



## **Effectiveness of muscle force and speed of movement carreau shot at distances of 6 and 7-meter Petanque sport**

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**Abstract:** There are several techniques in Petanque, including the roll, gentle lob, and full lob. The problem is that the point in the shot in Petanque was not optimal. The study aims to analyze the muscle strength factor/impulse force and speed of movement to produce a carreau shot. The study is a quantitative study with a descriptive approach and survey method. Data obtained from the analysis of the Kinovea application software version 0.9.4 involving 9 people sample. The results of this study showed a distance of 6 and 7 meters (average  $\pm$  std. dev), i.e.: 1) muscle strength or pulse  $4.73 \text{ N} \pm 0.36 \text{ N}$  and  $4.58 \text{ N} \pm 0.35 \text{ N}$ . 2) movement speed in backswing phase  $0.85 \text{ m/s} \pm 0.42 \text{ m/s}$  and  $0.59 \text{ m/s} \pm 0.27 \text{ m/s}$ , swing phase  $3.26 \text{ m/s} \pm 0.67 \text{ m/s}$  and  $3.17 \text{ m/s} \pm 0.78 \text{ m/s}$ , and release phase  $8.89 \text{ m/s} \pm 0.75 \text{ m/s}$  and  $8.37 \text{ m/s} \pm 0.58 \text{ m/s}$ . The conclusion is that shooting a carreau at a distance of 6 and 7 meters in this study obtained an average score of 17./14 in the middle category with a percentage of 31.5%/25.9%. This study was used as a reference to the trainer making a training program for each athlete to get a high-precision shot.

**Keywords:** muscle force, petanque, speed of movement.

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### **INTRODUCTION**

Sport is crucial to enhancing the reputation of a nation or an institution (Fajar et al., 2023; Pratiwi et al., 2018; Wisnu, 2022). Sports have become so popular not only as a physical activity but also as a means of fostering many other values and traits. Sports can foster the development of values such as sportsmanship, fair play, athletics, teamwork, and nationalism (Alimuddin et al., 2021; Lituhayu et al., 2023; Rahman, 2018; Terok & Huwae, 2021). Sports can help people develop their social, emotional, and cognitive abilities. Petanque is a sport where the emotional component depends on several factors, such as accuracy and focus. This reasonably priced sport is accessible to people of all ages and can be played anywhere as long as there is a firm or hard surface (Bustomi et al., 2020; Irawan, Ghassani, et al., 2022; Rusli et al., 2023). Petanque is a French game in which players roll iron balls as close to a wooden ball as they can, using a technique known as pointing. There are several techniques for pointing as well, including the roll, gentle lob, and full lob. In addition, there are other shots—perhaps better described as shooting techniques—that force the opponent's ball out of the target box. There are a few different approaches, including a ground shot, a short shot, and an iron shot (Okilanda et al., 2018; Sabilla et al., 2021).

A unique shooting game in which players must follow the official FIPJP (Federation Internationale de Petanque et jeu Provençal) rules in order to score as many points as they can. Athletes affiliated with Petanque UNNES (State University of Semarang) UKM (Student Activities Unit) have not been able to earn the full 100 points available in this category. One of the reasons UNNES Petanque competitors can't reach the top score is because of their inconsistent shooting, which is affected by movement or mechanics. Therefore, it's critical to analyse the motion's mechanics



in order to throw with the highest consistency and earn points during competition (Pasaribu et al., 2021).

Compatible with study Sinaga, & Ibrahim, (2019) It was stated that the four main markers that determine the shot are the backswing, release, swing/downswing, and ball height. There is relationship and interaction between these four indicators. Shots can be classified into four categories: touche, manque, reussi, and carreau. Throwing the ball to the target and replacing it with the thrown ball is known as a carreau. If the carreau shot meets the current regulations or specifications, it is deemed successful. Phases, sections, and indicators used in SHOOTING to produce consistent precision or accuracy, according to a study by Ardhiyanto, (2021) if the angle and point of the shot remain the same, the shot is considered consistent.

Why research biomechanics in sports? Sports biomechanics is necessary for trainers, physical education teachers, and other individuals involved in certain physical activities (Faoziyah & Suharjana, 2020; Umar et al., 2022; Wijaya et al., 2021). Choosing the equipment that athletes will use, beginning with talent identification, technique training, technique evaluation, and therapeutic training (movement technique formation exercises) (Emery & Tyreman, 2009; Ma'dum & Irawan, 2021; Sukadiono et al., 2022). The height of the ball, the angle or point at which the ball falls against the target, and the thrower's movement or mechanics all affect how the throw turns out (Gilles, 2015; Hamed et al., 2023; Rusdiana et al., 2019). The petanque game's movement or biomechanics have a big impact on how the shots turn out. Additionally, the biomechanics of petanques can reduce the likelihood of injury, reducing the need for analysis when shooting the petanque and offering evaluation to enhance movement when a problem or obstacle arises (Dyky & Kusuma, 2021; Irawan & Paulina, 2022). There are two important aspects in the biomechanics of petanque sports that are muscle force and speed of movement to get accurate and optimal shooting results.

Muscle force or muscle contraction is the force that exists in the human body that is useful to move the body with desire or purpose. The muscle force in the petanque sport is used to move the arm with the aim of throwing the ball towards the target. Without muscle strength, the ball thrown will not move or be thrown away. Lifting and holding the ball also requires muscle power. So, it's important to measure the muscle force used to throw the ball so it gets thrown accurately to the target (Kurniawan, 2010; Yachsie et al., 2022).

Speed is the ability to travel a certain distance in a short time. The speed of the arm movements is the result of the great influence of muscle strength or muscle contraction as well as how big the angle is used on the shoulder. The velocity of the arms movements will contribute to the ball thrown in the petanque sport when the player performs the shooting technique and contributes to the distance at which the ball falls. In petanque, there are three shooting moves: backwing, swing/downswing, and release. The smaller the angle on the shoulder, the greater the speed of movement in the arm to produce long distances (Abdillah, 2016; Marlina et al., 2023).

It is concluded that there are inconsistent results when shooting at 6 and 7 metres at obstacle 1 based on the observations made by the researchers from the POMPROV (Multievent for Students has Studies in University Level) 2022 at the UNNES (State University of Semarang) petanque field. The distance between 6 and 7 is the study's focus. The six-meter mark marks both the starting distance at which the player shoots and the beginning of the distance that determines the subsequent distance result. This is significant because when throwing, the ball must travel a certain distance in a row. Prior research provides a good explanation of the average angle and the optimal angle for a carreau shot when no other factors are present. Researchers were interested in analysing the consistency of a shot or shot in a petanque game where there were two factors, namely the contribution of muscle force/push and speed of movement, based on the issues discovered or prior literacy (Friskawati & Supriadi, 2022; Irawan et al., 2019; Puspaningtyas et al., 2022). Because version 0.9.4 is a video analysis tool for exercising in one of the sports by slowing down the movements that need to be examined and recorded, the researchers used it to assist in conducting the analysis (Surahman, 2020). The benefits of kinovea software version 0.9.4 include the ability to slow down movements so they can be recorded and used as assessment material, which facilitates movement analysis through video exercises (Irawan et al., 2021; Jariono et al., 2020).

**METHODS**

This study is quantitative descriptive using survey methods to describe data that has been collected systematically, finding the effectiveness of muscle style and the speed of the carreau shooting movement at distances of 6 and 7 meters at the resistance one (Maidiana, 2021; Sugiyono, 2017). The study aims to analyze the pulse muscle style and movement speed of three indicators, namely: 1) backswing phase; 2) swing/downswing phases; and 3) release phase. Research was carried out in the UNNES petanque field and samples were taken based on the following criteria: 1) active students who are members of the Petanque UNNES; 2) have participated in competitions, mainly in shooting games. The total sample in this study based on these characteristics was 9 people, consisting of 5 males and 4 females.

The following methods of gathering data were employed: 1) observation, which involved watching UNNES petanque athletes compete in events and complete exercises, particularly in shooting where a thrower's motions can affect the score. 2) Documentation: gathering and examining past match results, which are utilised as corroborating evidence in this research; additionally, recording or photographing the athlete as a sample with a digital camera to record movement during the shoot, with the analysis performed using the Kinovea software version 0.9.4. 3) Test: an exercise in accurate shooting. The purpose of this test is to ascertain how values add up when shooting a game.

**Table 1.** Precision Shooting Norms

Category	Value Acquisition
Very Low	$X \leq 8$
Low	$8 < X \leq 13$
Keep	$13 < X \leq 18$
Tall	$18 < X \leq 23$
Very high	$23 < X$

(Source: Gilles, 2015)

The shooting precision norm is used to determine the category of the result of the shot. The procedure used is to do six throws of each sample. By processing the percentage data obtained using the formula from Azahrah et al., (2021) that is:

$$NP = (n/N) \times 100\%$$

Information:

NP: Value in %

n: Earned value

N: Overall numbers

**RESULT AND DISCUSSION**

Data was taken from nine athletes who were samples of this study. Each sample performed six shots, and data collection was done on shots that had carreau category or had a five-value. The results of the study of the effectiveness of muscle strength and speed of movement at a distance of 6 and 7 meters at barrier/resistance 1 in petanque sports can be seen in the following table.

**Table 2.** Muscle Force or Thrust Exerted at a Distance of 6-Meters

N=9	Min	Max	Mean	Std. Deviation
Spherical Mass (g)	680	690	680	0.00
Max Ball Height (m)	1.02	1.83	1.37	0.23
Max Ball Height Distance (m)	1.77	2.25	1.98	0.14
Max Ball Boost Time (s)	0.28	0.43	0.34	0.04
Max Ball High Speed (m/s)	5.06	6.64	5.78	0.48
Time of Falling Ball (s)	0.76	1.00	0.87	0.07
Ball Falling Speed (m/s)	6.00	7.89	6.93	0.52
Final Time (s)	0.48	0.57	0.53	0.03
Final Speed (m/s)	10.53	12.50	11.45	0.68
Acceleration (ms <sup>2</sup> )	21.53	58.81	32.62	8.85
Muscle Force (N)	4.14	5.45	4.73	0.36

**Table 3.** Muscle Force or Thrust Exerted at a Distance of 7-Meters

N=9	Min	Max	Mean	Std. Deviation
Spherical Mass (g)	680	690	680	0.00
Max Ball Height (m)	1.37	2.04	1.76	0.22
Max Ball Height Distance (m)	2.41	3.19	2.78	0.26
Max Ball Boost Time (s)	0.39	0.50	0.45	0.03
Max Ball High Speed (m/s)	5.28	7.10	6.25	0.57
Time of Falling Ball (s)	0.93	1.19	1.05	0.08
Ball Falling Speed (m/s)	5.88	7.53	6.70	0.50
Final Time (s)	0.53	0.72	0.60	0.06
Final Speed (m/s)	9.72	13.21	11.67	1.01
Acceleration (ms <sup>2</sup> )	17.76	55.49	37.78	11.43
Muscle Force (N)	4.00	5.19	4.58	0.35

Table 2 and 3 are the results of the muscle force or hand push force to produce carreau shots 6 and 7 metres in petanque sports. From the result of both tables, it is explained that the value obtained experienced an average increase with a range of one meter. However, at a distance of 7 meters resulted in a standard value deviation above 1 more.

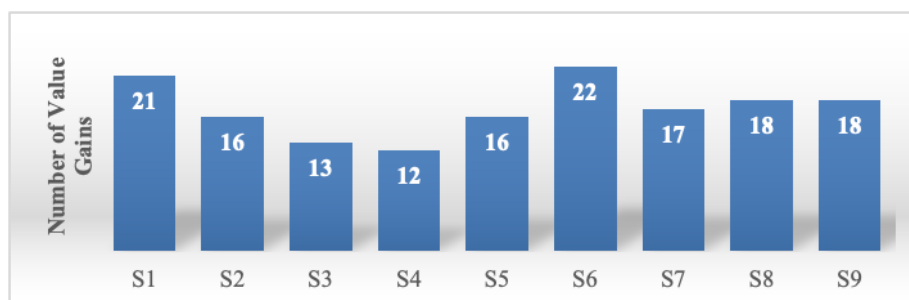
**Table 4.** Speed of Movement Caused at a Distance of 6-Meters

N=9	Min	Max	Mean	Std. Deviation
Backswing Distance (m)	1.23	2.41	1.86	0.36
Backswing Time (s)	1.17	4.10	2.64	1.07
Backswing Speed (m/s)	0.44	1.72	0.85	0.42
Swing Distance (m)	1.19	1.72	1.35	0.16
Swing Time (s)	0.33	0.50	0.42	0.05
Swing Speed (m/s)	2.41	4.35	3.26	0.67
Release Distance (m)	0.22	0.30	0.27	0.02
Release Time (s)	0.03	0.03	0.03	0.00
Release Speed (m/s)	7.24	9.86	8.89	0.75

**Table 5.** Speed of Movement Caused at a Distance of 7-Meters

N=9	Min	Max	Mean	Std. Deviation
Backswing Distance (m)	1.21	2.55	1.75	0.39
Backswing Time (s)	1.94	4.30	3.24	0.85
Backswing Speed (m/s)	0.39	1.31	0.59	0.27
Swing Distance (m)	1.16	1.68	1.29	0.15
Swing Time (s)	0.33	0.49	0.42	0.06
Swing Speed (m/s)	2.47	4.54	3.17	0.78
Release Distance (m)	0.21	0.28	0.25	0.02
Release Time (s)	0.03	0.03	0.03	0.00
Release Speed (m/s)	7.05	9.22	8.37	0.58

Tables 4 and 5 describe the results obtained in terms of the carreau movement speed of 6 and 7 metres in petanque sports. From the results of the table 4-5, it is explained that the value obtaining the average increase with the range of one meter. However, at the distance of 7 meters the average standard deviation is lower than at 6 meters.



**Figure 1.** The Result Obtained a Shot Value at a Distance of 6-Meters

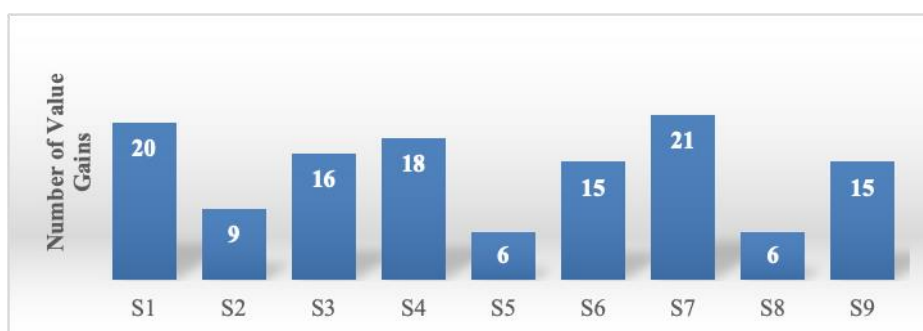


Figure 2. The Result Obtained a Shot Value at a Distance of 7-Meters

Figures 1 and 2 describe the values obtained by the sample at a distance of 6 and 7 meters by performing six repetitions.

Four acquisition values are associated with Petanque's special sports numbers on resistance 1: manque (value 0), touch (value 1), reussi (value 3), and carreau (value 5). Six repetitions were conducted on each sample in the study conducted at a distance of six metres. Counting the accumulation of shots, the total number of shots was 54, consisting of 19 carreau shots, 18 reussi shells, 4 touch shots, and 13 manque shots. The angle of the shoulder joints, hips, wrists, waist, and knees determines the overall outcome. In addition to the joint angle, other variables include the ball's height, the time it takes to release from the backswing phase, the distance it travels, and its variable speed (6–7 metres per second). The maximum height of the ball and muscle strength or touch vary depending on the outcome of each movement segment. The first distance of the shot that will influence or determine the shot at the next distance is six metres. The accuracy level should increase with proximity to the target, according to theory (Irawan & Ghassani, 2022).

It also needs regular exercise or repetitive motion exercises to produce a high level of accuracy. Consequently, in this sport, a six-meter distance ought to result in a high score. Anxiety levels will be higher when shooting from a six-meter range (Irawan, Ma'dum, et al., 2022). The highest sample for males, with a score of 20, is included in the high category, and for females, with a rating of 21, is placed in the higher category, considering the acquisition at a distance of 7 metres. In this sport, a 7-meter distance is considered a follow-up or second distance, following a 6-meter distance. The distance between each subsequent distance is one metre. The distance of seven metres decides if a person accumulates or receives the same score. The result of the shooting at the next distance is also determined by this distance, so it is equally as significant as the previous one. According to the theory of inaccuracies, this distance is less accurate than the last one (Irawan & Prastiwi, 2022). Nonetheless, a lot of athletes prefer this distance and get more points from it than from the distance before or after (Irawan & Munir, 2022). The most likely explanation is that anxiety is reduced in this distance when exercise places greater emphasis on it. It would be ideal for the athlete to be able to master every distance in order to achieve the highest score and accomplishment in this sport.

Turning your hand back from the starting position is known as the backswing phase in pétanque shooting. The swing/downswing movement will be longer, and the hand/touch muscle strength will be lower the longer the wrist distance from the vertebrae/back. The following phase movement is impacted by the backswing phase. The arm swing from behind to forward is known as the Swing/Downswing phase in petanque shooting. In petanque shooting, the ball moves out of the palm during the release phase. The release phase is used to calculate the ball's release based on the target or the distance that is available. The swing or downswing movement is longer and requires less hand contact or muscle force the longer the release distance. The ball's release direction is influenced by the release phase.

Hand muscle/touch force is a forward hand push with the weight of a petanque ball aimed at producing a carreau shot at the 1st obstacle in the sport. The strength of the muscle or touch of the hand is obtained from the multiplication between the mass of the object and the speed of the ball. The maximum height of the ball thrown has a strong influence on the outcome of the shot, and the shot that has the highest score is the carreau shot. These findings suggest that in order to achieve peak performance when shooting petanque, it's critical to examine the biomechanics. The primary objective

of petanque players is to shoot carreau, as it yields the highest score. The backswing phase, the swing/downswing phase, and the release phase are the three stages of shooting. The ball's angle, time, speed, distance travelled, and height vary depending on the phase (Irawan & Ghassani, 2022). This feature will influence the ball's maximum height, end speed at a specific distance, and muscle or touch strength, all of which will contribute to a shot that meets the target. Thus, before beginning training for the next level, it is crucial to focus on the initial internal factors. The outcomes presented in this article can serve as a guide for training petanque athletes to perform at their best.

### CONCLUSION

The results of the study revealed that there was an increase in the average value of muscle force/push strength from a distance of 6 meters to the distance of 7 meters. With this result, the average standard deviation also increased. In the direction of the aspect of the speed of movement there is an average increase in value and there is the average decrease in standard deviation. However, the average score of a shot dropped from 17 to 14 in the medium category. More clearly, there was a decrease in the average percentage of the shot score from 31.5% to 25.9%. The value was derived from the range of one meter.

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