

Eximia journal

www.eximiajournal.ro

Vol. 14/2025

PLUS
COMMUNICATION P



International
Communication & PR

Explosive Power and Its Relationship with Certain Physiological Variables and Technical Performance of Long Serve Accuracy and Defensive Blocking Skills in Volleyball

Ahmed Wihan, Mohammed Rashid Latif, Jamal Mohammed Shuaib

College of Physical Education and Sports Sciences, University of Diyala

ahmed.walhan@uodiyala.edu.iq, mohammed.rashid@uodiyala.edu.iq,
jamal.mohammed@uodiyala.edu.iq

Abstract. The aim of this research was to examine explosive power and its relationship with certain physiological variables and the technical performance of the long serve accuracy and defensive blocking skills in volleyball. It also sought to determine the nature of the relationship between explosive power and these variables. The researchers employed the descriptive method using correlational analysis, as it was deemed appropriate for addressing the research problem. The study sample consisted of (12) players from the volleyball team of the College of Physical Education and Sports Sciences at the University of Diyala. The researchers utilized appropriate tools, instruments, and devices, and conducted a pilot study followed by the main performance tests relevant to the research. After data collection and statistical analysis, the findings were presented, analyzed, and discussed. The researchers reached the following conclusions: The sample demonstrated explosive power levels that were consistent with their physiological status, as measured by resting heart rate and blood lactate concentration. The sample also showed an appropriate level of explosive power in line with the technical performance of the long serve accuracy and defensive blocking skills. Emphasis should be placed on improving explosive power in both upper and lower limb muscles, as this contributes to enhancing both physical and physiological readiness, as well as skill performance in volleyball. Recommendations: The development of explosive power in the arm and leg muscles should be prioritized to align with the demands of technical performance in volleyball. The tests used in this study should be incorporated into training programs. Further similar studies should be conducted on different samples to expand the scope of research in this area.

Keywords. explosive power, physiological variables, long serve accuracy, defensive blocking, volleyball

1. Introduction:

Volleyball is considered one of the fast-paced team sports that require players to possess a high level of physical, technical, and physiological abilities to achieve optimal performance, especially in offensive situations which are key to superiority in matches. The explosive power of the arm and leg muscles is among the most important physical abilities affecting performance, as it directly contributes to executing offensive skills such as long serve accuracy and offensive blocking.

Moreover, the technical performance of these skills is largely linked to some physiological variables that reflect the efficiency of the player's vital systems, such as resting heart rate, which is an indicator of the cardiovascular system's efficiency and general endurance level, and blood lactate concentration, which represents the degree of muscular fatigue accumulation and the body's ability to eliminate metabolic by-products during physical effort. These variables, alongside physical abilities, are considered the physiological foundation that determines a player's ability to perform efficiently under competitive pressure.

The significance of the research lies in linking physical abilities (explosive power) and physiological variables (resting heart rate and blood lactate concentration) with technical performance (offensive and defensive skills). This research aims to shed light on the integrative relationship between these variables and their reflection on the level of offensive performance in volleyball. It also contributes to building a knowledge base that coaches and researchers can rely on in developing specialized training programs in the sport of volleyball.

1.2 Research Problem:

Although explosive strength of the arm and leg muscles is one of the most important physical abilities for volleyball players, there is a scarcity of studies addressing its direct relationship with some physiological variables and its reflection on the technical performance of both offensive and defensive skills.

Based on researchers' observations, many players possess a good physical level, yet they do not achieve the same level of effectiveness in offensive performance. This suggests the presence of other overlapping factors, possibly physical and physiological, that may affect the technical performance level. Therefore, the researchers decided to study this problem by identifying the relationship between the explosive strength of the arm and leg muscles and some physiological variables and the technical performance of long serve accuracy and defensive blocking in volleyball, aiming to raise the physical, physiological, and technical levels and achieve the best results.

1.3 Research Objectives:

1. To identify the explosive strength of the arm and leg muscles, as well as some physiological variables and the technical performance of the long serve accuracy and defensive blocking in volleyball.
2. To find the relationship between explosive strength, physiological variables, and the technical performance of long serve accuracy and defensive blocking in volleyball.

1.4 Research Hypothesis:

1. There is a significant correlation between the results of the explosive strength tests for the arm and leg muscles and some physiological variables and the technical performance of long serve accuracy and defensive blocking in volleyball among the research sample.

1.5 Research Fields:

1.5.1 Human Field:

Players of the volleyball team at the College of Physical Education and Sports Sciences – University of Diyala, totaling (12) players.

1.5.2 Time Field:

From 1/3/2024 to 15/4/2024.

1.5.3 Place Field:

Volleyball court at the College of Physical Education and Sports Sciences – University of Diyala.

2. Research Methodology and Field Procedures:

2.1 Research Method:

The researchers used the descriptive method in the correlational approach because it focuses on identifying the relationship between two or more variables and expressing them numerically, which aligns with the nature of this study. (Sami Mohammed, 2000: 348)

2.2 Research Sample:

“The selection of a sample from the population under study poses a challenge to the researcher who aims to ensure the sample is adequate and representative of the population's characteristics.” (Al-Kubaisi & Al-Janabi, 1987: 68), Therefore, the researchers selected an intentional sample of 12 players from the volleyball team at the College of Physical Education and Sports Sciences – University of Diyala, out of a total of 16 players. "This type of sampling is used in exploratory and survey-based studies in particular" (Yassin & Abd, 1999: 22). Thus, the sample represents 75% of the research population.

2.3 Tools, Instruments, and Equipment Used in the Research:

2.3.1 Means of Data Collection:

(Arabic and foreign sources and references, Tests and measurements, Personal interviews, Supporting work team).

2.3.2 Tools and Devices Used in the Research

(Volleyball court, Two electronic stopwatches, Medical scale to measure weight and height, Markers and chalk, Whistle, Measuring tape (40 m) with 5 cm wide adhesive tape, Heart rate monitor (Rossmax), Blood lactate concentration device (Lactate Pro TM2, Model LT-1730, Japan), Medical cotton and disinfectants, Lactate level test kits, Medical syringe for blood sampling, Cooling container, EDTA-free blood storage tubes, Compression band for the upper arm).

2.4 Identifying Research Variables and Tests:

2.4.1 Physiological Variables:

After reviewing several scientific references and conducting personal interviews, the researchers determined the following physiological variables based on their expertise in sports training physiology (Resting heart rate, Blood lactate concentration).

2.4.2 Explosive Strength and Skill Tests:

Following a survey of several scientific references and expert interviews, the researchers identified the following tests to measure explosive strength and technical skills in volleyball (Explosive strength of arm and leg muscles, Long serve accuracy, Defensive block performance

2.5 Tests Used in the Research:

2.5.1 Medicine Ball Throw Test (2 kg) – From seated position, over the head: (Al-Zubaidi:1999:64):

Purpose: Measure explosive strength of the arms and shoulders

Tools: 2 kg medicine ball, measuring tape, chair, torso strap, evaluator

Performance: The player sits, holds the ball overhead, and throws it using only the arms (torso restrained). Three attempts – best one is recorded.

Scoring: Distance from front edge of the chair to where the ball first lands

2.5.2 Vertical Jump Test (Sargent Test) (Hassanin & Hamdi: 1997: 56):

Purpose: Measure leg explosive strength

Tools: Wall or board with height markings (150–400 cm), chalk

Performance: Player marks maximum reach standing, then jumps and marks again – three attempts, best is recorded

Scoring: Distance between standing reach and jump reach

2.5.3 Resting Heart Rate Test

Tool: Rossmax device

Purpose: Assess physiological adaptation

Procedure: Device strapped to left forearm, arm raised to heart level, pulse is measured at rest

2.5.4 Blood Lactate Concentration Test:

Using Lactate ProTM2 after one set of a volleyball match A blood drop from the fingertip is used to determine lactate concentration Measurement taken 5 minutes post-activity by the assisting medical team.

2.5.5 Long Serve Accuracy Test (Sobhi & Abdel Moneim, 1997: 209–210):

Purpose: To assess the accuracy of long serves in volleyball.

Tool: Volleyball court, Volleyballs, Court marked as illustrated in Figure (1)

Procedure: The player stands in the designated serving area and performs serves toward the opposite half of the court. The subject performs:

10 serves directed to zone (A)

10 serves directed to zone (B)

10 serves directed to zone (C)

Scoring:

4 points for each successful serve landing inside the designated square.

2 points for each successful serve landing in an adjacent square.

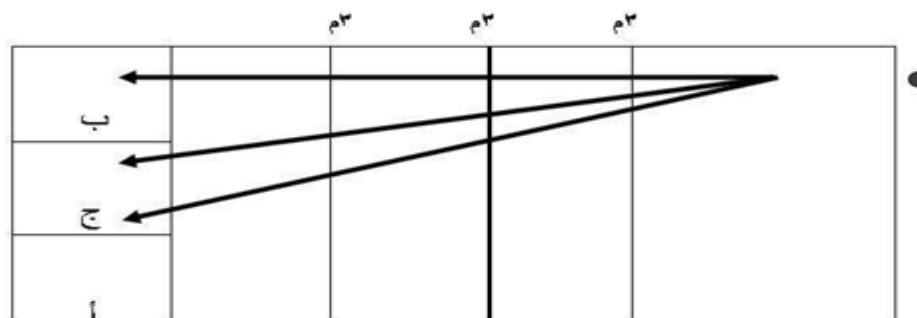


Figure (1)

illustrates the test procedure

2.5.6 Block Skill Test(Sobhi & Abdel Moneim, 1997: 251–252):

Purpose: To assess the player's ability to perform the blocking skill repeatedly at the same rate from different positions along the net.

Tools: Volleyball court, two benches, two volleyballs, stopwatch, official-height volleyball net.

Procedure: Two benches are placed in zones (4) and (2), each 50 cm away from the net. Two assistants stand on the benches, each holding a volleyball with both hands so that the ball is positioned 20 cm above the net level. The tested player stands in zone (3) inside the 3-meter line, facing the net. At the starting signal from the coach, with the stopwatch running, the player moves to one ball, jumps, and performs a blocking action by touching the ball with both hands. After landing, the player immediately moves to the other ball and repeats the block, then returns to the first ball, continuing this sequence for 15 seconds.

Scoring: The score is the total number of successful ball touches performed within 15 seconds.

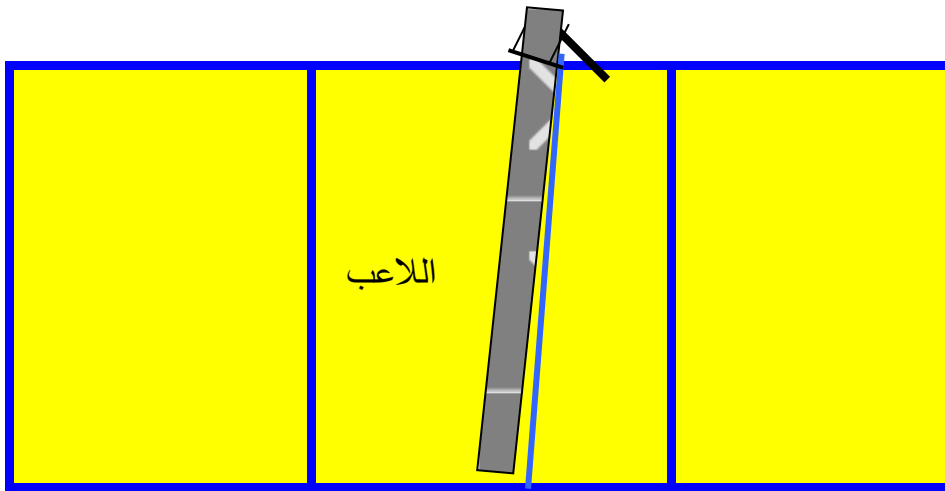


Figure (2)
illustrates the Block Repetition Test

2.6 Pilot Study:

Conducted on Thursday, 3/3/2024, on (3) randomly selected players from the research population, Detect and avoid potential implementation issues (Source: Al-Mandalawi, 1987: 107), The purpose of the pilot study was to:

- Ensure the validity of the chosen sample and tests.
- Assess test compatibility with player capabilities.
- Estimate the time required for testing.
- Train the research team and identify data recording procedures.

2.7 Field Procedures:

The main experiment was conducted from 1/3/2024 to 15/4/2024. It involved:

- Testing arm explosive strength (medicine ball throw).
- Testing leg explosive strength (Sargent jump).
- Measuring physiological variables (resting heart rate and blood lactate).
- Evaluating skill performance (long serve accuracy and block skill).
- Data was collected and statistically analyzed to achieve the research objectives.

2.8 Statistical Tools:

- Arithmetic Mean.
- Standard Deviation.
- Pearson Correlation Coefficient. (Source: Al-Kanani, 2009: 39, 49, 78)

3. Presentation, Analysis, and Discussion of Results:

3.1 Presentation and Analysis of Results for Explosive Strength Tests (arms and legs), Physiological Variables, and Technical Performance in Long Serve Accuracy and Defensive Blocking in Volleyball:

Table (1)

shows the values of the arithmetic means, standard deviations, calculated and tabulated Pearson correlation coefficient (r), and significance of differences for the tests measuring arm and some functional variables and the technical performance of the skills of long serve accuracy and defensive block in volleyball for the individuals of the research sample.

The Tests	Measurement Unit	- s	P	Values Correlation coefficient		Significance of Differences
				Calculated	Tabulated	
Test of Resting Heart Rate	BPM	64.666	0.656	0.823	0.57	Significant
Test of Blood Lactic Acid Concentration	mmol/L	11.929	0.789	0.795		Significant
Test of Long Serve Accuracy	Score	72	10.334	0.902		Significant
Test of Defensive Blocking Skill	Number of Trials	5.25	0.698	0.923		Significant
Test of Explosive Strength of the Arms	M	6.858	1.238			

At a significance level of (0.05) and a degree of freedom (10)

Based on Table (1), which presents the arithmetic means, standard deviations, calculated and tabulated Pearson correlation coefficient values (r), and the significance of differences for the tests of explosive strength of the arm muscles, certain physiological variables, and the technical performance of the long serve accuracy and defensive block skills in volleyball:

For the resting heart rate test, the arithmetic mean was (64.666) with a standard deviation of (0.656), For the explosive strength of the arms test, the arithmetic mean was (6.858) with a standard deviation of (1.238), The calculated correlation coefficient (r) was (0.823), which is greater than the tabulated value of (0.57) at a significance level of (0.05) and (10) degrees of freedom. This indicates a statistically significant relationship between resting heart rate and the explosive strength of the arms.

Regarding the blood lactate concentration test:

The arithmetic mean was (11.929) with a standard deviation of (0.789), The calculated (r) value was (0.795), which also exceeds the tabulated value of (0.57) under the same significance level and degrees of freedom, indicating a statistically significant correlation between blood lactate concentration and explosive arm strength.

As for the long serve accuracy test:

The arithmetic mean was (72), with a standard deviation of (10.334), The calculated (r) value was (0.902), again greater than the tabulated value of (0.57), signifying a significant correlation between long serve accuracy and explosive arm strength.

In the defensive block skill test:

The arithmetic mean was (5.25) with a standard deviation of (0.698), The calculated (r) value was (0.923), which is higher than the tabulated value of (0.57), confirming a significant correlation between defensive block performance and the explosive strength of the arms.

Table (2)

presents the arithmetic means, standard deviations, calculated and tabulated values of Pearson's correlation coefficient (r), and the significance of differences for the tests of explosive strength of the leg muscles, physiological variables, and technical performance of long serve accuracy and defensive blocking in volleyball for the research sample.

The Tests	Measurement Unit	- s	P	Values Correlation coefficient		Significance of Differences
				Calculated	Tabulated	
Test of Resting Heart Rate	BPM	64.666	0.656	0.823	0.57	Significant
Test of Blood Lactic Acid Concentration	mmol/L	11.929	0.789	0.795		Significant
Test of Long Serve Accuracy	Score	72	10.334	0.902		Significant
Test of Defensive Blocking Skill	Number of Trials	5.25	0.698	0.923		Significant
Test of Explosive Strength of the Legs	M	33.25	1.743			

At a significance level of (0.05) and a degree of freedom (10

Based on Table (2), which shows the arithmetic means, standard deviations, calculated and tabulated values of the Pearson correlation coefficient (r), and the significance of differences for the explosive strength tests of the leg muscles, some physiological variables, and technical performance in the skills of long serve accuracy and defensive blocking in volleyball:

For the resting heart rate test, the arithmetic mean was (64.666), with a standard deviation of (0.656), while the arithmetic mean for the explosive strength of the legs was (33.25), with a standard deviation of (1.743), The calculated (r) value was (0.811), which is greater than the tabulated value of (0.57) at a significance level of 0.05 and 10 degrees of

freedom, indicating a statistically significant correlation between resting heart rate and leg explosive strength.

In the blood lactate concentration test, the mean was (11.929), with a standard deviation of (0.789), The calculated (r) value was (0.843), exceeding the tabulated value of (0.57), thus confirming a significant correlation between lactate concentration and leg explosive strength.

For the long serve accuracy test, the mean was (72), with a standard deviation of (10.334), and the calculated (r) value was (0.928), higher than the tabulated value, showing a significant correlation between long serve accuracy and leg explosive strength.

In the defensive block skill test, the mean was (5.25), with a standard deviation of (0.698), and the calculated (r) value was 0.963, again greater than the tabulated value, indicating a statistically significant correlation between defensive block performance and leg explosive strength.

4-2 Discussion of the Correlation Results Between Explosive Strength Tests (Arm and Leg Muscles), Physiological Variables, and Technical Performance in Volleyball Skills:

In light of the results shown in Tables (1 and 2), it was found that there is a statistically significant correlation between the explosive strength of both arm and leg muscles, certain physiological variables, and the technical performance of the skills of long serve accuracy and defensive blocking in volleyball, The researchers attribute this significant correlation to the fact that explosive strength is one of the key determinants of an athlete's ability to produce fast and focused force in a short time, which is exactly what both long serve and defensive block skills require. The long serve demands speed in arm motion along with forward propulsive force, while the defensive block requires quick vertical take-off and upward thrust using leg strength. This aligns with Bompa (2015: 288) who stated that " Training for explosive strength enhances the efficiency of energy systems and increases the ability to perform technical skills related to speed and accuracy."

Moreover, the results also indicate a significant relationship between explosive strength and physiological variables. The researchers attribute this to noticeable improvements in physiological markers such as lower resting heart rate among athletes with higher levels of explosive strength, which reflects better cardiovascular and respiratory efficiency, contributing to faster recovery after intense effort. Additionally, lower blood lactate levels observed in athletes indicate a better ability to clear metabolic byproducts, enhancing the effectiveness of both the aerobic and anaerobic energy systems.

This is consistent with Harrison et al. (2019: 1499) who emphasized that " A low resting heart rate is a direct indicator of positive cardiovascular adaptations resulting from regular training "

Furthermore, Mohammad Ridha (2009: 470), citing Fox et al. (1989), stated " During training, there is an accumulation of lactic acid in the blood, which affects the athlete's ability and leads to fatigue. Before this acid returns to its equilibrium level at rest, the body must eliminate it before the next effort is performed."

4 – Conclusion:

Based on the above, the following conclusions were drawn:

1. The sample demonstrated explosive power levels that were consistent with their physiological status, as measured by resting heart rate and blood lactate concentration.
2. The sample also showed an appropriate level of explosive power in line with the technical performance of the long serve accuracy and defensive blocking skills.

3. Emphasis should be placed on improving explosive power in both upper and lower limb muscles, as this contributes to enhancing both physical and physiological readiness, as well as skill performance in volleyball.

Recommendations

Based on the conclusions, the researchers recommend the following:

1. The development of explosive power in the arm and leg muscles should be prioritized to align with the demands of technical performance in volleyball
2. The tests used in this study should be incorporated into training programs.
3. Further similar studies should be conducted on different samples to expand the scope of research in this area

Arabic References:

- Sami Mohammed Muslim; *Research Methods in Education and Psychology*, 1st Ed. (Amman: Dar Al-Masira for Publishing & Distribution, 2000).
- Aayed Kareem Al-Kinani; *Introduction to Statistics and SPSS Applications*, (Iraq: Dar Al-Dhia for Printing & Design, 2009).
- Abdul-Razzaq Kadhim Ali Al-Zubaidi; *The Effect of a Proposed Muscle Strength Training Program on Performance of Floor Exercises* (Unpublished Ph.D. Dissertation, College of Physical Education, University of Baghdad, 1999).
- Mohammed Ridha Ibrahim; *Field Application of Theories and Methods of Sports Training*, 2nd Ed. (Baghdad: University Printing & Publishing, 2009).
- Mohammed Sobhi Hassanein & Hamdi Abdel-Moneim; *Scientific Foundations of Volleyball and Measurement Methods*, 1st Ed. (Cairo: Book Center for Publishing, 1997).
- Wadee Yassin & Hassan Mohammed Abd; *Statistical Applications and Computer Use in Sports Education Research* (University of Mosul: Dar Al-Kutub for Printing and Publishing, 1999).
- Waheeb Majeed Al-Kubaisi & Younis Saleh Al-Janabi; *Samples and Their Use in Educational and Psychological Research*, *Generations Studies*, Issue 2, 1987.

Foreign References

- Tudor O. Bompa & Carlo Buzzichelli. *Periodization Training for Sports* (3rd ed.). Champaign, Illinois, USA — Human Kinetics. 2015.
- Harrison, C., Gill, N., Kinugasa, T., & Kilding, A. (2019). Physiological and performance adaptations to high-intensity interval training in team sports: a review. *Sports Medicine*.