

Correlation study between arm muscle endurance and arm length with pointing accuracy in Petanque

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Abstract:

Indonesian Petanque has contributed a Bronze medal to the Indonesian contingent at the 2015 Singapore SEA GAMES, but at the next SEA GAMES until 2019 Indonesian Petanque did not contribute any medals to the Indonesian contingent. Petanque games is determined by the accuracy of boules throw at the target of each game. Indonesian athletes lack of accuracy and consistency both in pointing and shooting during the games. Result of Both Pointing and Shooting depend on many factors including Arm Muscle Endurance and Arm Length. Unfortunately, only a few scientific studies have been reported exploring this sport. This study aimed to determine a correlation between the arm muscle endurance and the arm length with the accuracy of Pointing at distance of 8 m as a dominant distance in Petanque Games in Indonesia. A total of 38 athletes from all regions of greater Jakarta whom member of UNJ Petanque Club participated in the research voluntarily. Each participant is informed about the details of the research at the meeting conducted before the research. Each participant expressed approval to participate in the study verbally. Subjects in this study consisted of men (n = 20) and women (n = 18) aged between 18 years to 23 years with an average of $20,617 \pm 1.50$, height ranging from 158 cm to 173 cm with an average of 167.28 ± 1.31 . The study was conducted in the Petanque Court at UNJ Sport Complex in Jakarta, Indonesia. Data of Arm Muscle Endurance was collected by Flexed Arm Hang Test, Arm Length using Segmometer and Pointing Accuracy using Petanque Pointing Test. Data was analysed by regression and correlation analysis techniques. The results are, there are significant correlation between Arm Muscle Endurance and Arm Length with Pointing Accuracy ($r=0.602$ and $r=0.695$ respectively) and significant multiple correlation ($R=0.704$). The coefficient determination as $(R^2_{Y12}) = 0.496$. It was determined that 49.6% of the Pointing accuracy were due to the multiple effect of arm muscle endurance and the arm length. Based on these results, there was a significant relationship between arm muscle endurance and arm length and the pointing accuracy in petanque. Thus, to improve pointing accuracy the coach need to improve Arm Muscle Endurance of athletes.

Key Words: Flexed arm Hang, Body Segmentation, Boules Sport, Specific muscle endurance

Introduction

Petanque is a sport originating from Provence, France, which has become commonplace in several European countries. This game can be played by people of all ages, both male and female, so petanque is growing fast and is quite popular in Europe (Eler & Eler, 2018). To be developed into an achievement sport, this sport is standardized and rules are made by the formation of the main organization, namely Federation Internationale de Petanque et Jeu Provençal (FIPJP). It was found in 1958 in Marseille, France. The presence in Indonesia has not been known because several facts of this sport have existed since the 1990s, especially in hotels owned by France where the petanque sport is used as a means of supporting the hotel. However, petanque development and known to the public since 2011 when Indonesia hosted the 26th SEA GAMES in Jakarta – Palembang. Petanque is an achievement sport that is starting to be in demand by many people. Starting from children, adults, to the elderly can play it (Souef, 2015: 20). Petanque is a form of game that has the main goal of throwing an iron ball to get as close as possible to a wooden ball commonly called a cochonnet or boka and the position of both feet must be in a circle, therefore petanque sports have a character that tends to require accuracy (Caca Isa Saleh, 2012).

Petanque is played using an iron ball that has a diameter of 70-80 mm and weighs 650-800 grams (Laksana, Pramono & Mukkaromah, 2017; Loser et al., 2011; Suwanto, Kristiyanto, & Doewes, 2018). Petanque games can be played anywhere, as long as they are on a hard surface, but it is not recommended to play on grass or concrete (Tri Sutrisna, 2018). Petanque has 2 game techniques, namely pointing and pointing (Smith 1999, Friska Sari Gracia Sinaga, 2019). The pointing technique is a technique of delivering an iron ball (bosi) to be as close as possible to a wooden ball (boka) as a target. While the Pointing technique is a technique that aims to keep the opponent's bosi (iron ball) away from the boka (wooden ball). Pointing is a technique to bring the ball closer to the intended target. There are 3 pointing techniques, namely, rolling pointing (ball along the ground),

half-lob pointing (ball tossed slightly), high-lob pointing (ball is bounced high). Pointing rolling is suitable for fields that have a dense and hard soil texture. Half-lob pointing is suitable for all types of courts. High-lob pointing is suitable for soft court types. In doing the pointing technique, athletes can do it by squatting or standing. Pointing squats are usually done at a distance of 6-8 meters. As for standing pointing, it is usually done while playing at a distance of 8-10 meters.

In the petanque game the person who points is called a pointer (Kristanto, 2020). Pointers serve as the first determinant of strategy and rhythm in a match. Therefore a pointer plays an important role in the petanque game. If a pointer plays less than the maximum, the strategy that will be used will also not work well. It can even be said that the chances of winning the match will also be smaller. Petanque is a sport that requires very high concentration to support pointing techniques and pointing techniques. Because in one petanque match it can take 1-3 hours of playing time. Therefore, petanque athletes must be able to maintain concentration in order to do pointing and pointing with good results. In achievement coaching there are 4 pillars, namely mental (concentration, confidence, motivation, and anxiety), physical (physiological, biomotor, anthropometric), technique (pointing and pointing skills), and tactics (intelligence games when competing), this is the training pyramid. (Tudor O. Bompá, PhD & G. Gregory Haff, 2009). A person's physical appearance is also influenced by psychological factors. Physical development, psychological well-being and health when influencing a person in carrying out any sports activities. Skill factors include: movement coordination, reaction time, and so on. Physical factors in terms of anthropometry (weight, height, leg length, ability to move and others). Psychological and behavioral factors include (achievement motive, intelligence, self-actualization, independence, aggressiveness, emotion, self-confidence, motivation, enthusiasm, sense of responsibility, social sense, desire to win and so on.

Arm length, height, wrist flexibility, arm muscle strength, hand eye coordination and finally balance are the dominant physical factors that determine a petanque achievement (Adhe Oktaria Bustomi, 2020). Arm length is the distance between the top of the arm (humerus) and the ulna (ulna). (Prasetiadi, 2016:24). Arm length is influential in pointing because if the petanque athlete has long arms, the distance between the ball release and the target will be closer compared to athletes who have short arms.

For petanque athletes there are several factors that must be considered to support the success of an athlete. One of them is in making the throw, these factor in general as follows: throwing technique, arm endurance, mental, accuracy of decision, making on the technique used. With physical strength and endurance, a person will be more confident in throwing his boules so that it will produce an accurate throw. According to Sajoto (1988) muscle endurance shows the ability of a muscle or a group of arm muscles to carry out its duties for a long time. Muscle endurance according to Widiastuti (2017) is "The muscle capacity contracts continuously at the level of submaximal intensity." Regarding muscle endurance, Russel R Pate (1993) explains that "muscular endurance is muscle endurance which is very much determined by and closely related to muscle strength."

So the techniques for developing muscle endurance are very similar to those used to increase strength. Arm muscle endurance is very much needed in petanque sports, because with the ability of the arm muscles to be able to do throwing techniques, especially in this case the player is able to throw a greater number of pointing throws and of course right on target. Unfortunately, only a few scientific studies have been reported exploring this sport (Fong, Yam, Chu, Cheung, & Chan, 2012; Huang, Pan, Ou, Yu, & Tsai, 2014; Tsai, Yu, Huang, & Cheng, 2014).

Method

A total of 38 athletes from all regions of greater Jakarta whom member of UNJ Petanque Club participated in the research voluntarily. Each participant is informed about the details of the research at the meeting conducted before the research. Each participant expressed approval to participate in the study verbally. The research was conducted during the Covid 19 pandemic in Indonesia. Due to the Covid 19 pandemic, research needs to obtained permission from the Government by implementing Health Protocols such as limiting the number of participants, Wearing Masks, Washing Hands and giving hand sanitizer to participants. Participants in this study consisted of men (n = 20) and women (n = 18) aged between 18 years to 23 years with an average of $20,617 \pm 1.50$, height ranging from 158 cm to 173 cm with an average of 167.28 ± 1.31 .

All participants had one session of measurement conducted at UNJ Petanque Club in Jakarta Indonesia. Each participant completed a anthropometric questionnaire in a seat that has been arranged in such a way with a minimum distance of 1.5 m between seats. Participants were then called one by one to take Arm Length measurements. So that there is no accumulation of participants in one measurement post. Arm Length measurement using Flexible Sgmmometer (Cescorf Flexible Sgmmometer, CESCORF Equipamentos, Porto Alegre, Brazil) is recorded with a precision of close to 0.1 cm. Participants were instructed to take a breath and then hold their heads up when Arm Length measurements were performed. After the participants completed the arm length measurement then participants took a Petanque Pointing Test at the court and after that doing Flexe Hang Test to measure Arm Muscle Endurance. All measurements are performed by the same measurement team that has been given prior training.

After all the data is collected, the data is inputted into a form that has been provided. Descriptive statistics (min, max, mean, and standard deviation) for each indicator are calculated. After this, Simple Linear Regression and Multiple Linear Regression tests are conducted to determine association between Arm Muscle Endurance and Arm Length and Pointing Accuracy. All statistics analysis using SPSS software version 26.

Results

Table 1. Statistic Description of Arm Muscle Endurance, Arm Length and Pointing Accuracy

		Arm Muscle Endurance	Arm Length	Pointing Accuracy
N	Valid	38	38	38
	Missing	0	0	0
Mean		45.0526	74.4737	15.4737
Std. Error of Mean		.44458	.38599	.40399
Median		45.5000	74.5000	15.5000
Mode		46.00	72.00 ^a	17.00
Std. Deviation		2.74056	2.37938	2.49038
Variance		7.511	5.661	6.202
Minimum		40.00	70.00	11.00
Maximum		51.00	79.00	20.00

a. Multiple modes exist. The smallest value is shown

The data from the arm muscle endurance (X_1) measurement ranged from 40 to 51 with an average of 45.05, a standard deviation of 2.74 and a variance of 7.51. Below shows the frequency distribution for the arm muscle endurance data:

Table 2. Frequency Distribution of Arm Muscle Endurance (X_1)

No.	Interval Class	Median	Frequency	
			Absolute	Relative
1	40-42	41	8	21,0%
2	43-45	44	11	29,0%
3	46-48	47	15	39,5%
4	49-51	50	4	10,5%
Amount			38	100

The data from the measurement of arm length (X_2) was in the range of 70 to 79 with an average of 74.47 and a standard deviation of 2.30, variance of 5.6. Below shows the frequency distribution of the arm length data.

Table 3. Frequency Distribution of Arm Length (X_2)

No.	Interval Class	Median	Frequency	
			Absolute	Relative
1	69-71	70	3	7,9%
2	72-74	73	16	42,1%
3	75-77	76	13	34,2%
4	78-80	79	6	15,8%
Amount			38	100

The data from the measurement of pointing accuracy (Y) was in the range of 11 to 20 with an average of 15.47 and a standard deviation of 2.49, variance of 6.2. Below shows the frequency distribution of the arm length data.

Table 4. Frequency Distribution of Pointing Accuracy (Y)

No.	Interval Class	Median	Frequency	
			Absolute	Relative
1	10-12	11	5	13,1%
2	13-15	14	14	36,9%
3	16-18	17	14	36,9%
4	19-21	20	4	13,1%
Amount			38	100

The relationship between arm muscle endurance (X_1) and the pointing accuracy Y is expressed by the regression equation $\hat{Y} = -9.177 + 0.547X_1$. This means that the pointing accuracy can be estimated by the regression equation if the variable arm muscle endurance (X_1) is known. The relationship between arm muscle

endurance (X_1) and the pointing accuracy (Y) is shown by the correlation coefficient of $ry_1 = 0.602$, and this correlation coefficient must be tested first in terms of significance before it can be used to draw conclusions. The test for the significance of the correlation coefficient above showed that $p\text{-value} = 0.000$, meaning that the correlation coefficient $ry_1 = 0.602$ was significant. Thus, the hypothesis that there is a significant relationship between the endurance of arm muscles (X_1) and the pointing accuracy (Y) is supported by the data. The coefficient of determination for the endurance of the arm muscles in the pointing accuracy (RY_1) = 0.363. Thus, 36.3% of pointing accuracy was determined by the endurance of the arm muscles (X_1).

The relationship between the length of the arm (X_2) and the pointing accuracy (Y) is expressed by the regression equation $\hat{Y} = -38.735 + 0.728X_2$. This means that the pointing accuracy can be estimated by the regression equation if the variable arm length (X_2) is known. The relationship between the length of the arm (X_2) and the pointing accuracy (Y) is shown by the correlation coefficient $ry_2 = 0.695$; the correlation coefficient must be tested in terms of significance before it can be used to draw conclusions. The test for the significance of the correlation coefficient above showed that $p\text{-value} = 0.000$, which means that the correlation coefficient $ry_2 = 0.695$ was significant. Thus, the hypothesis that there is a significant relationship between the length of the arm (X_2) and the pointing accuracy (Y) is supported by the data. The coefficient of determination for arm length in terms of pointing accuracy (RY_2) = 0.484. Thus, 48.4% of the pointing accuracy was determined by the length of the arm (X_2).

The relationship between arm muscle endurance (X_1) and arm length (X_2) with the pointing accuracy (Y) is expressed by the multiple regression equation $Y = -35.562 + 0.156X_1 + 0.591X_2$. The relationship between the three variables is shown by the correlation coefficient $RY_{12} = 0.704$, and the correlation coefficient must be tested in terms of significance before it can be used to draw conclusions. The significance test of the correlation coefficient above showed that $p\text{-value} = 0.000$, confirming that the correlation coefficient $RY_{12} = 0.704$ was significant. The coefficient of determination (RY_{12}) = 0.496. This means that 49.6% of the pointing accuracy is determined by the endurance of the arm muscle (X_1) and the length of the arm (X_2) combined.

Discussion

Petanque is a sport that requires coordination, arm muscle endurance, flexibility, length of pull, arm length, and balance to provide a good throwing technique. Both physical and psychological factors must be supported by good and excellent long lasting training. The physical condition referred to not only has great muscle strength but also must be supported by good muscular endurance so that the athlete's appearance is not only good at the beginning of the match but is consistent until the end of the competition. Important psychological factors include visual coordination (accuracy), feeling of motion (feeling/sense of kinesthetics), concentration and emotional balance. Research conducted in Japan shows that accuracy can be improved by improving cognitive abilities through various videos watched by athletes. By frequently watching videos about a technique, it will visualize how to do the technique so that it will have an impact on the movement that is in accordance with what is visualized. (Hiromitsu et al 2021). Petanque sport is a sport that demands good accuracy (Widodo & Hafidz, 2018). Accuracy is the key to success as well as the goal to get the iron ball closer to the wooden ball. The sport of petanque is the same as the sport of bocchia. Playing petanque and bocchia requires great tactical ability and concentration by the player, the ability to analyze the game, as well as good accuracy (Reina, Domínguez-Díez, Urbán, & Roldán, 2018).

Sport, generally understood as motor activity, aimed at the wellness and health of the person, at healthy competitive play, can be intended as a tool for promoting those values necessary for the person to live well with himself and with others. Sport activity has always been a very educational discipline, since its origins. In fact, being a very widespread cultural phenomenon, it has educational and value implications that require the critical attention of pedagogy (Tinning, 2008). The physical condition is an integral part of components that cannot be separated, in terms of both improvement and maintenance. If an athlete is in good physical condition, there will be signs of an improvement in his abilities when carrying out motion. Efficient motion will form proportional motion, which means doing it economically and with automation. The flawless motion of an athlete can prevent them self from injury. (rucco at el 2020)

A player must have a good pointing technique so that the throwing results are good, and this technique is also influenced by how the player's position is standing, how his attitude is when making the throw and so on. This means that the pointing movement is not just as long as throwing the ball towards the target but at the angle at which the ball is released. This is what makes a player's arm length affect the result of the throw, because when the throwing motion occurs the range between the ball's point of release and the target point of the ball will be closer so that the percentage of hitting the target will be high. There is a direct effect of arm muscle endurance on the results of a pointing accuracy in Petanque. (kholifatul, 2020)

Petanque comparatively demands a very specific strength and endurance for successful intermittent repetitive pointing and performance, both during training and competitions. Compared to other strength or endurance events, it does not require very high demanding efforts in terms of strength and endurance fitness areas, yet, in its own sense, it demands much fitness to result in accurate pointing (Açıkada et al., 2019). In petanque, the arm is a major factor in determining the accuracy because arm muscle strength and arm balance

play a very important role in the ability of athlete to direct boules to predetermined targets area (M. Ilham, 2014). With good endurance skills, the movements will remain constant and stable during the process of training and at competitions.

Many factors influence success in petanque, and two factors include the physical condition and ability to move (Muladana, A. 2019). The elements that support these achievements need to be pursued so that they can support the optimal results. Based on our observations in the field and the results of fostering petanque athletes at regional and national levels, these two factors are very dominant. In petanque, arm muscle endurance is in high demand considering the amount of push and pull force that must be done continuously by the arm muscles. Endurance will have a big influence on the pointing rhythm of the athlete. Moreover, the arm length affects the athlete's arm range, which gives additional power to the boules so it can maintain the pointing accuracy.

It is our opinion that the physical aspect is the most important factor in petanque. This is supported by our study and data analysis, which showed that 36.3% of the pointing accuracy was determined by arm muscle endurance, and 48.4% of the pointing accuracy was determined by the arm length, whereas 49.6% of the pointing accuracy was determined by the combination of the arm muscle endurance and arm length. Of course, this can be the basis for other studies to determine how much other physical aspects contribute to determining petanque performance.

Compared with several studies that have been carried out related to petanque, this study was high in terms of novelty. Thus far, research has only been related to the biomotor, technique, and psychology components separately or together but has never examined the meaningful relationship between the biomotor components and the anatomy of athletes themselves, because the athlete's anatomy is also very important (Kristanto, A. A. (2020). In addition to the factors that affect pointing, it must also be considered the factors that affect muscle endurance. Among the factors that must be considered are precooling and warming up before doing exercise and competition because these two things greatly affect muscle endurance. (Rajeswaran et al, 2011). In other studies, it can be seen that an increase in muscle endurance can occur as long as athletes participate in championships. The more often and more athletes take part in the championship, the more their muscle endurance will increase (Abdelaziz D, 2011).

Therefore, we recommend that coaches pay more attention to the anatomical and biomotor components of athletes combined when carrying out training programs in the field. This is so that exercise can be done optimally to increase athletic performance. In addition, we also recommend other researchers look more closely at the anatomical factors of athletes associated with the biomotor, technical or psychological components in combination. This is aimed at the talent scouting process carried out in the field because, by looking at an athlete's anatomy, the talent scouting process will be easier and more effective.

Conclusions

According to this study, there is a significant relationship between combined arm muscle endurance and arm length and the pointing accuracy in petanque. Thus, the factors that support the pointing accuracy must be mutually supportive and reinforcing. Along with this study, we argue that it is still necessary to know and examine others factors that affect the pointing accuracy and calculate the multiple correlation. This will help to determine what factors most influence the pointing accuracy so the coach can choose the most suitable training method to improve each of the factors that affect the accuracy.

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