olympic training sport college, Donsetsk, Ukraine I Strength cond Res, 18 (4),

[9]. Foss, M.L. and Keteyian, S.J. (1998). Fox's physiological basis for exercise and sport. 6th Edn., MGraw-Hill Publishing Co., New York.

[10]. Fox SI 1999; Human physiology,6th ed. Wcb, mcgraw- hill, New York.

[11]. Fufh, You CY, Kong ZW.2002; Acute changes in selected serum enzymes and metabolite concentrations in 12 to 17 year, old athletes an all-out 100m, swimming sprint, percept, Mot, skills, Vol 95. No 3

[12]. Hyatt JP, Clarkson PM, 1998; Credtine Relase and Clearance Using MM Variabts Following Repeated Bouts of Eccentric. Exercise Medicine and Science in sports and Exercise 30. No 7.

[13]. Maughan R, Glesson M, Greenhaff P, 1997; Biochemistry Oj Exercise and Traini, Oxford University Press: New York.

[14]. McArdle WD, Katch FII, Katch VL, 1996; Exercise physiolog, energy, nutrition and human performance 4th ed. Williams, Wilkins Co, Baltimore.

[15]. Mckee T, Mckee J, 1996; Biochemistry, an introduction, brown publishers, Dubuque, lowe.

[16]. Pas Sett JR, How Ley ET, 2000; Limiting Factors for Maximum Oxygen Uptake and Determinants of Endurance Performance. Journal of Medicine & Science in Sports & Exercise.

[17]. Robergs RA, Roberts SO, 2000; Fundamental principles of exercise physiology for fitness, performance and health, MgGraw – Hill publi Boston.

[18]. Sherwood L,2001; Human Physiology, From Cells to systems,4th ed, Brooks-Cole Publishing Co: New York.

[19]. Sumida KD, FrischF, Donovan CM, 1995; Training Suppresses Hepatic Lactate dehydrogenase Activity without Altering the Isoenzyme Profile, Medicine and Science in Sports and Exercise.

[20]. Vander A, et al, 1998; Human Physiology, The Mechanisms of Body Function, 7th ed. Mc – Graw – Hill Publishers: Boston.

[21]. Viru A, Viru M, 2000; Nature of Training Effects In: Exercise and Sport Scinece, Edited By Garrett W, et al, Williams & Wilkins Philadelphia.

[22]. Staron RS, Hikida RS, 2000; Muscular responses to exercise and training. in: exercise and sports science. edited by Garrett W, et al. Williams & Wilkins publishing **Philadelphia.**

[23]. Sherwood, L. (2001). Human physiology from cells to systems. 4th Edn., Brooks-Cole Publishing Co., New York.

[24]. Ted A. Baumgartner and Andrews Jason. (1999). Measurement for evaluation and exercise. WCB Brown & Benchnark..

[25]. **https://www.eviq.org.au**

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