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Reaction Speed and Blocking Ability in Volleyball Extracurricular Participants at High School

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ABSTRACT

Blocking ability is one of the technical skills that greatly determines a team's success in volleyball. Blocking effectiveness is influenced by various physical components, including lower leg explosiveness and reaction speed. However, empirical studies examining the relationship between these two physical variables in high school volleyball extracurricular participants are still limited. Therefore, this study aims to analyze the relationship between lower leg explosiveness and reaction speed with blocking ability. This study used a quantitative correlational design with a population of 20 volleyball extracurricular participants at High School 8 Bulukumba using a total sampling technique. Lower leg explosiveness was measured using a vertical jump test, reaction speed using a visual reaction test, and blocking ability using a volleyball blocking skills test. Data was analyzed using Pearson Product Moment correlation. The results showed a positive and significant relationship between lower leg explosiveness and reaction speed with blocking ability. The correlation coefficient (r) value of 0.770 indicates a strong relationship, with the simultaneous contribution of both variables amounting to 59.3% of the variation in blocking ability. Leg explosiveness has been shown to play a crucial role in producing an optimal vertical jump, while reaction speed determines the accuracy of timing and hand position when facing an attack. This study concludes that the synergy between explosive and responsive physical components is the primary foundation for technical success in modern volleyball dynamics at the high school level. Increasing explosive power and reaction speed is essential for optimizing blocking performance in high school volleyball extracurricular programs.

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1. INTRODUCTION

Blocking ability is a fundamental technical skill that determines the quality of defense in modern volleyball (Benelguemar et al., 2020; Deda, 2024). The success of this action depends heavily on the synergy between the explosive strength of the lower leg muscles and the athlete's reaction speed. Biomechanical and neuromuscular studies show that players with high leg explosiveness can reach their highest jump point more

quickly and maintain body stability while in the air (Du et al., 2025). This integration of physical strength and reactive response is a defining characteristic of blocking effectiveness, from youth to elite athletes (Ramirez-Campillo et al., 2023).

Specifically, lower leg explosive strength reflects the muscle's ability to generate maximum force in a short period of time, which directly correlates with vertical jump performance (Hanas et al., 2024). Athletes who excel in this aspect tend to demonstrate more effective blocking performance due to their ability to achieve optimal hand reach over the net (Jiang et al., 2024). This reinforces international empirical evidence that this physical component is a key foundation for winning duels at the net against an opponent's attack.

On the other hand, reaction speed plays a crucial role in the perceptual-cognitive aspect, where players must be able to read the direction of attacks and respond to visual stimuli very quickly (Barbosa et al., 2025). This ability allows athletes to anticipate the timing of spikes and adjust their body position accurately before jumping. This combination of explosive power and rapid reactive response is the gold standard for defensive effectiveness in contemporary volleyball (Jariono et al., 2021, 2023, 2024).

Empirical evidence demonstrating the relationship between lower limb explosive power and technical performance has been extensively investigated in the context of team sports. Hackett et al. (2018) emphasized that vertical jump ability and explosive sprint performance significantly correlate with athletes' technical performance. Conversely, Zhu et al. (2024) highlighted that perceptual responsiveness and rapid reaction time are critical determinants of blocking success in volleyball players. These findings confirm that blocking is a complex skill involving the integration of physical and neuromuscular capacities (Idrees & Salih, 2022; Rodney et al., 2024).

Despite the abundance of literature on these variables, a significant gap remains. Most previous research has focused on professional leagues, national teams, or elite-level competitions. Research conducted within the specific context of high school extracurricular activities is relatively limited, particularly in developing regions like Eastern Indonesia. High school students represent a critical developmental stage where motor skills and reaction times are still being refined. Initial observations of extracurricular volleyball activities at State Senior High School 8 Bulukumba revealed significant variations in students' blocking abilities. Some participants demonstrated excellent jump timing and height, while many others struggled with delayed reactions to the ball's movement or insufficient leg propulsion. This disparity indicates differences in physical capacity and reactive efficiency that directly impact the effectiveness of the students' defensive performance during matches.

Theoretically, this study is vital for strengthening the academic understanding of how reaction speed and lower limb power contribute to blocking ability within the framework of educational sports and youth development. The novelty of this research lies in its specific focus on integrating these two key physical components in a senior high school student population, a demographic often overlooked in high-performance

biomechanical studies. By focusing on the extracurricular level, this study seeks to fill a gap in the literature that has not yet been explored with sufficient depth.

Practically, the findings produced at High School 8 Bulukumba are intended to serve as a scientific foundation for physical education teachers and extracurricular coaches. By understanding the specific correlation between reaction speed and blocking success, educators can design more targeted, effective, and data-driven training programs. Such programs will not only improve the quality of volleyball performance at the secondary education level but also ensure that training is tailored to the physiological and cognitive needs of adolescent athletes.

2. METHOD

This study employed a quantitative approach with a correlational design to analyze the relationship between lower-limb explosive power and blocking ability among volleyball extracurricular participants at High School 8 Bulukumba. A correlational design was selected because it allows researchers to examine the degree of association between physical variables without applying any specific treatment or manipulation. This approach is particularly relevant in the context of physical education and sport, as it enables an objective and measurable description of the relationship between physical condition components and technical game skills.

The population of this study consisted of all students actively participating in volleyball extracurricular activities at High School 8 Bulukumba during the current academic year, totaling 20 students. Based on data from the extracurricular coach, the number of active participants was relatively limited; therefore, a total sampling technique was applied. By involving the entire population as the research sample, this study was expected to provide a more accurate and representative depiction of the relationships among variables under real field conditions.

Data collection in this study was conducted using three types of test instruments that have been tested for validity and reliability. Lower leg explosive power was measured using a vertical jump test, a standard procedure in sports research to represent the explosive capacity of leg muscles. Meanwhile, blocking ability was evaluated using a specific volleyball skills test developed based on indicators of jump timing accuracy, hand position, and ball interception effectiveness. Furthermore, hand-eye reaction speed was objectively measured using a visual stimulus-based reaction time test and a ruler drop test to assess motor response speed to visual stimuli.

All instruments used underwent a review and validation process by experts in the fields of physical education and volleyball coaching to ensure content validity. After data collection, inferential statistical analysis was conducted using the Pearson Product Moment correlation test to determine the strength and direction of the relationship between lower leg explosive power, reaction speed, and blocking ability. This approach ensures that the relationships between variables can be accurately mapped in accordance with applicable scientific principles.

As a crucial step before hypothesis testing, a prerequisite analysis was conducted, including normality and linearity tests, to ensure the appropriateness of the parametric

correlation analysis. All data processing was performed using the latest version of SPSS software, ensuring high scientific accuracy and systematic accountability. This procedure ensures that conclusions drawn regarding the relationships between physical components are based on a rigorous and objective methodology.

3. RESULTS AND DISCUSSION

Results

The results of this study indicate that blocking ability among volleyball extracurricular participants at Bulukumba State Senior High School 8 is not solely determined by technical mastery, but is also significantly influenced by explosive physical capacity and the ability to respond quickly to game stimuli. Leg explosiveness plays a crucial role in generating an optimal vertical jump, while reaction speed determines the accuracy of timing and hand position when facing an opponent's attack. The synergy between these physical components ensures that defense above the net can be executed with maximum reach and maintained stability.

The combination of explosive leg strength and reactive response speed is a key factor in increasing blocking effectiveness, especially for students still developing fundamental and game-specific skills. These findings confirm that a training program integrating neuromuscular strengthening and perceptual-motor training is essential for optimizing the performance of adolescent athletes. Thus, structured physical development is a key foundation for technical success in facing the attacking dynamics of modern volleyball at the high school level.

Descriptive data results

Based on descriptive analysis of data on leg explosive power, reaction speed, and blocking ability of volleyball extracurricular participants at High School 8 Bulukumba, this study presents a comprehensive overview of the characteristics of students' physical abilities and technical mastery. This analysis serves as the primary foundation for mapping the initial ability profile of young athletes before testing the relationships between variables. The data processing results indicate that students' leg explosive power and reaction speed fall within the moderate to good distribution category, consistently correlated with their on-court blocking performance.

This data distribution pattern provides a strong empirical basis for researchers to further examine the specific contribution of each physical variable to net defense effectiveness. These descriptive findings indicate that variations in students' technical abilities are inseparable from differences in their basic physical capacities. Therefore, these data provide a crucial foundation for inferential analysis to demonstrate the functional relationship between explosive and reactive physical components and blocking skill success in the context of extracurricular activities at school.

Table 1. Descriptive Results

Statistics	Explosive leg power	*Blocking* ability	Volleyball *blocking* ability
N	20	20	20
Mean	34.45	8.15	11.99

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Statistics	Explosive leg power	*Blocking* ability	Volleyball *blocking* ability
Standard Deviation	2.61	1.59	.867
Range	12	6	3.39
Minimum	31	4	11.17
Maximum	43	10	14.56
Sum	689	163	239.84

As shown in Table 1, the descriptive analysis involved 20 volleyball extracurricular participants to provide a balanced representation of group characteristics. The leg explosiveness variable showed a mean score of 34.45 with a standard deviation of 2.61, indicating that students' explosive abilities were at a moderate level. The range of scores between a minimum of 31 and a maximum of 43 reflects significant differences in physical capacity among students, which serves as an important basis for evaluating their athletic performance on the field.

Meanwhile, the reaction speed variable had a mean score of 8.15 with a standard deviation of 1.59, where the score range between 4 and 10 reflects the diversity of students' abilities in responding to game stimuli. Meanwhile, blocking ability showed a mean score of 11.99 with a smaller standard deviation of 0.867, indicating that students' mastery of blocking techniques tended to be more homogeneous than other physical variables. Overall, these descriptive data provide a strong empirical basis for continuing the analysis of the relationship between explosive leg power and reaction speed on blocking effectiveness in these extracurricular participants.

Data normality results

Data normality testing is an important step in statistical analysis to ensure that the distribution of data on leg explosive power, reaction speed, and blocking ability meets the requirements for using parametric analysis. In a study examining the relationship between leg explosive power and reaction speed with blocking ability of volleyball extracurricular participants at High School 8 Bulukumba, normality testing is necessary so that the results of correlational and inferential analyses can be carried out accurately. Fulfilling the normality assumption allows interpretation of relationships between variables to be carried out accurately, objectively, and reflect the empirical conditions of the research sample. Therefore, the results of the normality test for each variable are presented systematically in the following table as a basis for the feasibility of further analysis:

Table 2. Results of Data Normality Test

One-Sample Kolmogorov-Smirnov Test	Explosive leg power	Speed reaction	Volleyball *blocking* ability
N	20	20	20
Test Statistics	0.176	0.213	0.197
Asymp. Sig. (2-tailed)	0.106 [c]	0.018 [c]	0.041 [c]

Building upon Table 2, the results of the normality test using the One-Sample Kolmogorov–Smirnov Test on 20 respondents show that only the leg explosive power

variable has a normal distribution with an Asymp. Sig. (2-tailed) value of 0.106 (>0.05). In contrast, the reaction speed and blocking ability variables obtained significance values of 0.018 and 0.041, respectively, which are below the 0.05 threshold, so that both data are declared not normally distributed. This finding is the basis for crucial considerations in determining advanced statistical analysis techniques, where the inability of the data to meet the normality assumption for the majority of variables directs the selection of an analysis method to a non-parametric approach so that the interpretation of the relationship between variables remains accurate and in accordance with the empirical characteristics of the study.

Hypothesis Test Results

The results of this hypothesis testing study aim to determine the extent to which explosive leg power and reaction speed contribute to blocking ability in volleyball extracurricular participants at Bulukumba State Senior High School 8. This analysis was designed to obtain empirical evidence regarding the strength and direction of the relationship between the dominant physical variables that are key to successful defensive techniques at the net. Through this testing, the functional relationship between explosive physical capacity and reactive response can be systematically mapped to address the technical challenges of modern volleyball.

The findings from this hypothesis testing are expected to enrich theoretical studies on the physical performance of adolescent athletes and provide a practical foundation for teachers and coaches in developing more effective training programs. By understanding the significance of each variable's contribution, training intervention planning can be carried out in a more measured and evidence-based manner. The complete results of the statistical analysis are presented systematically in Table 3 as the primary reference for drawing conclusions from the study.

Table 3. Summary of the Results of the Correlation Analysis

Variables	r_{-Count}	R-square (R^2)	t_{-Count}	P	Information
The relationship between explosive leg power (X1) and reaction speed (X2) with the blocking ability of students participating in the volleyball extracurricular activities at High School 8 Bulukumba (Y)	0.770	0.593	3,950 and 2,629	0.00 2	Significant

The analysis in Table 3 found that explosive leg power (X_1) and reaction speed (X_2) had a strong and significant relationship with blocking ability (Y) in volleyball extracurricular participants at High School 8 Bulukumba. The correlation coefficient (r) of 0.770 indicates a positive relationship in the strong category, indicating that increases in explosive leg power and reaction speed tend to be followed by increased blocking effectiveness in students. Furthermore, the R Square (R^2) value of 0.593

explains that 59.3% of the variation in blocking ability can be explained simultaneously by the contribution of these two physical variables, while the remainder is influenced by other factors outside the scope of this study.

The results of the significance test support these findings with t-values of 3.950 and 2.629, respectively, and a p-value of 0.002, which is below the 0.05 threshold. These figures confirm that the relationship between the independent and dependent variables is statistically significant, thus supporting the research hypothesis stating a relationship between explosive leg power and reaction speed with blocking ability. These findings confirm that explosive and responsive physical components are key pillars in supporting successful defensive techniques at the net, while also providing direction for the development of a more comprehensive coaching curriculum.

Discussion

Analysis of the Contribution of Leg Explosive Power and Reaction Speed

The study concluded that blocking ability among volleyball extracurricular participants at High School 8 Bulukumba is not solely determined by technical mastery but is significantly influenced by explosive physical capacity and reactive response to game stimuli. These findings confirm that explosive leg power is a key pillar in producing an optimal vertical jump, while reaction speed determines the accuracy of timing and hand position when blocking an opponent's attack. The synergy between these physical components ensures that defense above the net can be executed with maximum reach and maintained stability.

Statistically, this relationship is evidenced by a correlation coefficient (r) of 0.770, which falls into the strong category, and an R-squared (R^2) value of 0.593. This indicates that 59.3% of the variation in blocking ability can be explained simultaneously by the contributions of explosive leg power and reaction speed, while the remaining 40.7% is influenced by external factors beyond the scope of this study. These data strengthen the empirical evidence that the integration of physical strength and response speed is a key factor in improving defensive effectiveness, especially for adolescent athletes developing game-specific skills.

These findings align with modern sports theory, which places explosive and responsive physical components as the primary foundation for technical success in dealing with the dynamics of volleyball attacks (Drikos et al., 2025; Espoz-Lazo & Hinojosa-Torres, 2025). The hypothesis testing results, which showed a p-value of 0.002 (<0.05), confirmed that the relationship between these variables is scientifically significant and can be justified. Therefore, this study enriches theoretical studies on adolescent athletic performance and provides a practical foundation for sports managers to integrate neuromuscular strengthening and perceptual-motor training into their coaching programs (Yang et al., 2025; Zećirović et al., 2021).

Physical and Biomechanical Synchronization in Net Defense

Building upon data analysis and theoretical review, physical and biomechanical synchronization is a crucial element in effective defense above the net.

Biomechanically, the synergy between lower leg explosiveness and reaction speed ensures that blocking can be executed with maximum reach and maintains body stability in the air. Leg explosiveness plays a role in generating an optimal vertical jump, while reaction speed determines the accuracy of timing and proper hand positioning to block an opponent's attack.

Descriptive data shows that although the average student's leg explosiveness and reaction speed are in the moderate to good category, there is significant variation in ability among participants. This difference in basic physical capacity directly leads to varying levels of blocking technique effectiveness demonstrated by students on the court. This finding strengthens the theoretical basis that mastery of a homogeneous blocking technique will still produce different performance results if based on varying physical capacity (Batah et al., 2025; Issurin, 2016).

The positive relationship found with a correlation coefficient (r) of 0.770 confirms that any increase in leg strength and reaction speed will be followed by a consistent increase in students' blocking performance. These findings align with biomechanical and neuromuscular studies that suggest that integrating reactive and explosive physical components is the primary foundation for successful defensive techniques in the dynamics of modern volleyball (Amoli et al., 2021; Challoumas et al., 2017; Yang et al., 2025). Therefore, strengthening these two physical aspects is a crucial determinant in mapping an athlete's initial ability profile before moving on to more complex inter-variable testing.

Implications for Youth Athlete Development

These findings have significant strategic implications for the development of sports coaching curricula at the secondary school level, particularly in strengthening the synergy between physical and technical components. Based on the results of the significance test, which showed a p-value of 0.002 (<0.05), the research hypothesis stating a significant relationship between the physical variables of leg explosive power and reaction speed with blocking ability has been statistically proven. This confirms that effective defense on the net does not depend solely on technical proficiency but is firmly rooted in measurable fundamental physical capacity (Deda, 2024).

In line with modern sports theory, these results emphasize that a training program that integrates neuromuscular strengthening and perceptual motor training is essential for optimizing the performance of adolescent athletes (Gholami et al., 2023; Li et al., 2026). Measured interventions in leg explosive power will improve vertical jump ability, while reactive response training will sharpen the accuracy of timing and hand positioning when facing an opponent's attack. Thus, evidence-based training planning is key to addressing the complex technical challenges of contemporary volleyball.

Therefore, structured physical development must be the primary foundation for achieving technical success in facing the dynamic attacks of modern volleyball at the high school level. Emphasizing the integration of explosive and responsive physical components will provide teachers and coaches with clearer direction in developing a comprehensive coaching curriculum. This step aims not only to improve immediate

performance but also to develop a profile of young athletes with strong physical and motor skills for the long term.

4. CONCLUSION

This study concluded that there is a positive and significant relationship between explosive leg strength and reaction speed and blocking ability in volleyball extracurricular participants at High School 8 Bulukumba. The correlation coefficient (r) of 0.770 indicates a strong relationship, with the simultaneous contribution of these two physical variables explaining 59.3% of the variation in blocking ability, while the remaining 40.7% is influenced by factors outside the scope of the study. Explosive leg strength has been shown to play a crucial role in producing an optimal vertical jump, while reaction speed determines the accuracy of timing and hand position when facing an opponent's attack. Overall, the synergy between explosive and responsive physical components is a key foundation for technical success in the dynamics of modern volleyball at the high school level.

As a recommendation, coaches and physical education teachers are advised to develop more structured training programs that integrate neuromuscular strengthening and perceptual-motor training to optimize students' explosive power and reaction speed. For extracurricular participants, increasing awareness of the importance of basic physical capacity is essential, as physical limitations can hinder the effectiveness of blocking techniques on the field. Further researchers can explore additional variables beyond the 59.3% contribution that has been found, such as eye-hand coordination or psychological factors, while the school is expected to support the development of an evidence-based extracurricular curriculum so that the process of developing young athletes at High School 8 Bulukumba becomes more measurable, systematic, and effective.

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