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The accuracy of shooting petanque iron balls: Effectiveness of resistance band training

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ABSTRACT

Background Problems: There is an integration of strategy, calmness, and accuracy in petanque. Various training forms focus on several parts of the arm muscles to increase the stability of the arm muscles and the ability to throw the ball on target, however, no one has developed a training method that can enhance both accuracy and muscular strength. **Research Objectives:** This research aims to determine the effect of resistance band exercises on shooting accuracy in petanque athletes. **Methods:** This research employed a quasi-experimental method with a pretest-posttest approach and a control group design. The research subjects were divided into two groups (experimental and control) and given different treatments. The total number of research subjects consisted of 40 athletes with an average age of 21.43 ± 2.4 , a weight 56.07 ± 2.33 , a height 170.41 ± 5.12 , and a BMI 19.86 ± 2.56 . Data analysis was tested using a one-way ANOVA to compare the two groups. **Findings and Results:** The research results indicated that resistance band exercises for 16 weeks had a positive and statistically significant impact on increasing shooting accuracy in the experimental group compared to the control group in petanque athletes. **Conclusion:** The study found that resistance band training significantly improved throwing ability and accuracy among petanque athletes. The study lays solid groundwork for future research in this area and provides actionable recommendations for coaches and athletes seeking to enhance performance in petanque. It also stresses how important it is to look at other factors that might affect performance, like stroke technique and psychological aspects, in future research in order to improve training methods and accuracy assessment methods and get a full picture of how to improve petanque performance.

Keywords: Accuracy; shooting; pétanque; iron ball; resistance bands



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INTRODUCTION

²Petanque is a new sport in the world that uses small balls (boules) made of iron, or, in other words, “bosi” (iron balls). The Petanque game produces 13 points, preventing the opponent from reaching that number (Irawan et al., 2022; Pelana et al., 2021; Phytanza et al., 2022). The confederation of Mondiale Sport Boules states that Petanque is a game (boule) that involves throwing an iron ball towards a wooden ball (Jack), and both feet must form a small circle (hoop). There are also special shooting competitions (Solihin et al., 2022; Syahwira et al., 2022; Ulpiana et al., 2022). Petanque is contemporary sport enjoyed by many executives and

the public to maintain fitness (Ashari & Yulianti, 2022; Irawan et al., 2022; Kent & Hayes, 2021; Syahwira et al., 2022).

Interest in the sport of petanque usually occurs because it is easy to carry out movements and can be performed in indoor areas. Therefore, petanque is starting to be enjoyed by many people. Economical and affordable equipment has helped many communities emerge. Petanque is a type of small ball sport that is precise, accurate, and strategic (Makorohim et al., 2022; Putra et al., 2023; Rhamadha et al., 2023). It is supported by the fact that the character of petanque sports tends to require precision, no matter what age, position, or gender can play the sport (Perdana et al., 2022). However, based on its primary mechanical purpose, the game of petanque is a sport whose goal is to achieve maximum accuracy. Primarily, the throw must be stopped or hit by the targeted throw; thus, the result gets winning points (Bustomi et al., 2020).

This research was motivated by petanque athletes' shooting abilities, whose achievements were inconsistent during matches or competitions (Irham et al., 2022; Perdana et al., 2022). There were still many petanque athletes who only employed personal perception when throwing iron balls, without the support of muscle abilities or correct throwing techniques. Finger grip on the iron balls and the preparation phase of throwing can be maximised with good muscle ability and flexibility. The more perfect the direction of arm movement, the more effective and efficient throwing outcomes could be provided without exerting much force (Lubis et al., 2023). It took time and was based on experience in the field. However, for technical ability and the preparation phase for good throwing, additional forms of training for petanque athletes were required; hence, arm muscle support could improve athlete accuracy (Selva et al., 2023).

The realm of research in Petanque still lacks diversity, particularly in the domain of shooting accuracy. While some studies have implemented throwing accuracy programmes based on distance, such as utilising a shooting station ranging from 6 to 9 metres (Rony et al., 2021). The exploration of this topic remains limited. One study concluded that the method of accuracy training significantly influenced the results of iron ball throwing (Phytanza et al., 2022). However, the focus has mainly been on setting up hoops at various distances without delving into other potential factors. Other research has touched upon the influence of training on shooting accuracy in Petanque, discussing aspects like arm length, endurance, and confidence (Irawan et al., 2022; Lubis et al., 2023; Selva et al., 2023). Notably, a study emphasised the direct impact of arm length, arm muscle endurance, and self-confidence on shooting outcomes, with a significant correlation observed between arm length, muscle endurance, and confidence (Pelana et al., 2021). Despite these findings, a gap exists in understanding how maximum muscle strength affects accuracy results, particularly considering the repetitive nature of the activity and its implications for muscle endurance. Exploring this aspect could provide valuable insights into optimising training strategies and improving performance in Petanque shooting.

While existing literature studies have explored various aspects of throwing accuracy training, they often neglect the comprehensive evaluation of specific training methods' impact on throwing results, disregarding crucial factors such as petanque athletes' technique and muscle abilities, and relying solely on a limited range of distances (Phytanza et al., 2022). Consequently, the potential benefits of resistance exercises on throwing outcomes, including enhancements in contraction ability, explosiveness, and precision, remain largely unexplored (Banitalebi et al., 2021; Stojanović et al., 2021). Moreover, some studies have exclusively focused on mental aspects (Pelana et al., 2021), or movement analysis (Bustomi et al., 2020). Overlooking the holistic development of pétanque athletes' throwing skills.

Recognising the urgent need to equip coaches with effective training methodologies, there is a clear gap in the existing literature regarding rigorous control measures and the absence of comprehensive training methods designed to simultaneously improve accuracy and muscular strength in petanque athletes. Consequently, the incorporation of resistance bands into training regimens emerges as a promising avenue, providing targeted training modalities that are easily accessible through common media platforms. To address these shortcomings and contribute to the advancement of petanque training methodologies, this research initiative aims to investigate the efficacy of resistance exercises in enhancing both accuracy and muscular strength among petanque athletes. By systematically evaluating the impact of resistance training on throwing outcomes and addressing the limitations of previous research, this study endeavours to provide practical insights for optimising petanque training protocols and enhancing athletes' performance.

METHOD

Research Design

This research employed a quasi-experimental method with a pretest-posttest approach and a control group design. The research subjects were divided into two groups (experimental and control) and given different treatments. The experimental group was given a resistance band exercise programme for the upper and lower body twice weekly for 60 minutes per training session, which was carried out for 16 weeks. Meanwhile, the control group was not trained or treated during the same period. Furthermore, other measured research parameters included age, weight, height, and BMI, as well as a shooting accuracy test by simulating an actual match. Several parameters were taken before and after carrying out the training treatment. .

Research Subjects

The total subjects involved in this research were 40 petanque athletes (20 people as the experimental group and 20 as the control group) from sports students at Jambi University. Subjects were selected based on inclusion criteria, including males, being in good health, not experiencing acute or chronic injuries, and being active as athletes with a minimum of 6 hours of training time per week.

Research Procedures and Measurements

Anthropometry

Age data was collected using a questionnaire distributed at the end of the lecture meeting conducted offline. Then, body height was measured using a CA-brand manual stature metre, carried out directly by the researcher. Body weight measurements were obtained using SECA 762 brand scales. BMI was done using metric units, namely dividing body weight (kilogrammes) by body height squared (metres) (Santos et al., 2014).

Shooting Accuracy Test

The accuracy of petanque shooting in this research was measured using a shooting test. This test aimed to measure the athlete's accuracy when shooting. The tools and facilities included iron balls, hoops, shooting game stands, and stationery. The distance between the standing position and the target was 6-9 metres. In the initial implementation stage, the subject stood in a circle, holding the ball, and looked straight at the target. Then, the subject started with the body leaning forward and both arms swinging backward. Furthermore, the subject swung one of his most muscular arms forward and released the ball towards the target. All subjects must complete the shooting circuit up to station 5, and the results recorded were points from one ball throw (Bragazzi et al., 2020). Shooting data was collected twice, namely during the pretest and posttest.

Resistance Band Exercise Program

The experimental group was given training by following a resistance band (RB) programme for 60 minutes per session (07.00-08.00) and carried out two sessions per week for eight weeks. This exercise programme consisted of 10 minutes of warm-up (static and dynamic stretching), 40 minutes of RB, and 10 minutes of cool-down (static stretching). The RB programme included an abdominal curl-up, biceps curl, chest press, front shoulder raise, lateral shoulder raise, seated row, triceps extension, calf raises, chair squad, hip extension, hip flexion, standing abduction, standing adduction, and toe raise. Exercise intensity, including the number of repetitions, increased progressively every two weeks. The exercise intensity was set at three sets (90-second intervals per set) with 8-15 repetitions. Initial training began with a yellow band: 8 repetitions in weeks 1-4, 10 repetitions in weeks 5-6, 12 repetitions in weeks 7-8, and 15 repetitions in weeks 9-10. Then, in weeks 11-16, use the red ribbon: 10 repetitions in weeks 11-12, 12 repetitions in weeks 13-14, and 15 repetitions in weeks 15-16. The RB programme was supervised and directed by a licensed bodybuilding instructor. Details of the RB programme can be seen in Table 1.

Table 1. Resistance Band Exercise Program

Program	Content	Intensity	Frequency
Warm-up	Static and Dynamic Stretching		
	Upper Body	Lower Body	
Main exercise	Abdominal curl-up	Calf raises	8 rep (1-4 weeks)
	Biceps curl	Chair squat	10 rep (5-6 weeks)
	Chest press	Hip extension	12 rep (7-8 weeks)
	Front shoulder raise	Hip flexion	15 rep (9-10 weeks)
	Lateral shoulder raise	Hip abduction	10 rep (11-12)
	Seated row	Hip adduction	12 rep (13-14 weeks)
	Triceps extension	Toe raise	15 rep (15-16 weeks)
Cool down	Static stretching		

Data Analysis

The research data was presented as average values and standard deviations. Anthropometric data such as age, weight, height, and BMI were tested using one-way analysis or one-way ANOVA to compare the two groups. Then, the shooting accuracy variable was analysed using a paired *t*-test to test the differences between the two groups both before and after being given training treatment. All statistical analyses used the SPSS version 22 application with a significance level of $p < 0.05$.

RESULTS AND DISCUSSION

The results of anthropometric data from the two groups indicated that the average age, weight, height, and BMI did not show any statistically significant differences (See Table 2).

Table 2. Results of Anthropometric Comparison of Experiment vs Control

Variable	Total (N=40)	Group		p-value
		Experiment (n = 20)	Control (n = 20)	
Age (years)	21.43 ± 2.48	21.15 ± 3.14	21.71 ± 1.82	0.403
Weight (kg)	56.07 ± 2.33	55.87 ± 1.73	56.28 ± 2.93	0.301
Height (cm)	170.41 ± 5.12	170.21 ± 4.54	170.62 ± 5.71	0.512
BMI (kg/m ²)	19.86 ± 2.56	19.67 ± 3.21	20.05 ± 1.91	0.115

*significant $p < 0.05$

Table 3. Shooting Test Results in The Experimental Group

Variable	Experiment (N = 20)		Δ%	p-value
	Pretest	Posttest		
Shooting test	7.25 ± 3.02	12.25 ± 4.72	68.9%	0.001*

*significant $p < 0.05$

Table 4. Shooting Test Results in The Control Group

Variable	Control (N=20)		Δ%	p-value
	Pretest	Posttest		
Shooting test	6.75 ± 2.93	7.25 ± 3.43	7.4%	0.058

The research revealed a statistically significant change after the experimental group performed exercises using resistance bands for 16 weeks (p -value < 0.001). It could be seen from the change in delta between the two groups. The experimental group experienced an increase of 68.9%, and the control group experienced only 7.4%. It could be implied that the resistance band exercises positively affected the shooting accuracy of iron balls in petanque athletes. Petanque is a contemporary sport that is rapidly growing, especially in Indonesia. The exercise method is specifically employed to improve performance and achieve a specific goal to meet needs in the field. Research showed that after the experimental group carried out exercise treatment using resistance bands for 16 weeks, there was a statistically significant change (p -value < 0.001). It could be seen from the change in delta between the two groups. The experimental group experienced a more significant

increase than the control. It could be implied that the resistance band exercises positively impacted the accuracy of iron ball shooting in petanque athletes.

The research implementation was motivated by the characteristics of the petanque sport, which tended to require precision regardless of age, position, and gender (Makorohim et al., 2022). Petanque does have the primary goal of achieving maximum accuracy. The iron ball throw must hit the target that has been the target of the throw; hence, the result of the throw gets winning points. If the opponent covers the area, then use the strategy of keeping the opponent's iron ball away from the target of the throw (Bustomi et al., 2020). Until now, no one has specifically applied the use of resistance bands to the utilisation of training programmes in tanque. Only cornball has the same motion similarities, but it still does not have study-based development, so it is difficult to detect the motion analysis. Even so, some sports that have similar characteristics to sports through motion analysis of arm and wrist swings include basketball, tennis, badminton, and handball (Granacher & Behm, 2023; Huang et al., 2023; Lopes et al., 2019; Novak et al., 2023). Handball, for example, is known to have an eight-week study to investigate the effect of forearm resistance band training on throwing speed (Bragazzi et al., 2020).

Participants were divided into two groups that attended regular handball training sessions (three times a week), but the experimental group also participated in a programme specifically aimed at strengthening the forearm muscle region. This programme involved two resistance band exercises after a general warm-up in each regular session. It was found that a significant difference ($p \leq 0.05$) in throwing speed was found between the experimental group, which showed an increase of 8%, and the control group, which showed no increase (Kusumawati et al., 2022; Mascarin et al., 2017). In contrast to the study conducted on wheelchair basketball, the consideration used in the selection of this sport is that it relies more on the upper extremities, so that the dominance of movement will occur in the arm as a determinant of shot accuracy (Chaikhot et al., 2020; Turbanski & Schmidbleicher, 2010). The study focused on the comparison of shooting angles and shooting accuracy in wheelchair basketball players and basketball players, which showed that throwing angles affect clean shots (the ball goes directly into the net without bouncing on the ring or bounce board) in both basketball and wheelchair basketball (Chaikhot et al., 2020; Litchke et al., 2012).

Another finding of this study is that the clean shot angle of wheelchair basketball players is higher than that of basketball players (Litchke et al., 2008; Özdalyan et al., 2022). The reason for this may be due to the more active and superior upper-extremity motor skills of wheelchair basketball players. Difficulty in examining studies similar or identical to the needs of boules shooting skills in petanque makes this study still rare and requires further development due to the very specific motion analysis in the sport branch. Studies on petanque were still not well developed. Previous investigations regarding arm length, arm endurance, and confidence in shooting in the sport of petanque have been proven to have a direct role in throwing results (Pelana et al., 2021; Ulpiana et al., 2022). Five hypotheses on arm length had a direct effect on the results of the petanque shot throw: arm muscle endurance had a direct effect on the results of the petanque throw; self-confidence had a direct effect on the results of the petanque shot throw; arm length and arm muscle endurance had a direct effect on self-confidence. All were proven to have a significant relationship (Solihin et al., 2022); strengthened by the discovery of an exercise programme using distance modification through the application of posts, the instrument used for the ability test (shooting) used a number game (shooting station) of 1–5 with a distance of 6–9 ters. It can be concluded that there is an impact between the accuracy of exercise programmes and shooting results in petanque athletes aged 15-20 (Phytanza et al., 2022).

In addition, there is only one discussion of Petanque, which targets psychological aspects through descriptive assessments. This research stated that mental imagery training had a more significant impact than autogenic mental training on shooting accuracy in Petanque (Solihin et al., 2022; Syahwira et al., 2022). On the other side, the kinesthetic perception was affected by shooting accuracy in the sport of Petanque. An interaction was found between mental imagery, autogenic mental training, and kinesthetic training and perceptions of shooting accuracy in petanque sports. Therefore, it is best to choose athletes with high kinesthetic perception supported by programmed imagery exercises to obtain good petanque shooting accuracy. The research findings focused on discovering the psychological role of athletes in shooting results, which directly impacted throwing results.

No less important, the stages of throwing play a significant role in technical accuracy. The phases of holding the iron balls, foot position, and throwing the iron balls need special attention to steal points (Bustomi et al., 2020). Based on investigations of various literature discussing petanque, throwing accuracy results were influenced by several factors such as arm muscle ability and arm length (Pelana et al., 2021), mental training (Putra et al., 2023; Perdana et al., 2022), movement analysis (Bustomi et al., 2020), and a structured exercise programme through stations with differences in throwing distances that were carried out repeatedly (Phytanza et al., 2022). The research findings could increase the variety of applications of appropriate forms of exercise for petanque athletes. Generally, petanque, which requires precise throwing, needs to be supported by good muscle ability and kinesthetic perception. Thus, selecting athletes and the expected performance outcomes make it more accessible.

CONCLUSION

The study concluded that resistance band training significantly enhanced throwing ability and accuracy among petanque athletes, as demonstrated by a substantial increase in accuracy scores post-intervention compared to the control group's shooting results. The study also suggests that athletes can tailor their training regimen to their individual needs by combining resistance bands with various accuracy drills. However, it's crucial to acknowledge the study's limitations. The relatively small sample size may not adequately represent the diverse population of petanque athletes, and the focus solely on resistance band training neglects other potential variables influencing performance, such as shot technique or psychological factors. Additionally, the method of measuring shot accuracy requires further refinement to ensure the validity and reliability of the findings. Despite these limitations, the study lays solid groundwork for future research in this area and provides actionable recommendations for coaches and athletes seeking to enhance performance in petanque. Furthermore, it emphasizes the importance of considering additional influencing factors, such as stroke technique and psychological aspects, in future studies to refine training methodologies and improve accuracy assessment techniques for a comprehensive understanding of petanque performance optimization.

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CONFLICT OF INTEREST

The authors state there is no conflict of interest.

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