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Review Article

Identifying the Research Trend of Sport Biomechanics over the Last 20 Years: A Bibliometric Analysis of the Scopus Journal Database

Muchamad Arif Al Ardha[1ABCD], Nurhasan Nurhasan[1ADE], Dwi Cahyo Kartiko[1ADE], Chung Bing Yang[2ADE], Sauqi Sawa Bikalawan[1BCD], Ainun Zulfikar Rizki[1BCD] and Sevesti Violin Wilujeng Herista[1BCD]

[1]Surabaya State University
[2]National Dong Hwa University

Authors' Contribution: A – Study design; B – Data collection; C – Statistical analysis; D – Manuscript Preparation; E – Funds Collection

Corresponding Author: Muchamad Arif Al Ardha, e-mail: muchamadalardha@unesa.ac.id
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Abstract

Background. Sports biomechanics is an important part of coaching and athlete conditioning. The training process can be maximised through the implementation of sports biomechanics. Research related to sports biomechanics has grown significantly in recent years.

Objectives. This systematic review study aimed to analyse the development trend of sports biomechanics research over the last 20 years.

Materials and methods. This study used a bibliometric approach and a systematic review of the SCOPUS journal database to analyse research trends in the field of sports biomechanics.

Results. Over a period of twenty years, there were 259 studies that met the inclusion criteria. The analysis results showed a significant increase in the number of published studies over time, with a total of 2215 citations and an average of 1237 citation. The research tends to focus on biomechanical principles in the context of sports, with the keyword "Biomechanics" being the most dominant. The terms "Sport Biomechanics", "Human", and "Sports" were also identified as frequently occurring keywords in the research. In addition, these studies cover various aspects related to human body movement, including movement analysis, health aspects, and technology applications in sports.

Conclusions. This study provides insight into the major developments and focal aspects in sports biomechanics over the past two decades, as well as highlighting the diversity of research subjects within this field.

Keywords: coaching, sport science, training, athlete conditioning.

Introduction

Sports biomechanics research has developed significantly (Knudson, 2020). This field has played a crucial role in understanding how the human body interacts through movement (Yang, 2013), exercise (Patoz et al., 2023), and sports games (Muñoz et al., 2023). Analysis of research developments in sports biomechanics has brought us more depth regarding movement efficiency (Mishra, Singh, Ranjan, Singh, & Vidyarthi, 2019), injury prevention (Friesen & Oliver, 2022), and increased movement abilities (Tai et al., 2022).

Improving athlete performance can be achieved by understanding the mechanics of movement (Garcia, Guereño, Nuñez, & Etxarri, 2023) and how the body interacts with training loads (D. Zhang & Wang, 2023). Trainers can use biomechanical analysis to design more effective training programs (L. Zhang, 2020). This can help athletes reach their maximum potential in competition (Mujika, Halson, Burke, Balagué, & Farrow, 2018). The results of relevant sports biomechanics studies are very necessary to win at increasingly fierce levels of competition in sports (Barbosa et al., 2021).

Advances in technology used in sports biomechanics, such as high-speed cameras and inertial sensors (R. Howard, 2016), have opened the door to very detailed movement analysis (Hiley, 2012). This is not only relevant in the sports context, but also in medical rehabilitation and general health

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care (Akiyama, Nakashima, & Ogasawara, 2011). Research in sports biomechanics requires the ability to manage and analyze very large and complex data (Pataky et al., 2023). These data analysis skills can determine the effectiveness of the follow-up given to athletes (Haralabidis et al., 2021).

Biomechanics research also provides valuable insight into why injuries occur and how they can be prevented (Jang, Chang, Chen, Fu, & Lu, 2009). It is important to treat sports injuries because injuries are a serious problem that can end an athlete's career and have long-term impacts (Kent, 2019). Identifying injury risk factors and developing safer training techniques is not only important for professional athletes, but also for those involved in amateur sports.

However, the development of sports biomechanics research has not yet been systematically mapped. This bibliometric research and systematic review aim to look at the development of sports biomechanics research trends in the last 20 years with the following research questions:

- To analyze sport biomechanics research trends in the last 20 years.
- To evaluate the most countries contributed sport biomechanics research in the last 20 years.
- To discover the subject areas related to sports biomechanics research in the last 20 years.
- To analyze the keyword trends of sports biomechanics research in the last 20 years.
- To analyze the top 10 cited publications in sports biomechanics research in the last 20 years.

Materials and Methods

This type of research is a Bibliometric Analysis and Systematic Review. Article searches were carried out using a comprehensive strategy on SCOPUS research journal databases. The keyword used during the identification was "sport biomechanics". In addition, the exclusion criteria were journals non-English journals published in the last 20 years from 2023. There were 544 articles from SCOPUS that were mined on October 10th, 2023. Therefore, 259 articles were selected for further analysis by using VOS viewer computer software. There were 10 articles selected as the most cited articles and relevance which were selected for this systematic review. For standard operationalization, this study follows the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) (Figure 1).

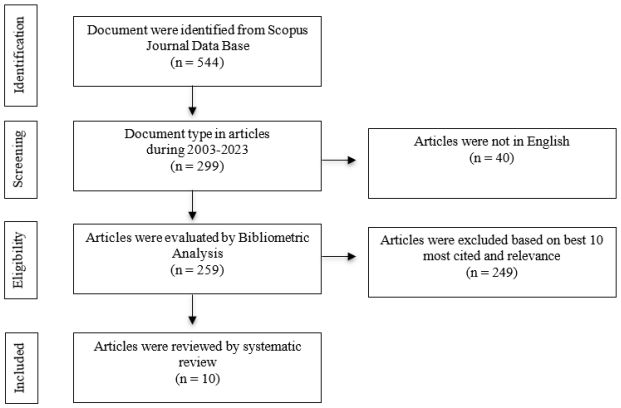

Fig. 1. PRISMA flowchart of the article selection process

Results

Research Trends of Sport Biomechanics in the Past 20 Years

The number of biomechanics articles published (n) has fluctuated over this 20 year period. The trend is not monotonous, with certain years seeing a significant increase in publications. This suggests that research interest and focus in sports biomechanics has evolved and changed over time. However, there has been a significant increase in total citations since 2017, which may reflect increased interest and recognition in sports biomechanics research. Overall, the data in table 1 illustrate significant developments in sport biomechanics over the past two decades.

Table 1. Document of sport biomechanics identified in the last 20 years

Year	n	Total Cited	Average Cited
2003	2	45	23.50
2004	0	0	0.00
2005	3	45	24.00
2006	3	69	36.00
2007	5	277	141.00
2008	2	64	33.00
2009	3	35	19.00
2010	7	174	90.50
2011	4	41	22.50
2012	9	141	75.00
2013	16	171	93.50
2014	8	96	52.00
2015	6	85	45.50
2016	7	76	41.50
2017	25	101	63.00
2018	16	175	95.50
2019	27	183	105.00
2020	20	186	103.00
2021	36	189	112.50
2022	33	54	43.50
2023	27	8	17.50
Total	259	2215	1237.00

Biomechanics research developed rapidly in 2013 (Figure 2). This is evidenced by the lack of research on sports biomechanics before 2013. In early 2003 research focused more on the variables of distance, height, time and speed. In early 2012 biomechanics research developed to involve other variables such as algorithms to see accuracy, sensor technology for measurements, and the use of IT technology. However, since 2021 there has still been no research involving the latest variables. It is possible that the development of sports biomechanics research will be affected by the Covid-19 pandemic phenomenon.

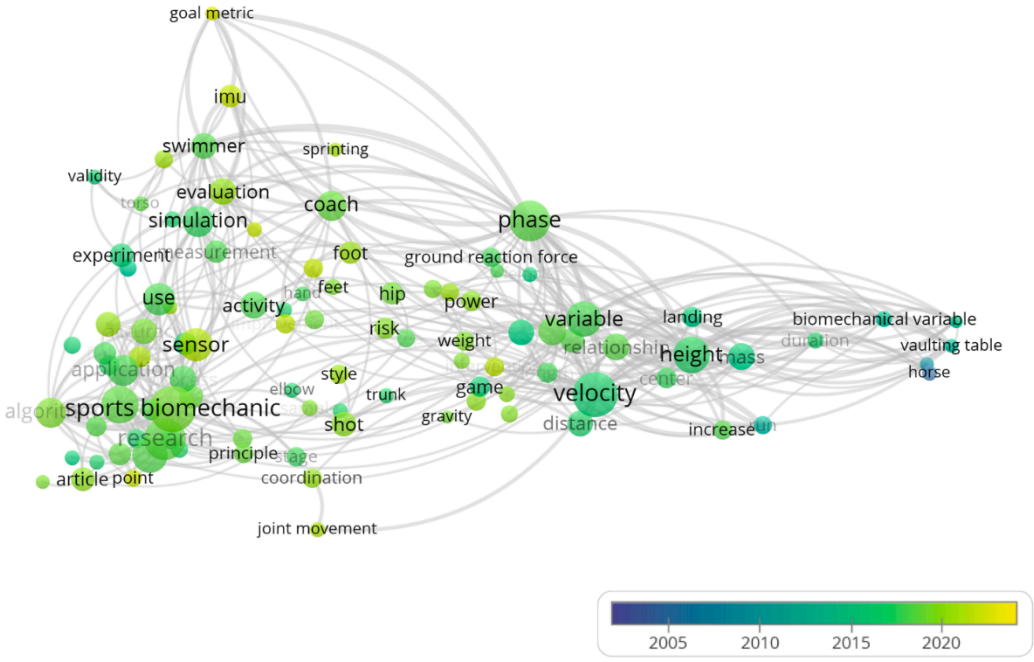

Fig. 2. Research topic trends in sport biomechanics research

Country Contributed to Sport Biomechanics in the Last 20 Years

Researchers selected the top 10 countries as the countries that contributed the most in the field of sports biomechanics (Table 2). Based on these results, one of the countries in Asia, namely China, dominates with contributions made almost twice as much as countries in Europe. However, the most citations are shown by countries in Europe.

Table 2. Top 10 countries contributed to sport biomechanics research

Country	n	Total Cited	Average Cited
China	71	308	189.50
United States	47	680	363.50
United Kingdom	30	444	237.00
Australia	18	215	116.50
Japan	17	107	62.00
Canada	14	229	121.50
Italy	13	199	106.00
Indonesia	10	20	15.00
Taiwan	8	19	13.50
Switzerland	8	36	22.00
Total	236	2257	1246.50

Overall, countries contributing to biomechanics research are in figure 3. The United States leads in total citations, while China has the most articles. Almost all continents contribute to biomechanics research except Africa. However, various collaborations between countries also occur in sports biomechanics research. The rapid development of biomechanics from various countries reflects the urgency of sports biomechanics in improving athlete performance.

Subject Areas Related to Sport Biomechanics in the Last 20 Years

In the field of Biochemistry, Genetic, and Molecular Biology, it was ranked 4th and contributed 66 articles with a total of 576 citations (Table 3). This illustrates the relevance of research at the cellular and molecular level in the context of sports biomechanics. Fields related to medicine and biomechanics collaborate to maintain the health and physical fitness of individuals, prevent injuries, understand the technical aspects of sports, and develop more effective medical devices. Collaboration between these two fields is key to providing better care to athletes, patients and the general public. It also reflects the importance of physical health and sports injuries in the context of biomechanics.

Table 3. Top 10 subject areas contributed to sport biomechanics research

Subject Areas	n	Total Cited	Average Cited
Medicine	114 (20.99 %)	1386	750.00
Engineering	106 (19.52 %)	853	479.50
Health Professions	81 (14.92 %)	811	446.00
Biochemistry, Genetics, and Molecular Biology	66 (12.15 %)	576	321.00
Computer Science	45 (8.29 %)	172	108.50
Social Science	42 (7.73 %)		42.00
Physics and Astronomy	28 (5.16 %)	107	67.50
Materials Science	24 (4.42 %)	62	43.00
Chemical Engineering	24 (4.42 %)	112	68.00
Agricultural and Biological Sciences	13 (2.39 %)	104	58.50
Total	543 (100 %)	4183	2363.00

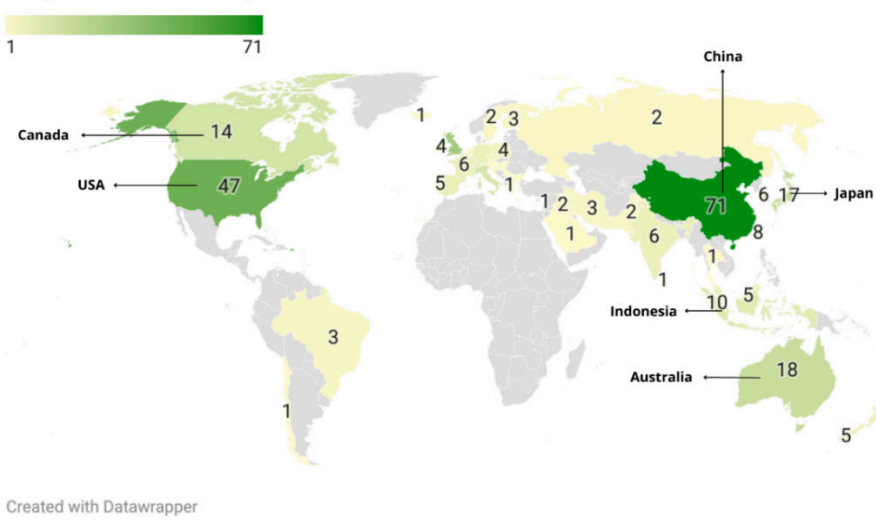

Fig. 3. Countries contributed to sport biomechanics research

The field of Engineering has a significant contribution to sports biomechanics research. Engineering has 106 articles contributing to sports biomechanics research. With a total of 853 citations and an average of 479.50 citations. Biomechanical engineering and technical approaches have played an important role in understanding human movement in the context of sport. Followed by Health Professions, which reflects the close relationship between biomechanics research and aspects of physical health, especially in treating and preventing sports injuries.

Computer Science has 45 articles contributing to sports biomechanics. The fairly high average citation (108.50) reflects the use of computer technology and modeling in research. The field of Computer Science also provides sophisticated data modeling and analysis. With a high average citation, this reflects technological developments in supporting biomechanics research. In this series, other fields such as Materials Science, Physics, and Social Sciences also have a role in understanding human movement and sports. Overall, this table reflects the diversity and complexity of research in sport biomechanics as well as the interconnections between various scientific fields that support a holistic understanding of human movement and sport.

Keyword Pattern in Sport Biomechanics Research Trend

The keyword "Biomechanics" dominates this list with a total of 121 studies (19.39 %). This reflects that a basic understanding of biomechanics is the main foundation in research in the field of sports biomechanics (Table 4). Biomechanics is a science that allows researchers to analyze human body movements scientifically. Using the principles of physics, mathematics and engineering, this research covers various aspects related to human movement, from the

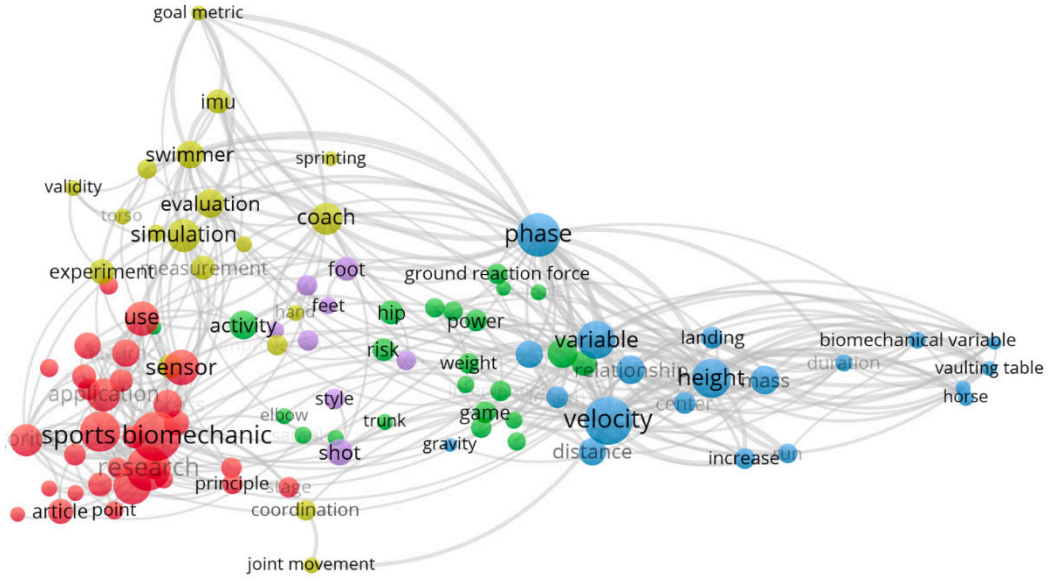

Fig. 4. Keyword interaction in sport biomechanics research

analysis of sports movements to the development of more efficient sports equipment. With a total of 1475 citations and an average of 798 citations, the term "Biomechanics" consistently appears in the scientific literature and has had a major impact on the development of this science.

Biomechanics research includes aspects such as human movement mechanisms, the human body's response to physical exercise, and the influence of physical factors on sports performance mapped by looking at connections in keywords (Figure 4). In general, there are 5 main keywords that are most dominant in relation to other keywords and form clusters. In cluster 1 (red), the sports biomechanics keyword is closely related to velocity (cluster 2/blue) and simulation (cluster 3/yellow). This proves that there is collaboration between various keywords to dig up deeper information on biomechanics.

Top 10 Cited Publications of Sport Biomechanics Research in the Last 20 Years

Table 4. Top 10 keyword patterns for sport biomechanics research

Keyword	n	Total Cited	Average Cited
Biomechanics	121 (19.39 %)	1475	798
Sport Biomechanics	97 (15.54 %)	1020	558.5
Human	93 (14.90 %)	1417	755
Sports	79 (12.66 %)	645	362
Biomechanical Phenomena	50 (8.01 %)	606	328
Kinematics	46 (7.37 %)	701	373.5
Sports Medicine	44 (7.05 %)	333	188.5
Physiology	37 (5.93 %)	749	393
Biophysics	29 (4.65 %)	334	181.5
Movement	28 (4.49 %)	208	168
Total	624 (100 %)	7588	4106

Table 5. Sports biomechanics top 10 cited publications in the last 20 years

Author	Total Cited	Research Purposes	Methods	Results
Aguinaldo, Buttermore, & Chambers, 2007	193	To analyse how torso rotation affects shoulder rotational torque during pitching.	Comparative	It suggests that certain throwing patterns can improve fielding efficiency, allowing players to perform better while reducing the risk of injury.
Glazier, 2010	125	To discuss key issues in the emerging sports science subdiscipline of performance analysis and future prospects.	Constraints-based approach	Performance analysis may be more suitable for sports biomechanics analysts and notation analysts than for sports scientists from other sports subdisciplines, such as sports physiology and sports psychology.
Song, 2013	84	To examine the rationality of the Fosbury flop method and current technology, as well as to provide reasonable recommendations for building a theoretical and sporting foundation.	Study on the analysis and simulation	This paper makes a reasonable analysis of the fosbury flop and perfect movement reduction using the principles of sports biomechanics.
Mihalik et al., 2012	69	To determine whether playing position, match type, or head impact location had an effect on head impact biomechanics measured in Bantam (13 and 14 years old) and Midget (15 and 16 years old) ice hockey players.	Prospective quantitative research	Impacts to the side of the head result in much higher rotational acceleration than impacts to the top, front, or back. Impacts to the head are more severe during matches than during training.
Taborri et al., 2020	56	To provide an overview of sports biomechanics applications found in recent literature that utilize wearable sensors. The research shows some information related to the sensors used as well as methods to analyze the data.	Literature review	To assess athlete performance, inertial sensors seem to be the most widely used. However, force sensors and electromyography are also used.
Wilson, 2008	56	To improve athlete and coach performance through increasing their understanding of every aspect of athlete performance.	Mix methods	Development areas that will enhance the use of video in training include real-time skill analysis, real-time automatic coding, and smart systems for motion analysis.
N. Li et al., 2018	52	To reduce stroke complications and assist body movement, a soft bionic ergonomic exoskeleton robot with 7 DOF was proposed.	Research and Development	The robot can help dyskinesia stroke patients restore their joint motion function and help them complete leisure activities (ADLs) such as drinking, eating, etc.

Table 5 (continued)

Author	Total Cited	Research Purposes	Methods	Results
Harpham, Mihalik, Littleton, Frank, & Guskiewicz, 2014	52	To determine how sensory and visual performance correlates with the severity of head impacts of football players and how visual and traditional sensory reaction time measurements are measured.	Prospective quantitative research	We found a significant relationship between head impact severity and visual and sensory performance; lower visual and sensory performance was associated with more severe head impacts.
Pappas, Sheikhzadeh, Hagins, & Nordin, 2007	52	To find out how gender and fatigue affect the peak values of biomechanical variables during landing from a jump.	Experimental study	Landing with a vertical ground reaction force and higher peak knee valgus may lead to a higher risk of knee injury in women.
Choppin & Wheat, 2013	46	To investigate the accuracy of Kinect in three domains: body scanning and anthropometry, segment tracking for motion analysis, and image segmentation for training and notation analysis.	Comparative	Kinect is currently not accurate for research that requires high accuracy and precision.

Biomechanics Optimizing Athletic Performance and Injury Prevention

Sports biomechanics has experienced significant progress as a science that combines the principles of physics with a deep understanding of human body movement. Through careful analysis, biomechanics helps athletes achieve their peak performance while minimizing the risk of injury. Aguinaldo et al. (2007) analyzed how torso rotation affects shoulder rotational torque during pitching in baseball and showed that understanding biomechanics can identify efficient throwing patterns. This not only increases efficiency on the field, but also allows players to perform better with a lower risk of injury. These findings make an important contribution for coaches and players to develop safer and more effective techniques in their sport. Furthermore, Glazier (2010) discusses key issues in the newly emerging subdiscipline of sports science, namely performance analysis. The constraints-based approach used in his research offers a new perspective in biomechanical analysis and may be more suitable for sports biomechanics analysts than for sports scientists from other subdisciplines. This emphasizes the importance of biomechanics not only as a tool to improve performance but also as a field of study that continues to develop and adapt to the needs of athletes and coaches.

Mihalik et al. (2012) revealed that impacts on the side of the head cause much higher rotational acceleration than impacts on the top, front, or back of the head. In the context of the sport of ice hockey, this understanding is crucial because it provides insight into how playing position, type of match, and location of head impact influence the impact biomechanics experienced by players, and this can be used to develop better protective equipment. Similarly, Taborri et al. (2020) indicate that inertial sensors appear to be most widely used to assess athlete performance. This research provides an overview of how sports biomechanics applications using wearable sensors can be applied in training and rehabilitation practices to monitor and improve athlete performance and reduce the risk of injury. Through the continued analysis and development of studies such as these, sports biomechanics continues to make valuable contributions to the world of sport. The integration of biomechanics in sports has been and will continue to be a critical pillar in efforts to optimize athletic performance and prevent injury.

The Development Biomechanics Methodology in Sports Science

Biomechanics has transformed and developed from simply the study of movement mechanics to become a critical foundation in sports science. Through the evolution of methodologies and interdisciplinary approaches, sports biomechanics now allows a more complex and holistic analysis of athlete performance. In a broader context, new methodologies in sports biomechanics involve the use of advanced technologies, such as computer modeling and movement simulation, as illustrated by Song's (2013) research on the Fosbury flop technique. The research uses biomechanical principles to analyze and refine technique in the high jump, showing how the theory and application of biomechanics can collaborate to produce recommendations that can form the theoretical foundation and practice of the sport. Advances in measurement technology and data analysis have also enabled researchers such as Mihalik et al. (2012) to study the impact of biomechanics from different angles. In their study of ice hockey players, they found that playing position, match type, and impact location on the head significantly influenced the measured impact biomechanics. This shows the importance of a specific and measurable approach in understanding and applying biomechanical concepts.

Finally, recent developments in biomechanical methodology include the integration of wearable sensors in sports research and training, as outlined by Taborri et al. (2020). This research offers an overview of sports biomechanics applications found in recent literature, showing how wearable sensors are used to collect athlete performance data. Through the integration of new scientific disciplines, technologies and methodologies, sports biomechanics continues to evolve and contribute to increased understanding of athlete performance. This discussion can be developed further by adding specific data and examples from the tables provided to support each point and illustrate how scientific discoveries have been applied in sports practice.

The Technological Innovation in Sports Biomechanics

Technological innovations in the field of sports biomechanics have brought about significant changes in the analysis and understanding of athletic movements. Advanced tools such as movement monitoring systems and computer simulations have enabled researchers to measure and analyze movement with extremely high precision, providing new insights into performance optimization and injury prevention strategies. For example, research by Aguinaldo et al. (2007) who examined the effect of torso rotation on shoulder rotational torque in pitching found that "certain throwing patterns can improve fielding efficiency, allowing players to perform better while reducing the risk of injury" (Aguinaldo et al., 2007). These findings not only enrich our knowledge of pitching biomechanics but also aid in the development of training techniques that can optimize performance and improve athlete safety. Mihalik et al. (2012) showed that "impacts to the side of the head produce significantly higher rotational accelerations than impacts to the top, front, or back of the head. Impacts to the head are more severe during competition than during training" (Mihalik et al., 2012). These findings are important in understanding the biomechanics of head impacts and can be utilized to design more effective protective equipment. Advances in wearable technology have also played an important role in sports biomechanics. As stated by Taborri et al. (2020), "inertial sensors appear to be the most widely used to assess athlete performance, but force sensors and electromyography are also used" (Taborri et al., 2020). This information emphasizes the importance of wearable technology in collecting accurate and real-time data that can be directly applied in athlete training.

Thus, technology has opened new avenues in sports biomechanics, not only in research but also in practical applications. Tools such as real-time video analysis systems, automatic coding, and smart systems for movement analysis, as described by Wilson (2008), "develop areas that will increase the use of video in training including real-time skill analysis, real-time automatic coding -time, and intelligent systems for movement analysis" (Wilson, 2008). The integration of this technology in athlete training and rehabilitation helps ensure that athletes can reach their full potential while maintaining their health and safety.

Discussion

Over the past two decades, sports biomechanics has seen an impressive evolution and diversification. This study was conducted with the aim of analyzing the development of research trends in sports biomechanics in the last 20 years. The research trend shown based on the results of the analysis is a significant increase dynamically from year to year. The development trend of sport biomechanics research began to be shown in 2005. From 2005-2010, the focus of sport biomechanics research was to discuss the principles or role of biomechanics in general. Research related to the scope of sports is still rare.

In 2011-2023, sport biomechanics research developed fluctuatively and dynamically. In these years, research related to all aspects of sport began to be conducted frequently, especially related to the scope of health. The contribution of sport biomechanics research in the scope of health is 20.99% of the total number of publications identified in this study. The role played by several countries in sport biomechanics research represents the intensity and interest in sport biomechanics research. China dominates with almost twice the contribution of European countries. The number of publications shown is 71 publications, this shows that China is very enthusiastic in developing sport biomechanics in its country.

Based on the results of the literature review, sport biomechanics research in the early 21st century was only able to measure in two dimensions. Currently, sport biomechanics research is able to measure in three dimensions, and provide data in real time. This development can occur due to the development of technology as well. The era of digitalization provides benefits with the creation of wearable devices that are able to measure and analyze the motion of a person in real time. The role of technology and computational tools in this growth cannot be overstated. With the adoption of sophisticated equipment like motion capture systems, force plates, and advanced simulations, researchers have been able to dissect athletic movement with unparalleled detail. This technological leap has allowed for more nuanced biomechanical questions to be asked and answered, offering tangible benefits for enhancing sports performance. The performance improvement that occurs in an athlete is related to the effectiveness of the movements performed. When the resulting motion is appropriate and effective, the risk of injury will decrease or even be able to avoid sports injuries.

Sports biomechanics research in the last two decades has experienced rapid progress, especially thanks to the development of increasingly sophisticated technology and movement evaluation devices (Howard et al., 2016). This has allowed researchers to observe and analyze human body movements with a high level of detail and accuracy (Amerineni et al., 2021). As a result, we now have a better understanding of the biomechanics of various sports, starting with running (Buxadé et al., 2021), swim (Izumi, Hyodo, Yoshioka, & Wada, 2023), a small ball game (Milanovich & Nesbit, 2014), big ball game (Slegers, Lee, & Wong, 2021) to heavy sports such as weightlifting (Sorensen, Haddad, Campbell, & Mirka, 2011).

One of the significant impacts of this research is the ability to optimize athlete performance (Waters, Phillips, Panchuk, & Dawson, 2019). With a better understanding of movement mechanics, trainers can design more effective training programs (L. Li, 2012). Biomechanical analysis also helps in preventing sports injuries by identifying potential excess stress on an athlete's body (Yan et al., 2023). This way, athletes can train smarter and safer (Ma & Huo, 2022). Not only in the world of competitive sports, but sports biomechanics research also has important implications in injury recovery (Zhu, Zhang, Sun, & Qi, 2021). A better understanding of body mechanics helps medical professionals design more effective rehabilitation programs (C. Zhang, Chen, Cao, Zhang, & Chen, 2019). This has helped many athletes overcome their injuries and return to their best performance (Wei & Yalong, 2021). Over the past two decades, there have also been developments in in-depth data analysis (Warmenhoven et al., 2019). Increasingly sophisticated statistical and computational methods allow researchers to analyze biomechanical data with greater precision (Knowles

& Dennison, 2017). This opens the door to more in-depth and accurate findings about how the human body moves in various sporting situations (Amarantini, Amarantini, Martin, Cahouët, & Berton, 2012).

Additionally, developments in communication and knowledge sharing have enabled sport biomechanics researchers to collaborate more effectively (Umek & Kos, 2016). They can share their discoveries with the wider scientific community (Xiang et al., 2022), accelerating the process of discovery and implementation of these findings in the world of sports (Amarantini, Rao, & Berton, 2010). However, challenges have also remained in recent years (Glazier & Mehdizadeh, 2019). Ethical debates arise with the use of monitoring technology in sports (Murray & Chuan, 2017). Questions about privacy, data use, and the influence of technology in sports competitions have become increasingly relevant topics (Luo, 2021). With all these developments and challenges, sports biomechanics remains an interesting and important field in the world of sports (Bartlett & Bussey, 2013). Research in this area continues to make valuable contributions to improving athlete performance, preventing injury, and deeper understanding of the human potential in sport (Forte, Neiva, & Marinho, 2021). The future of sports biomechanics research promises many more innovative findings that will help shape the world of sports in the future (Gutierrez, Walton, & Bezodis, 2023), (Yan-Xia, Lin, & Chong-Long, 2019), (King & Yeadon, 2015).

Conclusions

Sports biomechanics has witnessed remarkable growth and diversification in the last 20 years, as evidenced by our comprehensive bibliographic analysis and systematic review of the Scopus Journal Database. This study explored the key research trends, publication patterns, and the evolving focus of sport biomechanics research during this time frame. Sports biomechanics research has transcended geographical boundaries, with contributions from researchers and institutions worldwide. This global reach underscores the universal appeal of biomechanical principles in sports and the need for a comprehensive understanding of human movement. Furthermore, the collaborative spirit of sports biomechanics, involving experts from physiology, engineering, medicine, and coaching, has led to comprehensive strategies for athlete development and injury prevention. This confluence of knowledge and expertise has charted new paths for inquiry and application in the field.

Conclusively, the last twenty years mark a period of significant advancement in sports biomechanics, characterized by a broadened scope, integration of cutting-edge technologies, and substantive contributions to the realm of athletic performance and safety. This review not only highlights the robust nature of sports biomechanics as a field but also its ongoing potential to redefine the contours of sports science and enhance the athletic journey on a global scale. The advent of technology and computational tools has revolutionized sports biomechanics. Researchers have increasingly relied on sophisticated equipment, including motion capture systems, force plates, and computer simulations, to analyze sports movements with unprecedented precision. This shift has empowered scientists to explore complex biomechanical questions and provide practical insights for sports performance optimization.

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Conflict of interest

The authors declares that there is no conflict of interest in this study.

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Визначення тенденції розвитку досліджень у галузі спортивної біомеханіки за останні 20 років: Бібліометричний аналіз наукових публікацій у журналах, включених до наукометричної бази даних Scopus

Мухамад Аріф Аль Арда[1ABCD], Нурхасан[1ADE], Дві Кахйо Картіко[1ADE], Чунг Бінг Янг[2ADE], Саукі Сава Бікалаван[1BCD], Айнун Зульфікар Різкі[1BCD], Севесті Віолін Вілудженг Херіста[1BCD]

[1]Сурабайський державний університет
[2]Національний університет імені Донга Хва

Авторський вклад: A – дизайн дослідження; B – збір даних; C – статаналіз; D – підготовка рукопису; E – збір коштів

Реферат. Стаття: 11 с., 5 табл., 4 рис., 57 джерела.

Історія питання. Спортивна біомеханіка є важливою складовою тренування та фізичної підготовки спортсменів. Максимізації тренувального процесу можна досягти завдяки впровадженню спортивної біомеханіки. Протягом останніх років спостерігається значне зростання наукових досліджень, пов'язаних із галуззю спортивної біомеханіки.

Мета дослідження. Метою цього систематичного оглядового дослідження було проаналізувати тенденцію розвитку досліджень зі спортивної біомеханіки за останні 20 років.

Матеріали та методи. У цьому дослідженні застосовано бібліометричний підхід та систематичний огляд щодо наукових публікацій у журналах, включених до наукометричної бази даних SCOPUS з метою аналізу дослідницьких тенденцій у галузі спортивної біомеханіки.

Результати. Протягом двадцяти років було проведено 259 досліджень, які відповідали критеріям включення. Результати аналізу показали значне збільшення кількості опублікованих досліджень з плином часу, із загальною кількістю 2215 цитувань і середнім показником — 1237 цитувань. У дослідженнях основна увага приділяється біомеханічним принципам у контексті спорту, причому ключове слово «Біомеханіка» є найбільш домінуючим. Терміни «Спортивна Біомеханіка», «Людина» і «Спорт» також належать до категорії найпоширеніших ключових слів, що зустрічаються в дослідженнях. Крім того, зазначені дослідження охоплюють різні аспекти, пов'язані із рухом людського тіла, включаючи аналіз рухів, аспекти здоров'я та застосування технологій у спорті.

Висновки. Проведене дослідження забезпечує розуміння основних досягнень і ключових аспектів спортивної біомеханіки за останні два десятиліття, а також висвітлює різноманіття предметів досліджень в рамках цієї галузі.

Ключові слова: коучинг, спортивна наука, тренування, фізична підготовка спортсменів.

Information about the authors:

Al Ardha, Muchamad Arif: muchamadalardha@unesa.ac.id; https://orcid.org/0000-0002-9192-2072; Department of Physical Education, Universitas Negeri Surabaya, Jl. Lidah Wetan, Lidah Wetan, Kec. Lakarsantri, Kota SBY, Jawa Timur 60213, Indonesia.

Nurhasan: nurhasan007@unesa.ac.id; https://orcid.org/0000-0003-2790-5777; Department of Physical Education, Universitas Negeri Surabaya, Jl. Lidah Wetan, Lidah Wetan, Kec. Lakarsantri, Kota SBY, Jawa Timur 60213, Indonesia.

Kartiko, Dwi Cahyo: dwicahyo@unesa.ac.id; https://orcid.org/0000-0002-6727-0879; Department of Physical Education, Health and Recreation, Faculty of Sport and Health Science, Universitas Negeri Surabaya, Jl. Lidah Wetan, Lidah Wetan, Kec. Lakarsantri, Kota SBY, Jawa Timur 60213, Indonesia.

Yang, Chung Bing: yang.cb.ndhu@gmail.com; https://orcid.org/0009-0002-0949-1902; Department of Physical Education and Kinesiology, National Dong Hwa University, No. 1, Section 2, Da Hsueh Rd., Shoufeng, Hualien 974301, Taiwan.

Bikalawan, Sauqi Sawa: sauqisawa.20040@mhs.unesa.ac.id; https://orcid.org/0000-0003-2477-2382; Department of Physical Education, Universitas Negeri Surabaya, Jl. Lidah Wetan, Lidah Wetan, Kec. Lakarsantri, Kota SBY, Jawa Timur 60213, Indonesia.

Rizki, Ainun Zulfikar: ainun.20015@mhs.unesa.ac.id; https://orcid.org/0009-0006-7025-7209; Department of Physical Education, Universitas Negeri Surabaya, Jl. Lidah Wetan, Lidah Wetan, Kec. Lakarsantri, Kota SBY, Jawa Timur 60213, Indonesia.

Herista, Sevesti Violin Wilujeng: sevestiviolin.20013@mhs.unesa.ac.id; https://orcid.org/0009-0003-7975-3776; Department of Physical Education, Universitas Negeri Surabaya, Jl. Lidah Wetan, Lidah Wetan, Kec. Lakarsantri, Kota SBY, Jawa Timur 60213, Indonesia.

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