



ISSN Print: 2664-7559
ISSN Online: 2664-7567
IJSHPPE 2024; 6(1): 163-170
www.physicaleducationjournal.in
Received: 03-02-2024
Accepted: 11-03-2024

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Co-occurrence, network clustering, and trend topic analysis from hockey and dribbling keywords: Scopus database

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DOI: <https://doi.org/10.33545/26647559.2024.v6.i1b.118>

Abstract

Hockey is among a multitude of sports. Despite being a specialized sporting event that requires a unique skill, there has been less reporting on trend data. The objective of this study was to reference the published data for analysis, clustering, and evaluation of trend topics. The present study utilized the search terms "Hockey" and "Dribbling" to retrieve relevant English publications published in the SCOPUS database. The bibliometric tool was conducted using the RStudio software. The result from the database found twenty-three articles between 1990 and 2023 from "Hockey and Dribbling" citations were published in 18 journals. The network words from hockey and dribbling showed the highest frequency among female (9.6%), followed by hockey (9.6%), human (9.6%), male (9.6%), adult (9.6%), article (6.4%), athletic performance (6.4%), physiology (5.4%), human experiment (5.4%), humans (4.3%), sports (4.3%), athlete (3.2%), body composition (3.2%), body height (3.2%), and so on. The network approach analysis revealed four dominant clusters: (1) hockey, human, adult, athletic performance, physiology; (2) female, male, article, human experiment, sport, etc.; (3) velocity, anthropometry, body mass, skill; and (4) body composition, young adult, and fitness, respectively. In addition, the factorial analysis was conducted on terms that exhibited four distinct clusters. The research trend topic on hockey and dribbling has been focused on various topics including velocity, fitness, young adults, body height, body composition, hand strength, aptitude, athletic performance, physiology, reliability, skill, body mass, anthropometry, reaction time, attention, exercise test, and heart rate. Therefore, this study provides a summary of the potential areas of concentration for future research topics on hockey and dribbling in sports, including human subjects, anthropometry, athletic performance, fitness, and physiology.

Keywords: Bibliometric, clustering, data mining, dribbling, hockey

Introduction

Hockey is a highly popular sport in Western nations. Hockey is a competitive activity in which two teams use a stick and a ball to compete against each other, as indicated by prior statistics^[1]. Pyramid Football talents consist of a variety of physical skills, such as shooting, blocking, dribbling, passing, flicking, controlling, evading, and tackling, which are distinguished by their level of fitness and speed. Previous data suggests that the core principles of hockey involve the use of acceleration, deceleration, and changes in direction during the game^[2,3]. Therefore, a hockey player needs to have a wide range of abilities, including balance, strength, endurance, flexibility, hand-eye coordination, and agility^[4]. Prior research has examined various aspects of hockey performance, including agility drills^[5], high-intensity interval training^[6], strength, agility, and speed performance, sprint strength and agility^[7], anthropometry, Sargent jump test, core endurance, and agility performance concerning specific tests with and without the ball^[8], asymmetry of motor performance in the lower extremities^[9], immediate effects on hip isometric strength and flexibility^[10], the impact of strength and coordination training on specific skills in hockey players^[11], a test for speed and endurance^[12], and flexibility in elite inline hockey players^[13]. Therefore, a thorough analysis has been conducted on the available data regarding hockey from 2008, including various topics. The application of data mining methodology, particularly meta-analysis, can be used to evaluate upcoming trends in hockey and dribbling abilities. Previous studies have shown that the bibliometrics tool is useful in the field of sports studies^[14] and can generate new information from datasets^[15]. Unfortunately, the current papers have not been successful in proposing future trends and research clustering

that might offer valuable insights into upcoming strategies for hockey and dribbling. Therefore, this study aimed to find publications that were chosen using certain keywords and then analyze the text data through data mining techniques to investigate the published evidence, and group-related terms, and determine research patterns.

Methodology

This study entails performing a data mining analysis utilizing a Bibliometric tool within the Rstudio Software (version 4.3.2) and frequently utilized to access extensive and different databases such as Web of Science, SCOPUS, and PubMed [16]. This study aimed to examine the distribution of data, formation of clusters in networks, and emergence of topics in research conducted between 1990 and 2023 in the SCOPUS database. SCOPUS was chosen as it offers greater precision compared to Google Scholar and has better control over the referenced publications and indexing process [17]. Due to its accessibility and comprehensive coverage of peer-reviewed academic literature, the SCOPUS database was the most suitable choice for conducting the study [18]. The search's inclusion parameters were refined to specifically include the keywords "Hockey" and "Dribbling" from the article source. The analysis was conducted using the SCOPUS database, specifically focusing on papers written in English. The exclusion criteria included several types of publications, such as letters, reports, conferences, proceedings, and review data. The data analysis was performed using a Bibliometric tool, following the methods outlined in a previous study undertaken by Cobo *et al.* [19]. The data analysis was stated as previous studies [20, 21] and updated protocol in 2024 [22] with five consecutive phases. The steps involved in this procedure started with data collection, and specific requirements, transformation, processing, normalization, and data analysis on network clustering. The data on research articles about "Hockey" and "Dribbling" was collected from the SCOPUS database throughout phases I and II. Before doing Bibliometric analysis in Step III, the citation, bibliographic, abstract, and keyword data were exported to a CSV file and subsequently imported into the RStudio Software. The next phase entailed doing a bibliometric analysis to ascertain sources, documents, and the most frequently occurring words. Subsequently, network approaches, clustering, and factorial analysis techniques were implemented. Salton's Cosine and Walktrap algorithms were selected for normalization [23] in step IV and the Kamada-Kawai layout was used to present mapping visualization, network clustering, Treemap, and trend line [24,25].

Results

Distribution on Journal publication

Through the data-gathering procedure, a thorough collection of 23 scholarly articles on the subject of "Hockey and Dribbling" was uncovered. These articles cover the years 1990 to 2023. Table 1 included a comprehensive list of papers, providing details such as the author's name, journal source, research title, and published page.

The journals that had the most relevant articles were the Journal of Human Movement Studies (n=3), Journal of Sport and Exercise Psychology (n=3), Journal of Strength and Conditioning Research (n=2), British Journal of Sports Medicine (n=1), Canadian Journal of Applied Physiology (n=1), High Ability Studies (n=1), International Journal of Exercise Science (n=1), International Journal of Human

Movement and Sports Sciences (n=1), International Journal of Morphology (n=1), International Journal of Performance Analysis in Sport (n=1), Journal of Physical Education and Sport (n=1), Journal of Quantitative Analysis in Sports (1), Journal of Sports Medicine and Physical Fitness (n=1), Journal of Sports Sciences (n=1), Pedagogy of Physical Culture and Sports (n=1), Physical Activity Review(n=1), and Research Journal of Applied Sciences, Engineering and Technology (n=1). The document analysis showed that the top ten of total citations of sources or journals presented in the Journal of Sport and Exercise Psychology published by Jackson *et al.* (2006) (185 citations), Canadian Journal of Applied Physiology published by Keogh *et al.*, (2003) (68 citations), British Journal of Sports Medicine published by Lemmink *et al.* (2004) (53 citations), Journal of Sports Medicine and Physical Fitness published by Reilly *et al.* (1990) (51 citations), Journal of Sport and Exercise Psychology published by Ashford *et al.* (2010) (19 citations), Journal of Human Movement Studies published by Contreras Jordan *et al.* (2005) (17 citations), Journal of Sports Sciences Medicine published by Cheong *et al.* (2016) (16 citations), Journal of Sport and Exercise Psychology published by Winter *et al.* (2013) (11 citations), Journal of Human Movement Studies published by Kingman *et al.* (1997) (9 citations), and International Journal of Performance Analysis in Sport published by Tromp *et al.* (2011) (8 citations) respectively.

Most-Frequent words analysis

A comprehensive analysis of 23 publications utilizing the search terms "Hockey and Dribbling" reveals a collective count of 50 subdisciplines. The subdisciplines were represented using Salton's Cosine and Kamada-Kawai algorithms. The subdisciplines that were most frequently utilized in Figure 1 and 2 were as follows: female (9.6%), hockey (9.6%), human (9.6%), adult (8.6%), article (6.4%), athletic performance (6.4%), physiology (5.4%), human experiment (4.3%), humans (4.3%), sport (4.3%), analysis of variance (3.2%), athlete (3.2%), body composition (3.2%), body height (3.2%), controlled study (3.2%), normal human (3.2%), velocity (3.2%), young (3.2%), and adolescent (2.1%).

Network Approach and Words Clustering Analysis

After applying the Walktrap technique to analyze network clustering, the co-occurrence network's results were visualized in Figure 3 using the Kamada & Kawai Network Layout. The analysis of co-occurrence networks resulted in the identification of 25 main items, which may be classified into four separate clusters. The clusters are as follows: (1) The topics discussed in this article are hockey, human physiology, adult athletes, and athletic performance. (2) The article focuses on analyzing the differences between male and female athletes through human experiments and statistical methods such as analysis of variance and randomized controlled trials. It also emphasizes the importance of reliability and controlled studies in understanding normal human athletes. (3) The article examines the impact of velocity, anthropometry, body mass, and skill on sports performance. (4) Lastly, it explores the relationship between body composition, fitness, and young adult athletes, as shown in Table 2. In addition, the word clustering demonstrated a prominent visualization consisting of three clearly defined clusters (Figure 4), which corresponds to the results reported in Table 2.

Table 1: Cited Article Results in SCOPUS database between 1990-2023.

Authors	Journal	Title	Year
Reilly T & Seaton A.	J Sports Med Phys Fitness. 30 (2). 142-6.	Physiological strain unique to field hockey	1990
Scurr J & Dyson R.	J Hum Mov Stud. 33 (1). 15-30.	Player position, match half and score effects on the time and motion characteristics of roller hockey match play.	1997
Scurr J & Dyson R.	J Human Mov Stud. 32 (6). 235-251.	Analysis of roller hockey match play.	1997
Keogh JW, <i>et al.</i>	Can J Appy Physiol. 28(3). 397-409.	Evaluation of anthropometric, physiological, and skill-related tests for talent identification in female field hockey.	2003
Lemmink K, <i>et al.</i>	Br J Sport Med. 38(2). 138-142.	Evaluation of the reliability of two field hockey specific sprint and dribble tests in young field hockey players.	2004
Contreras OR, <i>et al.</i>	J Hum Mov Stud. 49. 193-213.	Transfer of tactical knowledge from invasion games to football.	2005
Jackson RC, <i>et al.</i>	J Sport Exerc Psychol. 28. 49-68.	Attentional focus, dispositional reinvestment, and skilled motor performance under pressure.	2006
Ashford KJ & Jackson RC.	J Sport Exerc Psychol. 32(4). 518-536.	Priming as a means of preventing skill failure under pressure.	2010
Tromp M & Holmes L.	Int J Perform Anal Sport. 11(2). 376-391.	The effect of free-hit rule changes on match variables and patterns of play in international standard women's field hockey.	2011
Hyrinen M, <i>et al.</i>	J Quant Anal Sports. 7(3). 9-9.	Match analysis of elite ice sledge hockey in Paralympics 2010.	2011
Winter S & Collins D.	J Sport Exerc Psychol. 35(3). 299-307.	Does priming really put the gloss on performance?	2013
Han Y.	Res J Appl Sci Eng Technol. 5(15). 4038-4041.	Hockey experimental study on the characteristics of different exercise load.	2013
Cheong JPG, <i>et al.</i>	J Sports Sci Med. 15(1). 167-175.	Investigating the contextual interference effect using combination sports skills in open and closed skill environments.	2016
Vinson D & Peters DM.	J Sport Sci. 34(4). 311-320.	Position-specific performance indicators that discriminate between successful and unsuccessful teams in elite women's indoor field hockey: implication for coaching.	2016
Bartolomei S, <i>et al.</i>	J Strength Cond Res. 33(11). 3123-3128.	Physiological and sport-specific comparison between division I and division II Italian male field hockey players.	2019
Kostitukevych V, <i>et al.</i>	J Phys Educ Sport. 20(5). 2735-2744.	Choice and experimental substantiation of tests for controlling physical and technical preparedness of hockey players.	2020
Mohan L, <i>et al.</i>	Intern J Human Mov Sports Sci. 9(1). 1-10.	Construction and development-field hockey specific skills' test.	2021
Quezada-Munoz Y, <i>et al.</i>	Int J Morphol. 39(5). 1323-1330.	Effects of a high-intensity interval training program on body composition and physical fitness in female field hockey players.	2021
Timmerman EA, <i>et al.</i>	High Abil Stud. 33(1). 65-85.	Examining the influence of multiple performance characteristics on selection into a representative team in field hockey.	2022
Tajudin FIM, <i>et al.</i>	Pedagogy Phys Cult Sports. 26(4). 270-275.	The effects of small-sided games versus traditional training on physical fitness and skills among under-12 hockey players.	2022
Tapsell LC, <i>et al.</i>	J Strength Cond Res. 36(6). 1720-1725.	Validity and reliability of a field hockey-specific dribbling speed test.	2022
Antara R, <i>et al.</i>	Phys Act Rev. 11(2). 42-51.	Effects of agility, coordination, and flexibility on dribbling skills in senior high school, female field hockey players.	2023
Spooner TW, <i>et al.</i>	Int J Exer Sci. 16(6). 497-512.	Effect of substitution time on physical-technical and cognitive performance in sub-elite male field hockey players.	2023

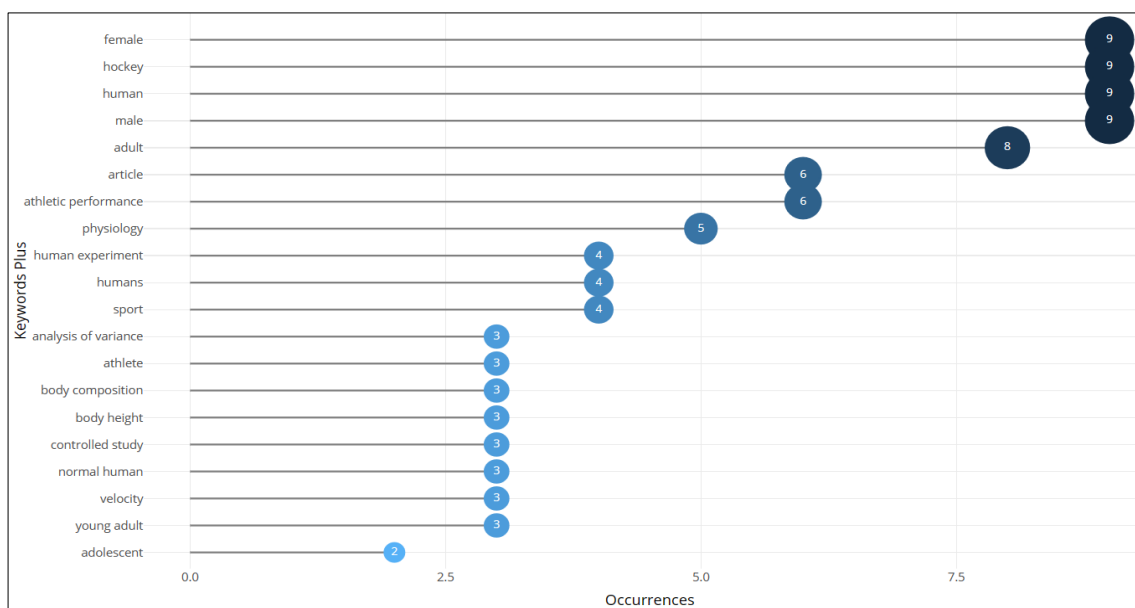


Fig 1: Most frequency words in 23 published articles between 1990 to 2023

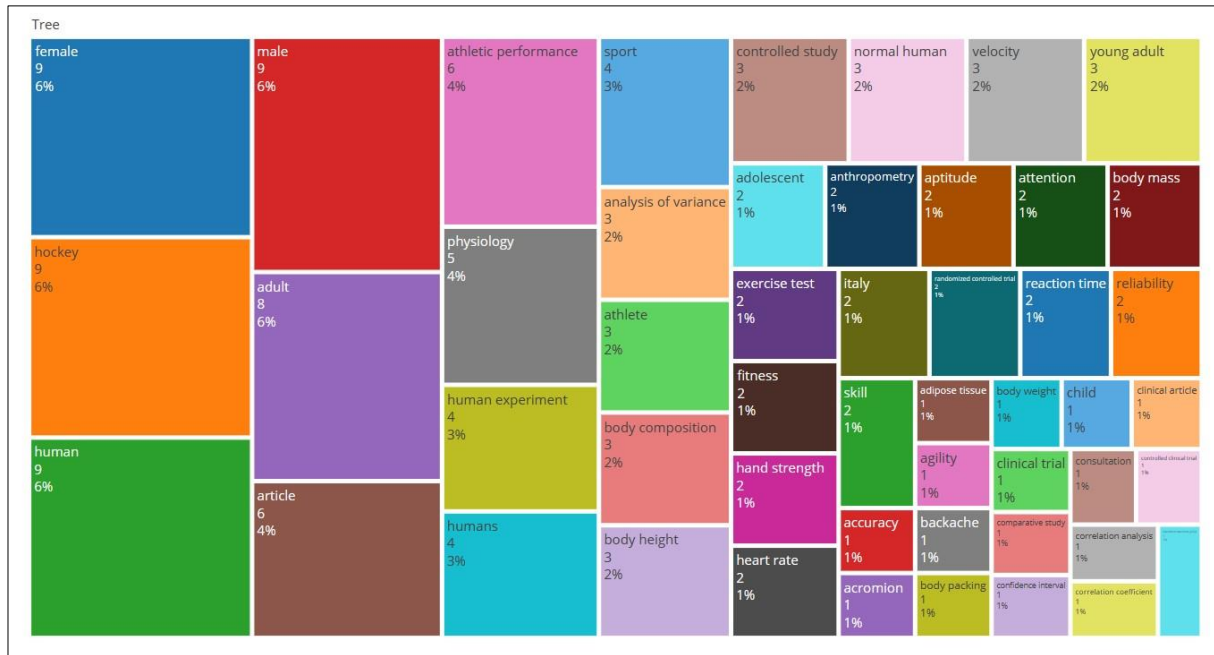


Fig 2: Treemap analysis of a total of 50 subdisciplines from “Hockey” and “Dribbling” between 1990 to 2023 in the SCOPUS database

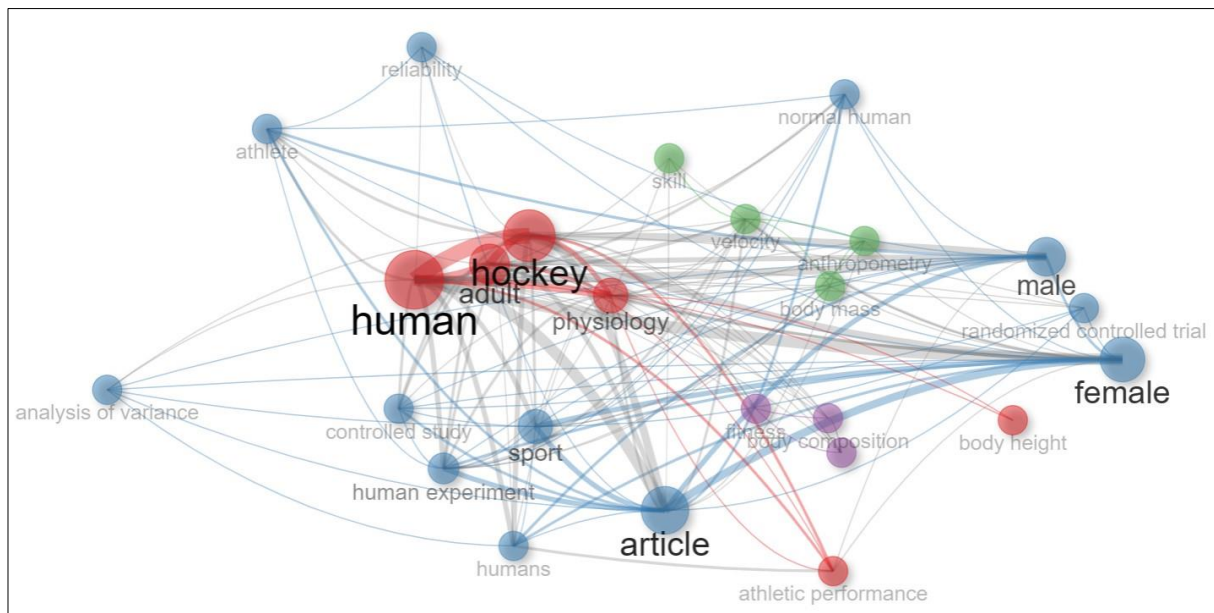


Fig 3: Co-occurrence Network from Network Approach Analysis

Table 2: Network Clustering from Network Approach Analysis

Network Clustering	Entries
1	hockey, human, adult, athletic performance, physiology
2	female, male, article, human experiment, humans, sport, analysis of variance, athlete, controlled study, normal human, randomized controlled trial, reliability.
3	velocity, anthropometry, body mass, skill
4	body composition, young adult, fitness

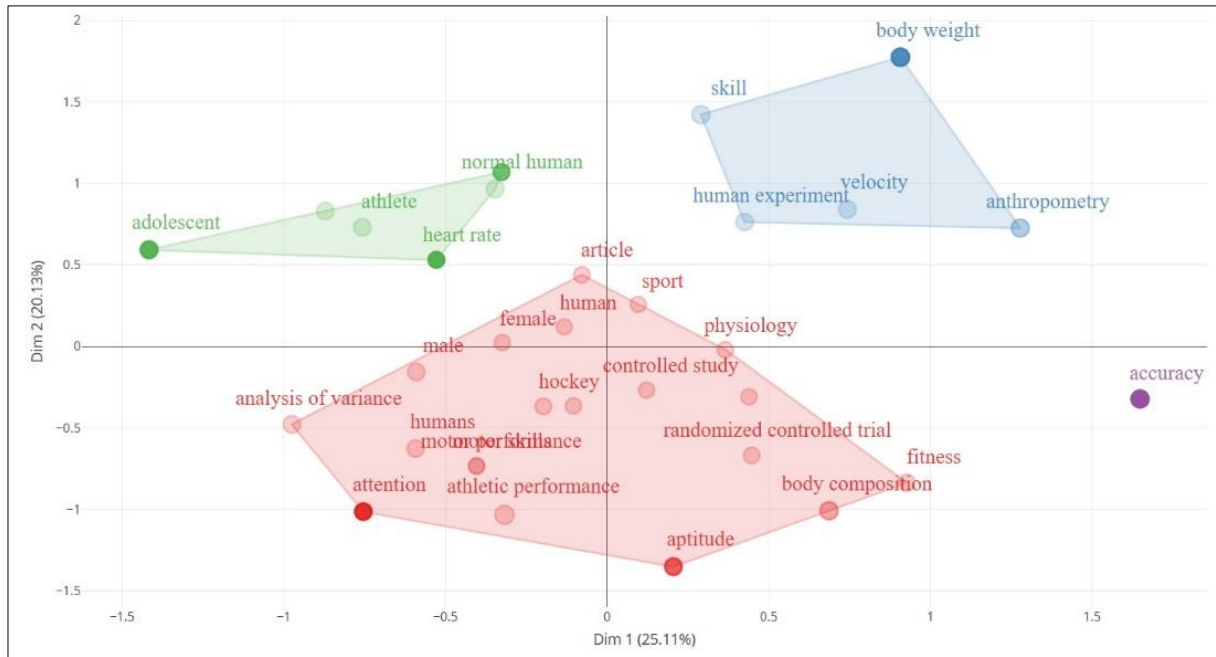


Fig 4: Word Clustering Map from 23 published articles between 1990 to 2023

Trend Topics Analysis

The topics examined from 1990 to 2022 encompassed various aspects such as heart rate, typical individuals, teenagers, physical exertion assessment, athletes, sports, scholarly articles, focus, response time, statistical analysis, controlled experiments, women, men, body measurements, weight, abilities, human capabilities, experimental studies on humans, reliability of human subjects, adults, randomized

controlled trials, physiology, athletic achievements, hockey, aptitude, hand grip strength, Italy, body structure, height, young adults, physical fitness, and speed (Figure 5). Articles published from 2020 to 2023 were examined using trend-updated keywords to study their focus on velocity, fitness, young adults, body height, body composition, hand strength, and athletic performance.

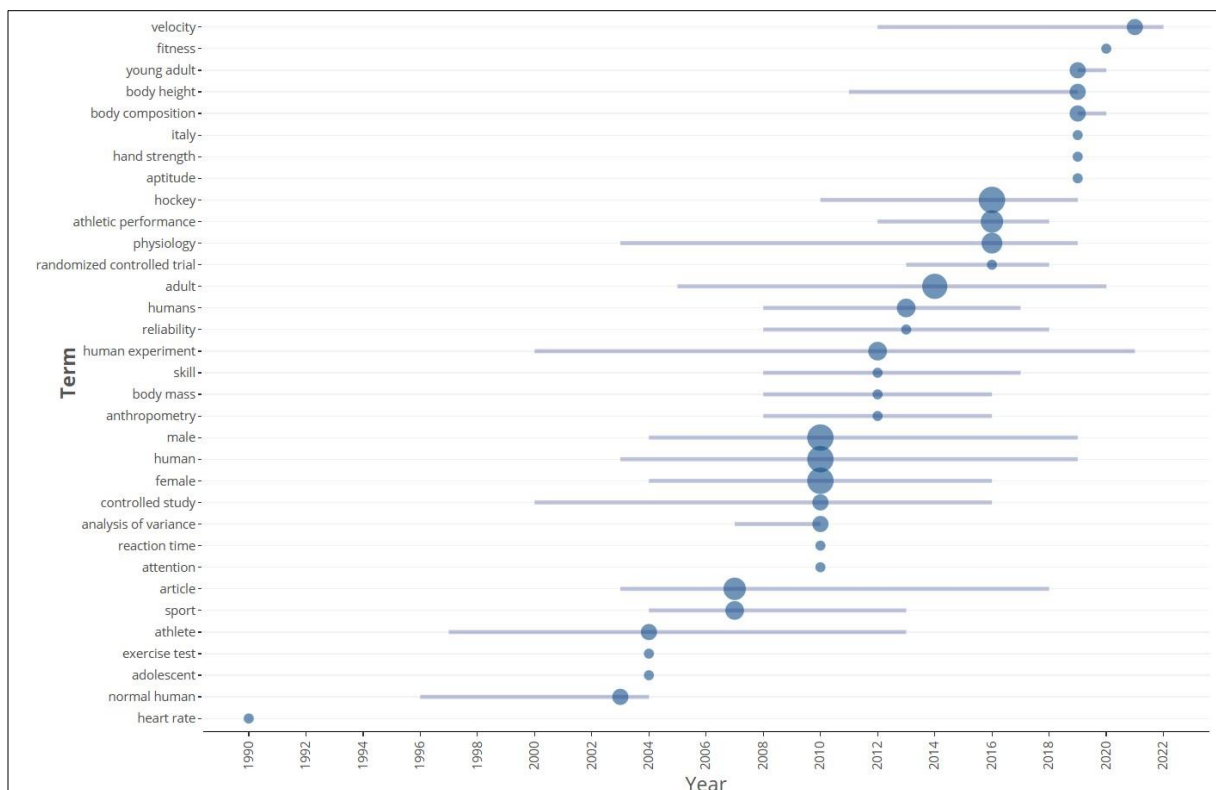


Fig 5: Trend topics from the words' frequency over time from 1990 to 2022

Discussion

This study offers the preliminary results of a data analysis conducted on the domains of hockey and dribbling within the field of sports. The bibliometric tool used in this study is one

of many software product line engineering tools that provide benefits in terms of cost-effectiveness, time efficiency, and quality [26]. The bibliometric tool has become increasingly popular in business research due to its progress, widespread

availability, and ease of use, much like other programs [27]. Moreover, this technique simplifies the process of identifying knowledge gaps and exploring novel ideas for study or research. It also helps determine the desired contributions to various industries [15, 28]. This tool provides the benefit of applying to a diverse array of datasets, enabling analysis that encompasses both quantitative and qualitative aspects. On the other hand, methodologies such as Systematic literature review have a more limited scope, mostly focusing on qualitative analysis. This tool has been applied in various fields such as in business and management [29].

The study discovered four network clusters based on phrases from 23 published papers, which is consistent with the findings of this study that revealed four network clusters. This software enables a thorough assessment of scientific publications in the many domains of research with many sources such as journals, authors, addresses, abstracts, and references to published literature. These sources include databases like Web of Science, PubMed, Dimensions, and SCOPUS. Bibliometric analysis is a reliable approach for achieving precise, transparent, and unbiased quantitative estimation results [30]. The study's findings indicate that the main keywords mentioned in the SCOPUS database were "hockey" and "dribbling." A total of 23 original publishing papers published between 1990 and 2023 recognized these keywords.

Network clustering and most frequency words.

The results from 18 research articles revealed that the subdisciplines most employed were female, hockey, human, adult, article, athletic performance, physiology, human experiment, humans, sport, analysis of variance, athlete, body composition, body height, controlled study, normal human, velocity, young, and adolescent, among others. Insufficient previous study exists regarding the relationship between data citation and this specific result. The choice to use Cosine normalization in this study was influenced by previous research that demonstrated the similarity between Salton's cosine and Person's cosine. A person's cosine was previously used to investigate potential co-citation in a library setting [31]. Moreover, Luukkonen and his colleagues argue that it remains the most efficient measure for describing the vector space obtained from the occurrence matrix of absolute data [32]. The study employed Kamada-Kawai architecture to generate a visualization of network mapping. The weights of the edges were determined based on their distance, as explained in the previous article [24] on network clustering analysis utilizing the Walktrap algorithm with distance. The study centers on the Kamada-Kawai layout visualization, a commonly employed force-directed technique for graph drawing that incorporates reflected symmetry [33].

The correlation networks and clustering in this investigation are consistent with the previous recommendation experiences [34, 35]. The network clustering approach has been widely used to analyze network structures in several fields [36]. There are unsupervised learning algorithms for the application of data analysis [37]. The Walktrap technique is an enhanced clustering method that employs a hierarchical agglomerative procedure. The methodology employed in this research is founded on the principle of a short-distance random walk approach, as originally suggested [38]. This algorithm is commonly selected in RStudio and bibliometric analysis for analysis the small datasets and sparse networks. Prior research on different approaches has depended on characteristics such as modularity, processing speed, and the composition of cluster members. Prior literature has

suggested the use of frequency analysis, co-occurring frequency analysis, and centrality analysis. The current study provided initial results about network clustering using database citations. However, the main goal of this study is to clarify the terms that are grouped about the research topic for future investigations. Based on the network clustering analysis carried out in this study, the terms "hockey" and "dribbling" were found to be the most common results in research articles referenced in the SCOPUS database from 1990 to 2023. This discovery provides evidence that hockey and dribbling have substantial potential as co-keywords for future research in the field of sports, as confirmed by previous studies [40, 41].

Trend topics of hockey and dribbling skills

Tapsell and colleagues researched to assess the accuracy and consistency of the Dribbling speed test [40]. The trend topic analysis identified potential areas of research encompassing a range of variables such as heart rate, typical individuals, teenagers, exercise testing, athletes, sports, scholarly articles, focus, response time, statistical analysis, controlled experiments, women, men, body measurements, weight, abilities, human behavior, human experimentation, reliability in humans, adults, randomized controlled trials, physiological aspects, athletic abilities, ice hockey, aptitude, hand grip strength, Italy, body structure, height, young adults, physical fitness, and speed. During the period from 2020 to 2023, there was a significant trend in various areas including speed, physical fitness, young adults, height, body composition, hand strength, and athletic ability. The results reported in this study are consistent with the updated data collected in 2023 by Antara and a collaborator, who investigated the agility, coordination, and flexibility of dribbling skills in senior high school hockey players [41]. Therefore, it is crucial to address the intricate topic of hockey and dribbling skills by considering multiple factors, such as network analysis or word clusters.

Limitation of study

The main sources of this data were obtained from the SCOPUS database, there is small evidence that 23 journals were cited. The completely published keywords "hockey and dribbling" were applied, and the other under-reviewed articles in 2024 were not recruited. Therefore, the other co-occurrence words or networks, clusters, and new trend topics may not be represented. Therefore, it is crucial to continuously research to acquire reliable data and useful in sports research.

Conclusion

The bibliometric analysis of specific articles in the SCOPUS database, utilizing the data mining tool, reveals the necessity for additional research on various variables including velocity, fitness, young adults, body height, body composition, hand strength, and athletic performance with the keywords "hockey and dribbling". The results of this research are consistent with an updated study [22] that proposes in the domain of sports analysis, particularly in forecasting hockey player performance.

Conflict of Interest: The authors declare no conflict of interest.

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