



CORRELATION OF ARM MUSCLE POWER AND FLEXIBILITY WITH SHOT PUT ABILITY

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ABSTRACT

This research is a type of quantitative research with a correlational design. The population in this study was all students at SMP Negeri 10 Kendari, totaling 288 people. Based on considerations, the selected population was all male students, totaling 110 people. The sample used in this research was 33 people. Or 30% of the population, namely all existing sons. The sampling technique was carried out using a stratified random sampling technique. The instrument for measuring arm muscle power uses the two-hand medicine ball put test. Measuring the flexibility of the backbone using a sit and reach test and the flexibility of the backbone using an extension dynamometer. The test to measure bullet-rejecting ability is to perform a repulsion starting from the boundary line to where the bullet falls, which is measured in meters. The data analysis technique uses descriptive tests, analysis prerequisite tests, namely normality and linearity tests, as well as hypothesis testing with the help of SPSS 20. The magnitude of the contribution of arm muscle power and flexibility of the together to shot put ability is shown by the coefficient of determination $r^2 \times 100\% = (0.946)^2 \times 100\% = 89.50\%$. This can be interpreted as 89.50% of the contribution or variable contribution of arm muscle power and flexibility of the spear to shot put ability.



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INTRODUCTION

Shot put is a sport that requires a combination of physical strength, correct technique, and good body coordination to achieve optimal performance (Rusli et al., 2023). In shot put, arm muscle power is an important factor in releasing the shot at optimal speed and distance (Hernado et al., 2017; Schofield et al., 2022). Strong arm muscles can provide greater impetus to the bullet, which in turn can increase the repulsion distance (Ashari, 2021; Watson et al., 2020). On the other hand, flexibility or the flexibility of the back and shoulder muscles can improve athletes to exploit more range of motion in the shot put, which can also contribute to better shot put performance (Sukamto et al., 2022). The ability to transfer arm muscle power to the bullet efficiently is greatly influenced by good shot put technique. Proper technique in using the arm muscles and the body as a whole is also crucial (Ambarwati et al., 2017; Pinheiro et al., 2020). Flexibility can influence an athlete's ability to maintain optimal body position and perform effective pushing movements (Saputro & Rumini, 2023).

When executing the shot put, lack of arm muscle strength or adequate flexibility of the stick can increase the risk of injury when performing the shot put. Weak or less flexible muscles can cause excessive tension in the muscles and joints, which can result in injury, especially in sports that require extreme movements such as shot put (Asmoro, 2021). Understanding the correlation between arm muscle power, spear flexibility and shot put ability can help coaches and students design more effective training programs. By focusing on developing arm muscle strength and increasing shot put flexibility simultaneously, students can increase their potential to achieve better shot put performance (Suheri, 2020; Anousaki et al., 2021).

Identify sports talents, including shot put. By understanding the correlation between arm muscle strength and shot put flexibility with shot put ability, schools can identify students who have the potential to become shot put athletes and pay more attention to developing these skills from an early age, by building arm muscle strength and improving shot put flexibility at an early age. Junior high school age can help students form a strong foundation for shot put skills in the future. This creates a solid foundation for the development of more advanced technical skills at higher levels later (Friarcha et al., 2020). Exercises that focus on arm muscle strength and spear flexibility not only help in improving shot put ability, but also have broad health benefits. Good arm muscle strength helps prevent injury and improves general physical performance, while flexibility helps maintain body flexibility and reduces the risk of injury (Naviri et al., 2022).

Research conducted by (Suheri, 2020), shows that participation in sports can have a positive impact on academic performance. By improving the correlation between arm muscle power, shot put flexibility, and shot put ability, schools can help students reach their academic potential by providing a healthy outlet for additional energy and focus. Practice and competition in the sport of shot put can also help students develop the qualities of leadership, teamwork, discipline, and perseverance. This is a valuable skill that can bring long-term benefits in their personal and professional lives.

Positive correlation between arm muscle strength and distance in shot put. Athletes with higher arm muscle power tend to be able to throw the shot put farther, considering the importance of explosive power in the shot put movement. The flexibility of the shot put plays an important role in an athlete's ability to exploit the full range of motion of the body in the shot put. Research has shown that athletes with better shot put flexibility tend to have better shot put technique, which in turn can affect performance and throw distance (Distriyadi, 2022).

Several studies have highlighted the importance of shot put flexibility in preventing injury when shooting. A lack of flexibility can increase the risk of injury to the muscles of the back, shoulders, and arms during pushback movements, thereby increasing the urgency to include flexibility training in athletes' training programs. Thus, recent research in this field highlights the importance of the correlation between arm muscle power and spear flexibility with shot put ability. A better understanding of these factors can assist coaches and athletes in designing more effective training programs and maximizing performance potential on the shot put field.

The problem that occurs is that junior high school students experience limitations in arm muscle power and flexibility because their physical development stage is not yet perfect. This can hinder their ability to perform shot put movements effectively. Lack of training that focuses on developing arm muscle strength and spear flexibility can be an obstacle in improving shot put ability in junior high school students. Physical education programs in schools often do not place enough emphasis on sports that require arm muscle strength and spear flexibility, such as shot put. Middle school students lack awareness of the importance of developing arm muscle strength and spear flexibility in improving shot put ability. Lack of motivation to train and improve performance in a particular sport can also be a factor in the problem. Not all schools have adequate sports facilities to train students in sports such as shot put. Lack of accessibility to appropriate training facilities can also be an obstacle in developing shot put skills in junior high school students. So the aim of this research is to determine the correlation between leg muscle power and flexibility with shot put ability.

METHOD

This research is a type of quantitative research with a correlational design consisting of arm muscle power, spear flexibility and shot put ability. This research was conducted at SMP Negeri 10 Kendari. The selection of the junior high school to be used as the research population was based on several suitability as a research location, namely the location of the research location was not far from where the students lived, as well as providing convenience in the research process, especially with regard to transportation for athletes and fellow teachers who assisted the researchers (Sugiyono, 2015). In addition, the available facilities provide flexibility for research, especially in athletics. Based on all these conveniences, especially with regard to learning time that can meet the demands of the research in question.

The population in this study was all students of SMP Negeri 10 Kendari, totaling 288 people, consisting of 98 class VII students, 104 class VIII students and 86 class IX students. Based on considerations, the selected population was all male students, totaling 110 people. The sample used in this research was 33 people. Or 30% of the population, namely all existing sons. The sampling technique was carried out using a stratified random sampling technique. Namely selecting male students from each class. Next, the sample was set at 30%. ($30/100 \times 110 = 33$ people). The instrument for measuring arm muscle power uses the two hand medicine ball put test (Sepdanius et al., 2019). Measuring the flexibility of the uses a sit and reach test and the flexibility of the back is carried out using an extension dynamometer (Fenanlampir & Faruq, 2015). The test to measure bullet-rejecting ability is to perform a repulsion starting from the boundary line to where the bullet falls, which is measured in meters (Novriadi & Hermanzoni, 2019). The data analysis technique uses descriptive tests, analysis prerequisite tests, namely normality and linearity tests, and hypothesis testing with the help of SPSS 20.

RESULT AND DISCUSSIONS

Research Result

The results of the descriptive analysis test between arm muscle power and flexibility of the spear and shot put ability are as follows:

Table 1. Descriptive Analysis of Arm Muscle Power (X1), Flexibility (X2), and Shot Put Ability (Y)

Variable	N	Minimum	Maximum	Mean	Std. Deviation
Y	33	5.10	7.60	6.57	0.63
X1	33	6.20	7.50	6.92	0.31
X2	33	27.50	48.00	34.51	4.38

Based on the results of the descriptive analysis, it is known that the shot put ability value is a maximum of 5.10, a maximum value of 7.60, a mean of 6.57, and a standard deviation of 0.63. The results of arm muscle power obtained a minimum value of 6.20, a maximum value of 7.50, a mean of 6.92, and a standard deviation of 0.31. Meanwhile, for the results of flexibility, the minimum value was 27.50, the maximum value was 48.00, the mean was 34.51, and the standard deviation was 4.38.

The frequency distribution of arm muscle power scores for students who were subjects in this study can be seen in table 2. Meanwhile, the histogram of the frequency distribution of arm muscle power variable scores (X1) is shown in figure 1.

Table 2. Frequency Distribution of Arm Muscle Power Scores (X1)

Interval Class	Frequency	Percentage
6,20 – 6,49	3	9,09
6,50 – 6,79	5	15,15
6,80 – 7,09	14	42,42
7,10 – 7,39	7	21,21
7,40 – 7,69	4	12,12
total	33	100,00

Percentage Frequency Interval Class Based on the analysis data above, it is known that the frequency value for arm muscle power is 3 people, a percentage of 9.09 with an interval class of 6.20 – 6.49. 5 people, percentage 15.15 with class interval 6.50 – 6.79. 14 people, percentage 42.42 with class interval 6.80 – 7.09. 7 people, percentage 21.21 with class interval 7.10 – 7.39. 4 people, percentage 12.12 with class interval 7.40 – 7.69. The histogram of the results of arm muscle power can be depicted as follows.

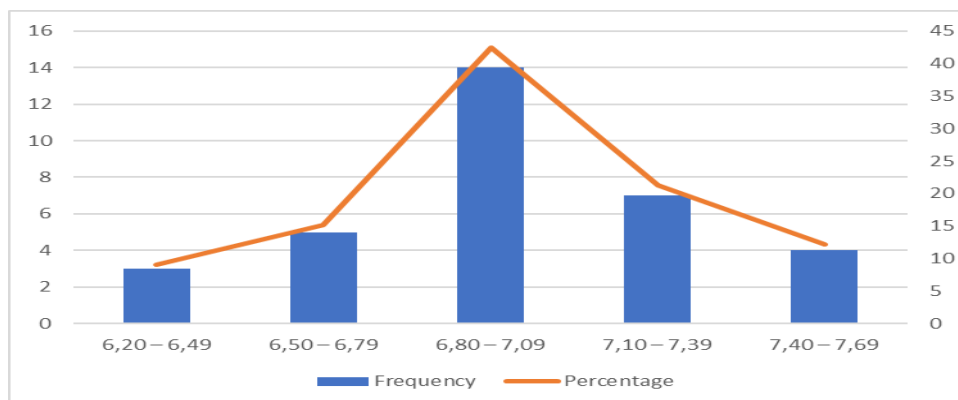


Figure 1. Arm Muscle Power Histogram

The frequency distribution of flexibility scores for students who were subjects in this research can be seen in table 3. Meanwhile, the histogram of the frequency distribution of flexibility variable scores is shown in figure 2.

Table 3. Frequency Distribution of Flexibility Score (X2)

Interval Class	Frequency	Percentage
27 – 30	6	18,18
31 – 34	12	36,36
35 – 38	7	21,21
39 – 42	7	21,21
43 – 46	0	0
47 – 50	1	3,03
total	33	100,00

Based on the analysis data above, it is known that the frequency value for flexibility is 6 people, a percentage of 18.18 with an interval class of 27 – 30. Of 12 people, a percentage of 36.36 with an interval class of 31 – 34. Of 7 people, a percentage of 21.21 with interval class 35 – 38. 7 people, percentage 21.21 with interval class 39 – 42. 0 people, percentage 0 with interval class 43 – 46. 1 person, percentage 3.03 with interval class 47 – 50. The histogram of the results of arm muscle power can be depicted as follows.

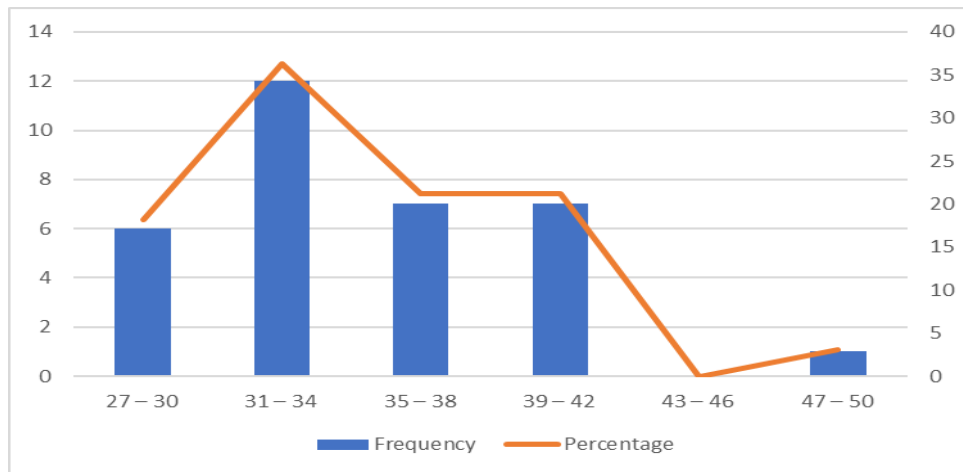


Figure 2. Flexibility Histogram

The frequency distribution of shot put ability scores for the students who were the subjects of this research can be seen in table 4. Meanwhile, the histogram of the frequency distribution of shot put ability variable scores is shown in figure 3.

Table 4. Frequency Distribution of Shot Put Ability Scores (Y)

Interval Class	Frequency	Percentage
5,10 – 5,60	4	12,12
5,61 – 6,10	5	15,15
6,11 – 6,60	6	18,18
6,61 – 7,10	12	36,36
7,11 – 7,60	6	18,18
total	33	100,00

Based on the analysis data above, it is known that the frequency value for shot put ability is 4 people, a percentage of 12.12 with an interval class of 5.10 – 5.60. 5 people, percentage 15.15 with class interval 5.61 – 6.10. 6 people, percentage 18.18 with class interval 6.11 – 6.60. 12 people, percentage 36.36 with class interval 6.61 – 7.10. 6 people, percentage 18.18 with class interval 7.11 – 7.60. The histogram of the results of arm muscle power can be depicted as follows.

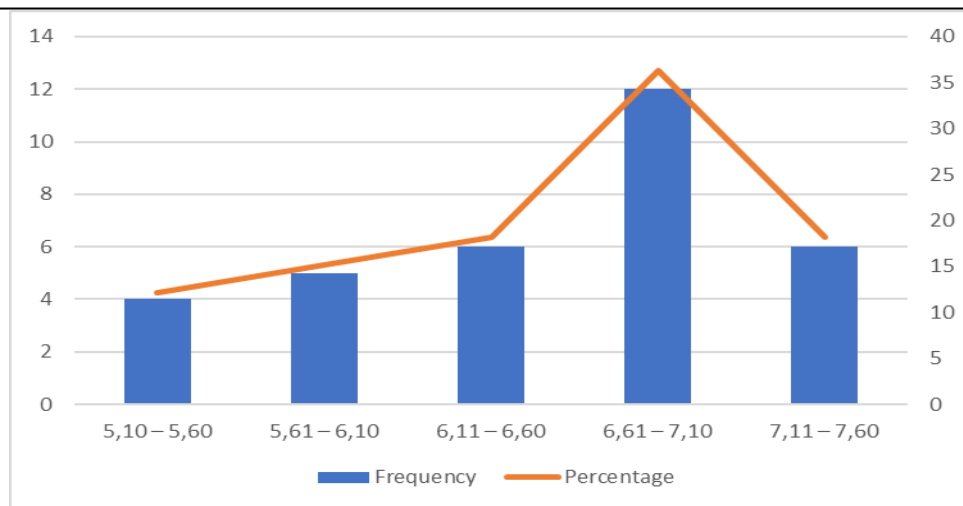


Figure 3. Histogram of Shot Put Ability

For the results of the data normality test on descriptive arm muscle power (X1), flexibility (X2), and shot put ability (Y) are as follows:

Table 5. Normality Test Results of Arm Muscle Power (X1), Flexibility (X2), and Shot Put Ability (Y)

	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	Df	Sig.
Y	0.154	33	0.054	0.949	33	0.121
X1	0.102	33	0.200*	0.972	33	0.547
X2	0.150	33	0.056	0.950	33	0.135

Based on the results of the normality test, there were two experiments carried out using the SPSS application, namely the Kolmogorov Smirnov test. Where the results obtained for the variable arm muscle power were 0.102, spear flexibility was 0.150, and shot put ability was 0.154. Meanwhile, using the normality test with Shapiro Wilk for arm muscle power, it was obtained at 0.547, flexibility at 0.135, and shot put ability at 0.121. From the results of the normality test above, it can be concluded that the value obtained is greater than 0.05 so that the data is normal.

Table 6. Linearity Test Results for Arm Muscle Power (X1), Flexibility (X2), and Shot Put Ability (Y)

Variable	N	α	Fcount	Significance
X1*Y	33	0.05	0,23	0.621
X2*Y	33	0.05	0,42	0.752

Based on the results of the linearity test with a sample size of 33 people, the value of arm muscle power and shot put ability was 0.23 with a significance level of 0.621. Meanwhile, the value of the stick's flexibility and bullet-rejecting ability was obtained at 0.42 with a significance of 0.752. From the results above it can be concluded that the linearity test value is greater than 0.05 so that the data is linear.

The correlation between shot put ability, arm muscle power and flexibility are jointly expressed in the form of a product moment correlation coefficient $r_{12} = 0.946$. The test results provide a significance value of 0.000 which is smaller than the significance level $\alpha = 0.05$. In this case it can be said that the correlation coefficient between the variable shot put ability and arm muscle power and flexibility of the shot put together is significant so that it can be interpreted that there is a significant relationship between the variable shot put ability with arm muscle power and flexibility of the spear. This relationship means that the higher the arm muscle power and flexibility of the spear, the greater the distance that can be achieved in shot put.

Table 7. Correlation of Arm Muscle Power (X1), Flexibility (X2), and Shot Put Ability (Y)

Correlation (r)	Correlation coefficient	Determination		Other Factors (%)
		r ²	%r ²	
r _{X₁Y}	0,946	0,895	89,50	10,50

The magnitude of the contribution of arm muscle power and flexibility of the stick together to shot put ability is shown by the coefficient of determination $r^2 \times 100\% = (0.946)^2 \times 100\% = 89.50\%$. This can be interpreted as 89.50% of the contribution or contribution of the variables of arm muscle power and flexibility of the spear to shot put ability, while the remaining 10.50% is influenced by other variables not studied in this research.

Discussions

Arm muscle power refers to the ability of the arm muscles to produce strength and thrust when performing the shot put movement. It involves a combination of strength, speed, and muscle coordination to create the momentum necessary to throw the bullet as far as possible. According to Power, the arm muscles are the key factor in determining the distance in shot put. The greater the arm muscle strength, the greater the force the athlete can produce to throw the bullet at high speed, which ultimately affects the distance achieved. Strength training specifically for the arm muscles, such as weight training, explosive training, and speed training, can help in developing arm muscle power. A structured and focused approach to an exercise program can significantly increase an athlete's arm muscle strength.

Various methods can be used to measure arm muscle power, including maximal strength tests, speed tests, and explosive strength tests. Using the right tools and technology can help coaches and athletes monitor the development of arm muscle power over time, which can influence overall shot put technique. Athletes with greater arm muscle power tend to have better control over shot put movements and are able to maintain body stability and coordination needed to achieve optimal performance (Hasanuddin & Hasyim, 2023).

Shot put flexibility refers to the flexibility of the back and shoulder muscles that allows athletes to achieve optimal range of motion in the shot put movement. Adequate flexibility allows athletes to perform shot put movements more smoothly and efficiently. Flexibility is very important in maintaining correct body posture and optimal range of motion when performing shot put (Hisham Ali Al-Aqra, 2022). Flexible muscles allow athletes to perform movements more freely and avoid injuries caused by improper movements.

Regular shot put flexibility training can help increase the range of motion in the shoulders and back, which in turn can improve the athlete's ability to perform shot put movements more efficiently. Static stretching, dynamic stretching, and relaxation techniques can be used to increase flexibility. Adequate flexibility of the shot put is also an important factor in preventing injury when doing the shot put. Flexible muscles are better able to absorb the pressure and stress that occurs during the shot put movement, which can reduce the risk of injury to the shoulders, back and other parts of the body.

According to Hashimoto et al., (2023), muscle power is an important element in creating the power needed to throw a bullet a significant distance. The greater the strength of the arm muscles, the greater the pushing force the athlete can produce, which contributes to a greater distance. The flexibility of the shot put allows athletes to achieve optimal range of motion in the shot put movement. With adequate flexibility, athletes can maintain proper posture and perform movements smoothly, potentially improving performance and reducing the risk of injury.

The relationship between arm muscle power and stick flexibility is an important factor in shot put ability. Although arm muscle strength is important in generating pushing force, flexibility also plays a key role in maintaining optimal technique and range of motion. It is important for trainers to design training programs that include exercises to increase arm muscle power and flexibility in a balanced way. An integrated approach can help optimize athletes' performance in shot put by strengthening these two important aspects. By paying attention to these aspects, a discussion of arm muscle power and flexibility of the shot put and shot put ability helps in understanding the complexity of the physical factors involved in this sport. With better understanding, coaches can design more effective and focused training programs to help athletes reach their maximum performance potential in shot put.

CONCLUSION

Arm muscle strength is a key factor in generating the force necessary to throw a bullet a significant distance. The greater the strength of the arm muscles, the greater the pushing force the athlete can produce, which contributes to a greater distance. The flexibility of the shot put allows athletes to achieve optimal range of motion in the shot put movement. With adequate flexibility, athletes can maintain correct body posture and perform movements smoothly, which has the potential to improve performance and reduce the risk of injury. So arm muscle power and stick flexibility are important in shot put ability. Although arm muscle strength is

important in generating pushing force, flexibility also plays a key role in maintaining optimal technique and range of motion.

The greater the strength of the arm muscles, the greater the pushing force the athlete can produce so that the impact is greater over a greater distance. So arm muscle strength and stick flexibility are important in shot put ability. Although arm muscle strength is important in generating thrust, flexibility also plays an important role in maintaining optimal technique and range of motion.

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