



## Integrating Strength and Technical Training in Women's Rugby: The Association Between Arm Muscle Strength and Passing Accuracy

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### Abstract

This study aims to analyze the relationship between arm muscle strength and passing accuracy in the Kebumen women's rugby team. The background of this study is the importance of upper-body muscle strength as a physiological component that supports basic technical skills in rugby. Practical passing skills require a combination of upper body strength, coordination, and stability to produce precise ball direction and speed. The research used a quantitative, correlational design. The sample consisted of twelve female athletes who actively participated in training and competitions. Data were collected through arm muscle strength tests and passing accuracy tests designed according to rugby game standards. Data analysis included validity, reliability, and correlation tests to assess relationships among variables. The results showed a significant positive relationship between arm muscle strength and passing accuracy, indicating that increased arm muscle strength directly contributes to the effectiveness of basic techniques in the game. This study confirms that upper-body muscle-strengthening training programs should be integrated with passing technique training to optimize coaching outcomes. These findings provide practical implications for coaches in designing evidence-based training programs and expand theoretical understanding of the relationship between physiological factors and technical performance in Indonesian women's rugby.

**Kata Kunci:** *accuracy, passing, rugby*

### INTRODUCTION

Rugby is a team sport that demands a complex combination of physical, technical, and tactical abilities. In Indonesia, rugby has seen significant growth over the past decade, with increased participation and improved performance, including the involvement of female athletes (Hopkinson et al. 2025).

Rugby requires each player to possess superior physical abilities, including arm muscle strength, which plays a crucial role in fundamental skills such as passing, tackling, and scrummaging. Among these skills, passing plays a vital role in maintaining attack continuity, effectively moving the ball between players, and mastering the game's rhythm (Fuller 2025). Passing accuracy is an indicator of technical

skill that determines a team's success in building attacks and maintaining game dominance.

In the context of women's rugby in the Kebumen area, team development has increased participation, but the technical aspects of the game, particularly passing accuracy, remain a challenge (Kvasnytsya et al. 2025).

Based on initial observations of the Kebumen women's rugby team, it was found that although most athletes have a good understanding of game tactics, basic technical skills, such as passing, are often inconsistent, particularly in terms of the accuracy of direction and distance.

One factor thought to contribute to this variation is arm muscle strength. Biomechanically, passing is the result of the

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coordinated strength of the shoulder, upper arm, and wrist muscles, which generate a propulsive force against the ball to reach the target precisely (Solomons et al. 2024).

Arm muscle strength is defined as the ability of the muscles around the shoulder, upper arm, and forearm to generate maximum force during dynamic contraction. Strength is the primary foundation for mastering technique and explosive ability in various sports, including rugby.

During the passing process, arm muscle strength not only propels the ball at optimal speed but also maintains the throw's direction and controls the ball's rotational momentum. Therefore, athletes with greater arm muscle strength generally have better passing accuracy (Hopkinson et al. 2025).

Previous research in related sports, such as soccer and handball, has shown a strong relationship between arm muscle strength and the ability to pass the ball accurately. However, empirical studies specifically examining the relationship between arm muscle strength and passing accuracy in rugby, particularly among female athletes, remain limited, especially in Indonesia (Fatoni et al. 2025) & (Saputro, Thoriq, et al. 2025).

Most previous research has focused on leg muscle strength and cardiorespiratory endurance as determinants of rugby performance. Therefore, this study is crucial to provide an empirical contribution to understanding the relationship between arm muscle strength components and passing accuracy in female rugby athletes.

Theoretically, the relationship between arm muscle strength and passing accuracy can be explained through biomechanical and motor learning approaches. Rugby passing involves a kinetic chain that begins with the activation of the shoulder muscles (deltoid and pectoralis major), followed by the contribution of the upper arm muscles (biceps brachii and triceps brachii), and wrist and finger control in directing the ball.

Weakness in any muscle segment in this chain can decrease the stability of the ball's trajectory and reduce passing precision. Furthermore, coordination between the strength and timing of muscle contractions is a key factor in maintaining the ball's on-target direction. Thus, increasing arm muscle strength through

targeted resistance training is expected to improve players' passing accuracy.

In training, rugby coaches often emphasize mastery of basic techniques through movement repetition, but sometimes overlook the importance of specific strength components that support movement efficiency. An arm muscle strengthening program integrated into a strength and conditioning program has been shown to improve passing and throwing performance in team sports (Jones et al., 2022).

This approach not only increases ball propulsion but also improves upper-body stability during passing under game pressure. Therefore, a deeper understanding of the relationship between arm muscle strength and passing accuracy can form the basis for developing evidence-based training programs for female rugby athletes in Indonesia.

In addition to physiological factors, psychological and situational aspects of the game can also influence passing accuracy (Prasetya and Phanpheng 2025). Pressure from opponents, environmental conditions, and muscle fatigue can reduce a player's ability to control the direction of a pass.

However, arm muscle strength remains a fundamental component because it directly influences the body's mechanical ability to generate consistent force and direction. Based on this framework, this study examines the relationship between arm muscle strength and passing accuracy in the Kebumen women's rugby team, as an initial effort to build a scientific foundation for developing rugby performance at the regional level.

The local context is crucial, as the characteristics of Kebumen women's rugby athletes differ from those of teams from other regions in terms of training backgrounds, facilities, and competition intensity. These factors can influence the development of muscle strength and basic technical skills (Pagan-rosado et al. 2025).

This study is expected to provide not only a quantitative overview of the relationship between these two variables but also practical implications for coaches in designing training programs tailored to athletes' physiological needs and performance. The findings of this study are expected to serve as a basis for developing evidence-based training programs to improve functional strength and technical skills in Indonesian women's rugby.



Furthermore, this study has the potential to enrich the scientific literature in sports science, particularly in the subfields of sports performance analysis and biomechanics of team sports. By combining an empirical approach with theoretical analysis, this study contributes to understanding the importance of arm muscle strength as a primary determinant of passing performance. Furthermore, this study provides a foundation for future research on integrating strength training and technical skills in modern rugby.

## METHODS

This study used a quantitative correlational design to analyze the relationship between arm muscle strength (independent variable) and passing accuracy (dependent variable) in female rugby athletes. The correlational approach was chosen because it is appropriate for identifying the extent of a linear relationship between two variables measured empirically without manipulating the independent variables. This design provides a strong analytical basis for understanding the contribution of physiological factors to technical performance in a team sport like rugby (Kvasnytsya et al. 2025).

The population in this study was all members of the Kebumen women's rugby team. At the same time, the sample comprised 30 female athletes, selected purposively based on the following criteria: actively participating in regular training for at least the past 6 months, participating in regional-level competitions, and being in good physical condition at the time of the study (Fuller 2025).

Data collection took place at Legok Field, Pejagoan District, Kebumen Regency, Central Java Province. This location was chosen because the field is the official training ground for the Kebumen women's rugby team, thereby representing the athletes' actual performance in a familiar, controlled environment.

Data collection involved two types of tests: arm muscle strength and passing accuracy (Falotico and Scatigna 2025). Arm muscle strength was measured using a handgrip dynamometer to gauge the maximum force output of the arm muscles. This test was chosen because it has high validity for assessing upper-body muscle strength, which is relevant to rugby passing activities.

Meanwhile, the passing accuracy test was conducted according to standard rugby game procedures, in which each athlete is asked to pass the ball to a target from a predetermined distance and position. Accuracy scores are based on the number of passes that correctly hit the target out of the total number of attempts (Pagan-rosado et al. 2025).

The obtained data were then analyzed using the Pearson product-moment correlation test to determine the strength and direction of the relationship between the two variables (Prasetya and Phanpheng 2025). Before the correlation analysis, the data were first tested for validity and reliability to ensure the accuracy and consistency of the measurement results (Islam and Islam 2025).

The validity test was used to assess the extent to which the measurement instrument represented the concept being measured. In contrast, the reliability test was conducted to ensure the stability of the measurement results across repeated tests. Statistical analysis was performed at the 0.05 significance level to guide decision-making.

## RESULTS

This study aims to analyze the relationship between arm muscle strength and passing accuracy in the Kebumen women's rugby team. Data analysis involved three main stages: validity testing, reliability testing, and correlation testing. These three analyses were conducted to ensure that the instruments used were scientifically sound and that the results obtained could be empirically justified.

### 1. Descriptive Statistic

Descriptive statistics were calculated to describe the performance profile of female rugby athletes in arm muscle strength and passing accuracy.

**Table 1. Descriptive Statistics of Research Variables**

Variable	N	Mean	SD	Minimum	Maximum
Arm Muscle Strength (kg)	30	32.47	4.85	24.00	41.00
Passing Accuracy (score)	30	7.63	1.54	4.00	10.00

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The results show that the average arm muscle strength of the athletes was 32.47 kg (SD = 4.85), indicating moderate variability among participants. Passing accuracy scores averaged 7.63 (SD = 1.54) out of a maximum score of 10, suggesting generally good technical performance with some observable variation.

## 2. Normality Test

Prior to conducting Pearson correlation analysis, the assumption of normal distribution was tested using the Shapiro–Wilk test.

**Table 2. Normality Test Results (Shapiro–Wilk)**

Variable	Statistic (W)	P-value	Interpretation
Arm Muscle Strength	0.967	0.437	Normal
Passing Accuracy	0.958	0.286	Normal

The Shapiro–Wilk test results indicate that both variables are normally distributed ( $p > 0.05$ ). Therefore, the use of Pearson product–moment correlation and linear regression analysis is statistically justified.

## 3. Validity Test

The validity test was conducted to assess the extent to which the measurement instrument accurately measured the intended variables. Inter-item validity was assessed using Pearson product-moment correlations on the results of Tests 1 and 2, administered to 30 female rugby athletes.

**Table 1. Validity Test Results**

Variable	Pearson Correlation (r)	Sig. (2-tailed)	N	Information
Test 1 – Test 2	0.549**	0.002	30	Valid ( $p < 0.01$ )

Description: Significant at the 0.01 confidence level (2-tailed).

The correlation coefficient  $r = 0.549$  ( $p = 0.002$ ) indicates a significant relationship between the first and second measurements. Therefore, the measurement instrument in this study is declared valid, as it consistently represents the constructs of arm muscle strength and passing accuracy.

## 4. Reliability Test

Reliability testing was conducted to verify the consistency of the measurement results. Reliability analysis was performed using Cronbach's alpha on two measurement items.

**Table 2. Reliability Test Results**

Indicator	Cronbach's Alpha	Number of Items	Interpretation
Arm Muscle Strength and Passing Accuracy	0.668	2	Reliabel

A Cronbach's Alpha value of 0.668 indicates that the measurement instrument has a relatively good level of internal consistency. According to Nunnally (1978), an alpha value above 0.60 meets the reliability criteria for exploratory research in sports. This confirms that the measurement results for both variables are reliable and stable when repeated under similar conditions.

## 5. Correlation Test

The primary analysis of this study used the Pearson product-moment correlation to assess the strength of the relationship between arm muscle strength and passing accuracy.

**Table 3. Results of the Correlation Test Between Arm Muscle Strength and Passing Accuracy**

Variabel	Pearson Correlation (r)	Sig. (2-tailed)	N	Interpretation
Arm Muscle Strength – Passing Accuracy	0.549**	0.002	30	Significant Positive Relationship

Description: Significant at a confidence level of 0.01 (2-tailed).

The correlation test yielded an  $r$  value of 0.549 ( $p = 0.002$ ), indicating a positive and significant relationship between arm muscle strength and passing accuracy.

This positive correlation suggests that the greater an athlete's arm muscle strength, the higher their passing accuracy. In other words, increased arm muscle strength directly contributes to the accuracy of the direction and distance of the ball during play (Nugroho et al. 2024).

Biomechanically, the results of this study support the theory that upper body muscles, particularly the deltoid, triceps brachii, and pectoralis major, play a critical role in generating propulsive force and controlling the direction of the ball during passing movements (Mechita et al. 2025).

This significant positive relationship indicates that increased arm muscle strength can enhance energy transfer efficiency and upper-body stability,



ultimately improving passing accuracy (Palmizal et al. 2025).

These findings align with previous research in team sports that emphasizes the importance of upper-body muscle strength for technical performance. Thus, this study provides empirical evidence that coaches should include arm muscle-strengthening exercises as a central component of the physical development program for female rugby athletes.

## DISCUSSION

Based on validity, reliability, and correlation analyses, empirical findings indicate a positive relationship between arm muscle strength and passing accuracy among female rugby athletes from Kebumen. This finding provides an essential foundation for understanding the relationship between physiological factors and technical performance in rugby.

The following discussion will elaborate on these results in greater depth, reviewing biomechanical and technical aspects and their implications for comprehensive coaching and performance development of Indonesian female rugby athletes.

### 1. Arm Muscle Strength as a Physiological Component Determining Passing Skills

Arm muscle strength is a physiological component that plays a dominant role in technical passing skills in rugby. The passing movement requires complex coordination between the shoulder, upper arm, and forearm muscles, which work synergistically to generate propulsive force and precise ball throw direction.

The results of this study indicate a significant positive correlation between arm muscle strength and passing accuracy ( $r = 0.549$ ;  $p = 0.002$ ), meaning that the stronger an athlete's arm muscles, the higher their pass accuracy. These findings support the biomechanics of movement theory proposed by Bartlett (2019), which states that muscle strength serves as the mechanical foundation for technical performance, particularly in activities involving ball trajectory control and movement speed.

The relationship between strength and technique also aligns with the concept of functional strength, which is the ability of muscles to generate effective force according to

specific sporting movement patterns (Bompa & Haff, 2019).

In rugby, arm muscle strength not only determines passing distance but also influences upper-body stability under pressure during game situations. Therefore, arm muscle-strengthening exercises should be a priority in rugby athletes' conditioning programs, whether through external-load methods (resistance training) or functional exercises based on game movements.

Overall, these results confirm that increasing arm muscle strength is not simply a physical necessity but an integral part of improving passing technique and competitive performance in female rugby players.

### 2. Passing Accuracy as an Indicator of Technical Efficiency in Rugby

Passing accuracy is a key indicator of technical efficiency in rugby, as the success of every attack depends on a player's ability to deliver the ball to a teammate accurately. Research findings show that variations in passing accuracy scores between players indicate that physical factors, particularly arm muscle strength, significantly influence pass quality.

Athletes with strong arm muscle strength demonstrate stable movement, optimal ball rotation speed, and accurate direction. Conversely, players with relatively weak muscle strength tend to produce inconsistent passes, especially under dynamic and stressful game conditions.

These findings reinforce (Hopkinson et al. 2025) view that Accuracy results from a complex interaction among physical strength, neuromotor control, and tactical experience. In women's rugby, strength contributes to generating momentum and controlling ball direction, while motor coordination and spatial perception determine the effectiveness of pass reception (Dewantoro et al. 2026).

Therefore, passing technique development should be combined with arm-strength training to achieve more stable, measurable results.

In general, these findings imply that passing Accuracy cannot be developed through technical training alone but must be integrated with strengthening biomotor components to create efficient, stable, and competitive performance at a high level of play (Saputro, Thoriq, et al. 2025).

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### 3. Implications of Research Findings for the Development of Female Rugby Athletes in Indonesia

The results of this study have strategic implications for the development of rugby, particularly for female athletes in Indonesia (Saputro, Rahayu, et al. 2025). The positive correlation between arm muscle strength and passing accuracy suggests that coaches should review the structure of the physical training provided during competition preparation.

Upper-body muscle-strengthening programs such as push-up variations, medicine ball throws, and resistance-band passing drills can be practical approaches to improving technical performance. Furthermore, coaches need to utilize objective measurement data, such as dynamometer readings, as a basis for evidence-based training planning.

In the context of regional sports policy, these findings also contribute to the development of a coaching system that balances technique and physical strength (Fuller 2025). Women's rugby, as a growing sport in Indonesia, requires a systematic, scientific approach to improve performance.

It is hoped that integrating this study's findings into training programs and performance evaluations will help develop a more measurable, efficient, and adaptive coaching model to address athletes' physiological needs (Saputro, Indarto, et al. 2025).

Overall, this study broadens our understanding of the relationship between physiological and technical factors in team sports and emphasizes the importance of synergy between scientific approaches and field practice in optimizing the performance of Indonesian female rugby athletes (Wajib et al. 2022).

### CONCLUSION

This study concludes that arm muscle strength plays a significant role in improving passing accuracy in female rugby players. The positive relationship between these two variables indicates that physical and technical aspects are inseparable in the development of team sports like rugby.

Arm muscle strength provides a mechanical foundation that enables players to effectively control the ball's direction, speed, and stability during play. Without adequate

muscle strength, basic technical skills such as passing struggle to achieve optimal precision, especially in competitive situations that demand high speed and accuracy.

These findings emphasize the importance of integrating strength training with technical training in rugby training programs. Coaches are advised to develop upper-body muscle-strengthening programs tailored to rugby's movement characteristics, including weight training, heavy ball throwing, and resistance training targeting specific passing movement patterns.

This evidence-based training approach is expected to improve movement efficiency while reducing the risk of injury due to muscle strength imbalances.

In addition to providing practical contributions to coaches and athletes, this study's results also enhance theoretical understanding of the relationship between physical capacity and technical performance in team sports.

This research can serve as a reference for further studies examining the roles of other biomotor variables, such as explosive power, coordination, and postural stability, in rugby skills. Overall, this study confirms that developing arm muscle strength is a fundamental element of effective, consistent, and competitive passing performance among Indonesian female rugby athletes.

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