

Bibliometric Mapping of Mental Toughness Research in Sports: Trends, Challenges, and Future Directions

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Abstract: This research is a quantitative descriptive study using a Systematic Literature Review (SLR) approach and bibliometric analysis to examine research trends related to mental toughness (MT) in physical education and sports. Research data were collected from the Scopus database using the keywords "mental toughness" and "sports," which resulted in 386 documents published between 2011 and 2024. A bibliometric analysis using VOSviewer maps revealed patterns of publication, author collaborations, and keyword co-occurrences. The results show five main scientific fields in MT research: Psychology, Medicine, Health Professions, Social Sciences, and Biochemistry and Molecular Biology. Prolific authors include Gucciardi, D.F., and Crust, L. The UK, the United States, and Australia are the most dominant countries in terms of publication. Co-occurrence analysis yields six thematic clusters, including developmental psychology, athlete performance, mental health, and student-athlete well-being. This study demonstrates that MT is a crucial multidisciplinary topic in enhancing sports performance and education. However, the limitations of using a single database are essential considerations for expanding the scope of future research to other databases, such as Web of Science. These findings are relevant for coaches, educators, and researchers developing evidence-based interventions to foster mental toughness.

Keyword : *Mental Toughness, Physical Education, Sport, Bibliometrics, Systematic Literature Review*

Introduction

Mental toughness (MT) has been recognized as a crucial psychological construct in sports science, influencing athletes' ability to cope with stress, perform under pressure, and maintain motivation (Gucciardi et al., 2015; Jones et al., 2002). Defined as an individual's ability to consistently perform at high levels despite challenges and adversities, MT has gained significant attention in both research and applied settings. The increasing interest in MT is reflected in the growing body of literature, spanning various disciplines such as psychology, physical education, and sports sciences (Clough et al., 2002; Cowden, 2017).

A bibliometric analysis of MT research in sports is essential to map the existing knowledge, identify influential authors and institutions, and uncover emerging trends. Bibliometric mapping, a technique that utilizes citation analysis and co-occurrence networks,



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provides a quantitative and systematic method for evaluating the impact and development of research areas (Van Eck & Waltman, 2010). Previous studies have explored the conceptual foundations of MT (Gucciardi et al., 2015), its measurement tools (Sheard, 2012), and its role in athletic performance (Crust & Clough, 2011). However, a comprehensive bibliometric analysis that visualizes the trajectory of MT research, collaboration networks, and thematic trends is still lacking.

The growing emphasis on MT in sports psychology is driven by its practical implications. Athletes with higher levels of MT are more likely to succeed in competitive environments due to their resilience, ability to manage emotions, and persistence (Mahoney et al., 2014). Consequently, coaches and sports psychologists have integrated MT development strategies into training programs (Connaughton et al., 2008). Despite this practical relevance, the research landscape remains fragmented, with studies exploring diverse aspects of MT, such as its relationship with performance (Cowden, 2017), its development over time (Jones et al., 2002), and the role of environmental factors (Gucciardi et al., 2015). This fragmentation necessitates a bibliometric approach to synthesize findings and highlight research gaps.

Moreover, analyzing the global distribution of MT research can provide insights into the dominant countries and institutions contributing to this field. Existing research suggests that the United Kingdom, the United States, and Australia are among the leading contributors (Gucciardi et al., 2015). Understanding geographical trends in MT research can inform future collaborations and funding opportunities.

This study aims to conduct a bibliometric analysis of MT research in sports by analyzing publications indexed in the Scopus database. By employing visualization tools such as VOSviewer, the study will identify key research themes, influential authors, and the evolution of MT research over time. The findings will contribute to a deeper understanding of the research landscape, offering insights into trends, challenges, and future directions for MT research in sports science.

In the Indonesian context, the study of MT in sports and physical education is gaining importance, particularly in the development of elite athletes and the overall improvement of physical education curricula. Indonesian sports performance has seen significant growth in international competitions such as the Asian Games and the SEA Games, yet psychological factors, including mental toughness, remain underexplored in the national sports development framework (Putra et al., 2020). Research on MT can contribute to improving Indonesian athletes' ability to handle pressure in competitive settings, an aspect that has been identified as a critical determinant of success (Susanto & Wibowo, 2018).

Furthermore, MT is also crucial in Indonesia's physical education sector, where resilience and perseverance are fundamental attributes in shaping students' approach to sports and

physical activities (Setiawan et al., 2019). Studies indicate that Indonesian students face high levels of academic and extracurricular stress, which affects their participation in physical education programs. Developing MT-oriented curricula can enhance students' motivation and engagement, ultimately leading to better physical and mental health outcomes (Hidayat et al., 2022).

Various models of sports research in Indonesia focus on talent development, physiological training, and skill acquisition, but there is limited emphasis on psychological attributes such as MT (Nugroho et al., 2018). Incorporating psychological resilience training into Indonesia's national sports strategy and physical education syllabus can provide long-term benefits, fostering athletes who are not only technically proficient but also mentally robust.

This study aims to conduct a bibliometric analysis of MT research in sports by analyzing publications indexed in the Scopus database. By employing visualization tools such as VOSviewer, the study will identify key research themes, influential authors, and the evolution of MT research over time. The findings will contribute to a deeper understanding of the research landscape, offering insights into trends, challenges, and future directions for MT research in sports science.

Method

This study falls under the category of quantitative descriptive research using a Systematic Literature Review (SLR) approach combined with bibliometric analysis to examine research trends related to mental toughness in physical education and sports. The SLR approach aims to systematically identify, evaluate, and synthesize relevant literature (Tranfield et al., 2003) (Leahy et al., 2020) (Watson et al., 2017) (Donnelly et al., 2017),. Research data were obtained from the Scopus database, which served as the primary source for the sampling process. Data collection was conducted on January 20, 2025, by applying the keywords "mental toughness" AND "sports" in the article title, abstract, and keywords fields (Article Title, Abstract, Keywords). The search yielded a total of 386 documents, consisting of 348 journal articles, 26 books, 4 book series, and 3 conference proceedings. The selected publication period ranged from 2011 to 2024. To ensure accuracy in the document selection process, the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) workflow was employed during the screening phase of the bibliometric analysis.

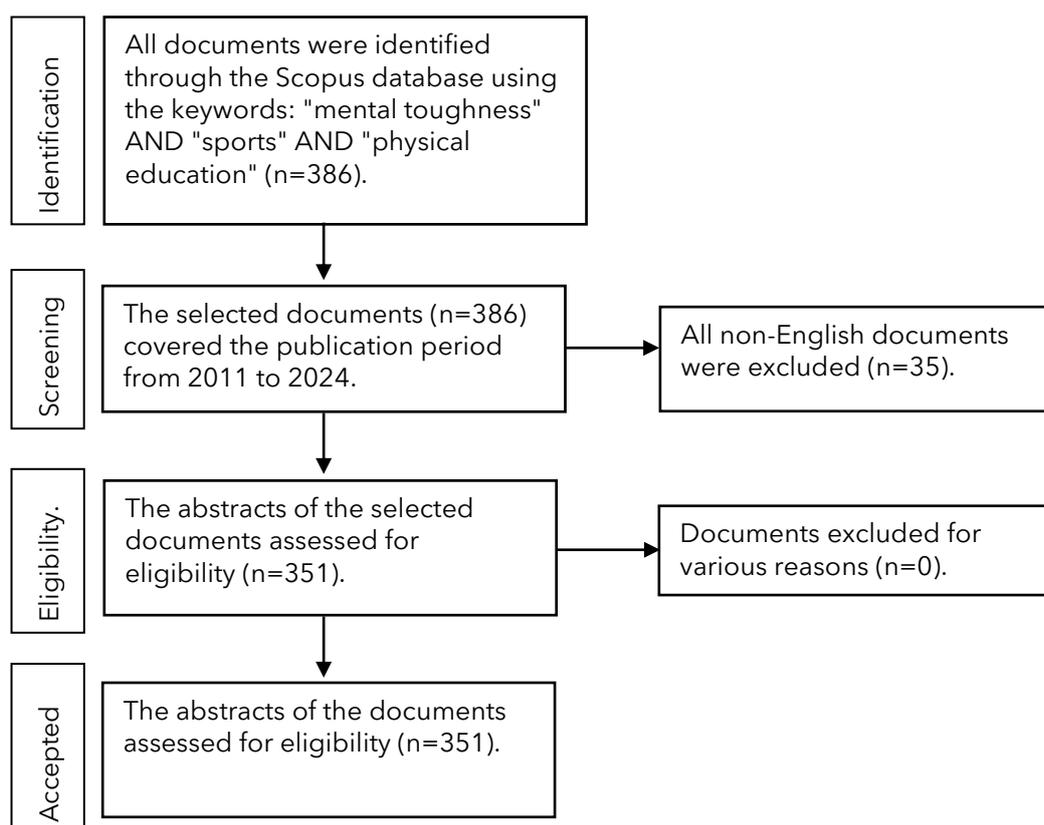


Figure 1. Metadata Search Design for Articles from Scopus

Bibliometric analysis was conducted using VOSviewer software to visualize relationships between publications, keywords, and author collaborations (van Eck & Waltman, 2010). This analysis aimed to explore publication patterns, author collaborations, and keyword co-occurrence trends in research related to mental toughness in sports and physical education. Several approaches were employed in the analysis: (1) Co-Authorship Analysis - to examine collaboration networks among researchers in this field; (2) Co-Occurrence Analysis - to identify topic trends based on frequently co-occurring keywords; and (3) Citation and Bibliographic Coupling Analysis - to understand citation relationships between the most influential documents in this research domain. The researchers applied specific parameters in VOSviewer to extract metadata from articles, including: (1) Type of analysis: Co-occurrence analysis; (2) Unit of analysis: All keywords; (3) Counting method: Full counting; (4) Minimum number of documents per author: 2 documents.

Results And Discussion

The table presents the Top 5 Rankings in various categories related to mental toughness research, based on bibliometric analysis using VOSviewer. This analysis identifies key subject areas, leading affiliations, source titles, influential authors, and dominant countries contributing to the field. The categories listed in the table include: Subject Area. The research on mental toughness is primarily concentrated in Psychology (158 publications), followed by Medicine

(134), Health Professions (119), Social Sciences (69), and Biochemistry, Genetics, and Molecular Biology (24). This highlights the interdisciplinary nature of mental toughness studies, which extend beyond sports psychology to include health sciences and medicine, Affiliation: The leading institutions publishing in this domain include The University of Queensland (15 publications), University of Lincoln (13), Curtin University (13), The Faculty of Health Sciences (11), and University of KwaZulu-Natal (10). These universities have contributed significantly to mental toughness research, demonstrating a strong academic presence in sports psychology and mental resilience studies, Source Title:

The most frequently cited journals publishing mental toughness research include *Frontiers in Psychology* (15 publications), *Retos* (12), *Psychology of Sports and Exercise* (10), *Cuadernos de Psicología del Deporte* (9), and *International Journal of Sport Psychology* (9).

Table 1. Top 5 Profiles in Mental Toughness Publications	
Categories	Top 5 Rankings
<i>Subject Area</i>	<i>Psychology (158), Medicine (134), Health Professions (119), Social Sciences (69), Biochemistry, Genetics and Molecular Biology (24)</i>
<i>Afiliation</i>	<i>The University of Queensland (15), University of Lincoln (13), Curtin University (13), The Faculty of Health Sciences (11), University of KwaZulu-Natal (10)</i>
<i>Source Title</i>	<i>Frontiers in Psychology (15), Retos (12), Psychology of sports and exercise (10), Cuadernos De Psicología Del Deporte (9), International Journal Of Sport Psychology (9)</i>
<i>Author</i>	<i>Gucciardi, D.F. (15), Crust, L.(13), Cowden, R.G. (11), Stamatis, A.(9), Brand, S. (7)</i>
<i>Country</i>	<i>United Kingdom (84), United States (79), Australia (43), Canada (26), Spain (20)</i>

These journals serve as key platforms for disseminating knowledge in the field of sports psychology and mental resilience: Author: The most prolific researchers in mental toughness include Gucciardi, D.F. (15 publications), Crust, L. (13), Cowden, R.G. (11), Stamatis, A. (9), and Brand, S. (7). Their research has significantly shaped the academic discourse on mental resilience in athletes, Country: The leading countries contributing to mental toughness research are United Kingdom (84 publications), United States (79),

Australia (43), Canada (26), and Spain (20). These countries have established strong research networks and funding for sports psychology, reflecting their leadership in the field.

Thematic Cluster of Mental Toughness

The results of data visualization analysis using the VOSviewer application indicate that the most frequently occurring keywords in this study sample include "human," "athlete," "male," "female," "article," "humans," "athletes," "human experiment," "psychology," and "questionnaire." The ten highest-frequency keywords, along with their bibliometric characteristics—including occurrences, links, total link strength, and average publication year—are presented in Table 2. The item density visualization of high-frequency keywords is illustrated in Figure 2.

This analysis provides in-depth insights into research trends in the field of physical education and highlights the relationships between various relevant concepts (Van Eck & Waltman, 2010). By employing bibliometric analysis methods, this study contributes to a better understanding of the dynamics and development of research in this domain (Börner et al., 2003).

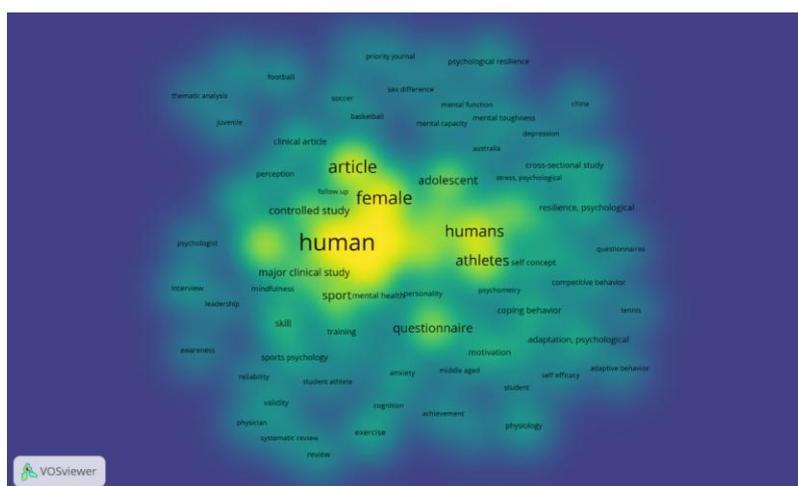


Figure 2. Visualization of Keyword Occurrence Frequency in the Field of Mental Toughness

Source: Researcher's data based on Scopus database (January 24, 2025), analyzed using VOSviewer.

Table 2. Top 10 High-Frequency Keywords in Physical Education Research.			
No	Keywords	Occurences	Total Link Strenght
1	Human	118	1439
2	Athlete	100	1255
3	Male	81	1084
4	Female	78	1020
5	Article	74	986
6	Humans	63	949
7	Athletes	55	829

presented in Table 3. Keywords highlighted in bold represent those with the highest frequency of occurrence.

Table 3. High-Frequency Keyword Clusters Related to Publications on Mental Toughness		
Cluster number/colour	Item (s)	Keywords (occurrences)
Cluster 1/Red	30	adolescent, age, article, basketball, behavior, child, clinical article, competition, controlled study, female, football, human, human experiment, injury, juvenile, male, mental capacity, mental function, mentally tough, parents, perception, priority journal, procedures, psychological resilience, qualitative research, semi structured interview, sex difference, soccer, thematic analysis, youth sport
Cluster 2/Green	29	achievement, anxiety, burnout, cognition, combat sports, exercise, imagery, martial art, martial arts, mental health, mental skills, mental toughness, mindfulness, motivation, optimism, performance, personality, physical activity, physician, physiological stress, psychological well-being, qualitative, review, skill, sport, sports psychology, systematic review, training, wellbeing
Cluster 3/Blue	27	adaptation, psychological, adaptive behavior, athletes, athletic performance, australia, competitive behavior, coping behavior, cross-sectional studies, cross-sectional study, depression, emotion, humans, mental stress, middle aged, psychological aspect, psychometrics, psychometry, questionnaire, questionnaires, resilience, psychological, self concept, self efficacy, self report, sports, stress, psychological, surveys and questionnaires, young adult.
Cluster 4/Yellow	14	adult, athlete, awareness, challenge, commitment, confidence, correlation analysis, interview, leadership, major clinical study, normal human, psychologist, reliability, validity.
Cluster 5/Purple	14	china, coping, covid-19, elite athlete, elite athletes, emotional intelligence, endurance, gender, positive psychology, psychological skills, resilience, tennis, toughness, validation.

Cluster 6/Tosca	11	<i>follow up, physiology, psychology, satisfaction, sport psychology, stress, student, student athlete, student-athlete, students, university.</i>
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Conclusions

Despite the challenges in developing MT in sports and physical education, the expanding body of research in this field provides a foundation for more effective interventions. With an increasing number of studies identifying factors contributing to MT, sports and education practitioners can refine strategies to help athletes and students reach their full potential.

This study relied solely on Scopus as a data source, which presents limitations in literature coverage. The exclusive use of Scopus may introduce bias in evaluating research, particularly when comparing different fields, institutions, or countries (Echchakoui, 2020; Mongeon & Paul-Hus, 2016). Future research should expand its scope by incorporating additional databases such as Web of Science (WoS) to deepen bibliometric analyses. Studies not indexed in Scopus, including non-English publications, may also provide valuable insights into MT within different cultural contexts. Therefore, future research should broaden its data sources by incorporating databases like Web of Science or Google Scholar to achieve a more comprehensive understanding.

Based on the findings of this study, it can be concluded that MT is a crucial aspect of sports and physical education, continuously evolving in scientific research. The increasing number of publications on this topic in recent years indicates a growing interest in understanding and developing MT among athletes and students. Certain universities and researchers dominate this field, with journals such as *Perceptual and Motor Skills* serving as key publication platforms. Geographically, the United States leads in the number of publications, reflecting a greater emphasis on sports psychology compared to developing countries like Indonesia.

Moreover, this study highlights the importance of a multidisciplinary approach to understanding MT, as described in the 4C's Model of Mental Toughness (Clough et al., 2002) and MT development models in sports (Gucciardi et al., 2015). The integration of physical training and appropriate psychological strategies can help athletes and students navigate competitive pressures and academic-social challenges.

Thus, these findings have significant implications for coaches, educators, and researchers in prioritizing psychological aspects in sports training and physical education. Efforts to enhance MT should be supported by evidence-based policies that emphasize a balance between physical and psychological aspects, enabling individuals to achieve their optimal potential in both sports and academics.

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Author Contribution

Conceptualization & methodology: Muhad Fatoni; investigation : Imron Nugroho Saputro; writing–original draft preparation: Anugrah Nur Whartadi.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this article.

Data Availability

The datasets generated and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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