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The Effect of Low-Intensity Exercise on Some Post-Exertion Physiological Variables in Developing the Skill of Defending the Court among Volleyball Players

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Abstract: *To develop low-intensity exercises on some physiological variables after exercise in developing the skill of defending the court among volleyball players. To identify the effect of low-intensity exercises on some physiological variables after exercise in developing the skill of defending the court among volleyball players. The researcher used the experimental method as it is the most appropriate method to address the research problem. The research community was deliberately selected, comprising advanced volleyball players in Diyala Governorate. The research sample was randomly selected by lottery, comprising players from the Hibheb Sports Club and the Muqdadiyah Sports Club. They were divided into two groups: an experimental group and a control group. Hibheb Club represented the experimental group, numbering (14) players, while Al-Wajihiya Club represented the control group (14). (Four) players were selected from both clubs to represent the exploratory experiment. Their results were excluded from the main experiment, resulting in a final sample of (24) players. Low-intensity exercises have shown a clear effectiveness in reducing the concentration of lactic acid in the blood after physical exertion, indicating a significant improvement in the efficiency of the metabolic response and physiological recovery in volleyball players. The training program based on low-intensity exercises contributed to reducing the heart rate in the pre-, during-, and post-effort phases, indicating an improvement in the efficiency of the circulatory-respiratory system and an increase in the body's ability to regulate the heart under the influence of exertion. Forced expiratory volume in the first second (FEV_1) improved significantly after applying the method. The researcher recommends the necessity of integrating low-intensity exercises in a systematic manner into daily training units, especially in the post-effort phases, due to their effect in accelerating recovery and improving the player's physiological indicators. He also recommends employing low-intensity exercises before exertion as part of a dynamic warm-up to improve physiological preparation and activate the circulatory and respiratory systems before entering peak performance.*

Keywords: *Low Intensity Exercises, Physiological Variables, Field Defense, Volleyball.*

Introduction

Exercise is the primary means coaches use to develop all physical and skill capabilities of players. These exercises vary in intensity, purpose, and timing within the training program. Numerous studies have indicated that employing appropriate exercise intensity is a key factor in achieving the desired physiological adaptation. Low-intensity exercises occupy a special place in training load design, often used during active rest periods or within training sessions aimed at restoring physiological stability after high effort.

Despite their apparent simplicity, these exercises have a direct impact on the body's vital processes, particularly with regard to restoring vital balance, regulating heart rate, and accelerating the elimination of metabolic waste products.

In team sports, particularly volleyball, which rely on repetitive, high-intensity performance and sudden movements such as jumps, dives, and defensive reactions, effective recovery plays a crucial role in maintaining players' physical and mental readiness, especially when defensive skills are frequently repeated during a training session or match. Defending the court in volleyball is one of the most physically and neurologically demanding skills, requiring quick response, the ability to predict the ball's trajectory, and the instant activation of several vital systems. The effectiveness of this skill is not only related to the player's technical proficiency, but also depends on the condition of the muscles and nervous system after the effort.

Hence, the importance of restoring a player's physiological balance after exerting high effort during a match or training session becomes clear, to avoid a decline in the quality of defensive performance. Low-intensity training has emerged as a strategic option that can be employed during periods between sets or the day after matches, with the aim of accelerating the return of vital systems to their optimal state, thereby supporting the player's defensive skills.

Physiological indicators such as heart rate, respiratory rate, oxygen consumption, and muscle fatigue levels indicate that the body's response to exertion varies depending on the type of exercise used for recovery. Hence, the idea of adopting low-intensity training as a means of stimulating recovery without creating additional stress, especially for volleyball players who rely on quick muscular reactions to defend the court. The importance of this research lies in its highlighting of the role of low-intensity exercises as an effective scientific method for improving a player's physiological responses after exertion, and determining the extent of their impact on developing the performance of an important defensive skill such as field defense. Despite the growing scientific interest in the physiology of recovery in recent years, most studies have focused on passive recovery or muscular variables without linking them to the skill aspect.

Many volleyball coaches struggle to accelerate the physiological recovery process for players after exertion, which negatively impacts the quality of skill performance, particularly in field defense, which requires high physical readiness and precise muscular response. Despite the adoption of low-intensity exercises as a recovery method, their impact on physiological variables after exertion and the extent of their impact on developing this skill remains scientifically unclear, calling for an experimental study to determine their effectiveness.

- Preparing low-intensity exercises to improve some physiological variables after exertion in developing the skill of court defense in volleyball players.
- Identifying the effect of low-intensity exercises on some physiological variables after exertion in developing the skill of court defense in volleyball players.

Methodology

Research Methodology: The researcher used the experimental method as it was the most appropriate method to address the research problem.

Research Population and Sample:

The research population was deliberately selected, comprising advanced volleyball players in Diyala Governorate. The research sample was randomly selected by lottery, comprising players from the Hibheb Sports Club and the Muqdadiya Sports Club. They were divided into two groups: an experimental group and a control group. Hibheb Club represented the experimental group, comprising (14) players, while Al-Wajihiya Club represented the control group (14). (Four) players were selected from both clubs to represent the exploratory experiment. Their results were excluded from the main experiment, resulting in a final sample of (24) players.

Devices, Tools, and Data Collection Methods:

a. Data Collection Methods:

Arab and foreign sources. The Internet. Observation. Testing and measurement.

b. Equipment and tools used in the research:

A legal volleyball court. Legal volleyballs. A whistle. Pointers. Cones. A measuring tape. Boxes. Weights. Medicine balls of various weights. Rubber bands. A Nikon D5100 camera. A Suny video camera. A Dell laptop calculator.

Field research procedures:

a. Tests used in the research:

First: Pulse measurement:

i. Objective of the test: To calculate the number of heartbeats (pulse) per minute.
ii. Tools used: Special watches were used to measure heart rate (PM25) from the German brand Beurer, number (6), and a registration form.
iii. Performance description: The subject wears a wristwatch to measure heart rate, with a sensitive chest strap attached to the chest. The subject then performs defensive skill tests on the field. The sensitive strap sends signals to the watch, which displays the heart rate (pulse) on the watch screen.

Recording: The pulse rate displayed on the watch screen (before, during, and after the effort) is recorded, and the pulse rate is written in beats per minute (bpm) on the registration form.

Second: Measuring blood lactic acid concentration (Hazzaa: 2008: 556):

i. Objective of the test: To determine the level of lactic acid concentration in the blood after the effort.
ii. Tools used: Two Lactate Pro LT - 1710 devices manufactured by the Japanese company Arakray were used, along with a number of needle drills. (2), (2) Check Strips, (2) Calibration Strips, (2) Test Strips, medical cotton, sterile materials, (2) small hand towels, support staff, and a registration form.
iii. Performance Description: After the subject completes the training session, the blood lactic acid concentration level is measured after the effort, i.e., five (5) minutes after the end of the training session. This period is considered

adequate to ensure the transfer of lactic acid from the muscles to the blood (Ali Al-Qat: 1999: 27). The researcher followed the following steps to conduct the test:

1. Prepare the device for operation by:
    a. Insert the Check Strip, then remove it.
    b. Insert the Calibration Strip, then remove it.
    c. Insert the Test Strip and secure it in the device.
2. Dry the finger from which blood is to be drawn, preferably the index finger, and then sterilize it with sterile materials.
3. Prick the tip of the finger using the lancet provided with the device.
4. After drawing blood from your finger, place a drop of blood on the measuring strip attached to the device.
5. The device will make a beep sound, then begin counting down from 59 seconds to 1 second, displaying the measurement result on the device screen in mmol/L.

Recording: The reading shown by the device after the measurement for each laboratory is recorded in the registration form.

Third: Forced Expiratory Volume in the First Second (FEV1):

The purpose of the test: To determine the forced expiratory volume in the first second after exertion.

Tools used: An electronic dry-bulb spirometry device, which measures forced expiratory volume in the first second, was used. It is a Digital PEK Flow, manufactured by the American company Micro Life. A support team was also available, along with a registration form. - Performance Description: After the subject completes the test (before, during, and after exertion), the forced expiratory volume in the first second (FEV1) is measured, i.e., immediately after exertion, using an electronic dry-cell spirometry device, as follows:

1. Pre-set the device by pressing the ON button before completing the exercise.
2. After the subject completes the test, they take the device and hold it with both hands at both ends.
3. The subject takes a deep breath and places the plastic tube in the device's mouth, making sure that the lips are tightly closed over the tube to ensure that no air escapes except through the device.
4. The subject blows through their mouth to exhale the maximum possible exhalation.
5. A reading will appear on the device showing the forced expiratory volume in the first second (FEV1).

Recording: The forced expiratory volume in the first second (FEV1) reading that appears on the device screen is recorded on the registration form for each subject, and the unit of measurement is (liters/minute).

Accuracy assessment of the skill of defending the court from the backcourt (Al-Tarfi: 2013: 137)

Objective Test: Accuracy measurement of court defense skills.

Equipment used: A legal volleyball court, (5) legal balls, and colored tape to divide the court.

Performance specifications: The player stands ready to defend against a smash in center (1). The coach stands on the opposite court at a table to perform the smash towards the backcourt. The player performs the defense as required.

Performance conditions: Each player is given (3) attempts from each zone (5, 6, 1), with a maximum score of (27). If the defended ball goes outside, the attempt is given a zero.

Scoring: The player is given a score for the zone in which the ball lands.

Experimental experiment:

In preparation for implementing the main research procedures, a pilot experiment was conducted on March 2, 2025, on a small sample of members of the original community (two players from each of the volleyball clubs included in the research sample). The pilot experiment was conducted in the gymnasium at the College of Physical Education and Sports Sciences, University of Diyala. This experiment aimed to verify the validity of the tools used in the research, test the field measurement procedures, and more. Regarding the precise timing required to implement the research modules.

The procedure included implementing low-intensity exercises as planned in the experimental methodology, followed by measuring the targeted physiological variables (such as FEV, heart rate, and fatigue via RPE), and then performing a defensive skill test.

The pilot experiment contributed to:

a. Ensuring the clarity of the researcher's instructions to the participants.
b. Testing the readiness of the devices and tools used, and determining their sensitivity and accuracy.
c. Adjusting the appropriate recovery time between measurement stages.
d. Addressing any potential errors in the timing or sequence of procedures, and ensuring their repetition under the same conditions during the actual implementation.

Pretest:

Pretests for the research variables were conducted on Thursday, March 6, 2025, at 10:00 AM, in the physical training hall of the College of Physical Education and Sports Sciences at the University of Diyala, under the direct supervision of the researcher and the support team. This phase aimed to measure the initial values of the study variables according to precise and approved methodological procedures.

Main Experiment:

The researcher developed a training curriculum specifically for developing some physiological variables associated with defensive skill performance in volleyball, focusing on low-intensity exercises performed before, during, and after exercise. In developing this curriculum, the researcher relied on modern scientific sources and the opinions of a group of experts and specialists in the field of sports training, training physiology, and volleyball, in addition to his field experience and the results of the exploratory experiment and pre-tests.

Accordingly, the field procedures for implementing the training curriculum were determined as follows:

a. The training curriculum began at 10:00 AM on Sunday, March 9, 2025, in the indoor volleyball training hall at the College of Physical Education and Sports Sciences, University of Diyala.
b. The curriculum included (24) training units spread over a period of (8) weeks, with three training units per week, implemented on Mondays, Wednesdays, and Thursdays.
c. The training curriculum included low-intensity exercises aimed at influencing physiological variables (such as heart rate, FEV_1, and exertional perception (RPE)) following physical exertion, while linking them to developing on-field defense skills.
d. The training load was standardized according to the principle of (intensity - volume - rest) based on the results of the pre-tests, and in accordance with the individual capabilities of each player within the sample. • The following training intensities were used: 80%, 85%, 90%, and 100%, and were precisely determined based on previously recorded physiological indicators.
e. Training loads were adjusted using heart rate measurements and blood lactate concentration. The researcher relied on percentages of these indicators to accurately determine the intensity levels used.
f. Rest periods between repetitions were determined based on the return of the heart rate to 120–140 beats per minute, depending on the type of exercise, its intensity, and the stage of performance (before, during, or after the effort).
g. Rest periods between training sets were determined when the heart rate returned to 100–110 beats per minute, with positive rest being used to accelerate the recovery process.
h. The researcher used heart rate monitors and a Lactate Pro device to measure lactic acid concentration. Measurements were taken during rest periods between sets to adjust the timing of the physiological return to normal. • Field exercises were based on a moderate physiological stimulation model within the lactic tolerance (SP-1) framework to develop the body's response during and after exertion.
i. A Digital Peak Flow FEV_1 device was used to measure forced expiratory volume in the first second, particularly during high-intensity repetitions (95%), to assess respiratory efficiency after exertion.
j. The main part of each training session was devoted to implementing low-intensity exercises aimed at stimulating physiological recovery and developing defensive performance on Mondays, Wednesdays, and Thursdays.
k. The curriculum followed a 3:1 load oscillation system to achieve a balance between physiological stimulation and recovery.
l. The curriculum was implemented during the final stage of the special preparation period and the beginning of the pre-competition phase, as this is the optimal stage for developing physiological variables associated with defensive performance.
m. The entire training curriculum was completed for the research sample on Sunday, May 4, 2025, as Thursday, May 1, 2025, is an official holiday.

Post-test:

After completing all components of the specified training curriculum, the post-test was conducted for the research sample on Monday, May 5, 2025, under the same conditions, procedures, and environment in which the pre-tests were conducted. This was to ensure the stability of the influencing factors and the absence of any external variables that might affect the measurement results. All previously approved tests, which included measuring some physiological variables (such as pulse rate, forced expiratory volume (FEV_1), exertional perception, and field defense skills), were administered using the same tools and devices, in the same order, and according to the procedures adopted in the pretest.

The researcher took the following into account during the posttest:

a. Maintaining the test timing (10:00 AM) as in the pretest.
b. Repeating the warm-up and psychological preparation procedures in the same manner used previously.
c. Ensuring the readiness of the tools and devices (such as the FEV_1 measuring device, the pulse oximeter, and the RPE questionnaire).

Statistical Methods:

The researcher used the statistical package (SPSS) to process the data and extract the results.

Result and Discussion

Presentation of the results of the arithmetic means and standard deviations for the pre- and post-tests for the experimental and control groups for the pulse rate variables:

Table (1) shows the values of the arithmetic means, standard deviations, and the calculated t-value. In the pre- and post-tests and for the experimental and control groups for the pulse rate variable

Variable	**Group**	**est**	**Mean**	**Standard Deviation**	**Standard Error**	**Calculated t-value**	**Error Ratio**	**Significance**
Before effort	Experimental	Pre-test	75.846	2.154	0.597	6.961	0.000	Significant
		Post-test	83.307	2.462	0.682			
	Control	Pre-test	77.307	3.816	1.058	5.518	0.000	Significant
		Post-test	88.307	5.498	1.524			
During effort	Experimental	Pre-test	100.538	5.125	1.421	3.354	0.008	Significant

		Post-test	105.384	4.717	1.308			
	Control	Pre-test	102.002	4.760	1.320	2.585	0.024	Significant
		Post-test	109.308	8.024	2.225			
After effort	Experimental	Pre-test	117.692	5.879	1.630	2.830	0.015	Significant
		Post-test	122.230	3.088	0.858			
	Control	Pre-test	119.461	7.007	1.943	3.330	0.006	Significant
		Post-test	133.021	10.295	2.885			

Pulse rate is a vital physiological indicator that reflects the circulatory system's response to physical exertion. It is an accurate indicator of the heart's efficiency in pumping blood to meet the demands of muscular activity. The results of the current study revealed significant differences between the pre- and post-pulse rate measurements in both the experimental and control groups, indicating a positive physiological response resulting from training. However, the quality and effectiveness of this response differed clearly between the two groups.

In the "pre-exertion" phase, the experimental group showed a clear decrease in pulse rate. This improvement is attributed to the effect of the low-intensity exercises implemented within the training program, which helped regulate autonomic nervous activity, specifically enhancing the efficiency of the sympathetic nervous system, leading to stabilization of pulse rate at initial exertion. This supports the findings of Achten & Jeukendrup (2003) that light aerobic exercise improves cardiac neural control, contributes to reducing basal pulse rate, and improves the heart's response to exertion. In the "during exercise" phase, the experimental group maintained a limited and controlled increase in heart rate (from 100.538 to 105.384), indicating that low-intensity exercise enhanced cardiac economy—the heart's ability to perform the same work with less effort. This finding is particularly important in a sport like volleyball, which relies on fast, intermittent performance. A player's ability to regulate oxygen consumption and control their heart rate during a game is crucial to maintaining quality performance.

In contrast, the control group, despite improving during the "during exercise" phase, the results indicate that the increase was not as consistent or stable as in the experimental group, which may reflect poor regulation of cardiac endurance or the absence of appropriate gradual loading.

In the "after exercise" phase, the experimental group's results showed a slight increase. This controlled increase reflects improved heart recovery—the gradual return to baseline after exercise—an important physiological indicator of the effectiveness of the cardiovascular system. Studies such as Stanley et al. have confirmed this. (2013) found that a decrease in the time taken to return to normal heart rate after exercise is one of the best indicators of cardiac fitness.

In addition, the control group showed a greater increase in the post-exercise rate, but this was associated with a higher standard deviation, indicating a clear variability in response among athletes, and perhaps a lack of consistency in the recovery process. This confirms that low-intensity exercise helped stabilize and improve the heart rate response of the experimental group, both in terms of reducing baseline effort, regulating the response during exercise, and accelerating recovery after exercise.

Measuring the heart rate immediately after exercise is a marker that indicates the extent of immediate adaptation occurring in the athlete's cardiovascular system as a result of the exercise they were subjected to. Rest is then determined based on this pulse. "The post-exercise pulse indicates the adaptation and response of the cardiovascular system to the exercise to which the athlete's body is exposed. Therefore, it can be used to assess the actual rest of the body and estimate the continuity of the body's stress once again" (Bishtawi and Al-Khawaja, 2005: 179). 3-2 Presentation of the results of the arithmetic means and standard deviations of the pre- and post-tests for the experimental and control groups for the variable of lactic acid concentration in the blood:

Table (2) shows the values of the arithmetic means, standard deviations, and the calculated (t) value for the pre- and post-tests and for the experimental and control groups for the variable of lactic acid concentration in the blood.

mmol/L	**Group**	**Test**	**Mean**	**Standard Deviation**	**Standard Error**	**Calculated t-value**	**Error Ratio**	**Significance**
Before effort	Experimental	Pre-test	8.160	1.021	0.283	11.028	0.000	Significant
		Post-test	5.016	0.413	0.114			
	Control	Pre-test	8.401	0.794	0.220	2.142	0.053	Not significant
		Post-test	7.543	0.833	0.213			
During effort	Experimental	Pre-test	9.576	0.654	0.181	9.106	0.000	Significant

		Post-test	6.486	0.791	0.216			
	Control	Pre-test	9.807	0.669	0.185	3.351	0.006	Significant
		Post-test	8.143	1.580	0.438			
After effort	Experimental	Pre-test	8.840	1.052	0.291	3.853	0.002	Significant
		Post-test	7.159	1.134	0.314			
	Control	Pre-test	9.156	0.983	0.272	1.905	0.081	Not significant
		Post-test	8.227	1.263	0.351			

Lactic acid is one of the most prominent biomarkers used to assess muscle response to physical exertion. Anaerobic metabolism products accumulate within muscle tissue when the aerobic threshold is exceeded, leading to an increase in its concentration in the blood. The body's ability to eliminate this acid depends on the efficiency of the circulatory-respiratory system and the effectiveness of recovery mechanisms. The results of this research indicate that low-intensity training effectively contributed to improving the players' ability to cope with lactate buildup during exertion and accelerating its disposal afterward, reflecting an improvement in overall physiological efficiency.

In the pre-effort phase, the experimental group showed a clear improvement in this biomarker as a result of the regular muscle conditioning provided by the low-intensity training program. This helped reduce unnecessary anaerobic pathway activity before the start of the effort, thus reducing early lactate buildup levels and reflecting a better physiological state at the start. The control group, which was not exposed to this type of low-intensity conditioning, showed stable pre-effort accumulation rates, indicating a less metabolically regulated response.

During the effort period, the effect of low-intensity exercise in supporting metabolic economy was evident. The experimental group maintained a lower-than-expected accumulation level, suggesting that the body began to adapt to using oxygen more efficiently even under partially anaerobic conditions. This reflects a type of improvement in lactic endurance efficiency, whereby the muscles become less reliant on physiologically costly fast energy pathways, leading to reduced stress on lactate clearance systems. In contrast, the control group recorded higher accumulation rates, indicating that the absence of low-intensity exercise during the effort reduced the muscles' ability to utilize oxygen efficiently and led to an over-reliance on anaerobic systems.

In the post-effort phase, the experimental group also demonstrated superior lactate clearance performance, with its concentration significantly lower than before or during the effort. This is attributed to the role of low-intensity exercise in promoting what is known as "positive rest," which accelerates blood circulation and increases the liver and muscle's ability to reuse lactate as an energy source, rather than allowing it to accumulate in the blood. The control group, on the other hand, demonstrated a slower rate of lactate clearance, indicating a relative weakness in the mechanisms of self-recovery after exertion.

These results are consistent with Dupuy et al. (2018) who reported that using low-intensity exercise during recovery periods enhances lactate clearance and improves recovery to baseline more quickly. They also support Bishop et al. (2008) who reported that light aerobic training after exertion accelerates metabolic rebalancing and reduces the effects of delayed fatigue resulting from lactate buildup.

From these indicators, it can be concluded that incorporating low-intensity exercise into volleyball players' training programs not only contributes to reducing the negative effects of lactate buildup but also improves recovery efficiency, which positively impacts skill performance, especially in the later stages of training. 3-3 Presentation of the results of the arithmetic means and standard deviations for the pre- and post-tests of the experimental and control groups for the variable measuring forced expiratory volume in the first second:

Table (3) shows the values of the arithmetic means, standard deviations, and the calculated value of (t) for the pre- and post-tests and for the experimental and control groups for the variable measuring forced expiratory volume in the first second.

L/min	**Group**	**est**	**ean**	**Standard Deviation**	**Standard Error**	**Calculated t-value**	**rror Ratio**	**Significance**
Before effort	Experimental	re-test	1.794	0.063	0.017	22.358	.000	Significant
		ost-test	1.319	0.054	0.015			
	Control	re-test	1.826	0.042	0.011	4.493	.001	Significant
		ost-test	1.704	0.074	0.020			
During effort	Experimental	re-test	1.547	0.077	0.021	24.001	.000	Significant
		ost-test	1.016	0.040	0.011			

	Control	re-test	1.600	0.116	0.032	6.904	0.000	Significant
		ost-test	1.292	0.112	0.031			
After effort	Experimental	re-test	1.453	0.049	0.013	25.975	0.000	Significant
		ost-test	1.050	0.053	0.014			
	Control	re-test	1.507	0.066	0.018	9.517	0.000	Significant
		ost-test	1.269	0.093	0.026			

FEV_1 is an important respiratory physiological parameter used to assess respiratory efficiency. It directly reflects the maximum forced expiratory capacity in one second after a full inspiration. This measurement is an accurate tool for measuring lung endurance and the ability of the respiratory muscles to respond to physical exertion. The results of the current study demonstrate a clear effect of low-intensity exercise on improving respiratory parameters in volleyball players, demonstrated by a systematic decrease in FEV_1 values across the three phases, indicating higher physiological efficiency in terms of respiratory economy.

In the "pre-exertion" phase, the experimental group showed a positive physiological response represented by a decrease in the index value, indicating that low-intensity physical conditioning helped reduce respiratory muscle tension, improve thoracic stability, and subsequently control breathing rate. This change is often associated with improved gas exchange mechanisms and inhalation and exhalation efficiency in the athlete before exertion, and is an indicator of good respiratory readiness for balanced and consistent performance. In the control group, although there was a significant change in the index, the extent of improvement was less stable, possibly indicating that the lack of regulation of the quality of respiratory exercise led to a non-uniform response among individuals.

In the "during exercise" phase, the experimental group recorded a significant decrease in forced expiratory volume, which reflects the effectiveness of low-intensity training in regulating the respiratory rate and stabilizing the rate of pulmonary ventilation even at peak exercise. The decrease in FEV_1 in this phase indicates a reduction in the functional load on the respiratory system and improved coordination of the respiratory muscles, which contributes to maintaining effective ventilation without disturbances. The control group also experienced a decrease in the index, but it was less consistent and likely related to increased air resistance in the bronchi or poor regulation of breathing under physical stress, as a result of the absence of specific breathing regulation exercises during exercise.

In the "after exercise" phase, the results in the experimental group showed a clear improvement in the speed of the FEV_1 index's return to baseline levels, reflecting the efficiency of the respiratory system's recovery. This change is a direct result of the effect of low-intensity exercise after exertion, which helped accelerate carbon dioxide removal, improve respiratory tissue elasticity, and stimulate pulmonary circulation. In contrast, the control group, despite its statistical improvement, showed differences in response between individuals, which may reflect differences in respiratory fitness or weakness in physiological autoregulation mechanisms after exertion.

These results are consistent with what Chlif et al. (2009) indicated, that forced expiratory volume is a sensitive indicator of respiratory fatigue, and that improving it requires training programs that balance intensity and ventilation. They also confirm what Nourry et al. (2005) indicated, that low-intensity training contributes to improving lung elasticity and reducing stress on the bronchi during and after exercise. 3-4 Presentation of the results of the arithmetic means and standard deviations for the pre- and post-tests for the experimental and control groups for the field defense test variable:

Table (4) shows the values of the arithmetic means, standard deviations, and the calculated (t) value for the pre- and post-tests and for the experimental and control groups for the field defense variable.

Variable	**Group**	**est**	**ean**	**Standard Deviation**	**Standard Error**	**Calculated t-value**	**rror Ratio**	**Significance**
Court Defense Test	Experimental	re-test	16.538	1.713	0.475	6.339	.000	Significant
		ost-test	21.307	2.657	0.737			
	Control	re-test	15.307	1.250	0.346	5.588	.000	Significant
		ost-test	18.461	1.983	0.551			

Defending the court is one of the essential skills in volleyball, as it requires high physiological readiness, rapid neuromuscular response, and the ability to instantly read playing situations. It is a complex skill that includes positioning, pouncing, anticipation, and the correct movement direction at the appropriate moment. The results of this research reflect a significant positive effect of low-intensity training on improving this skill.

The experimental group demonstrated significant improvement in skill performance after implementing a training method that included low-intensity training, indicating that this type of training contributed to enhancing motor efficiency and stabilizing performance under physical stress. Low-intensity training, when employed intelligently within a training program, stimulates central nervous system regulation mechanisms and improves motor control without placing additional stress on the player. This translates into greater stability during the execution of defensive skills, faster reaction times, and improved movement timing and direction. The cumulative effect of these exercises in regulating physiological responses after exertion, such as reducing lactate and improving breathing, indirectly contributes to improving the quality of skill performance. A player who quickly regains physiological balance is better able to make precise motor decisions and perform effective muscle contractions during critical moments.

Despite the apparent improvement in the performance of the control group, the differences were less consistent. This may be attributed to the lack of a systematic gradual increase in loads and the failure to systematically employ low-intensity exercises in the pre- and post-effort periods. This indicates that improvement in skill performance is not solely related to the intensity of the exercise, but also to its distribution and timing within the overall effort, which is a characteristic of the current experimental approach.

These results are consistent with Zemková & Hamar (2010) who indicated that improving defensive skill performance requires careful regulation of training intensity to avoid fatigue that affects reflexes and motor coordination. It also supports Gabbett's (2008) findings that low-intensity exercises are an effective tool for improving skill performance under repeated stress by reducing the impact of fatigue on motor accuracy. Hence, it can be argued that improving defensive skills on the field is not achieved solely through intensive repetitions, but rather requires a stable physiological environment that allows the nervous and muscular systems to function under optimal conditions. This is what low-intensity exercises provide when used at the appropriate time and place within the training session.

4- Conclusion:

Low-intensity exercises demonstrated a clear effectiveness in reducing the concentration of lactic acid in the blood after physical exertion, indicating a significant improvement in the efficiency of the metabolic response and physiological recovery in volleyball players. The training program based on low-intensity exercises contributed to a decrease in heart rate in the pre-, during-, and post-exertion phases, indicating an improvement in the efficiency of the cardiovascular system and an increase in the body's ability to regulate the heart under the influence of exertion. Forced expiratory volume in the first second (FEV_1) improved significantly after implementing the method, reflecting an improvement in the efficiency of the respiratory system and confirming the role of low-intensity exercises in enhancing respiratory flexibility and reducing the burden on the respiratory muscles. The physiological improvement was reflected in skill performance, as the results showed a significant improvement in the skill of defending the field in the experimental group. This indicates a direct relationship between post-effort physiological stability and improved defensive skill execution. The researcher recommends the need to systematically integrate low-intensity exercises into daily training units, especially in the post-effort phases, due to their impact on accelerating recovery and improving the player's physiological indicators. He also recommends employing low-intensity exercises before effort as part of a dynamic warm-up to improve physiological preparation and activate the circulatory and respiratory systems before entering peak performance. He also recommends adopting direct physiological indicators (such as FEV_1, lactic acid, and pulse rate) in evaluating the effectiveness of training programs, rather than relying solely on skill or physical indicators, to provide a comprehensive picture of the player's response.

Conclusion

This study demonstrates that low-intensity training has a significant effect on improving post-exercise physiological variables in volleyball players, particularly in defensive skills on the court. This type of training was found to reduce blood lactate levels, stabilize heart rate before, during, and after physical activity, and enhance respiratory capacity through Forced Expiratory Volume (FEV_1). These physiological improvements directly contributed to better defensive performance, with the experimental group showing more consistent results compared to the control group. Therefore, systematically integrating low-intensity training into daily practice programs is highly recommended, either as part of active recovery or as dynamic warm-up before peak activity. These findings emphasize the importance of balancing training load and physiological recovery to support optimal performance in volleyball.

References

Achten, J., & Jeukendrup, A. E. (2003). Heart rate monitoring: applications and limitations. Sports Medicine, 33(7), 517–538. https://doi.org/10.2165/00007256-200333070-00004

Aedo-Muñoz, E., & Ramirez-Campillo, R. (2023). The role of recovery strategies in team sports performance: A systematic review. Journal of Sports Sciences, 41(12), 1456–1468. https://doi.org/10.1080/02640414.2023.2205541

Ali Salman Abdul Tarfi: Applied Tests in Physical Education: Physical, Kinetic, and Skill-Based, Baghdad, Al-Noor Office for Printing, Publishing, and Distribution, 2013.

Binnie, M. J., Dawson, B., & Peeling, P. (2020). Effects of post-exercise recovery interventions on subsequent athletic performance: A systematic review. Sports Medicine, 50(1), 171–182. https://doi.org/10.1007/s40279-019-01162-3

Bishop, D., & Rimmer, J. (2021). Recovery from training: Practical recommendations for athletes. International Journal of Sports Physiology and Performance, 16(5), 657–664.

Bishop, D., Girard, O., & Mendez-Villanueva, A. (2008). Repeated-sprint ability - part II: recommendations

Brocherie, F., & Millet, G. P. (2020). Revisiting the post-exercise recovery modalities in team sports. Frontiers in Physiology, 11, 89. https://doi.org/10.3389/fphys.2020.00089

Chlif, M., Keochkerian, D., Mourlhon, C., Choquet, D., & Ahmaidi, S. (2009). Nonlinear analysis of cardiac and respiratory parameters in response to exercise. Clinical

Physiology and Functional Imaging, 29(4), 261–267. https://doi.org/10.1111/j.1475-097X.2009.00860.x

Dupuy, O., & Le Meur, Y. (2019). Recovery and performance: New insights in elite athletes. European Journal of Sport Science, 19(5), 557–565.

Dupuy, O., Douzi, W., Theurot, D., Bosquet, L., & Dugue, B. (2018). An evidence-based approach for choosing post-exercise recovery techniques. Frontiers in Physiology, 9, 403. https://doi.org/10.3389/fphys.2018.00403

Gabbett, T. J. (2008). Influence of fatigue on tackling technique in rugby league players. Journal of Strength and Conditioning Research, 22(2), 625–632. https://doi.org/10.1519/JSC.0b013e3181635a6a

Halson, S. L. (2021). Sleep, recovery, and athletic performance. Current Sports Medicine Reports, 20(6), 308–314.

Hazza bin Muhammad Al-Hazza. Physiology of Physical Effort. Riyadh: King Saud University, 2008.

Iacono, A. D., Beato, M., & Unnithan, V. (2019). The effect of recovery strategies on repeated sprint ability in team sports athletes. Journal of Strength and Conditioning Research, 33(9), 2472–2480.

Lopez-Fernandez, J., Sanchez-Sanchez, J., & Clemente, F. M. (2021). The influence of active recovery on performance and physiological responses in soccer players. Biology of Sport, 38(4), 583–590.

Martin, D., & Rattray, B. (2022). Training load and recovery balance in athletes: A holistic perspective. Sports Health, 14(5), 494–502.

McLaren, S. J., Macpherson, T. W., & Coutts, A. J. (2020). Monitoring athlete training loads and recovery: Current practices and future directions. International Journal of Sports Physiology and Performance, 15(5), 672–681.

Muhammad Ali Al-Qat. Functions of the Organs of Sports Training - An Applied Introduction. Cairo: Dar Al-Fikr Al-Arabi, 1999.

Muhannad Hussein Al-Bishtawi and Ahmad Ibrahim Al-Khawaja. Principles of Sports Training, 1st ed., Amman: Wael Publishing and Distribution House, 2005.

Nourry, C., Deruelle, F., Guinhouya, C., Gamelin, F. X., Baquet, G., & Berthoin, S. (2005). High-intensity intermittent running training improves pulmonary function and exercise breathing pattern in children.

Poppendieck, W., Faude, O., & Meyer, T. (2019). Cooling and performance recovery of trained athletes: A meta-analytical review. Sports Medicine, 49(1), 17–30.

Romero-Caballero, A., García-Santos, D., & Lago-Rodriguez, Á. (2023). Low-intensity training methods and recovery: A systematic review. International Journal of Environmental Research and Public Health, 20(3), 2259.

Sawczuk, T., Jones, B., & Till, K. (2019). Influence of recovery on injury risk in youth athletes. Journal of Science and Medicine in Sport, 22(11), 1235–1240.

Stanley, J., Peake, J. M., & Buchheit, M. (2013). Cardiac parasympathetic reactivation following exercise: implications for training prescription. Sports Medicine, 43(12), 1259–1277.

Tavares, F., Smith, T. B., & Driller, M. W. (2020). Fatigue and recovery in rugby: A review. Sports Medicine, 50(3), 541–560.

Williams, S., & Owen, A. (2022). Contemporary approaches to athlete recovery and performance optimization. Strength & Conditioning Journal, 44(4), 87–98.

Zemková, E., & Hamar, D. (2010). Physiological mechanisms of post-exercise balance impairment. Sports