

Petanque research trends and developments in the last decade: a systematic review

Tendencias y avances de la investigación en petanca en la última década: una revisión sistemática

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Abstract. This study analyzed petanque research and development trends in the last decade. The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) research method was applied in this study. The identification of past research documents used the keyword “petanque,” and 14,829 documents were obtained from five journal databases (Scopus, Pubmed, Crossref, Open-Alex, and Google Scholar). There were 1,291 articles selected that fit the inclusion criteria to be analyzed in bibliometrics. Ten articles were selected for review based on the most citations and most relevant to the research topic. The research trend analysis shows a dynamic development and a significant increase. Visualization of bibliometric analysis shows a diverse keyword network but has not yet expanded into various fields. Based on the study results, petanque was developed as an achievement sport and socialized to the public to make it more attractive. Its correlation with sports injuries also needs to be developed because sports injuries are crucial in a sport. The literature review results presented discussions related to athlete performance from several aspects and organizational management. Developments in petanque sports research that move dynamically need to be extended from various aspects and fields to make it more complex and widespread.

Keywords: technology integration, sport management, coaching methods, athlete performance

Resumen. Este estudio analizó las tendencias de investigación y desarrollo de la petanca en la última década. Se aplicó el método de investigación de los Ítems de Reporte Preferidos para Revisiones Sistemáticas y Meta-Análisis (PRISMA). La identificación de documentos de investigaciones pasadas utilizó la palabra clave “petanca” y se obtuvieron un total de 14,829 documentos de cinco bases de datos de revistas (Scopus, Pubmed, Crossref, OpenAlex y Google Scholar). Se seleccionaron 1,291 artículos que cumplían con los criterios de inclusión para ser analizados en términos bibliométricos. Se eligieron diez artículos para revisión, basándose en el mayor número de citas y los más relevantes para el tema de investigación. El análisis de las tendencias de investigación muestra un desarrollo dinámico y un aumento significativo. La visualización del análisis bibliométrico muestra una red diversa de palabras clave, pero que aún no se ha expandido a varios campos. Según los resultados del estudio, la petanca se ha desarrollado como un deporte de rendimiento y se ha socializado al público para hacerlo más atractivo. Su correlación con las lesiones deportivas también necesita ser desarrollada, ya que estas son cruciales en cualquier deporte. Los resultados de la revisión de la literatura presentaron debates relacionados con el rendimiento de los atletas desde varios aspectos y la gestión organizativa. Los desarrollos en la investigación de deportes de petanca, que avanzan de manera dinámica, necesitan ampliarse desde diversos aspectos y campos para hacerlo más complejo y generalizado
Palabras clave: integración de la tecnología, gestión deportiva, métodos de entrenamiento, rendimiento de los deportistas

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Introduction

Petanque was adapted from traditional games in France. The game aimed to throw iron balls (boules) as close as possible to the target ball, a small wooden ball (cochonnet). In addition, keeping other players' iron balls away is also another way of playing this sport. Petanque can be played by 1 to 6 people, with the division of match numbers in this sport being 11 people. Non-shooting match numbers require a field area with dimensions of 4 x 15 meters, while shooting numbers have their particular area (Jessica, 2015). One of the match numbers played by one person only is the shooting match (Ulpiana et al., 2022). Shooting requires high focus, calmness, and minimal distractions around the shooting area (Moreira da Silva et al., 2021). Focus and calmness are also needed in other match numbers in the sport of petanque, which is pointing (Selva, Sundar, & Arifudeen, 2023). A tiny size target with the estimated distance and fall of the thrown iron ball is why focus and calmness are needed (Hanief et al., 2019). On the other hand, the athlete's physical condition also affects the success of the throw (Rhamadhan, Hidayat, Kahar, & Hakim, 2023). The

level of success will affect the results or achievements of a petanque athlete (Maliki, Suherman, Prasetyo, Pradipta, & Hartono, 2022).

Petanque has developed into a highly demanded sport in various regions. Developments occur in terms of game techniques, rules, and globalization (Kurniawan et al., 2024; Parlindungan, Bangun, & Akhmad, 2019). In the academic sphere, research on Petanque has begun to receive attention from sports scientists in recent years. The research focus in Petanque covers various aspects, ranging from game techniques to game strategies, training development, and social and cultural impact analysis. In the last ten years, research on petanque has experienced a significant increase in quantity and quality. This increase is in line with the expansion of Petanque as a sport that competed in various national and international championships, such as the Sea Games and World Games. Educational and sports institutions contribute to this research through the study of sports biomechanics, the development of match analysis tools, and the influence of external factors on athlete performance (Carling & Court, 2013).

On the other hand, there are still gaps in the overall understanding of Petanque research development. Several studies with varying focuses have yet to be integrated into a comprehensive framework. The systematic reviews can provide an overall visualization of the trends and directions of Petanque research in the past decade. This review is expected to identify research topics, methodologies used, and significant contributions to the development of Petanque sports science. This systematic review aims to fill the gap by analyzing studies published between 2015 and 2024. It will accumulate and evaluate the findings of previous studies. The results of this review are expected to provide an in-depth insight into the development of petanque research and serve as a foundation for future studies. Thus, this research has a vital role in supporting the development of the sport of petanque.

Methods

A systematic search comprehensively analyzed research trends and developments in petanque over the past ten years (2015-2024). Research identification was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) method using the keyword “petanque”. The research identification process was carried out on August 31st, 2024. The inclusion criteria in this study are research in the form of articles that discuss petanque in 2015-2024. In addition, articles published in English and Indonesian are also a requirement for this criterion. Meanwhile, the exclusion criteria were articles that were not relevant to the topic of this research. Articles not published in English and Indonesian from 2015 to 2024 were also included in the exclusion criteria.

The eligibility articles used for the literature review are the articles with the most citations and relevance. The researcher applied these criteria and conditions to ensure the relevance and quality of the published research. Thus, the objectives of this study can be met, and a comprehensive explanation can be provided for readers.

Databases of SCOPUS, Pubmed, OpenAlex and the articles were indexing in Crossref and Google Scholar were used for systematic review databases in this research. The annotation method was applied to select the best ten articles for the literature review by considering this study's inclusion and exclusion criteria. The annotation method was to provide notes on the number of citations and research topics raised. Researchers found several titles that were the same in both databases used, for example in Google Scholar and Crossref. Google Scholar provides many more citation rather than Crossref. So, the annotation method must be done to avoid the accumulation of data identification or research documents.

Results

The identification process was done using the PRISMA method through 3 databases (SCOPUS, Pubmed, and

OpenAlex) and 2 index articles (Google Scholar and Crossref) (Figure 1). Based on the identification results, 14,829 documents with various formats were found, not just articles. The screening process was carried out using the inclusion and exclusion criteria determined by the researcher. The results of the screening process obtained as many as 1,344 suitable articles. The selection of 10 articles with the most citations was also carried out based on the screening process results. In this case, annotation is needed to record and mark the articles with the most citations. In addition, recording the research title was also carried out to avoid similarities in the titles of the articles taken. Researchers encountered several articles with the same title but different numbers of citations in other databases. Based on this, researchers decided to choose articles with more citations.

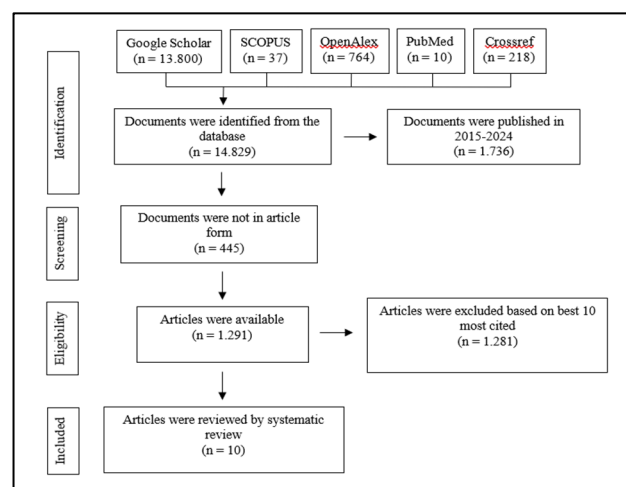







Figure 1. PRISMA flowchart screening process of petanque research

Table 1. Petanque's research publications in the last decade are based on different databases.

	Source	Paper	Cites	Cites/Year	H-Index
	SCOPUS	31	172	21.50	7
	Pubmed	9	0	0.00	0
	OpenAlex	535	1935	215.00	21
	Google Scholar	945	4547	505.22	28
	Crossref	216	93	10.33	3
	Total	1736	6747	752.05	-

Based on the identification results from 2015 to 2024, there are various research documents (Table 1). Each database represents its contribution to Petanque sports research. Google Scholar database provides the highest contribution, with the number of papers 998, and it has been cited 4547 times. This indicates that much research is done by citing research in the Google Scholar database. The PubMed database shows the least number of papers, only nine, with the number of citations still needing to be available. This phenomenon can be a reference for future research so

that Petanque's research in the health sector is further developed. Pubmed is one of the research databases that accumulate research in the health sector by integrating it into various fields, such as sports.

Research Trend of Petanque in the Last Decade

Research trends in petanque in the last decade show a significant growth trajectory, highlighting how academic interest in petanque has evolved (Figure 2 and Table 2). In 2015, 79 documents were published, representing 4.55% of the total publications over the decade. This number slightly decreased in 2016 (74 documents, 4.26%) and continued to dip in 2017 (73 documents, 4.21%), indicating a period of relatively low but consistent research activity in the early part of the decade. However, a turning point occurred in 2018, when published documents rose to 119, making up 6.85% of the total. This upward trend continued in 2019 with the same number of publications, suggesting growing momentum and heightened interest among researchers and practitioners.

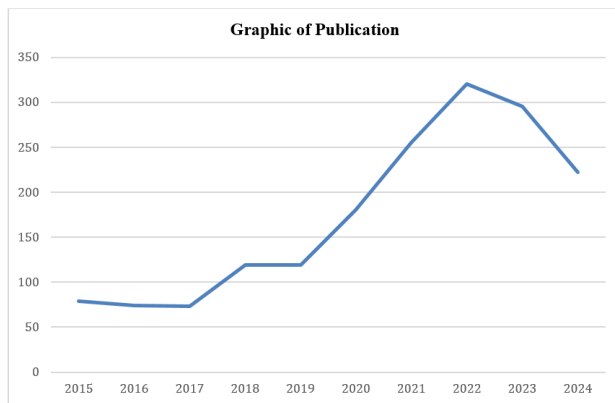


Figure 2. The trend of petanque research in the last decade

A more substantial increase in research output was observed from 2020 onward when the number of publications reached 180 documents (10.37%). This marked a significant leap in scholarly activity, likely driven by increased recognition of petanque as a competitive sport and its inclusion in regional and international sports events such as the Sea Games and World Games. This momentum continued to build in 2021, with 255 documents published (14.69%), further reflecting the sport's global expansion and its growing prominence within sports science and related disciplines. The peak of research activity occurred in 2022, with 320 documents (18.43%) representing the highest percentage of publications during the observed period. This surge likely indicates an increased interest in various aspects of petanque, from technical development and athlete performance to the social and cultural impacts of the sport.

The data reveals a gradual decline in publications in the latter part of the decade. In 2023, 295 documents were published (16.99%), representing a slight drop from the peak in 2022, while in 2024, the number of documents published fell to 222 (12.79%). It is important to note, however, that the data for 2024 may only partially represent part of the year, as the research identification process for this systematic review was conducted in August 2024. As such, the number of publications could increase by the end of the year. Despite the decline in recent years, the overall trend from 2015 to 2024 shows significant growth in research on petanque, reflecting the sport's increasing visibility and importance within the global sports community. The total number of documents published during this period is 1,736, indicating a robust and expanding body of knowledge. This progression underscores Petanque's potential as a field of academic inquiry, with future research likely to explore even more diverse areas, including biomechanics, coaching strategies, injury prevention, and technological integration within the sport.

Table 2.

Research publication of petanque in the last decade in different year

Year of Publication	Number of Documents	Percentage of Publication
2015	79	4.55%
2016	74	4.26%
2017	73	4.21%
2018	119	6.85%
2019	119	6.85%
2020	180	10.37%
2021	255	14.69%
2022	320	18.43%
2023	295	16.99%
2024	222	12.79%
Total	1736	100%

Keyword Network of Petanque Research in the Last Decade

Based on the analysis of VOSViewer software, a keyword network was obtained that visualizes the relationship of research topics over the past ten years (Figure 3). The different spellings of the keyword "petanque" result in different clusters displayed by the analysis. The keyword "petanque" shows that current developments focus on physical aspects such as endurance, psychological or mental athletes, accuracy in playing petanque, and the development of petanque sports in society. This proves that practitioners of this sport pay attention to the development of this sport for achievement purposes. Its relation with "motion analysis", "accuracy training", and "achievement", means that the development of petanque for achievement sports is indeed significant. The keyword "android" shows the correlation between petanque and the latest technology. The modernization of this sport is starting to develop and be carried out. This will undoubtedly impact efficiency and effectiveness in matches and analysis in this sport.

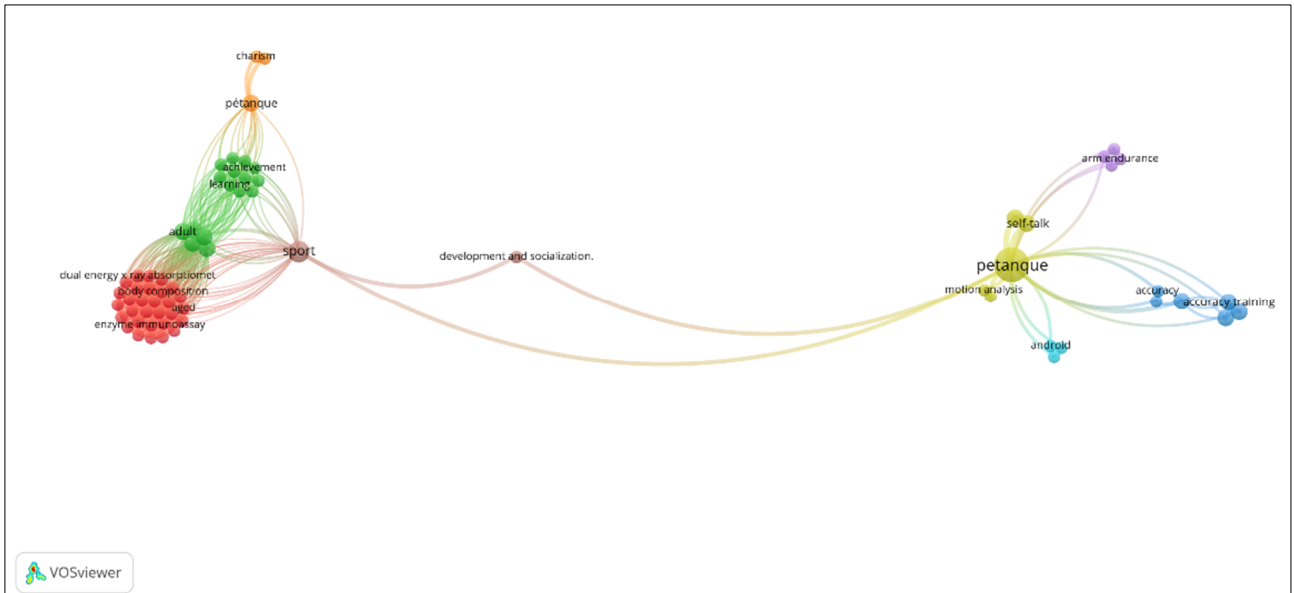


Figure 3. Keyword network of petanque research in the last decade

The keyword “development and socialization” indicates that this sport should be introduced to make it more popular and attractive to various groups. On the other hand, the relationship with the health sector has never been done. Research focusing on injuries or other health aspects related to athletes has yet to be found. Injury prevention in athletes is one of the essential things in maintaining the athlete's condition and performance. The strong correlation between the keywords “sport” and “health”, which also includes “body mass”, “body composition”, and “heart rate”, shows the critical role of the health field in the field of sports. The keyword network presented provides an overview of further research in developing research on the sport of petanque to be more significant. Extensions from various fields will expand this research cluster, thus providing a more comprehensive understanding to practitioners of this sport.

Keyword Trend of Petanque Research in the Last Decade

The visualization of keyword trends aims to see the development of petanque research each year from 2015 to 2024. Based on the visualization presented (Figure 4), the development of petanque begins with the process of developing the sport through introduction to the community. The keyword “development and socialization” appears in the 2015-2018 range. Then, in 2019-2022, research focused on achievement and coaching in this sport. Research in these years provides an overview of the substitution of petanque into an achievement sport. The emergence of the keywords “motion analysis,” “achievement,” “accuracy training,” and “arm endurance” are some examples of keywords that are evidence that petanque research as an achievement sport is starting to be developed.

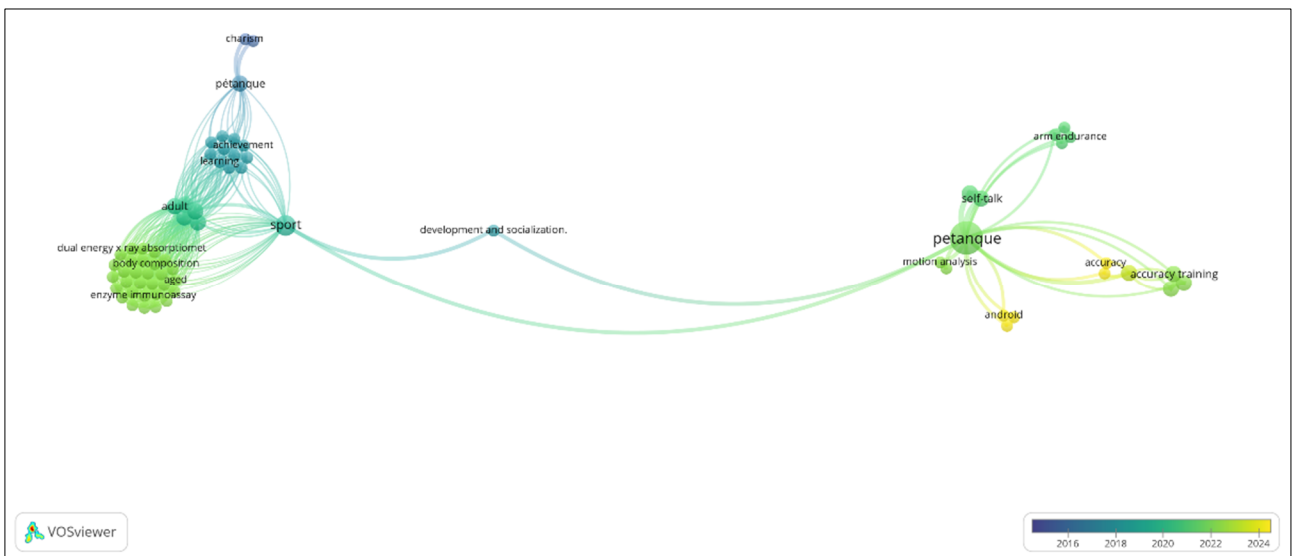


Figure 4. Keyword trend of petanque research in the last decade

In 2023-2024, the keyword “android” began to appear and became a sign of technological integration in this sport. This will certainly impact efficiency in practice in the field, such as during matches. The integration of technology in this sport also provides a new experience in exercising in a modern and sophisticated manner. Other keywords, such as “body composition” or keywords related to the health sector, have become of attention because they have also begun to grow in the 2022-2024 period. This is an indication of the importance of the involvement of the health sector in the sports field. However, this has not been realized in the sport of petanque, so there is no significant correlation between petanque and the health sector.

Top 10 Cited and Relevance Publications of Petanque in the Last Decade

The identification and screening process on Scopus, Google Scholar, OpenAlex, Pubmed, and Crossref databases resulted in 10 articles with the most citations, which follow the topic of this research (Table 3). This literature review provides an overview of previous research topics. The selection of articles with the most citations indicates that the articles were used as references for many researchers to develop the sport of petanque.

Table 3.
Top 10 most cited articles of petanque research in the last decade

Author	Cited	Research Purposes	Sample Characteristics	Study Design	Results
(Laksana et al., 2017)	100	To determine the role of petanque in supporting Central Java sports successes in terms of organization and administration, funding, government assistance, human resources, facilities and infrastructure, coaching, and the use of science and technology.	Management, KONI, athletes and coaches.	Qualitative Naturalistic	Petanque has the potential to develop and promote Central Java's successes; therefore, it is proposed that the sport be socialized and managed in the Regency / City, and regular competitions be held.
(Agustina, 2017)	97	To investigate the association between Unesa Petanque Club participants' levels of concentration and the accuracy with which they shoot petanque sports.	27 Unesa Petanque Club athletes.	Correlation Study	The value of rcount is smaller than Rtabel (0.345 < 0.381), indicating no significant link between concentration and petanque shooting accuracy among Unesa Petanque Club participants. The link between concentration level and shooting accuracy in petanque sports was just 11.90%.
(Sutrisna et al., 2018)	85	To develop a model of petanque shooting skill training for novices.	30 students from senior high school in Jakarta.	Research and Development	The initial exam yielded a shooting athlete / student score of 11.87%. After receiving treatment, athletes' and students' shooting abilities improved to 18.57%. This petanque sports shooting training program is useful for boosting beginners' shooting skills.
(Cahyono, 2018)	64	To measure the effectiveness and efficiency of shooting 7 meters utilizing biomechanical analysis.	3 East Java Petanque Athletes	Quantitative Descriptive	The effective shooting motion at a distance of 7 meters is with a backswing angle of 78° - 80°, an average swing speed of 3.66 m/s, a release angle of 80° - 82°, and a maximum ball height of 1.45 - 1.64 meters, which results in shooting carreau at a distance of 7 meter with the ball stopping not far from the target point.
(Bustomi et al., 2020)	60	To analyze pointing movement skill of Semarang Petanque athlete.	4 men and 4 women from the Semarang City petanque team.	Quantitative Descriptive	Based on the results of the analysis of pointing motion on the Semarang City petanque team by raters I, II, and III in terms of biomechanics, each assessment criterion may be learned from the following 8 research samples: 41% of the criteria are extremely suitable, 35.08% are suitable, 19.86% are nearly suitable, 2.52% are less suitable, and 0.51% are not suitable.
(Widodo & Hafidz, 2018)	51	To determine how much arm length, hand-eye coordination, and focus contribute to shooting accuracy, both separately and in combination.	10 East Java provincial petanque athletes.	Statistic Descriptive	Arm length contributed 0.13%, hand-eye coordination 3.92%, and focus 23.91%. The overall variable accounted for 43.69% of the accuracy of petanque shooting results.
(Pelana, Setiarnawijaya, Dwiyanana, et al., 2021)	27	To figure out the anatomical correlation between arm length, arm endurance, and self-assurance with the outcomes of petanque throwing.	16 petanque athletes.	Path Analysis	Results of throwing in petanque are directly influenced by arm length, arm muscle endurance, and athlete confidence.
(Tyas et al., 2022)	25	To determine how accuracy training affects petanque athletes' shooting performance.	20 athletes with ages 15-20 years.	Experimental Study	The accuracy training program has an impact on petanque competitors' shooting outcomes between the ages

Table 3.
Top 10 most cited articles of petanque research in the last decade

Author	Cited	Research Purposes	Sample Characteristics	Study Design	Results of 15 and 20.
(Alkhusaini & Nurhidayat, 2021)	22	To investigate the impact of shooting training with barriers on shooting game ability in petanque athletes.	15 petanque athletes	Experimental Study	The barrier-based shooting training paradigm improves petanque athletes' shooting results by 4.86%. In order to increase their performance, athletes must use a monitoring system in training plans into action. Petanque coaches need technology such as Android apps to monitor training and athletes' activities outside of training.
(Hidayah, Pratama, Rahayu, et al., 2024)	4	To evaluate athletes' requirements for tracking the execution of training plans for trainers and athletes using Android devices.	20 athletes, 5 licensed trainers, and 1 expert physical conditioning, 1 information, and 1 technology.	Quantitative Descriptive	

The importance of psychological aspects in the sport of petanque

The psychological aspects of petanque are crucial to an athlete's success, encompassing concentration, coordination, confidence, and the use of self-talk. These elements are intimately tied to the athlete's mental state during competition. Concentration helps athletes focus on the target, while coordination ensures the smooth execution of precise movements. Confidence allows players to trust their skills and perform under pressure. The ability to control oneself to stay calm is a key to mastering the game (Rizal et al., 2021). Self-talk, or the internal dialogue athletes use, helps regulate emotions and maintain composure, particularly in high-stress moments. The ability to control one's emotions and stay calm is essential to mastering the game, as mental stability directly impacts physical performance. Enhanced coordination emerges when self-control is fully optimized, contributing to an athlete's ability to execute complex tasks precisely. This is closely related to an athlete's mentality when playing a match. Good coordination will appear when self-control is maximized (Awang et al., 2019).

Effect of arm anatomy on throwing results

The anatomy of the arm, specifically arm muscle endurance and arm length, plays a crucial role in influencing an athlete's performance, particularly in determining the accuracy and power of their throw. Arm muscle endurance is critical because petanque matches can be lengthy, requiring athletes to maintain consistent performance over time. Players may experience fatigue without sufficient endurance, leading to reduced accuracy and control. Maintaining steady throws throughout a match is vital, and superior muscle endurance allows athletes to sustain their performance from the first throw to the last (Pelana et al., 2021). Moreover, arm length offers an additional advantage in petanque. Athletes with proportionally longer arms often benefit from greater leverage, which can improve the control and trajectory of the throw. This enables them to achieve more targeted and accurate results, especially when aiming for the cochonnet (target ball). Longer arms provide a natural extension that helps throw the boule (iron ball) more precisely, making adjusting for variables such as distance and landing angle easier. Therefore, endurance and arm length are essential physical attributes that can significantly impact an athlete's success in the sport, helping them

perform consistently and efficiently under competitive conditions (Setiarnawijaya et al., 2021).

Accuracy training for pointing and shooting

Accuracy training is a fundamental component of success in petanque, as it requires precise targeting in both shooting and pointing. Both techniques require athletes to aim at specific targets to knock the opponent's ball away or place their own boule as close to the cochonnet (target ball) as possible targets (Tyas et al., 2022). In shooting, the goal is to eliminate the opponent's boule with precision, while in pointing, the objective is strategically positioning one's boule in proximity to the target. Therefore, mastering these skills requires dedicated practice in accuracy training. Regular accuracy training for pointing and shooting, incorporating scenarios and variations that mimic real-game conditions, is essential for improving athlete performance (Irawan et al., 2022). Training regimens should be varied in distance, angles, and environmental conditions to simulate match-day challenges. By diversifying training, athletes can develop their ability to adapt to different game situations, which enhances their precision and consistency. Over time, athletes who engage in structured accuracy training are more likely to see improvements in their ability to perform under pressure, leading to higher levels of achievement in competitions. Ultimately, refining these technical skills significantly contributes to an athlete's success, as accurate execution in pointing and shooting is pivotal to winning matches in petanque.

Development of petanque sport

The development of petanque as a sport is essential to boost public interest and increase participation in the game. To achieve this, the role of sports practitioners including teachers, coaches, athletes, and sports organizations is crucial. These stakeholders are responsible for introducing petanque to the broader community and promoting its benefits as both a recreational and competitive sport (Suwanto et al., 2018). Their active involvement in educating potential players and organizing events helps build awareness and engagement. Schools and local sports clubs can serve as pivotal hubs where young athletes are introduced to the game, potentially nurturing future talent. In addition to grassroots efforts, professional management is required to ensure the long-term sustainability of petanque organizations. Once

the sport gains a foothold in the community through successful socialization campaigns, sports management systems must be implemented to oversee operations, organize competitions, and maintain the interest of players and fans alike (Fatchurrahman et al., 2019). Strong leadership, funding, and infrastructure support are vital factors that contribute to developing a thriving petanque community. With a well-structured management system in place, the sport can grow in terms of participation and professional recognition, leading to national and international competitions.

Petanque and technological advances

Integrating technological advancements, particularly biomechanics applications, has brought significant modernization to the sport of petanque. These applications allow coaches and performance analysts to effectively monitor and evaluate athletes' performance with precision. By utilizing biomechanics tools, coaches can track athletes' movements, analyze their technique, and provide more accurate feedback to improve performance. This technological progress allows for a more data-driven approach, which helps athletes refine their skills, enhance their strategy, and minimize errors during competition (Nurhasan, Al Ardha, Ristanto, et al., 2024).

Furthermore, developing Android-based applications has revolutionized how coaches and athletes interact with performance data. These applications allow for real-time data analysis, providing immediate insights into an athlete's strengths and areas for improvement. With the convenience of smartphones, coaches can quickly screen and assess athlete performance during training or competitions, offering instant feedback. This increased efficiency ensures that athletes receive timely guidance, which is crucial for making on-the-spot adjustments to their gameplay (Hidayah, Pratama, Nasuka, et al., 2024). Biomechanics and mobile technology have made the training process more streamlined, accessible, and practical, ultimately contributing to better overall athlete performance and advancing the sport of petanque in the digital age.

Discussion

Petanque is experiencing steady global popularity. The dynamic development of this sport continues to occur every year. Successful inclusion in international events such as the Sea Games is a testament to the development of petanque (Alis, Harmono, Pratama, & Indrayana, 2023). This study analyzes research trends and petanque development in the last decade. The results of the analysis show a significant development from year to year. Since the beginning of 2015, petanque research began to be developed and experienced a substantial surge from 2018 to 2022. However, since 2023, research has yet to be carried out massively and intensively.

Based on the results of country contribution mapping, Indonesia has the highest contribution to petanque research. The results of the bibliometric analysis show that there is a

tendency for research development in the coaching field. However, there needs to be petanque research that discusses the importance of sports injury or injury prevention in this sport. Knowledge related to sports injury is an important thing that must be developed in every sport (Esmailpoor et al., 2021). Understanding the prevention and treatment of injuries will help coaches and athletes maintain their performance and physical condition (Lystad et al., 2021). Stable performance and physical condition will affect the athlete's achievements (Loland, 2018).

The literature review resulted in a diversification in research topics, covering areas such as biomechanics, player performance, training methodology, psychological aspects, and the impact of socialization on the sport. Research continues to grow in improving the scientific foundations of petanque, providing insights that contribute to improving athlete performance and enriching the academic literature. Petanque has experienced very significant development in various regions. This phenomenon is characterized by regional, national, and international events that are always held yearly.

In line with this, an athlete's performance must continue to be evaluated so that the athlete's performance in the events held can be improved (El-Shobaki et al., 2018). The coach's role in conducting training conditioning for athletes is the key to developing an athlete's performance (Radzi et al., 2021). In Petanque, accuracy training is essential because this sport requires accuracy in playing it. Accuracy in determining the landing point is the key to successful shooting and pointing (Lubis, Lubis, Permadi, & Muhaimin, 2021). Shooting on target will reduce the number of points the opponent earns (Setyawan et al., 2023).

Pointing with the proper landing and the correct ball stop position makes it difficult for the opponent to get points (Pelana, Setiakarnawijaya, Anggraini, et al., 2021). In addition, the swing technique and the ball's release also determine the success of these two techniques (Nurhasan et al., 2023).

An athlete must master both techniques professionally (Parlindungan, Bangun, & Akhmad, 2019). Although there are only two techniques in playing petanque, special skills are needed in predicting and estimating the ball's fall (Borba et al., 2019; Paulina & Irawan, 2022). Psychological factors also determine an athlete's performance when the athlete competes (Dongoran, Muhammad Fadlih, & Riyanto, 2020). An athlete needs to control calmness, concentration, and self-confidence to master the game (Hidayat & Budiman, 2014).

On the other hand, physical factors also determine athletes' performance (Platonova, 2022). Arm muscle endurance and arm flexibility need to be trained so that athletes can provide maximum performance (Syahwira, Junaidi, Hidayah, Sumartiningsih, & Rahayiu, 2022). Kinematics analysis provides motion visualization for athletes and coaches to evaluate (Edriss et al., 2024). Measurement of arm ability based on endurance or strength can be done through kinetic analysis (Ancillao, Tedesco, Barton, & O'Flynn,

2018).

The digitalization era has impacted the development of Android-based sports biomechanics applications (Adesida, Papi, & McGregor, 2019). Athletes, coaches, and performance analysts can easily monitor the development of athlete performance in real time (Rana & Mittal, 2019). The database stored in the application also makes it easy for users to access information anytime and anywhere (Al Ardha, Nurhasan, et al., 2024). Advances in technology, by integrating aspects of sports and coaching, significantly impact the world of sports (Sarmiento et al., 2021). Sport is now seen as a physical activity and includes various components from various fields.

Digitalization in the sport of petanque will increase the attractiveness and interest in playing petanque. Extending the research related to technology integration in petanque sports is necessary. Thus, the expected digitalization can be achieved with the collaboration of various parties. In addition, research in measuring the endurance of a petanque athlete, for example, on cardiovascular, leg muscles, back muscles, or even abdominal muscles, needs to be done. Then, the health aspects of athletes, such as their relationship with sports injuries, also need to be developed. Thus, research on the sport of petanque can experience significant development and increase dynamically.

The limitation of this research is that it only reviews articles published within a specific decade (2015-2024). It may only capture some research developments in petanque. By focusing on a relatively short period, this review may overlook earlier studies that could provide valuable context or insights into the historical evolution of petanque research. Additionally, the study relies on a limited number of databases, such as Scopus, Pubmed, OpenAlex, Google Scholar, and Crossref. Lastly, the exclusion of research published in languages other than English or Indonesian further narrows the scope of this review, potentially missing essential contributions from non-English-speaking regions. Expanding the scope of years, databases, and research topics could yield a more comprehensive understanding of the sport's development and research trends.

Based on the data from this study, there is a gap that needs to be resolved in future research. The researcher suggested that research be conducted related to the development of petanque sport in the health field, especially sports injuries. In addition, in the next systematic review research, the range of years taken can be developed. So, it is not only limited to a decade or 10 years. It is hoped that phenomena can be found that need to be researched and developed again in further research. Thus, research on petanque sports can develop significantly.

Conclusion

Research on the sport of petanque has grown significantly in the last decade. However, the last two years have seen a decline in research in the sport. Research trends pre-

sented through graphs are evidence of this increase and decrease. Complementary data such as the results of bibliometry analysis, can be used as a visualization of the spread of research focus over the past decade. In addition, the results of the literature review provide an explanation of the research topics that were often studied by previous researchers. The selection of articles based on the most citations, makes it evident that the article is used as a reference in compiling current research.

Topics such as the development of petanque sport in a region, the influence of body anatomy on petanque techniques, the development of training models, and technology integration, have become a hot topic that has often been researched in recent years. This makes an indication that the development of petanque sport leads to sports achievements. However, these developments have not yet led to sports injuries and their prevention.

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