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The Effect of Special Exercises Based on Heart Rate Indicators on Developing Some Functional Indicators and Explosive Strength in Volleyball Players

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Abstract

The aim of the research is to identify the level of physical abilities among the research sample and to determine the best rest periods based on heart rate indicators (120 beats per minute or 130 beats per minute) for their development and functional indicators, the researcher assumed there are statistically significant differences between the pre-test and post-test and research sample included players from the Heet Sports Club in volleyball, which is one of the clubs in the Iraqi Premier League for the (2022-2023) season, totaling 16 players. The researcher used the training approach due to its suitability for the nature of the research problem and concluded that the prepared training program was effective and positive according to heart rate indicator (120 bpm). The conclusions included the effect of the level according to the pulse index (120 bpm), showing improvement in pulse level before exertion at complete rest, after 60 seconds, and after 90 seconds was observed. However, the level of improvement in the pulse recovery method (130 bpm) was better than that of the pulse recovery method (120 bpm).The recommendations included adopting an exercise approach based on the two heart rate indicators that the researcher utilized in the training program they will implement in future sports activities. Furthermore, it is essential to conduct physiological tests to calibrate training loads, as they play a significant role in the training process. and this achieves one of the sustainable development goals of the United Nations in Iraq which is (Good Health).

Keywords | **Pulse, Functional Indicators, Maximal Strength, Volleyball**

Introduction:

Sports training physiology in the modern era is considered one of the essential and fundamental foundations for all sports training processes. Its results have emerged in the form of continuous development in the levels of physical, technical, and tactical performance. This is because of its direct effect on the body's various systems, which enables an individual to develop adaptation processes that help the body cope with the fatigue and exertion resulting from training and competition. The development of the sporting level is considered to result from functional and biological adaptations that take place within the internal systems. As a result, the individual's functional capacities increase, with varying degrees of impact depending on the nature of the activity, the duration of practice, and the style of execution, in addition to improving the level of athletic performance to achieve high levels of achievement in various sports, **this has prompted** those interested in and involved with sports training to choose the most effective methods for enhancing performance. Volleyball is considered one of the sports that has received significant attention in research and has led to numerous developments in training techniques. The explosive strength characteristic is considered one of the important attributes of volleyball and other sports that require

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explosiveness. Increasing the volume of training requires coaches to have a proper understanding of training methods and techniques to manage and overcome these loads, which depends on recovering the pulse to (120 bpm) during repeated exercises or (130 bpm) (Qasim Hassan, (10). Choosing the right exercises and understanding the appropriate recovery time are essential for developing explosive strength and the physiological indicators for this sport. In conclusion, the focus of the research is to establish the correct scientific foundation for selecting appropriate sports based on the pulse indicator during repeated training loads to develop speed endurance and its physiological indicators.

Research Problem:

The variety of training methods and their diverse effects make it necessary for athletes to have physical preparation that aligns with their abilities and the demands of their specific sport or activity, and the attribute of maximal strength is one of the important qualities that plays an effective role in the game of volleyball. Based on the researcher's experience, being a specialist in this field, this quality is essential for performance in the sport. The researcher observed that one of the reasons for the decline in players' performance levels during competitions was through observation. The researcher decided to determine the rest periods between exercises according to the pulse indicator (120 bpm) or (130 bpm) to identify which one is better for the correct selection in terms of their effects on developing explosive strength and physiological indicators.

Research Objective:

To identify the best rest periods based on the pulse indicators (120 bpm or 130 bpm) for developing specific explosive strength and functional indicators.

Research Hypothesis:

There are statistically significant differences between the pre-test and post-test results in explosive strength tests and some physiological indicators among the individuals in the research sample.

Research Fields:

- **Human Field:** Volleyball players from the Heet Sports Club.
- **Temporal Field:** The period from 14/10/2022 to 5/3/2023.
- **Spatial Field:** Heet Sports Forum Stadium.

Methodology and Procedures:

Research Methodology:

The researcher used a training method with a pre-test and post-test design, as it is suitable for the nature of the research.

Research Population

The research population comprises the clubs in Anbar Governorate, which include four clubs (Anah Club, Heet Club, Al-Anbar Club, and Al-Fosfat Club), all of which are first division clubs and represent 100%.

Research Sample:

The study population was purposively chosen to represent the players of the Heet Sports Club volleyball team, which is one of the clubs in the Iraqi Premier League for the current season (2022-2023), with a total of 14 players and 3 additional players and the sample size constituted 25% of the original population. It was selected randomly through a draw so that the researcher could conduct pilot studies. The players were assigned to two groups through a simple random draw. The odd numbers represented the first experimental group, which used a heart rate recovery indicator of 130 bpm between repetitions, while the even numbers represented the second experimental group, which used a recovery heart rate indicator of 120 bpm between repetitions

The methods and tools used in the research:

Personal interviews - questionnaire form - Arabic and foreign sources and references - observation and experimentation - sterilized material - medical cotton - registration form - medical scale for weighing with a height measuring device, Italian-made brand (I.M.S) - handheld calculator,

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Sharp brand - two stethoscopes for measuring heart rate.

The tests used in the research :

Heart rate test: Muwafaq Assad (1)

Purpose: To measure the heart rate before exercise, after exercise, and after 60 seconds and 90 seconds. The researcher compared these measurements with the training requirements and rest intervals between repetitions

The scientific term: Refers to the heart rate (pulse rate) "the number of heart contractions (beats) per minute, expressed as the number of beats per minute" Qasim Hassan Hussein (2).

Two research groups performed pulse measurements during physical activity in four stages: before activity (complete rest), immediately after activity, after 60 seconds, and after 90 seconds.

Maximum oxygen consumption test (Vo2max): Ahmad Najy (3)

It consists of a maximum oxygen consumption test based on the running distance over a duration of 15 minutes on the track as follows:

Objective: To determine the maximum oxygen consumption based on the running distance over a duration of 15 minutes.

Tools used: Track and field area, 12 stopwatches, recording sheets, and a measuring tape to calculate the distance difference.

Description of performance: Three players were tested together to ensure a competitive element. The test began as follows: upon hearing the command "Take your positions," the players assumed the starting stance from a standing position. After hearing the starting signal, they began to run around the track for a duration of 15 minutes. The distance covered by each athlete during the 15 minutes was recorded to the nearest 25 meters When the specified time period (15 minutes) was completed, the stopwatch was stopped, and the distance covered by each participant is recorded on the registration sheet. This distance was then compared to the table to determine the score.

Vertical jump test from a standing position (Sargent test). Mohammed Sobhi (4)

Objective of the test: To measure the muscular strength of the legs in vertical jumping

Required tools: A wooden board (chalkboard) painted black, measuring 0.5 meters in width and 1.5 meters in length, with white lines drawn on it spaced 2 cm apart; a smooth wall at least 3.60 meters high from the ground; pieces of chalk or chalk powder; a piece of cloth to wipe off chalk marks after each attempt by the tester; the board can be replaced with a graduated piece of wood fixed to the wall.

The Procedures: The board or piece of wood is fixed to the wall so that its lower edge is at a height that allows the shortest tester to perform the test. Care should be taken to position the board at least 15 cm away from the wall to prevent friction with the wall during the vertical jump. A line is drawn on the ground perpendicular to the wall, measuring 30 cm in length.

Description of performance: The tester holds a piece of chalk that is at least 2.5 cm long, then stands facing the board and extends their arms upward as far as possible, making a mark on the board with the chalk while ensuring that their heels stay on the ground and the tester then stands sideways to the board, with their feet on the 30 cm line. They swing their arms down and back while bending the torso forward and downward, and they bend their knees to a right-angle position only- the tester extends their knees and pushes off with both feet to jump upward while vigorously swinging their arms forward and upward to reach the highest point possible. They make a mark with the chalk on the board or wall at the highest point they reach. Upon landing, the tester swings the arm closest to the wall forward and downward

Test instructions: The push-off must be done with both feet together from a standing position. Before jumping upward, the tester should swing their arms forward and downward to time the movement for maximum height. The tester is

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given 3 to 5 consecutive attempts, and the best attempt is recorded. Measurements are taken to the nearest centimeter. The jump must be executed with both feet together from a standing position, without taking a step or jumping off. The piece of chalk should not extend beyond the fingers to avoid affecting the results.

Research steps:

First: The pilot study.

The researcher conducted a pilot study with an assisting team on a group of three players, which included the following tests: heart rate, resting heart rate (before exertion), heart rate after 60 seconds, heart rate after 90 seconds, and explosive strength over a distance of 1000 meters. The pilot study took place at 10 AM on October 14, 2022, with the aim of verifying the validity of the tools used in the research.

On the following day, the researcher applied the exercises used on the research sample to determine the players' maximum limits. The researcher then used the intensity determination formula: (maximum limit × 100 / required intensity) (Muwafaq Assad, (1).

Second: Pre-Tests:

The tests were conducted as follows: a heart rate test was performed before exertion, followed by a heart rate test after exertion, then heart rate measurements after 60 seconds and after 90 seconds. Starting from October 19, 2022, the maximum oxygen consumption test (Vo2max) was conducted.

On October 21, 2022, the explosive strength test was carried out at 10 AM. All these tests were conducted at the Heet Sports Club field.

Third: Training Program

The training program lasted for 12 weeks, with two training sessions each week (totaling 3 months). Abu Al-Ala Abdul Fattah (5) stated, "Explosive strength training is conducted 2-3 times a week," and the total number of training units was 24.

Sports training experts recommend using loads less than the maximum. Each experimental group had a specific duration: the first group would begin when their heart rate returned to (130 bpm), then start performing repetitions. The second group would begin when their heart rate returned to (120 bpm), and then they would also start performing repetitions. The objective of the training was to develop and enhance explosive strength through a phased training approach or interval training, and The researcher relied on determining the components of training loads regarding rest periods. The researcher conducted a series of measurements of the players' heart rates to assess their capabilities and physical condition in order to establish the appropriate rest periods, as illustrated in the figure below. This also included determining when the player returns to their normal state (warming up). The equipment used included a chair, a stopwatch, and an electronic pulse measuring device. The subject sits on the chair immediately after performing physical exertion, and the pulse is measured directly at the end of the first minute for 15 seconds, and at the end of the second, third, and fourth minutes.

Resting Pulse	Immediately After Exertion	End of minute1	End of minute2	End of minute3	End of minute4
68	180	150	131	115	105

The researcher utilized the principles of gradual progression and variation in the training methodology to maintain the level of development achieved by the study sample. An example for four weeks of the intensity of the exercises used in the training program is illustrated, featuring a high-intensity interval training (80-90%) of maximum intensity.

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Weeks	Weeks Intensity	Units per week	
		First	Second
First	%81	80%	82%
Second	%.85	84%	86%
Third	%85	87%	83%
Fourth	%83	%85	%81

Fourth: Post-tests

After applying the explosive training program within the specified time, the researcher conducted the post-tests on January 20, 2023. The procedure was the same as the pre-test.

Statistical Methods:

The researcher used the Statistical Package for the Social Sciences (SPSS) to analyze the data statistically.

Results Presentation, Analysis, and Discussion:

Presentation of the results of my research group in the resting heart rate test (before exertion) with analysis and discussion.

Table .1 The arithmetic mean, standard deviation, and calculated (t) and tabulated (t) values before and after the test for the 130 bpm and 120 bpm groups in the resting heart rate test (before exertion).

Group	Pre-test		Post-test		Calculated (t) value	Tabulated t-value	Significance level
	Arithmetic Mean	±Standard deviation	Arithmetic Mean	±Standard deviation			
Group 1 130 bpm	68.400	3.286	60.00	6.00	5.715	2.132	Significant
Group 2 120 bpm	73.200	7.823	66.00	4.243	3.207		Significant

Presentation of the results of the research groups in the heart rate test immediately after exertion and their discussion.

Table .2 Heart rate test (after exertion), including the mean, standard deviation, and calculated and tabulated t-values for the two groups before and after the test

Group	Pre-test		Post-test		Calculated (t) and values	Tabulated t-value	Significance level
	Arithmetic Mean	±Standard deviation	Arithmetic Mean	±Standard deviation			
Group 1 130 bpm	208.400	8.173	204.000	4.242	0.970	2.132	Non-Significant
Group 2 120 bpm	206.800	12.775	207.600	6.841	0.241		Non-Significant

Presenting the results of the two research groups in the VO2 max test, which measures the maximum oxygen consumption.

Table .3 (VO2 max): The arithmetic mean, standard deviation and t-values were calculated for the 130 bpm and 120 bpm groups in the test and tabulated before and after the test. The maximum oxygen consumption score.

Group	Pre-test	Post-test

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	Arithmetic Mean	±Standard deviation	Arithmetic Mean	±Standard deviation	Calculated (t) value	Tabulated t-value	significance level
Group 1 130 bpm	56.500	0	62.800	2.464	5.715	2.132	Significant
Group 2 120 bpm	57.400	2.012	61	2.846	5.66		Significant

Discussion:

When observing the resting heart rate results (before exertion) for the two groups in Table (1), we find that the heart rate in the pre-test and post-test showed significant differences between the two tests. The researcher attributes these significant differences to the effect of the training program that was prepared by the researcher, in addition to the positive effect of application and attention, as well as scheduling physical rest times and the use of training loads based on heart rate, along with the precision in structuring these loads in terms of volume, intensity, and the type of exercises used, has had a significant impact. The human body does not experience only two states—rest and work—but rather three states: rest, work, and recovery" Abu Al-Ala Ahmed (5). Risan Khraibit (6) states: "Heart rate is crucial in assessing training status; an unusual slow heart rate in athletes is primarily an indicator of good cardiac function resulting from high training levels." by observing Table (2), it becomes clear that there is no significant difference in heart rate between the two groups after physical activity, both before and after the test. To ensure that the training regimen achieves the expected goals, the focus is primarily on developing the physiological capacity for specialized training. Measuring heart rate after exertion is one of the important functional indicators used in the field of training to understand and measure the adequacy of the cardiovascular and respiratory systems, which helps the coach assess the athlete's condition and the impact of training on the athlete, and it is used to adjust the training load."

Ahmed (3) emphasizes that "the heart rate after exertion shows an increase in the average among elite athletes, ranging from (180 bpm) to (230 bpm) when athletes are subjected to maximum physical load intensity." In the post-tests conducted for the two groups, the results show no significant differences between them. The researcher attributes these differences to the high-performance levels of the sample. "The heart rate after exertion (load) gives us an idea of the body's recovery state, allowing us to estimate the body's ability to resume exertion. In other words, the heart rate after exertion indicates how well the body can tolerate that effort", as noted by Mamdooh (7). From the results of maximum oxygen consumption in Table (3), it is clear that there are significant differences between the two groups before and after the test. The researcher attributed these differences to the inclusion of training variables. It helps in utilizing different loads and intensities to develop explosive strength, ranging from (75-90%) of the maximum strength that an athlete can exert and heart rate can be used as an indicator of the intensity of the exercise used to develop the desired performance and development of the resulting VO2 max. These distances were repeated with incomplete recovery between repetitions and short breaks between them, therefore, measuring maximum oxygen consumption is considered a comprehensive assessment of the four vital systems during exercise: the respiratory system, the circulatory system, blood, and muscles. Thus, it is relied upon by the physiological laboratory to evaluate training and train athletes." Abu Al-Ala Ahmed (5). Bastouisi Ahmed (8) indicates that "the efficiency of muscular work is related to the presence of a large amount of oxygen in the muscles or its transfer from the lungs to the

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muscles involved in movement through aerobic and anaerobic reactions, and this ratio increases with heart rate as the highest absolute value. Oxygen depletion occurs in young individuals aged 20 to 25 years," and the researcher attributes the improvement in leg muscle strength to the exercises implemented in the experimental program, which have shown their positive impact through the results obtained. As the strength of the players' leg muscles increases, it contributes to enhancing explosive power. The more the athlete can control the movements executed with their legs, the better. It is well known that strength does not develop automatically but through consistent training. This is what Qasim (9) quoted from Hart: "The process of improving explosive strength requires working with varying resistances" (9).

The use of undulating training loads, with methods and directions specifically designed to directly enhance the level of explosive strength, has been effective in facilitating recovery after the accumulation of maximal training loads. Explosive strength refers to "the ability to resist fatigue under a near-maximal to maximal load with high-intensity stimulation, primarily through anaerobic energy production," as stated by Qasim Hassan (10).

Conclusions:

From the results of this research, the researcher reached the following conclusions: The training based on the pulse indicator (120 bpm) was more effective. The methods based on the pulse indicators improved the heart rate level before exertion at complete rest, after 60 seconds, and after 90 seconds. However, the level of improvement in the pulse recovery method (130 bpm) was better than the pulse recovery method (120 bpm). An increase in the VO2 max (maximum oxygen consumption) level was observed after applying the training program, and the improvement was higher in the group that trained according to the pulse indicator (130 bpm).

Recommendations:

The researcher recommends using the exercise methods based on the pulse indicators introduced in the training program for future use in other sports activities. It is essential to conduct physiological tests to calibrate training loads, as they play an active role in the training process. Additionally, further studies and similar research should be conducted on the use of recovery methods across different age groups and for both genders.

Author's declaration:

Conflicts of interest: None

We confirm that all tables and figures in this article are ours and written by the researchers themselves.

Ethical-Clearance: this manuscript approved by local ethical committee of physical education and sport sciences college for women on (August /2024)

Author's contributions:

All contributions of this study were done by the researcher (I.H.) who get the main idea and work on writing and concluding also with number of experts, Khitam Mousa in revision, Ayman Sabah in translating, Haifaa Ahmed in proofreading

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Training Units Model for the Curriculum Used in the Physical Preparation Department.

Exercises	Training Unit Intensity	Volume	Rest Between Exercises	Rest Between Sets
Jumping forward with both legs	%83	10×3	1-2 Minute	2-3 Minute
Alternating jumps with the right and left legs on a 50 cm platform		10×3	1-2 Minute	2-3 Minute
Vertical Jump from a squatting position		10×3	1-2 Minute	2-3 Minute

تأثير تمرينات خاصة على وفق مؤشر النبض في تطوير بعض المؤشرات الوظيفية والقوة الانفجارية للاعبي الكرة الطائر

ايثار حمدي عبد الرحمن
وزارة التربية مديرية تربية الانبار

مستخلص البحث

هدف البحث التعرف على مستوى القدرات البدنية لدى أفراد عينة البحث، وتحديد أفضل فترات راحة على وفق مؤشري النبض (120 ن/د أو 130 ن/د) في تنميتها والمؤشرات الوظيفية وفرض الباحث بان هناك فروق ذات دلالة إحصائية بين الاختبارين القبلي والبعدي واشتملت عينة البحث لاعبي نادي هيت الرياضي بالكرة الطائرة أحد أندية الدوري الممتاز العراقي للموسم (2022- 2023) والبالغ عددهم (16) لاعباً. واستخدم الباحث المنهج التدريبي لملائمته وطبيعة مشكلة البحث واستنتج الباحث بان البرنامج التدريبي المعد كان فعالاً وايجابياً للعمل على وفق مؤشر النبض (120ن/د). وشملت الاستنتاجات ،كان تأثير المستوى وفق مؤشر النبض (120ن/د).وتحسين مستوى النبض قبل الجهد في الراحة التامة، وبعد مرور (60 ثا) وبعد مرور (90 ثا)، ولكن مستوى التحسن في اسلوب عودة النبض (130ن/د) كان افضل من اسلوب عودة النبض (120ن/د).وشملت التوصيات ،العمل على استخدام أسلوب التمارين على وفق مؤشري النبض اللذين استخدمها الباحث في مفردات المنهاج التدريبي الذي يعمل به مستقبلاً في الفعاليات الرياضية الاخرى. وضرورة اجراء اختبارات فسلجيه لتقنين الأحمال التدريبية لما لها من دور فاعل في العملية التدريبية. وهذا ما يحقق احد اهداف التنمية المستدامة للامم المتحدة في العراق (الصحة الجيدة).

الكلمات المفتاحية | **النبض ، المؤشرات الوظيفية ، القوى القصوى ، الكرة الطائرة**