



**STUDY OF CORRELATION BETWEEN POWER OF THE ARM  
MUSCLE AND ROM (RANGE OF MOTION) OF SHOULDER WITH  
THE RESULTS OF 9 METERS DISTANCE SHOOTING IN PETANQUE  
ATHLETE FACULTY OF SPORT SCIENCE STATE  
UNIVERSITY OF JAKARTA, INDONESIA**

**Ramdan Pelana<sup>1</sup>,**  
**Anom Ripki Irfansyah<sup>2</sup>,**  
**Yasep Setiakarnawijaya<sup>3</sup>**  
Sports Science Faculty,  
State University of Jakarta,  
Campus B, Jakarta,  
Indonesia

**Abstract:**

This study aims to (1) determine the correlation between the explosive power of the arm muscles and the results of shooting 9 meters in Petanque athletes at the Jakarta State University (FIO) Sports Faculty, (2) to determine the correlation between ROM (Range of Motion) and shooting results of 9 meters distance of UNJ's Petanque FIO athlete, (3) determine correlation between arm muscle explosive and shoulder ROM with the results of 9-meters distance shooting of UNJ Petanque FIO athlete. This type of research is correlational. The method used is quantitative with correlation techniques, measuring and recording the results of the test. The population in this study were 31 members of the UNJ Petanque FIO. The sampling technique is purposive sampling. The instruments used in this study were arm muscle explosive test, ROM Shoulder measurement, shooting distance of 9 meters. Data analysis used was regression test. The results showed that: 1) There was a significant correlation between the explosive power of the arm muscles and the results of shooting 9 meters distance of UNJ Petanque FIO athletes indicated by the  $t_{value} = 2.212 >$  from  $t_{table} = 2.101$ , this means coefficient  $r_{x1y} = 0.462$  was significant. 2) There was a significant correlation between ROM of shoulder and the results of shooting 9 meters distance from UNJ FIAN Petanque athletes indicated by the value of  $t_{count} = 2.815 >$  from  $t_{table} = 2.101$  means that the coefficient of  $r_{x2y} = 0.553$  was significant. 3) There was a significant correlation between arm muscle explosiveness and ROM of shoulder with the results of shooting 9 meters distance of UNJ FIO Petanque athletes indicated by the  $F_{value} = 6.286 >$  from  $F_{table} = 3.59$  which means the  $R_{y1-2}$  correlation coefficient = 0.652 was significant. Thus it can be concluded that the contribution of arm muscle explosiveness and ROM of

shoulder with the results of shooting 9 meters distance was 42.5% and the remaining 57.5% was affected by other variables.

**Keywords:** arm muscle explosion, Petanque, shoulder range of motion, shooting

## 1. Introduction

Petanque Sports is a form of ball game that aims to throw an iron ball as close as possible to a wooden ball called a jack / jack / boka and the foot must be in a small circle. In Indonesia, Petanque's sport was included in the 2011 Sea Games event in Palembang. Petanque Indonesia Sports Federation (FOPI) is the national organization of the Petanque sport in Indonesia. This sport can be played by anyone without any age restrictions, everyone can play this sport. This sport can be used for recreation or to kill the leisure time or even aim the achievement. In Petanque, there are 2 types of throws that determine the game in this sport, namely pointing and shooting. According to Gilles (2015) pointing is a throw that aims to bring the iron ball that we throw to the jack or boka, while according to Puttman (2011) shooting is to keep the opponent's ball near the jack area. Petanque's sport entered Jakarta in 2012, under the lecturers of the Faculty of Sport Sciences, Jakarta State University (FIK UNJ) at that time. In the same time, the organization of the UNJ Petanque Sports Club (KOP) was created.

Explosive power is the amount of effort carried out in units of time, it is a combination of speed and strength (Widiastuti, 2014). According to Bompa (2009) explosive power is the result of two abilities, maximum speed and maximum strength in the shortest possible time. In some cases explosive power is affected by internal and external factors, internal factors of sex, weight, length of limbs, physical fitness, and age. The external factor is the ambient temperature and air humidity. The explosive power of the arm muscles is the effort that results from maximum speed and maximum strength carried out by the body of the arm. The explosive power of the arm muscles is one of the supporting factors when doing a shooting throw at the Petanque sport.

ROM or range of motion is the full motion carried out by the joint between two bone, which results in large angular motion. (Kisner & Colby, 2014). ROM in health can be interpreted as a movement exercise carried out by the joints which aims to maintain joint flexibility from the stiffness or limitation of motion that occurs in the bones or joints. ROM is very closely related to flexibility in the body, the better the body's shape the better the scope of the joint. There are several ROM movements, namely flexion, extension, hyperextension, abduction, adduction, rotation, eversion, inversion, pronation, supination, and opposition. All of which are moved in the joints in the members of our body. On the shoulder there is a movement of abduction, adduction, extension, flexion. When shooting at Petanque, the shoulder performs an active movement of flexion, extension and hyperextension. Movement of the arm that swings from front to back while holding the ball that aims to get explosive power to throw. The angular

magnitude produced by the shoulder increases the chances of success in shooting at the Petanque sport.

A Petanque sport is determined by several factors such as the athlete's internal / psychological condition, environmental conditions, and the rhythm of the match. The rhythm of this match is seen from the location of the boka far or near, and the strategy of play to attack or defend. Games such as a distance of 9 meters and above are very difficult distances, due to distance, extra power is also a good technique. Victory can be achieved if we successfully make a throw, especially during shooting, the more we succeed in shooting the more chance we will win.

Therefore, the purpose of this study was to determine (1) Is there a correlation between arm muscle explosive power with the results of 9-meter distance shooting throws of Petanque athletes at the Jakarta State University Faculty of Sports Sciences (FIO UNJ)? (2) Is there a ROM (range of motion) of shoulder correlation with the results of a 9-meter distance shooting throw of the UNJ FIO Petanque athlete? (3) Is there a correlation between the range of motion of the shoulder and the arm muscles to the results of a 9-meter distance shooting of the UNJ FIO Petanque athlete?.

## **2. Material and Methods**

### **2.1 Samples**

The research was conducted at the Faculty of Sport Sciences (FIO) Petanque Field Campus B, Jakarta State University (UNJ), on July 27, 2018. The population in this study were 31 UNJ Petanque FIO athletes. The sampling technique is purposive sampling (Soekidjo N, 2010), with criteria, namely 1) active member of Petanque FIO UNJ 2) physical health 3) willing to take part in the study 4) present at the study. So the number of samples obtained is 20 samples or athletes. All participants were asked to fill out a health questionnaire and provided informed consent to participate in this study. All of the procedures were approved by the ethics committee of the Jakarta State University.

### **2.2 Data Collection Techniques**

#### **A. Power measurement of arm muscles**

The tool used was kettlebell weighing 4 kg, meter 10 meter and circle. First, the athletes enter into a circle like when they going to do a shooting while holding kettlebell, after that the athlete throws the kettlebell 3 times as far as possible, and takes the farthest distance from the 3 throws.

#### **B. Measurement of shoulder ROM**

The used tools are: note paper, black tape, Handphone camera or Kinovea Application digital camera. To measure shoulder ROM, sample shoots and then measuring the results of shooting. By using a ball, when throwing, from the right side it will take data on the range of shoulder motion when the shooting happens. The data taken is the

farthest point of hyperectency of the shoulder when holding the ball to the side of the body. Data is taken 2 times. And taken from the results of a successful ball.

### C. Measurement of shooting results

The tools used, Petanque fields, stationery, circles, iron balls, circles d = 1m for the target. The way in which the athlete throws an iron ball 20 times, then records the success of the target. It is considered a failure or invalid when the boule thrown falls outside the target circle, the foot is raised and stepped on the circle.

### 2.3 Statistical Analysis

We used regression analysis, to assess the relationship between arm muscle power, range of motion shoulder and shooting skill.

## 3. Results

**Table 1:** Data Result of Participants

Variable	Arm Muscle Power (m/meter)	Range of Motion Shoulder (degree / °)	Shooting Skill (score)
Maximum Value	7.8	90	13
Minimum Value	4.5	50	2
Modus	5	80	9
Mean	6.08	71.75	6.85
Standard Deviation	1.089	12.09	2.903
Median	6.35	75	7.5

### 3.1 Variable Arm Muscle Power ( $X_1$ )

The results of the study in Table 1 show the range of Arm Muscle Power ( $X_1$ ) is between 4.5 m to 7.8 m, the average value is 6.08 m, the modus is 5 m, the standard deviation is 1.089 m, and the median 6.35 m. Frequency distribution can be seen from table 2 below:

**Table 2:** Data Arm Muscle Power

No	Interval Class	Median	Frequency	
			Absolute	Relative (%)
1	4.5 – 5	4.75	7	35
2	5.1 – 5.6	5.35	1	5
3	5.7 – 6.2	5.95	1	5
4	6.3 – 6.8	6.55	5	25
5	6.9 – 7.4	7.15	3	15
6	7.5 – 8	7.75	3	15
Total			20	100

Based on table 2 when compared with the average value, it is seen that respondents who are in absolute number 1 are 7 respondents with relative frequency = 35 while those below the average in absolute number 4 are 5 respondents with relative frequency

= 25, and respondents who were above average in absolute frequencies number 1, 2, 5, and 6 were 8 respondents with a relative frequency = 40.

### 3.2 Variable ROM (Range of Motion) Shoulder ( $X_2$ )

The results of the study in Table 1 show that the range of motion ( $X_2$ ) ranges are 50 ° to 90 °, the average value is 71.75 ° modus degree is 80 °, standard deviation is 12.09 °, and median is 75 °. Frequency distribution can be seen from table 3 below.

**Table 3:** Data ROM (Range Of Motion) Shoulder

No	Interval Class	Median	Frequency	
			Absolute	Relative (%)
1	50 - 57	53.5	3	15
2	58 - 65	61.5	4	20
3	66 - 73	69.5	2	10
4	74 - 81	77.5	7	35
5	82 - 89	85.5	2	10
6	90 - 97	93.5	2	10
Total			20	100

Based on the table above when compared with the average value, it is seen that respondents are in absolute number 4 as many as 7 respondents with relative frequency = 35 and below average in absolute frequency number 2 while as many as respondents with relative frequency = 20, while respondents which is above the average frequency number 1, 3, 5 and 6 as much as the relative frequency = 45.

### 3.3 Variable shooting results Distance 9 meters (Y)

The results of the study in table 1 show the range of shooting results (Y) is between 2 to 13, the average value is 6.65, the standard deviation is 2.903 and the median is 7.5. Frequency distribution can be seen from table 4 below.

**Table 4:** Data shooting Distance 9 Meters

No	Interval Class	Median	Frequency	
			Absolute	Relative (%)
1	2 - 3	2.5	4	20
2	4 - 5	4.5	2	10
3	6 - 7	6.5	4	20
4	8 - 9	8.5	8	40
5	10 - 11	10.5	1	5
6	12 - 13	12.5	1	5
Total			20	100

Based on table above, compared with the average value, it is seen that respondents who are in absolute number 4 are 8 respondents with Relative Frequency = 40, and those below the average of 1 and 3, with each respondent 4 in absolute frequencies of each =

20, while respondents who are above average in absolute frequencies number 2, 5 and number 6 are 4 respondents with Relative Frequency numbers 3, 4 and number 5 = 20.

### 3.4 Correlation Between Arm Muscle Explosion ( $X_1$ ) with Shooting Skills Distance of 9 meters (Y)

The correlation between Y is expressed by the regression equation  $\hat{Y} = -0.6348 + 1.4836$ , meaning that the shooting results can be known or estimated by the regression equation, if the variable is known. The relationship with Y is shown by the coefficient = 0.462. After calculation, it is obtained = 2.212 greater than = 2.101. Which means the correlation coefficient = 0.462 states that there is a significant correlation between Y. Thus, the arm muscle power variable toward the results of shooting throws has an effect of 21.3%, designated by the output of the regression test results that the value is 0.213. While the rest is influenced by other factors.

### 3.5 ROM (Range of Motion) Relationship Shoulder ( $X_2$ ) with Shooting Skills Distance of 9 meters (Y)

The correlation between Y is shown by the regression equation  $\hat{Y} = -0.2682 + 0.1327$ , meaning that the shooting results can be known or estimated by the regression equation, if the variable is known. The correlation with Y is shown by the coefficient = 0.553. After calculation, it is obtained = 2.815 greater than = 2.101. Which means the correlation coefficient = 0.553 states that there is a significant correlation between Y. Thus, the variable ROM (Range Of Motion) shoulder to the results of shooting, has an effect of 30.5%, designated by the output of the regression test results that the value is 0.305. While the rest is influenced by other factors.

### 3.6 Correlation Between Shoulder Muscle Power ( $X_1$ ) and ROM (Range of Motion) Shoulder ( $X_2$ ) with Shooting Skills Distance of 9 meters (Y)

The correlation  $X_1$  and  $X_2$  with Y is shown by the regression equation  $\hat{Y} = -7.069 + 0.949 + 0.1136$ , meaning that shooting skills can be estimated by the regression equation, if the Arm Muscle Power and ROM (Range of Motion) of the shoulder are known. The correlation with Y is shown by the coefficient = 0.652. After calculation, it is obtained = 6.286 greater than = 3.59. Which means that the correlation coefficient = 0.652 states that there is a significant correlation between and against Y. Thus, the variable arm power and ROM (Range of Motion) of the shoulder to the results of 9-meter shooting distance has an effect of 42.5%, designated by output the regression test results that the value is 0.425. While the rest is affected by other factors.

## 4. Discussion

The explosive power is the amount of effort carried out in units of time, a combination of speed and strength. Just as the meaning of explosive power is the result of two

abilities, maximum speed and maximum strength in the shortest possible time. The explosive power is the ability to produce a large amount of energy in the shortest amount of time possible. Therefore, strength is a supporting factor of explosive power, strong muscles will make fast movements with great power, so that in explosive power training must also involve the speed of motion in it. Internal factors are factors that originate in the athlete's own body including: gender, weight, length of limbs, physical fitness, and age.

The muscle is an organ that allows the body to contract. The arm has two parts, namely the upper arm and forearm. The arm has muscles that are a source of strength. The muscles in the arms include: coracobrachialis, biceps, triceps, brachialis, brachioradialis, deltoid, palmaris longus, flexor carpi ulnaris, flexor carpi radialis, flexor digitorum superficialis, flexor pollicis longus, pronator quadratus, extensor carpi radialis longus, extensor carpi radialis, extensor carpi radialis longus, extensor carpi ulnaris, supinator, abductor pollicis longus, extensor pollicis brevis, extensor pollicis longus.

#### **4.1 Range of Motion (ROM) Shoulders**

The connection between bones is called articulations. In order to move, a special structure is called a joint. With the presence of joints, it helps facilitate movement. The joints that make up the human skeleton are found in several places. ROM or Range of motion is the full motion carried out by the joint between two bones, which results in large angular motion. According to Perry S, ROM is a collection of a number of movements produced by 3 members of the body's movers.

ROM (Range of Motion) is the maximum amount of movement that a joint can do in one of three body parts, namely sagittal, transverse and frontal. Understanding other ROMs is a joint movement exercise that allows contraction and muscle movement, where the client moves each joint according to normal movements either actively or passively. There are two types of ROM, namely:

- a. Active ROM, which is a movement carried out by someone (patient) using their own energy. The nurse provides motivation, and guides the client in carrying out joint movements independently according to the range of normal joint motion (active client). 75% muscle strength. This is to train the flexibility and strength of muscles and joints by actively using the muscles.
- b. Passive ROM, which is the energy released for training comes from other people (nurses) or a facilitator. The nurse moves the client's joints according to the normal range of motion (passive client). 50% muscle strength. The indications of passive exercise are semicomatose and unconscious patients, patients with limited mobilization are not able to do some or all of the range of motion independently, patients with total bed rest or patients with total paralysis. This passive range of motion is useful for maintaining flexibility in the muscles and joints by passively moving other people's muscles, for example, the nurse raises and moves the patient's legs.

## 4.2 Shooting Skills in Petanque Sports.

The skills are simply defined as an ability to carry out tasks that have specific goals to be achieved. While William H. Edwards defines skills as a measure of the success of the quality of movement and produces constant motion that is correct to achieve certain goals. Thus, skill is the ability of a person to make a move with a purpose. To make our ball immediately hit the opponent's ball with the aim of dropping it from the jack it is called shooting in petanque. And shooting is a type of throw to drive the opponent away from the target (boka).

Shooting is one of the basic techniques of throwing in petanque, to drive the opponent away from the target boka. This technique is needed when opposing bosi is close to boka. The essence of the difficulty level of shooting techniques is also affected by the position of the body, the position of the foot that must be stable when the ball is carried out, so that all members of the body have a good balance.

Shooting is actually a series in Petanque's game because it really determines the game. It is also a strategy to play petanque whether to attack or defend, if you attack then the game of petanque will shoot more than pointing.

Some things to do in shooting techniques, are:

## 4.3 Arm and Grip (how to hold the ball)

When holding the ball of fingers and palms must be tight but not gripping the ball tightly, the ball only attaches to the knuckles, so that when throwing the ball it will be easily directed to follow the knuckles and get a good alignment of the ball.

The power source or the throwing pivot of the shooting technique lies in the swing of the arm, there are two core movements when throwing the ball; the backward swing and forward swing, the result's movement is like a pendulum movement, the backward swing must be slower to get the peak of the swing and then swing in the future, which has a greater speed than the backward swing, when making a forward swing there is no jerking of the arm, the greater the jerking motion, the more movement will be generated so that the swing control becomes unbalanced, it aims to have a swing naturally do not use large force so that the resulting throw has a good level of straightness or accuracy.

In addition to grip the ball, the wrist also affects the results of shooting techniques, openings on the wrist can increase energy and produce ball heights which will later determine the angle of throw, with the opening of the thrown ball the wrist will experience a back spin.

The origin of the word petanque is *pieds tanques*, which means that the feet stick to the ground, so that if there are obstacles on the feet, it must clean or tidy up the surface of the ground until it is really comfortable. There are a number of foot positions when performing shooting techniques, but one of the most efficient positions is the foot which is a pile, is the same foot as the hand that throws the ball, if the throw uses the right hand then use the right foot and vice versa, it aims so that the position of the body has a balance, the position of the knee is not too bent which can lead to coordination of



arm swing with a foot stack not in harmony or in rhythm. But the knee is also not locked, this can cause movement to become stiff.

The view when making shooting techniques must be focused on the target of throwing when doing the view must be fixed on the target because it will stimulate the brain to order muscles or movements that are a series of movement; from the swing of the arm to opening the wrist until the end of the technique movement shooting.

## 5. Conclusion

In our study, there is a significant correlation between muscle power and 9 meter distance shooting with a correlation coefficient of 0.462. The linear regression equation with the equation  $\hat{Y} = -0,6348 + 1.4836$ , with a contribution of 21.3% of the arm muscle explosive power to the shooting result of a distance of 9 meters. There is a significant correlation between ROM (Range of Motion) of the shoulder and the results of shooting at a distance of 9 meters with a correlation coefficient of 0.553.

The linear regression equation with the equation  $\hat{Y} = -0.2682 + 0.1327$ , with a contribution of 30.5% from ROM (Range of Motion) Shoulder to the results of shooting distance of 9 meters. There is a significant correlation between muscle explosive power and ROM (Range of Motion) of the shoulder to the results of shooting 9 meters distance the correlation coefficient of 0.652. Multiple regression equation with equation  $\hat{Y} = -7,069 + 0,949 + 0,1136$ , with a contribution of 42,5% of muscle power and ROM (Range of Motion) of the shoulder to the results of shooting distance of 9 meters

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