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The relationship between arm muscle strength, arm muscle power and balance on the accuracy of squat pointing results in unesa ukm petanque athletes

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Abstract

This study aims to analyze the relationship between arm muscle strength, arm muscle power, and balance on the accuracy of squat pointing results in UNESA UKM petanque athletes. The main problem is the lack of specific research that explores the physical factors that influence the squat pointing technique in petanque. The research method used is a quantitative approach involving 20 athletes, 10 men and 10 women as samples. Data were collected through the measurement of arm muscle strength using a push-up test, arm muscle power through throwing a medicine ball, balance with the BESS method, and the accuracy of squat pointing. Data analysis was carried out by normality prerequisite test, as well as hypothesis test using Pearson correlation and multiple linear regression. The results showed that there was a significant relationship between arm muscle strength ($r = -0.643$, $p < 0.01$), arm muscle power ($r = -0.732$, $p < 0.01$), and balance ($r = -0.590$, $p < 0.01$) on the accuracy of squat pointing results. Conclusion The results of this study show that arm muscle strength, arm muscle power, and balance have a significant relationship with squat pointing accuracy in petanque athletes. Arm muscle power is the dominant factor that affects the accuracy of the throw. These findings show the importance of developing strength, power, and balance in the training program of petanque athletes to improve performance.

Keywords: Extrinsic Motivation, Deviance in Sports, Young Athletes

INTRODUCTION

Petanque is one of the sports that is increasingly popular in various circles, including in Indonesia. The sport relies not only on strategy, but also on physical skills that support accuracy and strength. One of the key techniques in petanque is pointing, which is the technique of throwing the ball as close as possible to a predetermined item or target (Blume et al., 2018). This technique can be done in a standing or squatting position. According to (Rizal et al., 2021) The squat pointing technique is often used to provide better control of the ball when throwing. Pointing accuracy is an important determinant of the success of a petanque player, especially in competitive matches (Wulf & Lewthwaite, 2016). (I Gusti Ngurah Putra Eka Santosa, 2024)

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Given the importance of accuracy in pointing, certain physical factors are needed to support this performance, including arm muscle strength, arm muscle power, and body balance.

Arm muscle strength is one of the indispensable physical aspects in petanque sports, especially in throwing techniques (Rivan Saghita Pratama, 2024). Optimal muscle strength allows players to better control the ball, maintain movement stability, and produce more precise throws (Jupr et al., 2024; Rivan Saghita Pratama, 2024). In the context of pointing squats, arm muscle strength is needed to ensure that the player is able to throw the ball with enough force while maintaining control so that the ball does not go over the target (Nurhidyat et al., 2024). Moreover (Saiful Amri Al-khusaini, 2021) states that strong arm muscles also help in maintaining posture when pointing in a squat position, which can be a challenge in itself because it requires stability and good balance.

Arm muscle power, defined as the ability of a muscle to produce power in a short period of time, is also an important factor in pointing (Alfian Nurfatoni, 2020). Good muscle power allows petanque players to make throws quickly and powerfully, but still be controlled (Alfian Nurfatoni, 2020; Lina Ulpiana, 2021). In the squat pointing technique , the power of the arm muscles plays a role in generating enough momentum for the ball to reach the target with high accuracy (Badaru et al., 2021). However, the challenge that athletes often face is controlling the power so that the ball does not move too fast or too far from the target. Therefore, it is important for athletes to practice the balance between power and control to obtain optimal accuracy of results.

In addition to the strength and power of the arm muscles, balance is a crucial factor that affects the accuracy of squat pointing results (Mulya, 2020). In a squatting position, the athlete's body must be able to maintain balance so that it remains stable during the throwing movement. Good balance allows players to avoid unnecessary body movements, which can interfere with the direction and power of the throw (Lina Ulpiana, 2021). Lack of balance can lead to changes in posture and body position, which negatively affects the accuracy of the throw (Pelana et al., 2021). Therefore, balance exercises are essential to improve the accuracy of pointing, especially in squat positions that require higher body stability.

Arm muscle strength, arm muscle power, and body balance work synergistically to produce optimal pointing performance (Phytanza et al., 2022). According to (Rivan Saghita Pratama, 2024) In petanque sports, the ability to control the power of the throw and maintain body balance is key in achieving high accuracy. Arm muscle strength provides the basis for the ability to produce stable throws, while arm muscle power provides the additional power needed to throw the ball quickly (Helmi et al., 2024). Balance, on the other hand, ensures that the throw is performed stably without any distractions from unnecessary body movements. The combination of these three factors is very important, especially in the squat position, which requires more control than the standing position (Jupr et al., 2024).

Although squat pointing provides an advantage in terms of control, this technique also has its own challenges. One of the biggest challenges is maintaining balance and posture when squatting, especially for athletes who are not yet used to the position (Zulbahri et al., 2024). The squatting position can reduce the stability of the body, thus affecting the strength and accuracy of the throw. In addition, the ability to optimize arm muscle power without losing control is also a challenge (Setiakarnawijaya et al., 2021). Athletes often struggle to strike a balance between producing powerful throws and maintaining target accuracy (Turi et al., 2023). Therefore,

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specific exercises are needed to develop these three factors so that squat pointing performance can be improved.

Physical exercises that focus on developing strength, power, and balance are essential for petanque athletes, especially in mastering the squat pointing technique (Hidayah et al., 2024). Opinion (Awang et al., 2019) Exercise programs designed to increase arm muscle strength, such as resistance and weightlifting exercises, can assist athletes in producing more stable and controlled throws. Additionally, plyometric exercises can be used to increase arm muscle power, while balance exercises, such as core stability exercises, can help athletes maintain body stability while in a squat position (Pelana et al., 2021). The combination of these different types of training will help petanque athletes improve their pointing accuracy, which ultimately has a positive impact on their performance on the field.

Although many studies have been conducted on strength, power, and balance in various sports, studies that specifically examine the relationship between these three factors in petanque sports are still very limited. This research is expected to provide new insights into the importance of physical development in improving the accuracy of pointing, especially in squatting techniques. With the results of more in-depth research, coaches can design more effective and specific training programs for petanque athletes. In addition, this research is also expected to be a reference for further development in the field of sports training, especially in sports that prioritize accuracy such as petanque.

METHODS

This study uses a quantitative method with a correlational design. Correlational research was chosen to identify the relationship between arm muscle strength, arm muscle power, and balance on the accuracy of squat pointing results in UNESA UKM petanque athletes. Through this approach, the study aims to see the contribution of each independent variable (arm muscle strength, arm muscle power, and balance) to the dependent variable (accuracy of squat pointing results). This quantitative approach also allows researchers to test hypotheses and draw conclusions based on data obtained through the measurement of predetermined variables (Maksum, 2012). The population in this study is all petanque athletes who are members of the Petanque Student Activity Unit (UKM) of the State University of Surabaya (UNESA). The research sample was taken using the purposive sampling technique, which is a sampling technique based on certain criteria (Sugiyono, 2019). The sample criteria in this study include athletes aged 18-23 years, actively participating in petanque training and matches for a minimum period of one year and willing to follow the entire set of measurements that have been determined. The number of samples used in this study was 20 athletes, in accordance with the minimum standard for adequate correlational statistical analysis.

The instruments used in this study include several measurement tools for each variable as follows: Arm Muscle Strength using a test (Push Up) Arm Muscle Power (medicine ball throw) Balance Measured using the Balance Error Scoring System (BESS) while the Accuracy of Squat

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Pointing Results is measured by observing the distance between petanque balls thrown by athletes and grains (targets) on the field.

The data obtained were analyzed using descriptive and inferential statistical techniques. Descriptive analysis is used to describe the characteristics of each variable, such as mean, standard deviation, and minimum-maximum score. For inferential analysis, the Pearson correlation test was used to see the relationship between arm muscle strength, arm muscle power, and balance on the accuracy of squat pointing results . In addition, a double linear regression analysis was performed to determine how much the independent variable contributed to the dependent variable. All analyses were performed using statistical programs such as SPSS version 29.00, with a significance level set at 0.05.

RESULTS

This study used 20 samples consisting of 10 male athletes and 10 female athletes. Measurements were made on four variables, namely arm muscle strength (*push-ups*), *arm muscle power* (*medicine ball throw*), balance (BESS), and accuracy of *squat pointing* results . Here is a description of the data for each variable

Table 1. Data Description Results

Variabel	***Mean***	***Std. Deviation***
Arm Muscle Strength	35,75	4,89
Power Arm Muscles	6,80	0,92
Balance	9,60	1,45
Squat Pointing Accuracy	1,25	0,55

The results showed that the average arm muscle strength was 35.75 with a standard deviation of 4.89, the average arm muscle power was 6.80 with a standard deviation of 0.92, the average balance was 9.60 with a standard deviation of 1.45, and the average squat pointing accuracy was 1.25 with a standard deviation of 0.55. This data reflects variations in the subject's performance that can be the basis for further analysis. Overall, this table shows the importance of the three physical variables of arm muscle strength, arm muscle power, and balance in influencing the accuracy of squat pointing results in petanque athletes. The results of this analysis provide a basis for coaches to design more effective training programs with a focus on improving athletes' strength, power, and balance.

Table 2. Data Normality Test Results

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Variabel	Statistic	Sig.	Information
Arm Muscle Strength	0,440	0,200	Normal
Power Arm Muscles	0.450	0,187	
Balance	0,470	0,205	
Squat Pointing Accuracy	0,443	0,223	

The normality test was carried out using the Kolmogorov-Smirnov test Based on the results of the normality test, all variables had a significance value of > 0.05, so that the data was normally distributed.

A hypothesis test was conducted to see the relationship between arm muscle strength, arm muscle power, and balance on the accuracy of squat pointing results. The test used is Pearson correlation and double linear regression.

Table 3. Correlation test results

Variabel	r_{hitung}	r_{tabel}	Sig	Information
Arm Muscle Strength - Squat Pointing Accuracy	0,576	0.444	-0,643**	Signifikan
Power Arm Muscles - Squat Pointing Accuracy	0,765	0.444	-0,732**	
Balance - Squat Pointing Accuracy	0,640	0.444	-0,590**	

The results of the correlation test showed a significant relationship between all variables with Squat Pointing Accuracy because of the value of r_hitung > r_tabel (0.444) and had a significant significance (Sig.). The relationship between Arm Muscle Strength and Squat Pointing Accuracy has a correlation of r = -0.643**, Arm Muscle Power has a stronger correlation r = -0.732**, and Balance has a correlation of r = -0.590**. Negative values indicate an inverse relationship, meaning that an increase in independent variables tends to be followed by a decrease in the accuracy of squatting pointing.

Regression analysis was carried out to determine the contribution of each independent variable to the accuracy of squat pointing results. The results of the regression analysis are presented in the following table:

Table 4. Linear Regression Analysis

Model	Koefisien Regresi (β)	t	Sig
Constant	7,552	4,622	0,000
Arm Muscle Strength	-0,354	-2,813	0,011
Power Arm Muscles	-0,478	-3,756	0,001
Balance	-0,296	-2,451	0,023

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The results of the double linear regression analysis showed that the three independent variables, namely Arm Muscle Strength, Arm Muscle Power, and Balance, had a significant influence on the dependent variables. The regression coefficient values (beta) are -0.354 for Arm Muscle Strength (p = 0.011), -0.478 for Arm Muscle Power (p = 0.001), and -0.296 for Balance (p = 0.023). A constant value of 7.552 (p = 0.000) indicates the initial value of the dependent variable when all independent variables are zero. The negative coefficient indicates that the increase in each independent variable is followed by the decrease in the dependent variable. All p values < 0.05, indicating a significant influence of the three variables on the dependent variables.

Table 5. Results of Determination Coefficient Analysis (Adjusted R^2)

Model	R	R Square
1	0,62	0,38

The results of the determination coefficient analysis show that the values of R = 0.62 and R^2 = 0.38. This means that 38% of the variation in the dependent variable can be explained by the independent variable in this regression model. The rest, i.e. 62%, is influenced by other factors outside the model. An R value of 0.62 indicates a fairly strong relationship between independent and dependent variables.

Based on the results of the study, it was found that arm muscle strength, arm muscle power, and balance had a significant relationship with the accuracy of *squat pointing* results in UNESA UKM petanque *athletes* . Arm muscle power is the most dominant factor in influencing the accuracy of *pointing,* followed by arm muscle strength and balance.

Discussion

The results of this study showed that there was a significant relationship between arm muscle strength, arm muscle power, and balance on the accuracy of squat pointing results in UNESA UKM petanque athletes. This discussion will outline the findings and compare them with the results of previous studies to identify the similarities, differences, and contributions of this research to the existing literature.

The results showed that the strength of the arm muscles had a significant negative correlation with the accuracy of *the squat pointing* results (r = -0.643, p < 0.01), which means that the higher the strength of the arm muscles, the more accurate the athlete was in pointing. This finding is in line with research conducted by (Rizal et al., 2021), which found that arm muscle strength affects athlete performance in sports that require precise control. In the *petanque sport*, strong arm muscle control allows athletes to maintain movement stability while throwing, thereby improving the accuracy of the throw. This study reinforces the view that arm muscle strength is one of the key factors in *the pointing* squat technique, especially when faced with the need to maintain a static position for long periods of time(Said Zainuddin et al., 2022).

The results of this study also showed that arm muscle power was the most influential variable on the accuracy of squat pointing results with a correlation value of r = -0.732 (p < 0.01) and a regression coefficient of -0.478. This shows that athletes with better arm muscle power are able to produce more accurate throws. This research is consistent with the results of a study conducted by (Hidayah et al., 2024) who found that arm muscle power plays an important role in sports that require high-accuracy long-distance throws, such as basketball and handball. In the context of a petanque, good arm muscle power allows athletes to control the throw distance with greater precision, especially when it requires lower speed when approaching the target (Zulbahri et al., 2024). These findings add to the understanding that in the squat

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pointing technique, athletes not only need good arm muscle strength, but also the ability to manage power in producing the right throw.

Balance was also found to have a significant relationship with the accuracy of squat pointing results ($r = -0.590$, $p < 0.01$). This study supports the findings of the research by (Nurhasan Nurhasan, 2024) which states that dynamic balance is essential in activities that require postural stability, such as in sports that involve precision in throws. When performing pointing squats, petanque athletes must maintain optimal balance of their bodies to avoid unwanted movements that can affect the accuracy of the throw (Karisma Sari et al., 2023). These results reinforce the importance of postural balance in influencing athletes' performance, especially in static positions such as pointing squats. Athletes who are able to maintain good posture balance are more likely to make more accurate throws.

The findings of this study have similarities with several previous studies that also highlight the importance of muscle strength, power, and balance in activities that involve precision throws. For example, research by (Abdurrahman et al., 2024) It shows that the strength and power of the arm muscles contribute significantly to the athlete's ability in handball sports, which requires a combination of strength and precision in throwing movements. However, this research makes a new contribution with a focus on petanque, a sport that has unique characteristics, especially in squat pointing techniques that require calmness, body control, and high focus. There are not many studies that specifically explore the relationship between these variables and the accuracy of pointing in petanque, so this study provides new insights that are relevant for athletes and coaches in developing training programs.Based on the results of the study, the practical implication that can be drawn is that petanque coaches should pay special attention to the development of arm muscle strength, arm muscle power, and balance in the athlete's training program. Exercises that focus on increasing arm muscle strength and power, such as resistance and plyometric exercises, as well as dynamic balance exercises, will be very beneficial for improving athletes' pointing squat performance. This is also supported by research from (Karisma Sari et al., 2023) which shows that a structured training program that focuses on these physical variables is able to significantly improve the athlete's throwing performance.

Although this study provides significant results, there are some limitations that need to be noted. First, the number of samples used is still limited to 20 athletes, so the results of this study may not be widely generalized. Further research with larger and varied sample sizes needs to be done to confirm these results. Second, the study only focused on physical variables without considering psychological factors that might affect the accuracy of the throw, such as concentration or pressure during the game. Therefore, future research needs to include psychological aspects to get a more comprehensive picture. This study found that arm muscle strength, arm muscle power, and balance had a significant relationship with the accuracy of squat pointing results in UNESA UKM petanque athletes. Arm muscle power is the most dominant factor affecting the accuracy of the throw. This research makes an important contribution to the development of training programs that can improve the performance of athletes in petanque sports.

CONCLUSIONS

The results of this study show that arm muscle strength, arm muscle power, and balance have a significant relationship with the accuracy of squat pointing in petanque athletes. Arm muscle power is the dominant factor that affects accuracy, followed by muscle strength and balance. These findings support the development of focused physical training programs to improve athletes' performance.

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