Using a Biomechanical Analysis Approach to the Accuracy of Shooting Throws in Petanque Sport: Literature Review

Boby Helmi
Taufiq Hidayah
Harry Pramono
Mugiyo Hartono
Tatang Iskandar

1Universitas Negeri Semarang
2Universitas Islam 45 Bekasi

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Corresponding Author: Taufiq Hidayah, E-mail: taufiqhidayah@mail.unnes.ac.id
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Abstract

Study Purpose. The purpose of this study was to determine how biomechanical analysis can be used in petanque shooting techniques.

Materials and methods. This review study followed the PRISMA standards for systematic reviews and meta-analyses. Studies had to be published within the previous five years, from January 2019 to July 2023. (1) shooting petanque; (2) biomechanical analysis were the keywords used in the search process. Scopus and the Science and Technology Index (SINTA) were used for study.

Results. This review consists of nine studies. In five research articles, motion analysis was considered, which resulted in a discussion of the direction and angle of petanque throw biomechanics. Four research articles deal with the analysis of petanque shooting accuracy, leading to a discussion of angle, direction, arc, and focus.

Conclusions. Biomechanical analysis helps to understand intensity, speed, and posture for better bidding, improved performance, and reduced risk of injury, while increasing speed and efficiency, preventing muscle imbalances, and achieving better technical positions in shooting petanque sports.

Keywords: biomechanical, accuracy, shooting, petanque.

Introduction

The character of Petanque sports tends to require accuracy, anyone who wants to play Petanque no matter what age, position, gender is allowed to play this sport (Yulingga Nanda Hanief, 2019). Based on the purpose of its main mechanics, petanque games are included in sports that have the aim of achieving maximum accuracy. This means that the throw made must be right on a specific target to get the winning point (Apriani et al., 2021). Various studies have explored different aspects of the sport of petanque. Development of a shooting training model for beginners, emphasizing the importance of throwing accuracy (Badaru, Hasmyati, et al., 2021). Assessing interest in petanque among visitors to specific courses, and finding a mix of low to very high interest (Sahruni et al., 2023). The results highlight the need for training and development in this sport, especially in terms of human resources (Yahya Andi Amry, 2021). The results of the evaluation evaluated the athletes’ shooting ability, identifying a need for improvement in this area (Isdarianti et al., 2022). These studies collectively underscore the importance of training, development and skill enhancement in the sport of petanque.

A systematic literature review is a method used to analyze, synthesize, and summarize the existing literature on a particular topic (Dwidienawati et al., 2023). This method involves a rigorous and systematic approach to collecting and analyzing data from relevant sources (Moher et al., 2015). The purpose of a systematic literature review is to provide a clear and objective summary of the current state of knowledge on a particular topic, identify gaps in the literature and suggest areas for future research. This method is widely used in various fields including education healthcare, sports science, psychology, social science, and business and management (Amjad & Fernandes, 2023).
Various studies have explored the application of biomechanical technology in sport, highlighting its potential in injury prevention, technique improvement and performance optimization (Leckrone, 2021). Biomechanics is the study of human movement and the interaction between forces acting on the human body (Toma & Irawan, 2022). Research in this area has been conducted in several different contexts. Biomechanical analysis in relation to shooting throws in the sport of petanque. It explains how biomechanics affect ball flight and the importance of an accurate ball impact point for a correct shot (Ariwijaya et al., 2021). Various studies have explored the biomechanical aspects of shooting in various sports. Apply mathematical and physical methods to analyze shots, focusing on arm trajectory, shot direction, angle, effort, and velocity (Zhen et al., 2015). The results of another study highlighted the challenge of maintaining postural stability in precision sports such as shooting, proposing a measurement chain to evaluate this aspect (Words, 2000). These studies collectively underscore the importance of biomechanical factors in shooting performance.

Accuracy training One of the factors that can affect the accuracy of shooting in petanque sports so that it is inaccurate and imprecise includes a lack of arm muscle strength and a lack of analyzing biomechanics (Badaru, Kasmad, et al., 2021). The results of the study where accuracy is the ability of an athlete to direct the ball to the intended target or target with a good and perfect landing (Istikomah, 2023). Accuracy in the biomechanical analysis approach is closely related to the accuracy of the shooting point distance and shot power, because of one’s ability to control free movements towards a target.

There have been many studies conducted in the past that have resulted in several developments in improving shooting accuracy in petanque sports, including a model of shooting skills training in petanque sports (Sutrisna et al., 2018), android-based petanque sport module (Wulandari & Wibowo, 2022), Learning Media Video Tutorial Basic Techniques of Petanque Throwing (Ayu et al., 2022).

The main purpose of analyzing the biomechanics of petanque pointing motion is to find out errors in movement and ball motion will create optimal movement, find out errors in performing techniques completely and accurately, and create athletes who have the opportunity to become champions especially in matches. Petanque games are included in sports that have the aim of achieving maximum balance and accuracy. This means that the throws made must be right on certain targets to get the winning points. The character of petanque sports tends to require accuracy, anyone who wants to play petanque no matter how old, position, gender is allowed to play this sport. In accordance with the main purpose of petanque sports into the sport to achieve maximum accuracy.

**Materials and methods**

The words “Biomechanical Analysis” and “Petanuqe Sports” were searched for in articles published from Sinta (Science and Technology Index) and Scopus Collections (Science Citation Index Expanded. Social Science Citation Index. Arts & Humanities Sams Citation Index) from 2019 to 2023. As shown in the flow chart (Figure 1), a total sample of 9 articles was obtained from a total of 137 articles by following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses guidelines. (PRISMA) (Moher et al., 2015) during the identification, suitability screening, and inclusion phases.

The following variables were taken into account in the literature review (a) annual trend of articles published between 2019 and 2023 (b) distribution of first author’s institution (c) number of authors (d) field of study (training, health, other education management or mixed) (e) type of study (experimental, descriptive correlational, longitudinal) and (1) average number of citations per article.

**Statistical Analysis**

The abstract article title and keywords were focused on as these things are sufficient to generate reliable and usable article into for follow-up research. Only open access articles were included in this review study as the authors did not want to exclude anyone who did not have access to their research. The following inclusion and exclusion criteria were used to obtain only relevant studies.

**Result**

Various time periods can be seen in the evolution of the number of publications, as depicted in Figure 2. First, there has been a marked increase in scientific output from 2019 (50 articles). Then in the following year there was a decrease in 2020 (10 articles) in the year there was an increase in 2021.
Biomechanical analysis is used to address the problems that occur in petanque shooting and provide recommendations on what is needed to improve performance.

Discussion

Based on the results of the study, there are four main indicators that determine shooting, namely backswing angle, swing, release angle, and ball height. The four indicators are interrelated and influence each other. The backswing angle will affect the swing speed, and the swing speed will affect the release angle of the ball, and these three indicators will produce the maximum height of the ball. In shooting there is no definite reference to the four indicators (Sinaga & Ibrahim, 2020). There are three indicators in determining the results of the shooting throw movement, namely the backswing angle, swing speed, and release angle, if the backswing angle, the release angle is small then the swing speed must be large in order to reach the target at a distance of 8 meters. Vice versa, if the backswing angle and release angle are large, the swing speed needed is also small in order to reach the target at a distance of 8 meters, this is in accordance with what was stated by (Cahyono et al., 2018). These three indicators affect the results of shooting throws, if one indicator is more dominant then other indicators are required to adjust because these three indicators are interrelated. Seeing the acquisition of shooting precision samples with an average score of 19.6 and included in the “medium” category, so it is necessary to increase shooting practice so that it can achieve maximum results.

Various studies have explored the factors that influence shot accuracy in petanque. That eye-hand coordination, concentration, and confidence play an important role in shot accuracy. Further demonstrating the effectiveness of shooting drills using obstacles in improving shooting game ability (Saifulamri Alkhusaini et al., 2021). Other research also argues that the development of a petanque shooting training model for beginners, by emphasizing the importance of training to achieve high throwing accuracy (Badaru, Hasmyati, et al., 2021). Then the results of another study comparing the effects of concentration and focus (22 articles) in the following year there was an increase in 2022 (30 articles) and in the following year 2023 (25 articles).

Based on the literature the biomechanical analysis that can be applied in the petanque shooting throw technique is shown in the table above. The review consists of nine studies. In five research articles, motion analysis is discussed, resulting in a discussion of the direction and angle of petanque throw biomechanics. Four research articles discuss the analysis of petanque shooting accuracy, which results in a discussion of angle, direction, arc, and focus. Based on throwing mechanics in petanque, the main goal is expected to produce accuracy in throwing and shooting.

Table 1. Changes in the number of publications per year

<table>
<thead>
<tr>
<th>Year Published</th>
<th>Number of Articles</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2019</td>
<td>50</td>
<td>33%</td>
</tr>
<tr>
<td>2020</td>
<td>10</td>
<td>8%</td>
</tr>
<tr>
<td>2021</td>
<td>22</td>
<td>16%</td>
</tr>
<tr>
<td>2022</td>
<td>30</td>
<td>25%</td>
</tr>
<tr>
<td>2023</td>
<td>25</td>
<td>18%</td>
</tr>
<tr>
<td>Total</td>
<td>137</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 2. Study summary table

<table>
<thead>
<tr>
<th>Topic</th>
<th>Sample</th>
<th>Results</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biomechanical analysis of pointing and shooting petanque on athletes TC PON XX Papua</td>
<td>Athlete</td>
<td>Angle, Direction</td>
<td>Sinaga &amp; Ibrahim (2020)</td>
</tr>
<tr>
<td>Biomechanical analysis of concentration and coordination on the accuracy in petanque shooting</td>
<td>Students</td>
<td>Angle, Direction, and Focus</td>
<td>Awang et al. (2019)</td>
</tr>
<tr>
<td>Analysis of Pointing Motion in Petanque Sport</td>
<td>Athlete</td>
<td>Angle, Direction</td>
<td>Bustomi et al. (2020)</td>
</tr>
<tr>
<td>Analysis of Backswing and the Use of Star Excursion Balance Test (SEBT) on the Results of Petanque Shooting Throws</td>
<td>Athlete</td>
<td>Angle, Direction</td>
<td>Awang Irawan &amp; Sirodjul Munir (2021)</td>
</tr>
<tr>
<td>Analysis Of The Level Of Shooting Ability Of Petanque Athletes</td>
<td>Athlete</td>
<td>Angle, Direction</td>
<td>Ulpiana et al. (2022)</td>
</tr>
<tr>
<td>Analysis of Pointing Motion in Squatting Position from Biomechanical Aspects</td>
<td>Athlete</td>
<td>Angle, Direction</td>
<td>Paulina &amp; Irawan (2022)</td>
</tr>
<tr>
<td>Analysis of pointing accuracy on petanque standing position: Performance and accuracy</td>
<td>Athlete</td>
<td>Angle, Direction, and Focus</td>
<td>Irawan et al. (2022)</td>
</tr>
<tr>
<td>Accuracy Training Program: Can Improve Shooting Results of Petanque Athletes</td>
<td>Athlete</td>
<td>Angle, Direction, and Focus</td>
<td>Phytanza et al. (2022)</td>
</tr>
<tr>
<td>Investigation into the mechanisms leading to explosion of pétanque balls</td>
<td>Athlete</td>
<td>Angle, Direction, Curvature, and Focus</td>
<td>Loser et al. (2011)</td>
</tr>
</tbody>
</table>
coordination training on shooting game ability, found that both were significant but concentration training gave better results (Lubis & Permadi, 2021). These studies collectively highlight the importance of physical and mental training in achieving shot accuracy in petanque. Utilizing biomechanics for training allows for smart practice planning so that you can get the most out of it in the shortest amount of time and in the safest way possible.

The study of sports biomechanics helps people understand how the body reacts to intensity, angles and postures in sports. In other words, studying sports biomechanics helps players choose the sport that suits them best. When poor form and technique are used, biomechanical analysis can highlight the details and help understand the stress that poor technique puts on joints and surrounding tissues. Biomechanical analysis can help athletes of all ages and abilities to improve performance or reduce pain. In summary, the biomechanical benefits of improving speed and strength are as follows: help eliminate muscle imbalances, which means less wear and tear on ligaments and joints, and better training technique.

Sports biomechanics is the study of the mechanical principles of human movement and how they apply to sports performance. Over the past fifty years, there has been considerable development in motion analysis systems and computer simulation modeling of sports movements, making biomechanics a highly specialized field. Biomechanics research often relies on ordinary least squares (OLS) regression, but statistical learning methods such as ordered regression models can be used to handle high-dimensional data sets and improve variable selection. These models have been used to reduce the number of variables and identify key predictors of performance in sports biomechanics research (Kipp & Warmenhoven, 2022).

Biomechanics is a field that combines engineering, physics (specifically mechanics), and knowledge of the workplace environment. General biomechanics is a branch of biomechanics that studies the basic laws governing the organic human body at rest and in motion. Biomechanics is a study that specializes in analyzing segments of human body motion, one of which is quantitative data on angles in degrees (Hughes et al., 2021). Studying the impact of these components has two main advantages. First of all, this research enables training that improves skills while reducing the risk of injury. In addition, it improves performance and physical fitness in terms of strength, cardiovascular and flexibility. Performing biomechanical analysis has many benefits as it provides a wealth of data for different types of human movement analysis. Especially, biomechanical analysis can improve athletes' performance (increase their performance) and reduce the risk of injury.

**Conclusions**

Based on the results of the use of biomechanical analysis in petanque shooting techniques based on literature and research. Six articles focused on motion analysis, examining biomechanical area and speed in petanque shooting. The remaining articles discuss shooting technique, focusing on speed, area, distance and focus. Biomechanical analysis helps understand the impact of intensity, speed, and posture in shooting and helps players get more accurate shots. Analysis of biomechanical techniques can help athletes improve performance and reduce the risk of injury. Benefits of biomechanical analysis include increased speed and strength, reduced muscle imbalances, and better stance technique.

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**Conflict of Interest**

The authors reported no potential conflicts of interest.

**References**


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Information about the authors:

Helmi, Boby: sibobhelmi@student.unnes.ac.id; https://orcid.org/0000-0003-2163-6756; Department of Physical Education, Faculty of Sport Science, Universitas Negeri Semarang, Sekaran, Kec. Gn. Pati, Kota Semarang, Jawa Tengah 50229, Indonesia.

Hidayah, Taufiq: taufiqhidayah@mail.unnes.ac.id; https://orcid.org/0000-0002-9732-9624; Faculty of Sports Science and Coaching, Universitas Negeri Semarang, Sekaran, Kec. Gn. Pati, Kota Semarang, Jawa Tengah 50229, Indonesia.

Pramono, Harry: hpr4mono@mail.unnes.ac.id; https://orcid.org/0000-0002-9673-5823; Faculty of Sports Science and Coaching, Universitas Negeri Semarang, Sekaran, Kec. Gn. Pati, Kota Semarang, Jawa Tengah 50229, Indonesia.

Hartono, Mugiyo: mugiyohatono@mail.unnes.ac.id; https://orcid.org/0009-0002-6833-5563; Department of Physical Education, Faculty of Sport Science, Universitas Negeri Semarang, Sekaran, Kec. Gn. Pati, Kota Semarang, Jawa Tengah 50229, Indonesia.

Iskandar, Tatang: tatang@unismabekasi.ac.id; https://orcid.org/0000-0003-4164-6097; Physical Education Department, Universitas Islam 45 Bekasi, Jl. Cut Mutia No. 83, Margahayu, Kec. Bekasi Tim., Kota Bks, Jawa Barat 17113, Indonesia.


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