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Two decades of petanque research: A bibliometric analysis of dominant physical components (2002–2023)

Ramdan Pelana^{acde,*}, Ayu Purnama Wenly^{cde},
Ratiyono^{bcd}, & Sukiri^{de}

Universitas Negeri Jakarta, Indonesia

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ABSTRACT

Background: This article provides an empirical review of studies on petanque that focuses on dominant physical factors. **Research Objectives:** This study employs Publish or Perish software to create a homogeneous database of scientific articles from Scopus and Google Scholar-indexed journals. Researchers choose bibliometric analysis to observe and comprehend the distribution, trends, impact, and structure of scientific literature and to discuss it using predetermined keywords. **Methods:** Based on the results of a search on petanque with the time parameter 2002-2023, there were 268 articles found on Google Scholar and 11 articles indexed by Scopus. The selected articles focused on the dominant physical components of petanque. **Findings and Results:** Apply traditional bibliometric laws and use VOSviewer for data processing. These articles highlight the exponential increase in scientific production in the two decades of sport petanque. The article summarises the high fragmentation of authors with the highest levels of scientific production, 20 years of evolution in relevant thematic topics, and their concurrent concentration in three major blocks: (i) hand-eye coordination in petanque sports, (ii) kinaesthetic perception in petanque sports, and (iii) wrist flexibility in petanque sports. This article, spanning a database from two decades, provides evidence of evolution and paves the way for researchers seeking alternative visions of the predominant physical characteristics in the sport of petanque. **Conclusion:** This study offers valuable information about how petanque research has changed over time, shows how research affects the main physical traits of petanque, and helps explore other areas of study related to petanque. It can be concluded that the most dominant physical components in the sport of petanque are coordination, kinaesthetic perception, and wrist flexibility.

Keywords: Bibliometrics; petanque; dominant physique



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Corresponding Author: Ramdan Pelana, Department of Physical Education, Faculty of Sports Science, Universitas Negeri Jakarta, Jakarta, Indonesia
ramdanpelana@unj.ac.id

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INTRODUCTION

In the last two decades, the sport of petanque has shown increased attention in the academic field, especially related to the dominant physical factors that affect athlete performance (Hanief & Purnomo, 2019). Petanque, which originated in Provence, France, has now developed into a popular international sport, including in Southeast Asian regions such as Indonesia (Setiakamawijaya et al., 2021). The establishment of the Indonesian

Petanque Sports Federation (FOPF) in 2011 and its participation in the SEA Games are evidence of the growing existence of this sport nationally (Pelana, Setiakarnawijaya, Dwiyan, et al., 2021).

Petanque is played by all age groups because this sport is lighter compared to other types of sport (football, badminton or cycling) (Zulham & Kholik, 2020). The characteristic of the Petanque sport lies in the accuracy of throwing the iron ball against the target (Nurfatoni & Hanief, 2020). The aim of the petanque game is to throw the metal ball close to the wooden ball (Safitri et al., 2021). There are two basic techniques in playing petanque, the first is pointing and the second is shooting. Pointing is a type of throwing a petanque ball to get close to the target ball (Maliki et al., 2022) and shooting aims to keep the opponent's ball away from the target ball, the goal is to reduce the opponent's points and increase the team's points (Pelana, 2016).

This sport is a static sport because it does not require too much motion activity but still requires physical components such as muscle strength, endurance, balance, coordination and focus (Kurniawan et al., 2022). Petanque is played without physical contact so the risk of injury is small (Pelana et al., 2019). Important factors that influence Petanque players are the basic techniques of playing Petanque and good physical condition for throwing (Badaru et al., 2021). In this sense, many studies have shown that concentration and accuracy are factors for successful petanque games (Irham et al., 2022). The basic movement in petanque games is throwing targets, petanque athletes must focus on making these movements in training and matches (Parlindungan et al., 2020).

Therefore, the recommendation of physical factors needed in the sport of petanque is a solution in providing a meaningful training programme for prospective athletes. The preparation of training programmes must be tailored to the needs and characteristics of the sport of petanque so that training can run well and improve maximum results in all aspects of supporting achievement (Faradilah et al., 2024; Phytanza et al., 2022). Thus, the temporal evolution of the study of dominant physical characteristics in relation to the sport of petanque requires an extensive and meta-analytic study that provides a visionary view for petanque coaches and the scientific community, namely through a bibliometric approach that analyses data and metadata from existing petanque game research.

A number of studies have been conducted to examine trends and developments in petanque research. For example, a systematic review by Nurhasan et al. (2024) focuses on research trends over the past decade, but is still general in nature and has not emphasised specific physical aspects. On the other hand, the bibliometric study by Hafidz et al. (2024) mapped petanque research in the Scopus database for the period 2011-2024, but has not in-depth highlighted the development of physical topics which are an important foundation in the performance of petanque athletes.

Based on a review of the previous literature, a significant gap was identified: there is no bibliometric study that specifically analyses the evolution of the dominant physical components in the sport of petanque using a multi-database approach and a longer timeframe. Furthermore, no bibliometric analysis has been found that explicitly links the development of the literature to three key physical components: eye-hand coordination, kinaesthetic perception, and wrist flexibility, which have been shown to contribute to performance in the sport. Therefore, this study aims to conduct a bibliometric analysis of scientific publications on the dominant physical components in the sport of petanque over the past two decades (2002-2023), using data from two main sources, namely Google Scholar and Scopus, processed through Publish or Perish software and visualised with VOS viewer. This approach provides broader and more representative data coverage, especially since most petanque research from Indonesia has not been indexed in Scopus. This study focused on answering three main research questions:

- **RQ1:** How has research on petanque developed in the last two decades?
- **RQ2:** Who are the authors, publication sources and countries that have contributed the most to petanque research?
- **RQ3:** What are the main topics related to the dominant physical components most studied in petanque research?

By answering these questions, it is hoped that this article will provide a comprehensive overview of the trends, directions and contributions of petanque research and provide an important foundation for the development of more focused and evidence-based training programmes and future research.

METHOD

This study employed a qualitative bibliometric analysis approach, focusing on the interpretation and scientific mapping of bibliographic data related to petanque research. The method was adapted from the bibliometric workflow described by Natakusumah (2016) and the scientific mapping procedures suggested by Donthu et al. (2021), emphasising the analysis of relationships among research constituents.

Data Source and Search Strategy

The bibliographic data for this study were collected from two major academic databases, namely Scopus and Google Scholar. To facilitate systematic retrieval and management of bibliographic information, the search process was conducted using the Publish or Perish software. The selection was focused exclusively on scientific journal articles, ensuring that the dataset remained homogeneous and maintained a high standard of academic quality. The search strategy involved the application of specific keywords, namely "petanque," "pétanque," and "petanque in sport," combined with the boolean operator ("OR") to maximise the breadth of the search results. These keywords were formulated and refined based on recent bibliometric studies in the field (Hafidz et al., 2024; Nurhasan et al., 2024). Additionally, the search was limited to articles published within the timeframe of 2002 to 2023 to capture two decades of research development. The initial search process identified a total of 268 articles from Google Scholar and 11 articles from Scopus. After applying the inclusion criteria — relevance to petanque, focus on physical components, and availability of bibliographic metadata — a final sample of 68 articles was selected for detailed analysis and mapping. Table 1 summarises all the search terms and databases used.

Table 1. Search Terms and Databases

Database	Search Terms Used	Time Span
Scopus	("petanque" OR "pétanque" OR "petanque in sport")	2002–2023
Google Scholar	("petanque" OR "pétanque" OR "petanque in sport")	2002–2023

Data Analysis and Mapping

The collected bibliographic data were subsequently imported into the VOSViewer software for detailed analysis and visualisation. VOSviewer was used to conduct a co-occurrence analysis based on keywords, aiming to identify the most frequently studied topics related to the physical components of petanque. We also performed a co-citation analysis to map the intellectual structure of the field by examining the relationships between frequently cited references. Through these bibliometric mapping techniques, the study was able to visualise research trends, identify dominant themes, and explore influential authors, publication sources, and contributing countries within the domain of petanque research.

Inclusion and Exclusion Criteria

To ensure the relevance, quality, and consistency of the bibliographic dataset, specific inclusion and exclusion criteria were applied. The inclusion criteria were (i) articles published from 2002 to 2023, (ii) articles written in English, (iii) studies about petanque related to sports science, physical aspects, or performance analysis, (iv) articles published in peer-reviewed journals listed in Scopus or Google Scholar, and (v) articles that included complete bibliographic information like title, authors, keywords, and abstract. Meanwhile, the exclusion criteria included (i) non-journal publications such as conference proceedings, book chapters, theses, or magazine articles; (ii) articles not specifically centred on petanque or mentioning it only incidentally; (iii) duplicate records retrieved from both Scopus and Google Scholar; and (iv) articles lacking accessible full texts or containing incomplete metadata.

Article Selection Process

The article selection process followed a modified PRISMA approach to ensure transparency and replicability. During the identification phase, a total of 279 records were retrieved through database searches (11 from Scopus and 268 from Google Scholar). After removing 4 duplicates, 275 records remained for the screening phase, where titles and abstracts were assessed for relevance. At this stage, we excluded 180 articles

due to their lack of direct relevance to petanque. The remaining 95 full-text articles were further evaluated for eligibility, resulting in the exclusion of 27 articles due to reasons such as being conference papers, theses, or having incomplete data. Finally, a total of 68 articles met all criteria and were included in the bibliometric analysis. The detailed procedure is summarised in **Table 2**.

Table 2. Article Selection Summary

Phase	Description	Number of Articles
Identification	Articles identified through database searching (Scopus: 11, Google Scholar: 268)	279
Duplicates removed	Duplicate records removed	4
Screening	Records screened by title and abstract	275
Excluded at screening	Articles excluded as irrelevant	180
Eligibility	Full-text articles assessed	95
Full-text excluded	Conference papers, theses, incomplete data	27
Included	Articles included in final analysis	68

RESULTS AND DISCUSSION

This section aims to clarify the findings obtained from the bibliometric analysis in the sport of petanque. The aim is to explain the findings thoroughly and precisely, exploring the fine details discovered through this research. Furthermore, this section examines the consequences and relevance drawn from the bibliometric findings.



Figure 1. Temporary Trend of Publications on Petanque (2003–2023)

Figure 1 depicts the number of articles on petanque published from 2003 to 2023. Based on **Figure 1**, the 2022 article database with the most publications, namely 81 scientific publications.

Year	Title and author	Citations
2017	The Relationship between Concentration Level and Petanque Sports Shooting Accuracy Results in UNESA Petanque Club Participants (Nurfatoni & Hanief, 2020).	111
2018	Petanque Sports Shooting Skill Training Model For Beginners (Sutrisna et al., 2018).	48
2018	Analysis of Backswing and Release Shooting Carreau at a Distance of 7 Meters for Petanque in East Java Athletes (Cahyono & Nurkholis, 2018).	39
2018	Revitalization of Urban/Urban Communities Through Petanque Sports (Okilanda, 2018).	37
2016	The Relationship between Leg Muscle Strength and Static Balance with Shooting Results in Petanque Club Athletes (Pelana, 2016).	32
2019	Petanque: What are the physical factors that determine his achievements? (Hanief & Purnomo, 2019).	30
2018	Petanque Socialization as a Sport Today (Okilanda et al., 2018).	29

Year	Title and author	Citations
2020	Analysis of Pointing Movement in Petanque Sports (Bustomi et al., 2020).	29
2018	Contribution of arm length, hand eye coordination, and concentration on shooting accuracy in petanque (Widodo & Hafidz, 2018).	28
2019	Biomechanical analysis of concentration and coordination on the accuracy in petanque shooting (Irawan et al., 2019).	27
2020	Petanque: can hand eye coordination, wrist flexibility, strike flexibility and balance contribute to shooting shot on the iron? (Nurfatoni & Hanief, 2020).	20
2019	Biomechanics analysis of pointing and shooting petanque on TC PON XX PAPUA athletes (Gracia Sinaga & Ibrahim, 2019).	16
2020	Differences in the effect of imagery training and without imagery training on improving the shooting ability of UNDIKMA petanque athletes.	15
2019	The contribution of height, arm length, balance, concentration and kinesthetic perception to shooting accuracy in petanque sports (Pradana & Nurkholis, 2019).	13
2022	Accuracy Training Program: Can Improve Shooting Results of Petanque Athletes Aged 15-20 Years (Phytanza et al., 2022).	11
2020	Contribution of Concentration, Body Height, Arm Length, and Kinesthetic Perception to the Pointing Results of Petanque Athletes in East Java (Kristanto & Nurkholis, 2020).	11
2017	The effect of sport technology on student-athletes' Petanque Skill Performance (Pilus et al., 2017).	11
2019	Study of the relationship between arm muscle power and shoulder rom (range of motion) with the results of a 9-meter long-range shot in Petanque athletes, Faculty of Sports Science, Jakarta State University, Indonesia (Pelana et al., 2019)	10
2021	Petanque Sports Management Survey on Petanque UKM Unnes Semarang City in 2020 (Hervi & Qoriah, 2021).	9
2021	Physical Fitness Profile of Petanque Athletes in Pekalongan Regency (Safitri et al., 2021).	8

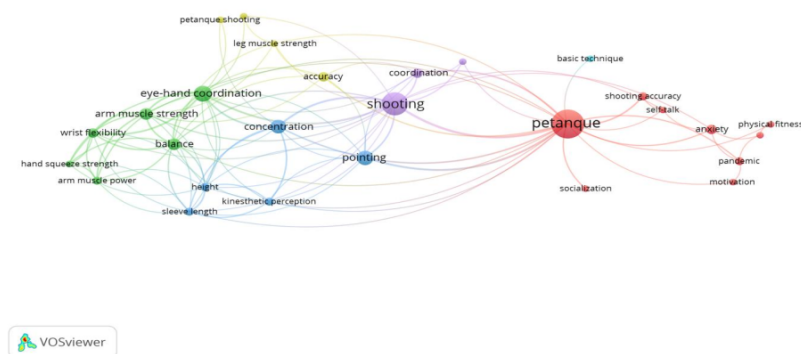


Figure 2. Network Visualisation

Figure 2 shows a visualisation of the co-occurrence network which explains the network or relationship between one term and another in research in the field of petanque for the period 2003-2023. The 68 articles indexed by Google Scholar and Scopus, they can be grouped into 6 clusters which can be identified through the color of the nodes of each keyword. Cluster 1, which is denoted red, includes terms related to anxiety, motivation, pandemic, petanque, petanque athlete, physical fitness, self-talk, shooting accuracy, socialisation. Cluster 2, denoted in green, consists of arm muscle power, arm muscle strength, balance, eye-hand coordination, hand squeeze strength, and, and and wrist flexibility. Cluster 3, which is denoted in dark blue, consists of terms such as concentration, height, kinesthetic perception, pointing, and and sleeve length. Cluster 4, which is symbolised in yellow, consists of terms such as accuracy, leg muscle strength,

petanque shooting, and and static balance. Cluster 5, which is symbolised in purple, consists of terms such as coordination, imagery, exercise, and shooting. Cluster 6, which is denoted in light blue, consists of terms such as basic technique.

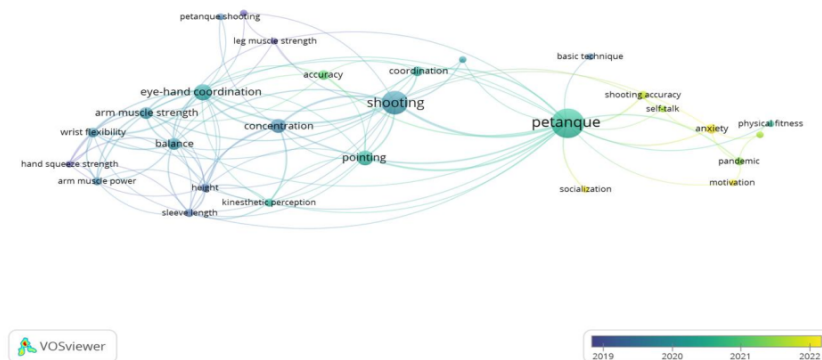


Figure 3. Overlay Visualisation in Co-Occurrence

Figure 3 describes the mapping and grouping of petanque research trends based on historical traces or years of research publication. Information obtained from the results of the overlay visualisation in Figure 4 can be used as a reference for identifying and detecting state-of-the-art research in the field of anxiety and athletes conducted in the 2003-2023 period. Brighter colours (yellow) indicate the most recent research.

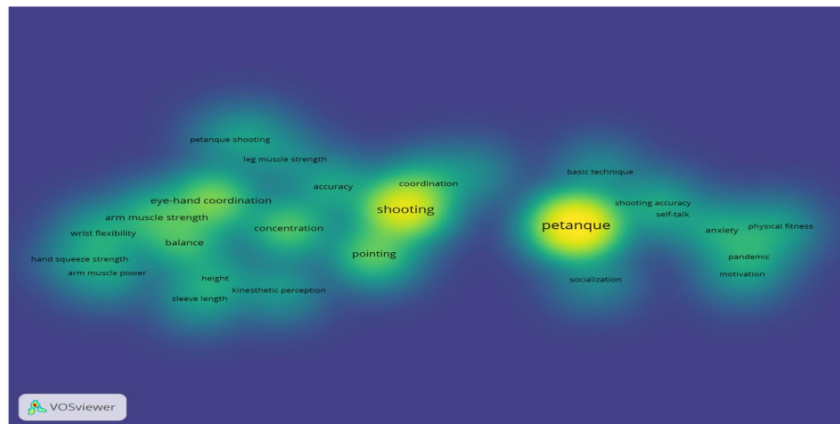


Figure 5. Density Visualisation on Co-occurrence

From the results of the visualisation shown in **Figure 5**, it can be seen that there are areas that are dense or have high density at one node with other nodes. The saturation level identified in the number of keywords marked in yellow means that the area is a topic that has been extensively researched. Meanwhile, nodes marked in dark colour indicate that the topic has not been studied. The level of saturation identified in the number of keywords marked in yellow means that the area is a topic that is widely researched and indexed by Scopus and Google Scholar. The topics are shooting and petanque. Meanwhile, nodes marked in dark colour indicate that the topic has not been studied much. These topics are hand-eye coordination, balance, height, arm muscle strength, accuracy, and others which are not clearly visible in **Figure 5**.

Coordination

There are 7 articles that discuss eye and hand coordination in petanque. The body parts that are directly involved when shooting are arm muscle strength and hand eye coordination (Agustini et al., 2018). The coordination that must be possessed by a petanque athlete is eye-hand coordination (Mulya, 2020). To find the best petanque athletes, hand-eye coordination, and flexibility must be the main factors (Rasyono & Setiowati, 2021). Good eye and hand coordination will result in the right throw (Nurfatoni & Hanief, 2020). Petanque requires good hand eye coordination to coordinate hand eye movements when throwing the ball towards the target (Widodo & Hafidz, 2018). Eye-hand coordination is a member of the biomotor factors that determine petanque performance (Hanief & Purnomo, 2019). But the results of the research Susandi Eka Wahyudhi et al. (2021) obtained the results of the study that there was no relationship between hand eye coordination and shooting skills in petanque games in Central Sulawesi petanque athletes.

Kinesthetic Perception

Based on the database there are 5 articles that are suitable for discussing kinesthetic perceptual positions in petanque sports. Kinesthetic perception contributes to shooting petanque, good perceptual ability to determine the fall of the ball so that it hits the target (Pradana & Nurkholis, 2019). Petanque athletes must be able to feel between wrong and right movements in pointing movements to get maximum results (Kristanto & Nurkholis, 2020). To produce the right throw, good kinesthetic skills are needed in predicting the right throwing angle and also accurate throwing power (Pelana, Setiakarnawijaya, Anggraini, et al., 2021).

Wrist Flexibility

Providing an exercise programme that can increase wrist flexibility is a good solution to tie athlete performance to petanque. Flexibility is a very important and necessary element in shooting petanque. Flexibility supports the quality of allowing a joint segment to move optimally thereby enabling a muscle or group of muscles to contract in a maximally shortened and elongated position. Flexibility plays an important role in the success of shooting petanque (Handayani et al., 2021). Wrist flexibility is one of the biomotor factors that determine petanque performance (Hanief & Purnomo, 2019). However, different research results were obtained based on research Susandi Eka Wahyudhi et al. (2021) with the title Hand Eye Coordination, Arm Muscle Strength, and Wrist Flexibility in Petanque Athlete Shooting Skills. The results of the study stated that wrist flexibility was not related to petanque shooting accuracy.

CONCLUSION

The exponential growth of petanque studies over the period 2003-2023 is evidenced by the 286 articles extracted. The large number of publications indicates the increasing interest in the scientific community to study the sport of petanque and an increase in the publication period between 2003 and 2023. The highest number of publications in 2022 was 81 publications of scientific articles, and the highest number of citations in 2017 was 111 cited. The researcher is (Agustina & Priambodo, 2017), entitled The Relationship Between the Level of Concentration and the Accuracy Results of Petanque Sports Shooting in Unesa Petanque Club Participants. This research provides important insights into the evolution of petanque research to analyse trends in petanque research, provide evidence of the impact of research on the dominant physical components of petanque, and develop other fields of study on petanque. It can be concluded that coordination, kinaesthetic

perception, and wrist flexibility are the most dominant physical components in the sport of petanque. Further research can be conducted to explore the relationship between certain physical components, such as coordination, kinaesthetic perception, and wrist flexibility, with athlete performance in petanque. What percentage does each of these contribute so that it can provide recommendations to coaches about which physical components have the greatest influence on athlete performance and can help in designing more effective training programmes.

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CONFLICT OF INTEREST

All authors declare that there is no conflict of interest whatsoever in this research.

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