Systematic Literature Review:Research on Basketball Sports Biomechanics Using VOSviewer in the Scopus Database from 2015 to 2025

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ABSTRACT

The era of modern sports science, biomechanics plays a crucial role in enhancing athletic performance, particularly in basketball. Biomechanics examines human body movements based on mechanical principles, which are applicable to fundamental techniques such as passing, shooting, dribbling, and jump shots to improve efficiency and prevent injuries. This study conducts a bibliometric review of basketball biomechanics literature indexed in the Scopus database from 2015 to 2025 using the VOSviewer software. The analysis includes publication trends, citation counts, author collaboration, and keyword and abstract term mapping. The results show fluctuating trends in both publications and citations, with a peak in publications in 2020 followed by a decline since 2022. Author collaboration is identified in two main clusters, indicating a well-organized research structure. Dominant keywords relate to injury, motion biomechanics, and applications in basketball and rehabilitation. Abstract terms are grouped into several thematic clusters, reflecting the diversity of research focuses. This study provides a comprehensive and systematic overview of the research landscape in basketball biomechanics, serving as a foundation for further evidence-based research and training development.

AUTHORS' CONTRIBUTION
A. Conception and design of the study;
B. Acquisition of data;
C. Analysis and interpretation of data;
D. Manuscript preparation;
E. Obtaining funding

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INTRODUCTION

The era of modern sport science, sports biomechanics has become one of the key disciplines supporting athletic performance, including in basketball. Biomechanics is the science that studies human body movements based on mechanical principles, encompassing force, torque, velocity, and momentum. In the context of basketball, biomechanics plays a vital role in optimizing fundamental techniques such as passing, shooting, dribbling, and especially jump shots, aiming for greater efficiency and reduced injury risk (Huang et al., 2023; Irawan & Prastiwi, 2022; Sánchez-Sixto et al., 2021). Research on basketball biomechanics has continued to grow over the past decade, in line with the increasing demand for science-based training. However, due to the abundance of available literature, it is challenging to understand how this research theme has

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evolved over time, who the key authors are, and which keywords are most frequently used.

Therefore, this article aims to conduct a Systematic Literature Review (SLR) of Scopus-indexed articles discussing basketball biomechanics from 2015 to 2025. Utilizing VOSviewer software, the study applies bibliometric analysis to identify publication trends, citation counts, author and institutional collaborations, as well as keyword and abstract term mapping (Al Husaeni & Nandiyanto, 2022a; Gardazi et al., 2023; Hayati et al., 2023; Ibda et al., 2023).

The findings of this study are expected to provide a comprehensive overview of the basketball biomechanics research landscape, and to serve as an initial reference for researchers, coaches, and academics in developing scientifically grounded studies and training methods. Therefore, this research focuses on exploring the literature on basketball biomechanics from 2015 to 2025 through the following questions:

1. How has the publication trend in basketball biomechanics research developed from 2015 to 2025?
2. How has the citation trend in basketball biomechanics research developed from 2015 to 2025?
3. What patterns of author collaboration exist in basketball biomechanics research from 2015 to 2025?
4. What are the most frequently used keywords in basketball biomechanics research from 2015 to 2025?

What are the most frequently used abstract terms in basketball biomechanics research from 2015 to 2025?

METHODS

This study is a systematic and comprehensive literature review that focuses on an in-depth analysis of research related to biomechanics in the sport of basketball. The review was conducted using the bibliometric software VOSviewer and based on data from the Scopus database, covering the period from 2015 to 2025. The methodology applied in this research is a bibliometric study utilizing a structured and explicit mapping approach, which enables the identification of various research trends, scientific writing patterns, and citation behaviors in the field of sports biomechanics. Bibliometric analysis serves as a vital tool for organizing and examining bibliographic data, such as scientific journal articles, with support from specialized software such as VOSviewer and Publish or Perish. These tools provide capabilities to visualize citation networks and author collaboration patterns across the reviewed literature (Al Husaeni & Nandiyanto, 2022b; Amutuhaire, 2022; Aprile et al., 2021; Nandiyanto et al., 2023; van Dalen, 2021).

Through this approach, the study aims to offer a detailed, systematic, and structured perspective on the development and dynamics of basketball biomechanics research indexed in the Scopus database over the past decade. Technically, this bibliometric research process consists of four main stages: (1) searching and reviewing relevant bibliographic records, (2) filtering the bibliographic dataset according to inclusion criteria, (3) refining and completing metadata to ensure accuracy and

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completeness, and (4) analyzing the bibliographic data to interpret overall patterns and research trends (W. H. Lam et al., 2022; Muktiarni et al., 2023).

Figure 1.
Bibliography Search Through Publish or Perish Software

Bibliographic Filtering

The process of bibliographic filtering and selection in this study was carried out based on several rigorous criteria, including: (1) Only journal articles written in English were considered; (2) The documents must contain content relevant to the context of basketball biomechanics; and (3) The publications must be issued by reputable and recognized publishers indexed in major bibliographic databases. Each bibliographic entry included or excluded from the bibliometric analysis underwent thorough verification by cross-referencing data through the official Scopus database, based on the extracted results from Publish or Perish software (Turmuzi et al., 2023). Various document types—such as conference proceedings, short notes, errata, editorials, duplicates, reviews, and articles lacking abstracts or keywords—were excluded from further analysis. In the initial search using PoP software, a total of 200 bibliographic entries were retrieved. These entries were then screened against the inclusion criteria, resulting in 180 accepted entries and 20 rejected entries due to noncompliance. To provide a quantitative overview of the bibliographic distribution, Table 1 presents the number of entries collected for each year within the study period based on the PoP search results.

Table 1.
Bibliographic Search Results 2015 to 2025

Year	Accepted	Percentage	Rejected	Percentage	Total
2015	25	96%	1	4%	26
2016	15	88%	2	12%	17
2017	24	92%	2	8%	26
2018	24	100%	0	0%	24
2019	17	77%	5	23%	22
2020	26	90%	3	10%	29
2021	24	92%	2	8%	26
2022	15	88%	2	12%	17
2023	6	75%	2	25%	8
2024	4	80%	1	20%	5
total	180		20		200

Bibliographic Analysis

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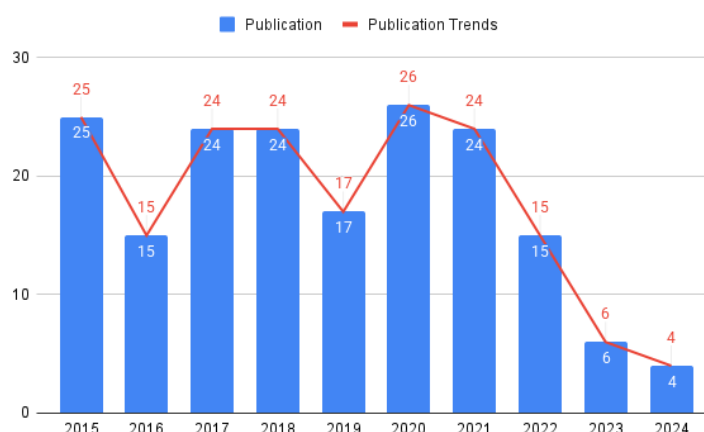krisnadesto@gmail.com

The bibliometric analysis in this study focused on four main aspects to provide a comprehensive overview of research development in the field of basketball sports biomechanics. These aspects include: (1) trends in the number of publications over time, (2) Identification of journals that most frequently publish articles related to basketball biomechanics, (3) Most cited articles as indicators of academic influence and relevanc, and (4) Analysis of the most frequently used keywords by authors to highlight the central focus of research in this field, along with other relevant bibliometric indicators. To facilitate the analysis, a specialized software called VOSviewer was employed. This tool processes and visualizes bibliographic data in a comprehensive manner (Andrews, 2021). VOSviewer is capable of detecting dominant terms and offering a variety of visual representations of bibliometric data, such as citation maps, co-authorship networks, and keyword maps that illustrate the core themes across the literature. With these features, VOSviewer enables researchers to identify significant patterns, trends, and relationships within the analyzed bibliographic dataset (W. S. Lam et al., 2023). The analysis was conducted using a dataset file exported from EndNote, which had been systematically organized to ensure compatibility and efficiency when processed in VOSviewer.

RESULTS AND DISCUSSION

Results

Publication Trends Analysis

Figure 2 shows that the total number of articles published on basketball biomechanics from 2015 to 2024 amounted to 180 articles. The trend in publication numbers indicates a fluctuating pattern, with periods of both increases and decreases across certain years. Notable increases in publication output occurred between 2016 and 2017, and again between 2019 and 2020. Conversely, declines were observed between 2015–2016, 2018–2019, 2020–2021, 2022–2023, and 2023–2024. A relatively stable or plateaued publication rate was noted between 2017 and 2018. Overall, across the span of 2015 to 2024, the highest number of publications on basketball biomechanics was recorded in 2020, while the lowest occurred in 2024. This indicates that the average number of publications remained relatively high from 2015 to 2021, followed by a significant decline beginning in 2022 through 2024

Figure 2.
Publication Trends

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Citation Trends Analysis

Figure 3 shows that the total number of citations for articles related to basketball biomechanics from 2015 to 2025 reached 5,594 citations. The citation trend reveals a fluctuating pattern, with one period of increase and multiple periods of decline. The only increase occurred between 2016 and 2017, while declines were recorded in the periods 2015–2016, and continuously from 2017 to 2024. Across the entire timeframe of 2015–2025, the highest citation count occurred in 2015, with 1,669 citations. Despite relatively stable publication numbers in the following years, the overall trend in citations declined. This may reflect delays in citation accumulation or shifts in research focus within the field.
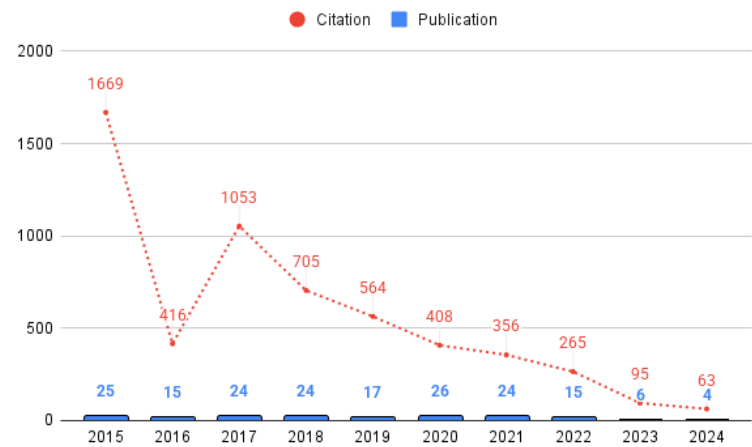
Figure 3.
Citation Trends

Author Collaboration Analysis

Figure 4 and Table 2 present the results of the author collaboration analysis in this study. From a total of 735 authors, 15 authors were identified as having strong collaboration networks, based on the criterion of having authored at least two publications. As visualized, two main collaboration clusters emerged: The first cluster (red) centers around key figures such as Gregory D. Myer and Timothy E. Hewett, dan The second cluster (green) is led by Kevin R. Ford as the central node. Table 2 provides details on the number of documents and the Total Link Strength for each author in the two clusters. Kevin R. Ford had the highest number of documents and collaboration strength in Cluster 2, while Gregory D. Myer and Timothy E. Hewett dominated Cluster 1. These findings indicate a well-organized and structured pattern of collaboration among leading researchers in the field of basketball biomechanics

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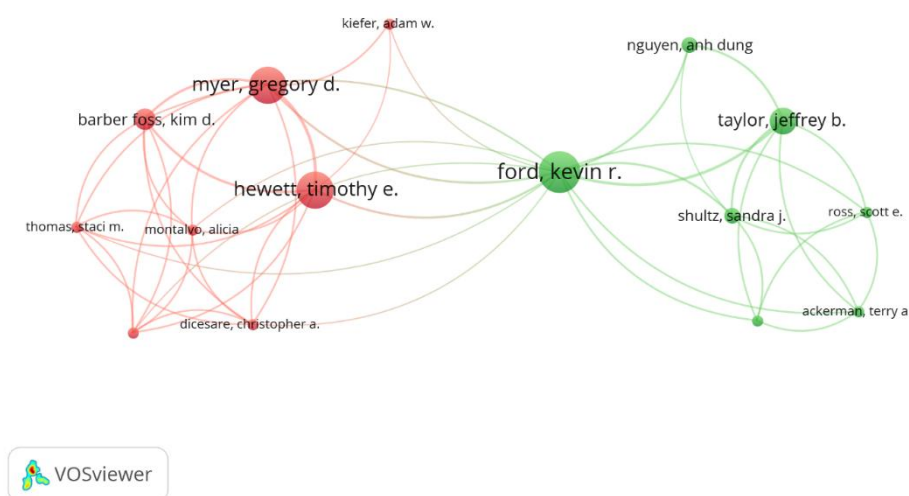
Figure 4.
Visualization of Author Collaboration Network

Table 2.
Number of Author Collaboration Links

Author	Documents	Total Link Strength
Cluster 1		
barber foss, kim d.	4	18
dicesare, christopher a.	2	13
hewett, timothy e.	7	22
jayanthi, neeru a.	2	13
kiefer, adam w.	2	4
montalvo, alicia	2	13
myer, gregory d.	7	23
thomas, staci m.	2	13
Cluster 2		
ackerman, terry a.	2	10
ford, kevin r.	8	30
nguyen, anh dung	3	7
ross, scott e.	2	10
schmitz, randy j.	2	10
shultz, sandra j.	3	13
taylor, jeffrey b.	5	17

Publication Keyword Analysis

A total of 509 author keywords were analyzed using a minimum occurrence threshold of five times. From this analysis, 17 keywords were identified as having strong linkage based on Total Link Strength measurements. The keywords were grouped into four distinct clusters, each represented by different colors and characterized by the number of items they contained: Cluster 1 (red) includes keywords such as "ankle," "kinematics," and "kinetics.", Cluster 2 (green) features keywords like "ACL," "footwear," and "injury prevention.", Cluster 3 (blue) contains terms such as "anterior cruciate ligament," "biomechanics," and "team sports.", Cluster 4 (yellow) includes "basketball," "performance," and "rehabilitation.". Figure 6 illustrates the keyword co-occurrence

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network, where "biomechanics" appears as the central keyword with the highest level of connectivity. This visualization reflects strong thematic relationships between dominant keywords used in basketball biomechanics research.
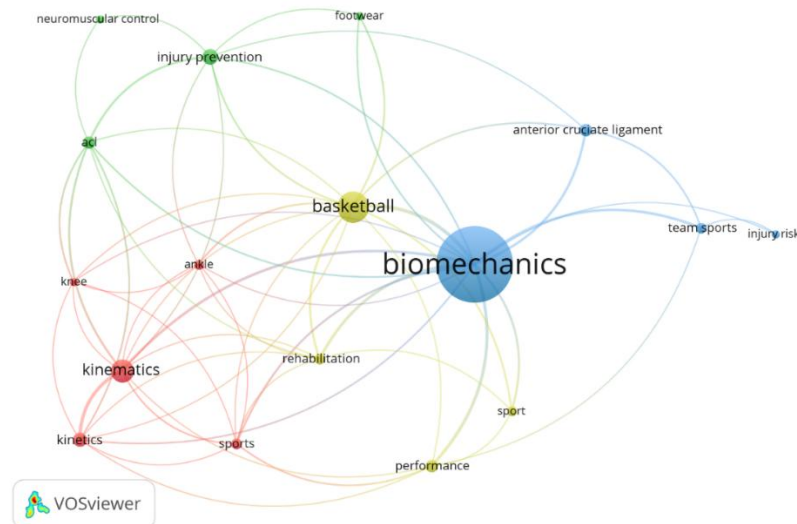
Figure 5.
Author Keyword Network Visualization

Table 3.
Author Keyword Grouping

Keyword	Occurrences	Total Link Strength
Cluster 1 (5 items)		
ankle	6	8
kinematics	15	24
kinetics	9	17
knee	5	8
sports	7	12
Cluster 2 (4 items)		
acl	8	15
footwear	5	5
injury prevention	10	12
neuromuscular control	5	2
Cluster 3 (4 items)		
anterior cruciate ligament	8	9
biomechanics	51	50
injury risk	5	2
team sports	7	9
Cluster 4 (4 items)		
basketball	20	27
performance	8	13
rehabilitation	7	14
sport	6	7

Abstract Term Analysis

From a total of 5,033 terms extracted from article abstracts—with a minimum occurrence threshold of ten times—149 terms were identified as having strong network

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connections based on Total Link Strength. Figure 7 displays the visualization of the term co-occurrence network, where these terms are organized into several thematic clusters represented by different colors. Each cluster highlights a major theme in the basketball biomechanics literature: Cluster 1 focuses on ACL injuries and related parameters such as "ACL injury," "female athlete," and "risk.", Cluster 2 relates to exercise and intervention, with terms like "control group," "exercise," and "pain.", Cluster 3 is centered on game and competition aspects, including "game," "fatigue," and "shot.", Cluster 4 pertains to physical conditioning and performance, featuring terms such as "movement," "jump height," and "training.". This structured term mapping reveals the complexity and diversity of research themes associated with biomechanics, sports injuries, and athletic performance in basketball.
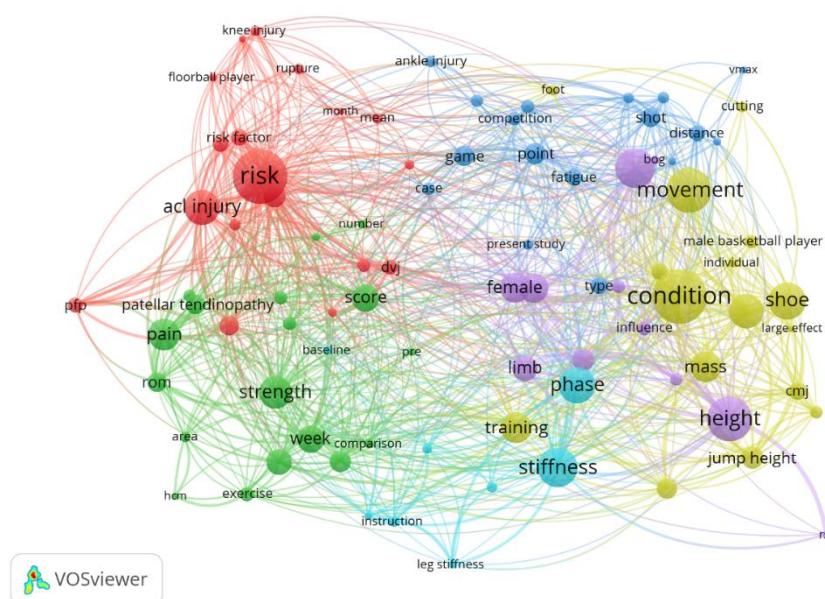
Figure 6.
Abstract Network Visualization Terms

Table 4.
Abstract Term Grouping

Cluster	Keyword	Occurrences	Total Link Strength
1	acl	33	465
1	acl injury	52	913
1	anterior cruciate ligament	21	335
1	dvj	22	318
1	female athlete	29	472
1	female player	10	208
1	floorball player	12	154
1	initial contact	14	220
1	knee flexion	19	296
1	knee injury	15	219
1	mean	16	194
1	month	10	156
1	pfp	22	372
1	risk	83	1306

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Cluster	Keyword	Occurrences	Total Link Strength
1	risk factor	24	461
1	rupture	15	209
1	season	23	341
1	soccer player	13	177
1	study design	17	332
2	area	15	187
2	athletes	12	173
2	comparison	14	183
2	control group	38	527
2	exercise	21	331
2	hcm	10	130
2	intervention	31	499
2	number	13	134
2	pain	47	598
2	patellar	18	188
2	patellar tendinopathy	29	292
2	patient	20	324
2	pre	12	143
2	rom	28	479
2	score	41	554
2	strength	49	717
2	volleyball	19	307
2	week	41	691
3	ankle injury	17	157
3	ball	16	212
3	case	18	172
3	coach	12	138
3	competition	20	228
3	direction	19	237
3	distance	23	316
3	fatigue	24	267
3	game	30	372
3	point	31	388
3	point shot	12	164
3	present study	15	211
3	review	18	187
3	shooting	17	196
3	shot	28	324
3	type	25	397
3	vmax	10	64
4	center	25	372
4	cmj	26	327
4	condition	83	786
4	countermovement jump	30	383
4	cutting	16	96
4	foot	15	193
4	individual	14	222
4	jump height	32	435
4	jump performance	18	306
4	large effect	10	204
4	male basketball player	20	260
4	mass	46	624
4	movement	68	592
4	shoe	56	487

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Cluster	Keyword	Occurrences	Total Link Strength
4	training	46	654
4	velocity	51	693
5	asymmetry	32	459
5	bog	13	338
5	female	44	684
5	height	67	700
5	influence	21	363
5	limb	38	450
5	magnitude	18	261
5	male	43	725
5	rsi	13	171
5	sex	19	447
5	speed	60	742
6	baseline	11	197
6	drop landing	14	253
6	external focus	11	292
6	instruction	15	362
6	leg stiffness	12	255
6	lower limb	15	196
6	phase	54	616
6	stiffness	60	894

Discussion

This study provides a comprehensive overview of the research trends in basketball biomechanics from 2015 to 2024, based on publication and citation data extracted from the Scopus database. The fluctuation in the number of publications, as reflected in the graphs, suggests that interest in this topic has been dynamic, with research activity peaking in 2015 and 2020, followed by a decline in recent years. The decline may be attributed to shifts in research focus or a time lag in citation accumulation, which is also evident in the downward trend in citations despite relatively stable publication output.

The analysis of author collaboration reveals the presence of two prominent clusters of researchers, with key figures such as Gregory D. Myer and Kevin R. Ford playing central roles. These structured patterns of collaboration underscore the importance of interdisciplinary and cross-institutional partnerships in advancing the quality of research in basketball biomechanics.

From the keyword analysis, it is evident that the research focus centers on terms associated with injury, injury prevention, kinematics, and performance-related factors such as jump height and training. This reflects two primary research themes: the optimization of athlete performance and the mitigation of injury risks, both of which are critical issues in competitive sports. The structured clustering of abstract terms further illustrates the thematic richness and complexity of scientific inquiry in this field.

The bibliometric method applied in this study successfully captured thematic patterns and linkages that help shape a more systematic research framework. These results are highly valuable for researchers and sports practitioners in designing more focused and evidence-based research or training interventions. They also open

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opportunities for further exploration of areas that remain under-researched in the basketball biomechanics domain.

CONCLUSION

Based on the bibliometric analysis of basketball biomechanics literature in the Scopus database from 2015 to 2025, the following conclusions can be drawn:

1. Publication Trends: The development of publications shows a fluctuating pattern, with a total of 180 articles published during the 2015–2024 period. There was a notable increase in publications in 2016–2017 and 2019–2020, peaking in 2020. However, a significant decline occurred from 2022 to 2024, with the lowest publication count recorded in 2024.
2. Citation Trends: A total of 5,594 citations were recorded from 2015 to 2025, following an inconsistent trajectory. The highest number of citations occurred in 2015 (1,669 citations), with a general downward trend in subsequent years.
3. Author Collaboration: Two main collaboration clusters were identified, comprising 15 authors who met the criterion of having at least two publications. The first cluster (red) is led by Gregory D. Myer and Timothy E. Hewett, while the second cluster (green) is headed by Kevin R. Ford. These collaboration patterns suggest an active and organized research structure in this field.
4. Keyword Analysis: Seventeen main keywords were found, forming four distinct clusters. The central keyword was "biomechanics," reflecting the core of the research focus. Other keyword groups addressed injury and prevention ("ACL," "injury prevention"), biomechanical dimensions ("kinematics," "kinetics"), and applied aspects in basketball and rehabilitation.
5. Abstract Term Analysis: A total of 149 frequently occurring terms were identified and grouped into thematic clusters. These included themes such as ACL injuries and risk, training programs and interventions, game and competition aspects, and physical condition and athletic performance—illustrating the complexity and breadth of topics within basketball biomechanics research.

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