Journal of Rare Cardiovascular Diseases
ISSN: 2299-3711 (Print) | e-ISSN: 2300-5505 (Online)
www.jrcd.eu
RESEARCH ARTICLE

The effect of different ratios of the five stresses on the enzyme concentration ratioBlood LDH and LA, anaerobic lactic acid capacity, and defensive performance endurance in volleyball in 17-19 year olds

Saif Shaker Kamel[1*], Dr. Rabie Lafta Dakhel[2],
Faculty of Physical Education and Sports Sciences, University of Thi-Qar, 64001, Iraq,

*Corresponding Author

Article History
Received: 07.10.2025
Revised: 11.11.2025
Accepted: 26.11.2025
Published: 15.12.2025

Abstract: This study aimed to identify the effect of two training programs based on different ratios of five training stress intensities on selected physiological indicators, anaerobic lactic capacity, and defensive performance endurance in volleyball players aged 17–19 years. The physiological indicators examined included blood lactic acid (LA) concentration and lactate dehydrogenase enzyme (LDH) concentration, which are closely related to anaerobic metabolism and fatigue resistance during high-intensity sports performance. The research problem emerged from repeated observations of performance decline and increased defensive errors among youth volleyball players in the advanced stages of matches, suggesting insufficient development of anaerobic and lactic capacities necessary for sustaining defensive performance. The researcher adopted an experimental method using two equivalent experimental groups. The research community consisted of 22 players from the Specialized Volleyball Center in Al-Jabaish District, Iraq, from which 14 high-smash players were intentionally selected and divided equally into two experimental groups. Both groups underwent pre- and post-testing for physiological variables, anaerobic lactic capacity, and defensive performance endurance. The first experimental group trained using intensity ratios ranging from 75–100%, while the second group trained at slightly lower ratios of 75–95%. The training programs were applied over a period of 10 weeks, with three training units per week, using interval and repetitive training methods with controlled load components (intensity, volume, and rest).**Results** showed statistically significant improvements in both experimental groups between pre- and post-tests in blood lactic acid concentration, LDH enzyme concentration, anaerobic lactic capacity, and defensive performance endurance, indicating the effectiveness of both training programs in developing physiological adaptation and performance endurance. However, comparison of post-test results between the two groups revealed no significant differences in lactic acid concentration, LDH enzyme levels, or anaerobic lactic capacity. A significant difference was found only in defensive performance endurance, favoring the first experimental group, which trained with higher maximum intensity exposure.

Keywords: VOlleyball training, anaerobic lactic capacity, lactic acid concentration, lactate dehydrogenase (LDH), training stress ratios, high-intensity interval training, defensive performance endurance.

INTRODUCTION

The importance of the research lies in In order to improve the physiological indicators under investigation through the correct direction of training loads, thus developing the anaerobic and lactic capacities that are positively reflected on the performance endurance in volleyball in general and defensive performance in particular, the research problem and through following up on the developments in the game of volleyball, it was observed that signs of fatigue appeared on the players in the advanced stages of the match, in addition to the presence of simple errors that would affect the team's level in general, which indicates that some physiological indicators related to the performance endurance characteristic are not at their best levels, in addition to the anaerobic and lactic capacity. This is what prompted the researcher to delve into this problem by placing his

exercises within two training programs that are applied to two groups with specific percentages of intensity that differ for each group in an attempt to address the players' ability to endure defensive performance in volleyball for the longest possible period and to know which of the two programs workers can plan their programs according to. The objectives of the research were to prepare special exercises to develop some physiological indicators, anaerobic capacity and defensive performance endurance in volleyball for ages 17-19 years. Preparing two training programs with different training intensity ratios implemented (for the two experimental groups) to identify the superiority of the two training programs through the post-results (post-post) of the two experimental groups in the physiological measurements, anaerobic capacity tests, and defensive performance endurance in volleyball. The researcher assumed that there was an advantage for one of the two groups in the post-results (post-post) of the physiological measurements, anaerobic capacity tests, and defensive performance endurance in volleyball. The researcher used the experimental method by designing the two experimental groups as it is one of the most efficient means to reach a solution to the problem under study. The research sample was the players of the specialized center in Al-Jabaish, numbering (22) players, while the research sample was chosen intentionally, and they are the high smash players, numbering (14) players.

1- Research definition

1-1 Introduction and importance of the research

Sports physiology is the basic pillar upon which the science of training is based to bring the player to the best levels because it relies on scientific facts derived from objective laboratory measurements and tests that give accurate results that can be relied upon to know the functional status of the player. In addition, every activity or physical effort that is carried out leads to different physiological responses of the body's functional systems, and the degree of these responses varies according to the degree of loads implemented, whether oxygenic or non-oxygenic. Thus, training loads can be directed and regulated based on the physiological capabilities that characterize the athlete and according to the training goal. There are some games, including volleyball, in which the performance of some of its skills is characterized by high intensity and in a relatively short time, which requires the player to have a high anaerobic capacity, i.e. the ability to rebuild.ATP is quickly released to provide the energy needed for muscle contraction, in addition to the rapid elimination of lactic acid. Therefore, this ability must be developed through optimal training to appear in a manner consistent with performance. In addition, it gives the coach a clear idea to monitor the player's health status and protect him from reaching critical conditions that negatively affect the efficiency of the functional systems, as well as the level of skill performance and the player's inability to carry out the tactical duties assigned to him. This is reflected in the overall level of the team, as he has become the missing link in implementation. This applies to all games, including volleyball, as volleyball is one of the organized games that require players to have integrated physical capabilities to implement its skills, which are characterized by accuracy and speed in performance, whether offensive or defensive, and for relatively long periods according to the nature of the match. This shows us that it is necessary for the player to possess physiological requirements that enable him to continue to implement skills with high efficiency without a drop in the level of performance, especially in defensive performance. Based on the above, it is necessary to resort to using exercises according to specific intensities that are consistent with the goal sought by the study and are on a single line of influence with the study variables to improve them through the correct direction of loads. Training thus develops anaerobic and lactic capabilities, which positively impacts volleyball performance in general and defensive performance in particular.

1-2 Research problem

By following many youth league and first division volleyball matches, and being a former player in the Iraqi Premier League, the researcher found that a team with a good level of defensive skills can control the match and put the opposing team in a difficult situation, as the good implementation of defensive skills reflects positively on the implementation of offensive skills according to prior planning, thus increasing the chances of obtaining points and outperforming the competitor, leading to winning the match. However, in the advanced stages of the match, the researcher noticed fluctuations in technical performance, especially defensive skills, as a result of repeated effort, in addition to the presence of simple errors that would affect the team's level in general, in addition to the appearance of signs of fatigue on the players, which indicates that some physiological indicators related to the performance endurance trait are not at their best levels, in addition to the players' anaerobic capacity being relatively immature according to performance requirements.

1-3 Research objectives

1- Preparing two training programs with different training intensity ratios implemented (for the two experimental groups).
2- To identify the differences between the results of the pre- and post-tests of the two experimental groups in some physiological indicators, anaerobic capacity and defensive performance endurance in volleyball for volleyball players aged 17-19 years.
3- To identify the superiority of the two training programs through the post-test results (post-post) of the two experimental groups in physiological measurements, anaerobic capacity tests, and defensive performance endurance in volleyball.

1-4 Research hypothesis

1- There are statistically significant differences between the results of the pre- and post-tests of the two experimental groups in some physiological indicators, anaerobic capacity and defensive performance endurance in volleyball for volleyball players aged 17-19 years.

2- There is an advantage for one of the two groups in the post-post results of the physiological measurements, anaerobic capacity tests, and defensive performance endurance in volleyball.

1-5 Research areas

1-5-1 Human field: Volleyball players from the Specialized Center - Al-Jabaish District

1-5-2 Time frame: 10/15/2024 to29/9/2025

1-5-3 Spatial area: Sports hall in Al-Jabaish district

2- Research methodology and field procedures:

MATERIAL AND METHODS

2-1 Research Methodology:

The researcher used the experimental method using the two equivalent experimental groups.In this method, more than one group is used, provided that equivalence is achieved between the two groups in all variables.(S. Sh. Kamel, 2023)[(1)]that can affect the dependent variable in the experiment.

3-2 Research community and sample:

The research community consisted of young players of the specialized volleyball center in Al-Jabaish district, numbering (22) players. The research sample was chosen intentionally, and they were (14) high smash players. The sample percentage was (63.63%) of the original community. The sample was divided into two groups intentionally, with (7) players in each group.

2-3 Sample homogeneity and equivalence:

2-3-1 Sample homogeneity:

To reach to level one equal damn Search, To avoid Factors that may affect on results Experience from where Differences Individualism between Players(Hassan, 2025)[(2)], He did researcher By conducting some Measurements Related With variables(height, the weight, the age chronological, training age)Which from Her business that affect on progress Search Using Factors difference, Whenever He was greater from(30%)It means that Sample not Homogeneous

Table No. (1)

It shows the homogeneity of the research sample in terms of training age, height and weight.

coefficient of variation	standard deviation	arithmetic mean	Unit of measurement	Measurements and variables	T
1.951%	4.276	219,142	month	Chronological age	1
4.921%	2.243	45,571	month	Training age	2
3.353%	2.455	73,214	kg	the weight	3
1.927%	3.472	180.121	poison	height	4

2-3-2 Equivalence of the two research groups:

In order to know the reality of measurements and tests for the two experimental groups Fig andTo attribute differences to the experimental factor, the two groups must be completely equivalent in all conditions.(kamel, 2024)[(3)]So that work is done on the same baseline. Therefore, the researcher measured these

([1])Saif Shaker Kamel: The effectiveness of rubber ropes and power ropes training on the values of some kinematic variables and the accuracy of performing the serving skill in sitting volleyball, Thi Qar University Journal of Physical Education Sciences, Volume 1, Issue 2, 2023, p. 261.

(2) Mustafa Khaled Abdel Hassan: The effect of comprehensive vision exercises on improving the perception of the field of vision and the accuracy of the passing skill of junior football players. Thi Qar University Journal of Physical Education.vol2 .I2.2025.p.128.

([3]) Saif Shaker Kamel:Training according to the principle of kinetic momentum and its effect on the values of some kinematic variables and the accuracy of performing the smash serve skill in volleyball .Journal of Thi

indicators to ensure that there were significant differences in the mentioned variables and to ensure the equivalence of the two groups. To achieve this, the test (t) For independent samples between the two groups, as shown in Table No. (2), which allows the researcher to conduct his research and apply his exercises.

Table No. (2)

Shows the arithmetic means, standard deviations and the value of (T) Calculated and significance level value for the two groupsThe two experimentsIn the pre-test

Type of indication	Sig	value T The calculated	The second experimental group		experimental group First		Statistical parameters tests
			A	S	A	S	
Non-moral	**0.212**	**1.429**	**3,199**	**217,714**	**4,859**	**214,571**	Chronological age
Non-moral	**0.701**	**0.805**	**2,160**	**46**	**2,410**	**45,142**	Training age
Non-moral	**0.613**	**0.749**	**2,429**	**73.72**	**2.563**	**72,714**	The mass
Non-moral	**0.924**	**0.098**	**3,199**	**179,285**	**2.14**	**179,428**	height
Non-moral	**0.473**	**0.824**	**1.748**	**10.445**	**1.346**	**11,133**	Lactic acid concentration
Non-moral	**0.785**	**0.368**	**6.725**	**456,285**	**5.307**	**455,094**	Enzyme concentration ratioLDH
0.610	**0.492**	**1.417**	**10,771**	**1.238**	**10,421**	**Dr. Tha**	**Defensive performance**

2-4 Methods and tools used:

✓Information collection methods:

☉Arabic and foreign sources.☉Personal interviews.☉Note.☉Testing and measurement.

✓Tools and equipment used:

- Electronic device for measuring height and weight (1).
- Blood storage tubes containing a substanceEDTA anticoagulant No. (20).
- device(Lactate pro2) made in Japan by the company (Arkray) To measure the concentration of lactic acid in the blood.
- German-made device from the company ((Beurer heart rate monitor
- The volleyball court is legal.
- Volleyballs (32) of different types.
- Rings with a diameter of (60 cm) number (20).
- Barriers of different heights (20, 30, 40 cm) number (10) and of (50 cm) height number (10)
- (30) (30) cm high signs.

2-5 Field research procedures

2-5-1 Defining search variables

After reviewing many similar studies and scientific sources in the field of sports training physiology and conducting some personal interviews The research variables that were agreed upon were determined in accordance with the research problem and were as follows:

1- Lactic acid concentration in the blood.
2- Enzyme concentration ratio (LDH) in the blood.
3- Lactic capacity.
4- Defensive volleyball performance.

2-5-2 Research tests:

First // Lactic aerobic capacity test (anaerobic step test)[1)]

- Test objective: To measure the anaerobic lactic capacity for 60 seconds.

Equipment and tools: A seat or box 40 cm high, an electronic stopwatch, and a scale for measuring weight.

Qar University for Physical Education Sciences, Vol. 1, No. 4, Part 2, 2024, p. 143.

(1) Muhammad Hassan Allawi, Muhammad Nasr al-Din Radwan: Measurement in Physical Education and Sports Psychology, 1st edition. Cairo, Dar Al-Fikr Al-Arabi, pp. 157-167.

- Performance specifications: The tester stands facing the side of the box or bench, and one foot is placed on the box (the tester's preferred leg) while the other leg is free on the ground. When the timing signal is given, the player begins to raise the free leg and place it next to the leg above the box and repeat this performance in a rhythm of two counts (one - two, one up… two down). The tester must perform the largest number of steps within 60 seconds. The step is not counted if the tester bends the torso forward or bends the free leg..
- Recording method: The number of steps taken by the test subject within (60) seconds is calculated (performance time), and the anaerobic lactic capacity is calculated using the following equation.

1.33 Lactic anaerobic capacity $= \frac{\text{وزن المختبر (كغم)} \times \text{المسافة المقطوعة (ارتفاع الصندوق)} \times \text{عدد الخطوات}}{\text{الزمن}}$

Second // Defensive performance endurance test in volleyball[(1)].

- **Purpose of the test:**Measuring defensive performance endurance in volleyball.
- **Tools used:**Legal volleyball court, balls number (20) type (Mikasa), (2) Fox whistles, (3) Casio electronic time clocks, adhesive tape, metric measuring tape, (3) 60 cm high benches.
- Test administrator:A recorder calls out the names first and records the test time second.
- **Performance specifications:**Warm-up should be done for a period of (10-15) minutes in order for all the player's body systems and organs to be prepared to reach a heart rate of (120-130) beats/minute, because this test requires high physical preparation and readiness, noting that the number of stations that the player performs in this test is (17) stations.

- The player prepares behind the service line towards the centre (1) (starting point), which is (2 m) away from the service line. At the start signal, the player moves quickly to the station (A) In position (1) to receive the ball coming from the opposite side of the field by the coach, then he moves to station (B) in position (6) which is (3 m) away from station (A) to receive the ball in the same way, then he moves back to position (1) in station (C) and leaves a distance of (50 cm) from the side line to defend the ball directly executed by M. The coach who stands on a bench in position (4) of the opposite field, then he takes a step to the side to change his direction to station (D) in order to defend diagonally the ball executed by M. The coach who stands on a bench in position (3) of the opposite field, also takes a step to the side to change his direction to station (E) in order to defend diagonally the ball executed by M. The coach who stands on a bench in position (2) of the opposite field.
- Then the player moves to the station (F) In position (6) which is (3 m) away from station (E) to defend the straight smash ball executed by M. The coach who stands on a bench in position (3) of the opposite field, then the player takes a step to the side to change his direction towards station (G) to defend diagonally the ball executed by M. The coach who stands on a bench in position (2) of the opposite field, then he takes a step to the side to change his direction to station (H) to defend diagonally the ball executed by the coach who stands on a bench in position (4) of the opposite field.
- Then it moves diagonally to the station (I) which is (4 m) away from station (H) to defend the field with one arm by flying or rolling the far falling balls between positions (1 and 2) above the attack line, then he moves to station (J) which is (3.5 m) away from (I) to defend the field with one arm by flying or rolling the far falling balls between positions (6, 3) above the attack line.
- Then the player moves to the station (K) which is (3.5 m) away from station (J) in center (2) pulled slightly outwards away from the net to perform the skill of defending the court for the diagonal smash balls executed by M. The coach who stands on a bench in center (4) of the opposite court.
- The player then moves to the station (L) which is (4 m) away from station (K) in center (3) to defend the balls falling and executed by the coach M. behind the block wall with one arm by diving, then he moves to station (M) which is (4.5 m) away from station (L) to cover the ball falling behind the block wall with one arm by diving in center (2) and executed by the coach M. who is standing on a bench in center (4) of the opposite field.
- Then the player advances onto the net at the station (N) In center (2) to make a blocking wall by blocking the ball executed by the coach who stands on a bench in center (4) of the opposite field, then he moves with crossed steps to the side to station (O) which is (4 m) away from station (N) in center (3) to make a blocking wall by blocking the ball executed by the coach who stands on a bench in center (3) of the opposite field, then the player moves with crossed steps to the side and returns to center (2) again in station (P) to make a blocking wall by blocking the ball executed by the coach, then the player returns to move with a side

([1])Mahmoud Nasser Amoush: The effect of functional exercises using the metabolic adaptation method (MetCon) on some physiological variables, biomotor capabilities, and defensive performance endurance in volleyball for young players, PhD thesis, University of Babylon, College of Physical Education, 2021, p. 74.

movement to station (Q) in center (3) to make a blocking wall by blocking the ball executed by the coach, which is the last station and at that point the test ends.

- **Registration:**The test scores for each station are recorded by the assessors on a pre-prepared form. The test time is also recorded by the timer from the moment the starting whistle is heard until the end of the test. The scores are recorded as follows:

First: Recording the score of the transmitting skill:

- The correct ball that is directed in an arc above chest level to the area designated in center (2) (*) and serves offensive tactics with high quality, the examiner takes (4) points.
- The correct ball that is directed in an arc above chest level and is located on the borders of the center (2) and serves offensive tactics, the examiner gets (3) points.
- The correct ball that is in an arched shape above chest level and far from the center (2) and inside the attack zone, the examiner takes (2) points.
- The ball that is not curved and is below chest level and is located on the borders or inside the center (2) and does not serve offensive tactics, the examiner takes (1) point.
- The correct ball that is in an arched shape above chest level and far from the center (2) and outside the attack zone receives a score of (1) for the examiner.
- If the tester fails to receive the ball, he gets (zero) points.

Second: Recording the skill score of defending the field:

- (4) points are given if the ball is curved above chest level and directed to the center (2) which serves the offensive tactics with high quality.
- (3) points are given if the ball is curved above chest level in a location far from the center (2) but in the front line of the field, as there is more than one possible attacking tactic.
- (2) points are given if the ball is curved above chest level in a position close to the centre of the (2) preparation position but in the back line of the field where offensive tactics are not possible.
- (1) point is given if the ball is in a position far from the set-up position in the back line, causing the absence of a number of offensive tactics.
- Zero is given if the player fails to return the ball to his teammates on the field.

Third: Recording the score of the blocking wall skill:

- (2) points are given for each ball that the player blocks when making a blocking wall and it falls inside the square in the opposite center.(*).
- (1) point is given for each ball that the player blocks when making a blocking wall and it falls away from the square and into the opposite field.
- (2) points are given for each ball that the player blocks when making a blocking wall and goes into his court, as the team can receive it and more than one offensive tactic is possible.
- (1) point is given for each ball blocked by the player when making a blocking wall and it goes into his court and the team can complete it and there are no possible offensive tactics.
- A player is given a score of zero if he fails to block the ball when making a block wall.

✓ The final grade is calculated according to the following equation:[1)]

Volleyball defensive performance endurance test = accuracy score × number of stations (17) / performance time.

The entire test will be repeated if the coach or player fails to perform properly during all stages of the test, after giving the player sufficient rest.

Third // Measuring the concentration of lactic acid and enzymeLDH in blood

The concentration of lactic acid in the blood is measured using:device(Lactate pro2)After (5) minutes of implementing the test, which is the best period for the transfer and accumulation of lactic acid from the muscles to the blood, both the concentration ratio of the enzyme (LDH) Blood immediately after exertion, after (5) seconds of performing the (defensive performance endurance test in volleyball)

2-6 Exploratory experiments:

First pilot experiment:-

The researcher conducted a first pilot experiment for the tests used in the research on Friday 11/22/2024 in the closed sports hall of the specialized center in Al-Jabaish district on a sample of (4) players who are part of the research sample, and they were:The aim of this is as follows:

- Ensure that the playground and the tools used are fit for the tests.

(*)Draw a square in the center (3,2) with dimensions of 2 x 2 m.

[1]Muhammad Matar Al-Ajili: Calculating Accuracy Test Scores in the Fields of Mathematical Research, Najaf Al-Ashraf, Dar Al-Diaa for Printing and Design, 1st ed. 2017, p. 93

- The extent of testers' readiness to apply the tests.
- Preparing the support team and familiarizing them with the nature of the work and procedures.
- Knowing the time taken to implement the tests used in the research.

The second exploratory experiment: -

The researcher conducted a second exploratory experiment on Saturday 11/23/2024 in the indoor sports hall of the specialized center in Al-Jabaish district on the members of the experimental group. During this experiment, the exercises used in the research were applied to the two experimental groups for the purpose of verifying the following matters: determining the number of repetitions for each exercise used from the jumping exercises.

- The suitability of the exercises for the research sample members and the possibility of applying them.
- Determine the maximum intensity for each exercise in order to regulate the training loads during training units.
- Knowing the recovery time (rest) and returning the player's ability to perform the next exercise with the same efficiency.
- Knowing the time required to apply the training vocabulary prepared by the researcher.

2-7 Main experiment

2-7-1 Pre-tests

The researcher, in the presence of the assistant staff, conducted the pre-tests and measurements for the research sample on the morning of Wednesday, November 27, 2024.In the indoor sports hall of the specialized center in Al-Jabaish district, the anaerobic lactic capacity test and the defensive performance endurance test in volleyball were tested, then the physiological indicators under study were extracted after the implementation of the final test.

2-8-2 Main Experiment

In order to obtain effective exercises, it was necessary to review modern sources and references in the science of sports training, which would be sufficient to enrich the researcher with information that would help him in developing his exercises.(Kamel, 2023)[(1)].

❖ The most important clarifications regarding the application of the two training programs**:**

- **The application starts on Saturday 11/30/2024 and ends on Wednesday 2/5/2025.**
- **The duration of implementing the exercises within the two programs is (10) weeks.**
- **The days of implementing the exercises within the two programs (Saturday - Monday - Wednesday) of each week**
- **The number of training units in which it was applied is (30) training units.**
- **Number of special exercises used (22) exercises.**
- **Number of exercises applied in the training unit (3) exercises.**
- The researcher considered the relationship between the components of the training load (intensity, volume, and rest).
- **The high-intensity and low-intensity interval training method and the repetitive training method were adopted for the first and second experimental groups.**
- The researcher used intensity undulation (2-1) for both groups.
- **Training intensity levels used for the first experimental group (75-100)%**
- **Training intensity levels used for the second experimental group (75-95)%**

2-8-3 Post-tests for the research sample: -

The post-tests and measurements of the research sample were conducted on Wednesday (2/5/2025) in the closed sports hall of the specialized center in Al-Jabaish district after the completion of the period of applying the exercises prepared by the researcher within the two training programs that took (10) weeks. The researcher was keen to provide the same conditions of the pre-tests and measurements and their procedures followed to conduct the post-tests and measurements.

2-9 Statistical methods:

The researcher used statistical methods that helped in processing the results and testing the research hypotheses through the use of the statistical bag (IBM SPSS Statistics 24) which are:

- Arithmetic mean. Standard deviation. Coefficient of variation. Pearson correlation coefficient.

([1])) Saif Shaker Kamel: The effect of Tabata exercises on the level of some elements of physical fitness and the accuracy of performing the blocking wall skill in volleyball, European Journal of Sports Science Technology, Volume 13, Issue 46, 2023, p. 14.

- a testT)) for correlated samples. T)) test for independent samples. Percentage

3-1 Presentation and analysis of the pre- and post-test results of physiological indicators, anaerobic lactic capacity test, and defensive performance endurance in volleyball for the first experimental group.

Table (5)

Shows the values of arithmetic means, standard deviations and the value of (T) Calculated physiological measurements and tests of anaerobic lactic capacity and defensive performance endurance in volleyball before and after the first experimental group

The result	Sig	T calculated	(After me)		(Before me)		Unit of measurement	Processors / Measurements
			A	S	A	S		
moral	0.001	6,369	0.714	14.121	1.346	11,133	millimoles/liter	Lactic acid concentration
moral	0.000	14,016	6.264	498,714	5.307	455,094	Unit/L	Enzyme concentration ratioLDH
moral	0.001	6,028	2.194	59,141	2.517	50,081	kg.m/s	anaerobic lactic capacity
moral	0.000	7,570	1.213	15,210	1.238	10,421	Dr. Tha	Defensive performance

-Knowing that the valuet-tabulary 1.943 at 6 degrees of freedom and 0.05 significance level

By reviewing the data in Table (5), the results of the post-tests showed the presence of statistically significant differences between the pre- and post-test measurements for all the variables under study, in favor of the post-test, which indicates the effectiveness of the training program or the effort exerted in bringing about clear physiological changes.

3-2 Presentation and analysis of the pre- and post-test results of physiological indicators, anaerobic lactic capacity test, and defensive performance endurance in volleyball for the second experimental group.

Table (6)

Shows the values of arithmetic means, standard deviations and the value of (T) Calculated physiological measurements and tests of anaerobic lactic capacity and defensive performance endurance in volleyball before and after the first experimental group

The result	Sig	T calculated	(After me)		(Before me)		Unit of measurement	Processors / Measurements
			A	S	A	S		
moral	0.000	6,811	0.692	14,422	1.748	10.445	millimoles/liter	Lactic acid concentration
moral	0.000	10,843	9.281	501,142	6.725	456,285	Unit/L	Enzyme concentration ratioLDH
moral	0.001	6,747	2,811	58,087	2.193	49,142	kg.m/s	anaerobic lactic capacity
moral	0.004	4,457	1.185	13,842	1.417	10,771	Dr. Tha	Defensive performance

-Knowing that the valuet-tabulary 1.943 at 6 degrees of freedom and 0.05 significance level

By reviewing the results of Table (6), we note that the results of the study showed statistically significant differences between the pre- and post-measurements for all defensive performance indicators, which indicates the effectiveness of the training program in developing the defensive aspects under study.

3-3 Presentation and analysis of the post-test results of physiological indicators, anaerobic lactic capacity test, and defensive performance endurance in volleyball for the two experimental groups.

Table (7)

Shows the values of arithmetic means, standard deviations and the value of (T) Calculated physiological measurements, anaerobic lactic capacity tests, and defensive performance endurance in volleyball for the two experimental groups.

The result	Sig	T calculated	(After me - second trial)		(After me - first trial)		Unit of measurement	Processors / Measurements
			A	S	A	S		
Non-	0.438	0.802	0.692	14,422	0.714	14.121	millimo	Lactic acid

moral							les/liter	concentration
Non-moral	0.224	1.283	9.281	501,142	6.264	498,714	Unit/L	Enzyme concentration ratioLDH
Non-moral	0.496	0.701	2,811	58,087	2.194	59,141	kg.m/s	anaerobic lactic capacity
moral	0.041	2.288	1.185	13,842	1.213	15,210	Dr. Tha	Defensive performance

-Knowing that the valuet-tab 2.179 at 12 degrees of freedom and 0.05 significance level

By reviewing the results of Table (7), we note that all variables did not show significant statistical differences between the two experimental groups, with the exception of defensive performance tolerance in volleyball, where the average for the first group was (15.181 d/s) compared to (13.842 d/s) for the second group, and the value of (t = 2.288) and at a significance level of (Sig = 0.041), which is a significant difference.

RESULTS AND DISCUSSION

By examining the results of Tables (5-6), it is clear that there are significant differences in all study variables in favor of the results of the post-tests and measurements. The researcher attributes these differences to the nature of the exercises implemented, which were prepared by the researcher and applied by the members of the two experimental groups. These exercises were characterized by the fact that most of them were complex (physical-skill), while others were only skill-based. The application of each of them required relatively long periods of time, targeting some elements of physical fitness that would affect the study variables, in addition to some components of the two anaerobic energy systems under study. We note that the concentration of lactic acid in the blood increased in the post-test compared to what it was in the pre-test. This indicates an increase in the ability of the research sample members to exert high physical effort without a decrease in the level of performance efficiency and to continue with it for relatively long periods, in addition to an increase in the ability to resist fatigue and pain resulting from the accumulation of that acid. This development is due to the fact that the researcher, during the two training programs and during the application of the exercises, used intensities appropriate to the training goals and organized the intensity of the training load in a way that did not lead the players to rest. Complete and keeps them from getting into overload states, but it does not allow for rebuilding.ATP is produced at a high speed in order to achieve the required response, which is the splitting of glycogen stored in the muscles to produce glucose, which is broken down anaerobically, causing the accumulation of lactic acid. This is what (Falah Hassan) confirmed, that working at high intensity is able to increase lactic acid in the blood due to the anaerobic sugar breakdown process that the body performs to restore the ATP compound inside the muscle cell, with insufficient oxygen coming to the working muscles, which leads to the inability of the mitochondria to introduce the released hydrogen ion into the respiratory chain, and thus pyruvic acid combines with the hydrogen ion, forming lactic acid (1) In addition to the enzymeThe increase in LDH present in the muscles is closely linked to the concentration of lactic acid in the blood, as it is the cofactor in the reaction that works to convert pyruvic acid resulting from the breakdown of sugar in the absence of oxygen (anaerobic glycation) into lactic acid, and the increase in this acid is a result of the increase in the speed of the reaction that produces it, and the increase in this speed of the reaction indicates an increase in the concentration of the LDH enzyme in the blood.It is mentioned by everyone who(Alaa and Hind) thatEnzyme activityLDHIt increases with the increase in its concentration as a result of exposure to great physical effort, which leads to the conversion of pyruvic acid resulting from the breakdown of glucose into lactic acid in larger quantities.(KazemandMuhalhal, 2024) [(2)]As for the development in the lactic anaerobic capacity index, the researcher attributes it to the nature of the exercises that were prepared, as many of them were characterized by working according to the lactic energy system. In addition, some of these exercises, when applied with specific training intensities, targeted the muscular endurance of the lower limbs, which contributed to achieving appropriate physiological responses. The use of training volumes commensurate with the degree of difficulty of the exercises implemented, which were applied continuously and regularly, contributed to achieving the required adaptation. This is what was observed from the results of Tables (5) and (6) referred to above when examining

([1]) Falah Hassan: The effect of anaerobic training on the efficiency of some vital organizations and biochemical variables to develop lactic endurance in basketball players. PhD thesis. College of Physical Education, University of Babylon, 2008, p. 138.

([2]) Alaa Jawad Kadhim and Hind Qasim Mahlahal: A study of the effect of anaerobic effort on some biochemical indicators among advanced fencers, Thi Qar University Journal of Physical Education Sciences, Volume 1, Issue 4, Part 2, 2024, p. 160.

some of the indicators related to the lactic system, as the two training programs were intended to increase the player's ability to withstand fatigue resulting from lactic accumulation and to continue physical effort with the same strength and speed until the end of the test time used to evaluate the state of the lactic anaerobic capacity of the research sample members. (Amr Allah Al-Basati) states ([3])and(Skinner) ([4]) Developing anaerobic (lactic) capacity results in an increase in the activity of enzymes responsible for energy production anaerobically. Also, this type of exercise used requires anaerobic energy by nature, which after adaptation leads to an increase in the muscle's glycogen stores.[1) (2)]As for endurance defensive performance in volleyball, the researcher intended during his preparation of the exercises to target many biomotor abilities that would affect the player's performance during the match by using some means and tools, in addition to being a major influence on the player's movement during the implementation of the test, because by its nature it requires players to have accuracy, balance and coordination, in addition to explosive power and distinguished speed and transitional speed during the implementation of defensive skills and moving between test stations. All of these elements to develop them require the implementation of high intensities (maximum and submaximum), and this is what the members of the two experimental groups were subjected to, except that the first group carried out exercises with maximum intensity at a greater rate than the second group, and this is what had a positive effect on the physiological indicators under investigation and anaerobic capacity.H"The lactic acid cycle improves the player's functional state and increases his ability to exert effort for relatively long periods without a drop in the level of performance efficiency, which in turn is reflected in the quality of defensive performance endurance," says Ahmed Youssef. "Regulating the intensity, volume and density of training loads in special training units to develop performance endurance is done by imposing an effective training load on the muscles and vital systems, ensuring that players perform under the influence of an appropriate level of fatigue, which is necessary to develop special endurance."[3)]

CONCLUSION

The two training programs for the two experimental groups contributed to bringing about important physiological changes represented by an increase in muscle stress indicators (LA, LDH), along with a significant improvement in lactic anaerobic capacity. These changes demonstrate the effectiveness of training in improving physical performance and physiological functions related to high-intensity effort.

1- All variables did not show significant differences between the two groups, except for defensive volleyball performance tolerance, which recorded statistically significant differences in favor of the first experimental group, which indicates that its training program was more effective in improving muscle adaptation and reducing signs of fatigue, while the remaining indicators had similar effects between the two groups, indicating the similarity of the two groups' ability to maintain the acid-base balance of the blood.

5-2 Recommendations:

1- Emphasis is placed on using compound exercises similar to certain playing situations, with appropriate training intensities, to raise the anaerobic efficiency of volleyball players during training and matches.
2- Adopting the implementation of exercises according to the standardized training intensity ratios in the training program for the first experimental group as basic data when training volleyball players to reach the best levels of special endurance.
3- Using intensity ratios in the first training program for other sports whose skills are characterized by speed, strength (explosive, characterized by speed) and agility.
4- Applying exercises to other age groups and with training intensities that suit their training level.
5- Adopting physiological indicators as a means of evaluating the level of training status reached by the player.

Sources and referencesArabic and English

- Muhammad Matar Al-Ajili: Calculating Accuracy Test Scores in Mathematical Research, Najaf, Dar Al-Diaa Printing and Design, 1st ed. 2017.
- Falah Hassan: The effect of anaerobic training on the efficiency of some vital organizations and biochemical variables to develop lactic endurance in basketball players. PhD thesis. College of Physical Education, University of Babylon, 2008.

([1])The simple command of God: Rules and foundations of sports training and its applications, Alexandria, Maaref Establishment, 1998, p. 75.

[(4)]Skinner, J. And McLain, T: The Transition From Aerobic To Anaerobic Metabolism, R-O-Exercise And Sports. P236

(1)Ahmed Youssef Moataeb: The effect of a training method using a proposed field in developing the special endurance of young people in handball.,PhD Thesis, University of Baghdad / College of Physical Education and Sports Sciences2003, p. 73.

- Alaa Jawad Kazim and Hind Qasim Mahlahal: A study of the effect of anaerobic effort on some biochemical indicators among advanced fencers, Thi Qar University Journal of Physical Education Sciences, Volume 1, Issue 4, Part 2, 2024.
- Ahmed Youssef Mutab: The effect of a training method using a proposed field in developing the special

	36.32 d	Time of exercises used in the main section			80%	Training intensity		the first	
	Explosive power, distinctive speed, defensive endurance ((Developing anaerobic capacity and the player's ability to endure defensive performance))					Training unit objectives		First	
me ise ne, ne,	Total exercise time	Actual performance time	Total rest between		Rest between sets	Groups	Rest between repetitions	Repetitions	Exercise time	Exerc code
			Groups	Repetitions						

endurance of young people in handball, PhD thesis, University of Baghdad / College of Physical Education and Sports Sciences, 2003.

- Muhammad Hassan Allawi, Muhammad Nasr al-Din Radwan: Measurement in Physical Education and Sports Psychology, 1st edition. Cairo, Dar Al-Fikr Al-Arabi.
- Mahmoud Nasser Amoush: The effect of functional exercises using the metabolic adaptation method (MetCon) on some physiological variables, biokinetic capabilities and defensive performance endurance in volleyball for young players, PhD thesis, University of Babylon, College of Physical Education, 2021.
- Saif Shaker Kamel: The effectiveness of rubber ropes and power ropes training on the values of some kinematic variables and the accuracy of the serving skill performance in sitting volleyball, Thi Qar University Journal of Physical Education Sciences, Volume 1, Issue 2, 2023.
- Saif Shaker Kamel: The effect of Tabata exercises on some elements of physical fitness and the accuracy of the blocking skill in volleyball, European Journal of Sports Science Technology, Volume 13, Issue 46, 2023.
- Saif Shaker Kamel:Training according to the principle of kinetic momentum and its effect on the values of some kinematic variables and the accuracy of performing the smash serve skill in volleyball, Thi Qar University Journal of Physical Education Sciences, Volume 1, Issue 4, Part 2, 2024, p. 143.

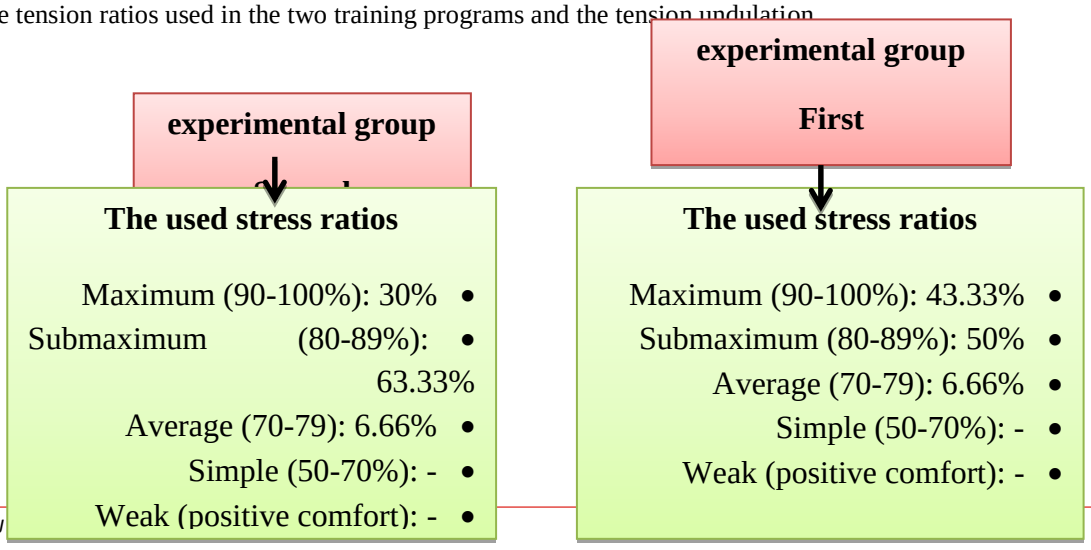
- Amr Allah Al-Basati: Rules and Foundations of Sports Training and its Applications, Alexandria, Maaref Establishment, 1998.

- Skinner, J. And McLain, T: The Transition From Aerobic To Anaerobic Metabolism, R-O-Exercise And Sports.

- Mustafa Khaled Abdel Hassan: The effect of comprehensive vision exercises on improving the perception of the field of vision and the accuracy of the passing skill of junior football players. Thi Qar **University Journal of Physical Education.vol2.I2.2025.**

- Appendix (1)

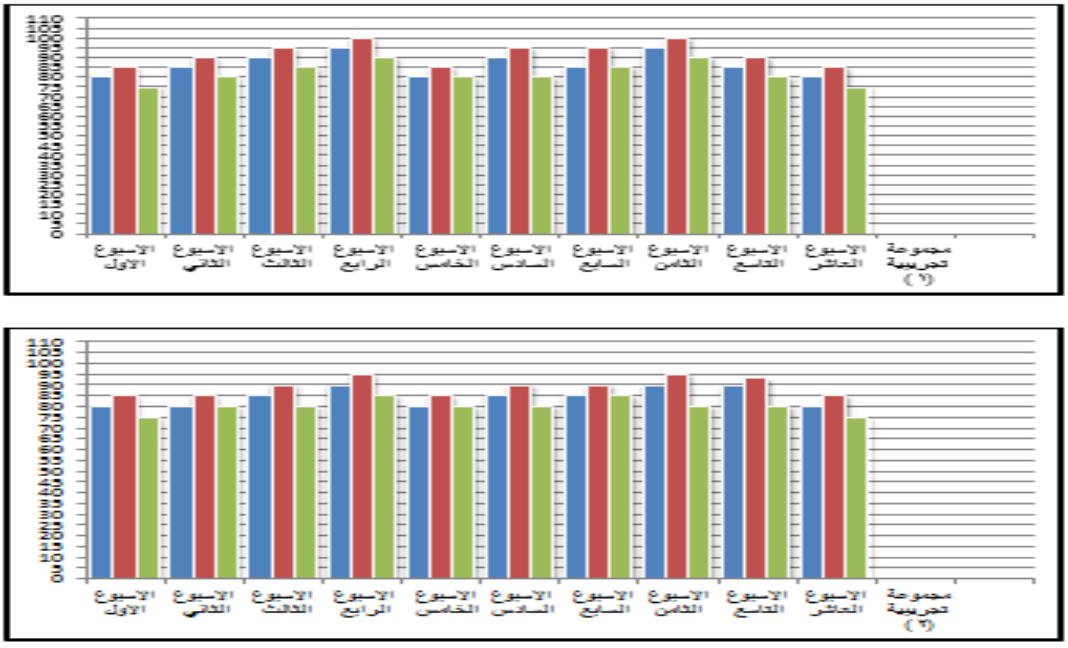
YesYThe tension ratios used in the two training programs and the tension undulation



ise is	747.75	222.75	225	300	75	3	50	3	24.75	S1
	600.9	200.9	400	-	80	5	-	1	40.18	S6
	746.9	246.9	500	-	100	5	-	1	49.38	S12

Appendix (2)

Shows how to structure the exercises within the training program for the two groups and how to formulate them



- **Exercise name(S6) :**
  Multi-height jump drill with defense and blocking wall

- **Exercise description:**
  1. The player starts by double jumping (with both feet).)To cross the three barriers one by one.
  2. After passing the hurdles, the player quickly moves towards the net to the center (2).
  3. Performs a blocking wall against a set piece.(Simulation of an attack) by the coach or a teammate.
  4. After making the block, the player quickly drops back behind the attacking line to prepare for defense.In Center (6).
  5. The player performs a defense against an attacking ball.fromThe coachStanding inCenter (4) toSame side of the stadium.
  6. The player then moves to the back of the group.
  7. Repeat the exercise(3)Consecutive times within a group of(3)players.

- **Exercise name (S1):**
  Zakzak on the agility ladder with the triple defensive maneuver
  - ❖ the movement..
  - ❖ The player ends up in the area between center (5) and center (4), then:
  1. He prepares to defend on the attacking line between positions (5 and 4) in front of the ball from the coach, standing in position (4) on the opposite side of the field.