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The Relationship Between Leg Muscle Endurance And Explosive Power With Jumping Ability In Volleyball Players

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ABSTRACT

Optimal performance in volleyball is strongly influenced by players' physical condition, particularly the muscular endurance and explosive power of the leg muscles, which directly support vertical jumping ability. This study aims to examine the relationship between these two physical components and the jumping height of volleyball extracurricular players at SMAN 1 Blega Bangkalan. A correlational survey method was employed with total sampling technique, involving all 27 extracurricular members as subjects. Muscular endurance was measured using the hurdle jump test, while explosive power and jumping ability were assessed through the vertical jump test. Data analysis included the Shapiro-Wilk normality test, Levene homogeneity test,and Pearson correlation.Normality test results indicated that both variables were normally distributed (p>0.05),,and data variance was confirmed homogeneous (p=0.247).The correlation test yielded a Pearson Correlation value of 0.611 with a significance of 0.001 < 0.05, indicating a significant moderate-to-strong relationship between leg muscle endurance and explosive power toward jumping ability. It is concluded that simultaneous improvement of both physical components contributes substantially to the optimization of players' vertical jump performance during actual match conditions.

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A. Conception and design of the study;
B. Acquisition of data;
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INTRODUCTION

Volleyball is a non-contact team sport characterized by its dynamic gameplay. The mechanics of the game are relatively accessible, requiring players to rally the ball within their team and direct it ove the net into the opponent's court. Due to its straightforward regulations and engaging nature, volleybll has garnered a vast following across all levels of Indonesian society.According to Siregar et al. (2021), volleyball is an inclusive sport suitable for all age groups-from children to adults-and can be played by both men and women. Fundamentally,volleyball involves rebounding the ball in the air over a net, aiming to ground it within the opponent's boundaries to secure a victory (Pradana, as cited in Fikri et al., 2024). It is a team-based game where players use their hands or bodies to strike the ball over the

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net while simultaneously preventing it from touching the floor on their own side (Pradana & Bacthiar, as cited in Saputra & Aziz,2020). Pribadi (2023) emphasizes that mastering fundamental techniques is essential for effective play,including the overhand service, underhand service, upper passing, lower passing, blocking,and smashing. Proficiency in these core techniques is critical when facing competitive matches (Krensnapati, as cited in Atsani, 2020). Comprehensive mastery of these skills can be achieved through consistent practice and targeted training methodologies. One of the primary physical components supporting performance in volleyball is endurance.

Endurance refers to the body's capacity to perform tasks over an extended duration without experiencing excessive fatigue, while maintaining energy reserves for daily activities (Is & Hariansyah, 2020). Additionally, explosive power is a vital component in various sports disciplines as it directly influences individual and team performance outcomes (Rahmawati et al., as cited in Oktariana & Hardiyono, 2020). Explosive power, or power, is essential in nearly all sports as it integrates both strength and speed (Abady, 2019). In volleyball, this is exemplified through movements such as jumping, sprinting, or the take-off phase of a jump.Jumping ability is defined as a person's physical capacity to lift their body weight rapidly and in a coordinated manner using leg muscle strength. This ability is indispensable in volleyball for executing techniques like smashing, blocking, and serving. A smash is a powerful strike intended to kill the ball in the opponent's area; it is highly advantageous for players possessing a high reach, vertical leap, and striking precision (Wilastra & Antoni, 2021). Superior jumping ability allows players to reach the ball at an optimal height for both offensive and defensive maneuvers. Since jumping is a fundamental movement in most sports, it is particularly vital in volleyball for executing effective smashes (Anggara & Yudi,2019).

Based on this background, the research questions for this study are: (1) Is there a correlation between leg muscle endurance and vertical jumping ability among extracurricular players at SMAN 1 Blega; and (2) What is the relationship between the hurdle jump and vertical jump ability,and which component is more effective in determining performance? This study aims to determine the relationship between leg muscle endurance and jumping ability, as well as to analyze the correlation between leg muscle explosive power and the jumping performance of extracurricular volleyball players at SMAN 1 Blega. Theoretically,this research provides additional insights into the correlation between endurance, explosive power, and jumping capacity in sports science. Practically, the results serve as a foundation for coaches to develop efficient training programs, an evaluation tool for athletes to improve their individual training quality, a suggestion for institutions to enhance their volleyball programs, and a methodological reference for future studies on physical conditioning and athletic achievement.

METHODS

Research Design

The approach applied in this study is a survey method with a correlational design, as the data collection process was conducted through a series of direct tests and

physical measurements of the subjects. This research design is structured to analyze the relationship between two independent variables leg muscle endurance(X_1)and leg muscle explosive power (X2) and the dependent variable, which is the jumping ability of volleyball players (Y). Specifically, this study aims to identify the presence or absence of a correation between leg muscle endurance and explosive power toward jumping ability, encompassing three forms of correlation: the correlation between leg muscle endurance and jumping capacity (rx1.Y), the correlation between explosive power and jumping capacity (rx2.Y), and the simultaneous multiple correlation of both endurance and explosive power toward jumping ability RY(x1.x2).

Variables and Operational Definitions

As previously stated, research variables are constructs with diverse values that serve as the primary focus of scientific investigation. The independent variables in this study include leg muscle endurance and leg muscle explosive power, both of which play a crucial role in influencing a player's jump performance. The dependent variable is the jumping ability of volleyball players, which is directly affected by these two physical condition components.

Population and Research Sample

The population is the entire generalization area consisting of subjects or objects with specific qualities and characteristics selected by the researcher for study and conclusion (Mardhiyah et al., 2025). The population in this study comprises all students participating in the volleyball extracurricular activities at SMAN 1 Blega Bangkalan, who possess heterogeneous physical ability levels. A sample is a portion of the population taken through specific procedures to ensure accurate data and valid conclusions (Dewi et al., 2025). Based on these considerations and the relatively small size of the volleyball extracurricular group at SMAN 1 Blega Bangkalan, the entire membership was designated as the research sample.Consequently,the sampling technique used is total sampling (saturated sampling), where all members of the population are included as samples.

Research Instruments

Researchers utilize research instruments to collect data systematically and objectively to produce valid and reliable results. A research instrument is a tool used to gather data or measure subjects regarding a research variable (Muslihin et al., 2022). In this study, the instruments consist of a series of physical tests tailored to the characteristics of the variables studed,including tests for leg muscle endurance, leg muscle explosive power, and jumping ability.

Leg Muscle Endurance Test: Conducted using the Wall Sit method, where participants stand with their backs against a wall, bend their knees at a 90-degree angle, and maintain that position for as long as possible without hand assistance. The duration maintained (in seconds) serves as the indicator of endurance; a longer duration reflects a higher endurance capacity. Additionally, the Hurdle Jump instrument is used, requiring participants to perform lateral jumps repeatedly over obstacles 30-60 cm high for one minute. Leg Muscle Explosive Power and Jumping Ability Test: Measured using the Vertical Jump Test. Participants stand upright next to a measuring board and perform a

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maximum vertical leap. The difference between the standing reach height and the jumping height (in centimeters) reflects the leg muscle's explosive power. The vertical jump was selected because it quantifies the combination of strength and muscle contraction speed in producing explosive movements. The test is performed twvice,with the highest value recorded as the final score.

Table 1.
Vertical Jump Assessment Norms

No	Category	Standard Value
1	Excellent	73 cm and above
2	Good	60-72cm
3	Average	50-59cm
4	Poor	39-49cm
5	Very Poor	38 cm and below

Source: Nugroho & Yuliandra (as cited in Iskandar,2024)

Furthermore based on Arifah & Dinata (2014), the evaluation of the Standing Long Jump was also conducted through a squat-style long jump test designed to measure three domains simultaneously: cognitive, affective, and psychomotor, using systematic and measurable procedures.

Data Collection Techniques

Data collection was carried out instages. First,jumping ability was measured via the vertical jump by calculating the difference between standing reach and maximum jump height. Second,leg muscle explosive power was similarly measured using the vertical jump, as this instrument accurately captures explosive muscle capacity. Height was calculated based on the difference between sitting reach and jumping reach (Masrur, 2025). Third, leg muscle endurance was measured using the Hurdle Jump, where participants jumped over 30-60 cm obstacles repeatedly within a one-minute duration.

Data Analysis Techniques

Data analysis focused on examining data structure, identifying relationship patterns between variables, and interpreting statistical meanings comprehensively. Before hypothesis testing,prerequisite tests were performed:

Normality Test: Aimed to verify if the data distribution follows a normal pattern using the Kolmogorov-Smirnov method via SPSS. The criteria: if p-valuu>005,,the data is normally distributed. Homogeneity Test: Conducted using the Levene Test to ensure equal variance among sample groups (p-valuln>005)

The primary hypothesis was tested using Multiple Linear Regression, as the study in volves two independent variables and one dependent variable. This analysis determines the simultaneous influence of leg muscle endurance(X_1)and explosive power(X_2)on ju mping ability (Y).The regression model is as follows:

$$Y = a + b_1X_1 + b_2X_2$$

Where:Y=Jumping Ability;X_1 = LegMuscle Endurance;X_2 = LegMuscle Explosive Power;a=Constantb_1,b2=Regression Coefficients.

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RESULTS AND DISCUSSION

Result

This study was conducted on February 11,2026, involving 27 extracurricular volleyball players from SMAN 1 Blega as the research subjects. Measurements were carried out on two main variables, namely leg muscle endurance using the hurdle jump test and leg muscle explosive power using the vertical jump test. The measurement results of both variables are presented in full in Table 2 below.

Table 2.
Measurement results

No	Name	Hurdle Jump
1	FR	54
2	IM	45
3	MJ	46
4	NS	50
5	MA	42
6	LDS	43
7	MFH	47
8	FRP	39
9	NA	50
10	F	60
11	LI	57
12	DA	42
13	AS	46
14	MF	27
15	AJ	41
16	GAW	59
17	AWA	63
18	MJ	49
19	SAQ	58
20	MZ	45
21	KR	43
22	R	43
23	MTA	49
24	M	47
25	BA	36
26	MU	39
27	AM	37

Table 2. Research Data on Leg Muscle Endurance (Hurdle Jump) and Leg Muscle Explosive Power (Vertical Jump) of Extracurricular Volleyball Players at SMAN 1 Blega.

Descriptive Statistics

A summary of the descriptive statistical analysis results for both research variables is presented in Table 3 below.

Table 3.
Descriptive Statistics of Leg Muscle Endurance and Leg Muscle Explosive Power on Jumping Results

Variable	N	Minimum	Maksimum	Mean	Std.Deviation
Leg Muscle Endurance	27	27	63	46.56	8.210
Leg Muscle Explosive Power	27	228	284	251.44	14.108

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Table 3 shows that among the 27 players who participated as research subjects, leg muscle endurance had a minimum score of 27, a maximum score of 63, a mean score of 46.56,and a standard deviation of 8.210. Meanwhile,leg muscle explosive power showed a minimum score of 228 cm, a maximum score of 284 cm, a mean score of 251.44 cm,and a standard deviation of 14.108. The variation in standard deviation values for both variables indicates significant differences in physical abilities among the players. Therefore, differentiated training programs are needed to equalize the physical condition of all team members.

Normality Test

The normality test was conducted to ensure that the data distribution approximated a normal distribution pattern. Muslimah et al. This study used the Shapiro-Wilk test through IBM SPSS Statistics. The results of the normality test are presented in Table 4 below

Table 4.
Results of the Shapiro-Wilk Normality Test

Variabel	Test Type	Statistik	df	Sig.
Leg Muscle Endurance	Hurdle Jump	0,971	27	0.626
Leg Muscle Explosive Power	Vertical Jump	0,974	27	0.700

Table 4 shows that the significance value of leg muscle endurance (hurdle jump) was 0.626>0.05, and the significance value of leg muscle explosive power (vertical jump) was 0.700 >0.05. Both variables were normally distributed, indicating that they met the requirements for further statistical analysis.

Homogeneity Test

Homogeneity indicates that the variability of learning outcomes between two groups is not significantly different, so the comparison of results can be fair and valid. Fitriani & Nurwahidah The hypothesis states that if the significancevalue(Sg)>005,the variance between groups is considered homogeneous; conversely, if Sig.<0.05, the data are considered non-homogeneous. Al Fatih et al.

Table 5.
Results of the Homogeneity Test of Leg Muscle Endurance and Leg Muscle Explosive Power on Jumping Results

Variable	Test Basis	Levene Statistic	df1	df2	*Sig.*
Leg Muscle Endurance-Leg Muscle Explosive Power	Based on Mean	1.644	3	9	0.247
	Based on Median	1.412	3	9	0.302
	Based on Median and with a djusted df	1.412	3	6,767	0.320
	Based on trimmed mean	1.629	3	9	0.251

Table 5 shows that the significance value based on mean was0.247>0.0.This indicates that the variables of leg muscle endurance and leg muscle explosive power on jumping results had equal or homogeneous variances. Therefore, all prerequisite assumptions for correlation analysis were fully satisfied.

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Correlation Test

The correlation test was conducted to determine whether there was a relationship between leg muscle endurance and leg muscle explosive power on jumping results at a significance level of 0.05.If the significance valx>0.05,there is no relationship between the variables;conversely,if the significance value <0.05,there is a significant relationship between the variables.The results of the correlation test are presented in Table 6 below.

Table 6.
Results of the Correlation Test of Leg Muscle Endurance and Leg Muscle Explosive Power on Jumping Results

Variable		Leg Muscle Endurance	Leg Muscle Explosive Power
Leg Muscle Endurance	Pearson Correlation	1	0,611***
	Sig. (2-tailed)		< 0,001
	N	27	27
Leg Muscle Explosive Power	Pearson Correlation	0,611***	1
	Sig. (2-tailed)	<0,001	
	N	27	27

Table 6. shows that the significance value of the correlation between leg muscle endurance and leg muscle explosive power on jumping results was 0.0011<0.05,with a Pearson Correlation value of 0.611. This indicates that there was a significant relationship in the moderate-to-strong correlation category between endurance (hurdle jump) and explosive power (vertical jump)among the extracurricular volleyball players of SMAN 1 Blega.

Discussion

The results of the study showed a significant relationship between nutritional status and physical fitness levels of students at As-Syafa'ah Elementary School. The correlation coefficient of 0.869indicates a very strong relationship between the two variables. Therefore,the better a student's nutritional status, the higher their physical fitness level. Optimal nutritional status positively impacts students' physical abilities. Students who receive adequate nutritional intake tend to have sufficient energy to carry out various activities, both in the learning process and in sports. Conversely, students with poor nutritional status generally have lower endurance and fatigue more easily. This study's findings align with those of Hidayat et al.(2024),which stated that nutritional status contributes 82.81% to physical fitness. Research by Ridho et al. also showed a significant relationship between nutritional status and physical fitness, with a moderate correlation. In this study, the majority of students were in the normal nutritional status category with moderate to good physical fitness levels. This indicates that students with normal nutritional status tend to demonstrate better physical abilities than students with undernutrition or obesity.Nutritional status is influenced by various factors, including dietary patterns, physical activity,family environment, and parental understanding of nutrition. Elementary school-aged children require a balanced nutritional intake that

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includes carbohydrates, protein, fat, vitamins,minerals, and water to support growth and daily physical activity. Furthermore, physical activity plays a crucial role in improving physical fitness. Students who exercise regularly generally have better endurance, muscle strength, and lung capacity.Therefore, schools need to focus on sports development and education about the importance of nutrition for students. This study also found that there are still students who are underweight or obese. This condition requires special attention because it can impact students' health and physical abilities.Therefore,nutrition education programs, healthy lifestyle habits, and regular sports activities need to be implemented continuously. In general, the research results demonstrate that nutritional status plays a crucial role in supporting the physical fitness of elementary school students. Fulfilling good nutritional needs will help students grow and develop optimally and have a healthy and fit physical condition.

The Relationship between Leg Muscle Explosive Power and Jumping Ability

The variable of leg muscle explosive power in this study was measured using the vertical jump test, and the results showed a significant relationship with the jumping ability of the extracurricular volleyball players of SMAN 1 Blega. The Pearson correlation value obtained was 0.611 with a significance level of<0.001, confirming that leg muscle explosive power had a strong and statistically significant relationship with the players' jumping ability. Therefore,this variable cannot be overlooked in designing volleyball physical training programs.Explosive power is a combination of muscle strength and speed in producing explosive movements. Muscle explosive power is the capacity of the neuromuscular system to generate maximum force within the shorest possible time. In addition, explosive power is defined as the ability of muscles to overcome resistance with a high contraction speed. Both perspectives emphasize that a volleyball player's jumping ability is largely determined by how much explosive force can be generated by the leg muscles within a very short time during upward propulsion.

The research data showed that the average vertical jump score of the players was 251.44 cm with a standard deviation of 14.108. The maximum score achieved was 284 cm, while the minimum score was 228 cm. This score range of 56 cm demonstrates that the explosive power potential of the players' leg muscles varied considerably, which was directly reflected in each individual's jumping ability. Players with higher vertical jump scores possessed greater competitive advantages in performing volleyball techniques that rely on jump height. Jumping ability, as a primary indicator of leg muscle explosive power quality, occurs because this movement requires coordination between strength,speed,and technique simultaneously.Arifah Pitri et al., in the study entitled "The Effect of Burpees Training on Leg Muscle Explosive Power and Arm Muscle Endurance of Volleyball Players at SMAN 1 Gunung Tuleh, West Pasaman Regency", is closely related to the present study. Measurements were conducted through pre-tests and post-tests using the vertical jump test to determine the jumping ability of volleyball players. The results showed that improvements in endurance and leg muscle explosive power influenced the players' jumping ability. This condition implies that training programs designed in an integrated manner to simultaneously develop both physical components

will provide more optimal effects on improving the jumping ability of extracurricular volleyball players at SMAN 1 Blega in the future.

CONCLUSION

Based on the results of the data analysis, it was found that there was a significant relationship between leg muscle endurance capacity and explosive power on jumping performance among the extracurricular volleyball athletes of SMAN 1 Blega. The Pearson correlation value of 0.611.

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