REVIEW ARTICLE

Association between Physical Activity and Exercise with Cognitive Function: A Bibliometric Analysis

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Abstract

Background: Visualization is a practical method to determine a scientific field's underlying intellectual framework. This study aims to conduct a scientometric analysis of selected scientific literature to assess research trends regarding the association between physical activity exercise, and cognitive function domains. The objective is to present a summary of the findings and identify the trending topics between 1970 and 2023 for this field of study.

Methods: In the current bibliometric analysis, relevant documents based on a reliable search strategy taken from the Web of Science (WOS) database were checked and evaluated using Excel, VOSviewer, and the bibliometrix R-package.ss

Results: The hot topics included Physical Activity, Exercise, Cognition, Aging, Dementia, Depression, Alzheimer's disease, and Rehabilitation. "Frontiers in Psychology" and "International Journal of Environmental Research and Public Health" were the most active journals in this research area. Also, developed countries such as the United States, the United Kingdom, Canada, Australia, and Germany were the most productive countries. In addition, the top organizations which produced the most scientific documents were from Europe, Oceania, and North America. In the same vein, Arthur F Kramer was identified as the most active author. The study results will greatly contribute to future interdisciplinary articles by showing common trends in this research area.

Conclusion: The combination of PA and cognitive function is still a hot zone of future research. According to this study, the majority of literature on PA and cognitive function is from developed countries, and other cognition topics such as executive function, memory, and anxiety have obtained less attention from researchers.

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Keywords: Bibliometric, Physical activity, Cognitive function, Exercise, Scientometrics

Introduction

Inactive and sedentary individuals constitute about one-quarter of the world's population, according to World Health Organization (WHO) research.[1] Meanwhile, a major risk factor for mortality is physical inactivity. Lack of physical activity is thought to increase mortality risk factors by 20% to 30%.[2] This highlights the importance of physical activity (PA) for human health. Any movement that is initiated by skeletal muscles and results in an energy expenditure higher than the resting level is referred to be a PA.[3] Different research has been conducted to discuss the health benefits of PA.[4] For instance, a meta-analysis study determined the positive long-term effects of physical activity on health.[5] Elsewhere, it is dealt with the association between a specific level of PA and health

status in adolescents.[6] In addition to adolescents, this relationship was also found significant in adults as well.[7] PA has been shown to be protective against premature death and non-communicable diseases such as type 2 diabetes, cardiovascular disease, and cancer.[8]

A number of studies have demonstrated the advantages of PA on mental and physical health.[9] PA may help diabetic patients avoid some of the possibility declines in episodic memory.[10] PA can also influence children's cognition positively.[11] Therefore, engagement in PA could be known as a great feasible strategy to lower the likelihood cognitive decline.[12] This has prompted scholars to combine PA and cognitive function in their research.[13] As proof, it is reported in a systematic review study that PA and cognition have a positive relationship.[14] Likewise, during a cross sectional study, regardless of age, physical activity was associated with faster reaction time during these conditions. In the old population, higher PA was linked to improved performance just in the incongruent condition, according to the response accuracy findings.[15] A study of 170 participants over the age of 50 from the Royal Perth Hospital, Australia, showed that people who participated in the physical activity group had better-delayed recall compared to those in the usual care group,[16] while a study conducted in the United States revealed that PA associated with a 36% reduced risk of impaired cognitive and better memory and executive function maintenance over time.[17]

Regarding the evaluation of different theories about PA and cognitive function, various literature reviews have been conducted; some of them have been critical and narrative reviews[18, 19] while others have been in the form of a meta-analysis.[20] Thus, bibliometric studies that systematically present an in-depth view of the study domain are currently lacking. Bibliometrics is a scientometric approach that looks at how a field's trends and knowledge structure interact to generate quantitative, repeatable, and impartial data. It is becoming more popular as a tool for assessing the quantity and quality of research performance.[21] This research method provides authors and researchers with an opportunity to access a great informative understanding of their study field and promotes interdisciplinary collaboration.[22] Also, researchers in classic literature review summarize the articles based on their personal opinions, which may cause various biases, while the bibliometric approach allows us to do a structured, quantitative and accurate analysis for publications.[23] Also, in comparison with traditional literature review methods, such as systematic review, bibliometric analysis offers a great benefit in demonstrating unbiased, rigorous, timely, visual, and comprehensive scientific maps.[24] According to Figure 1, it is clear that in recent years, the publication of documents in this study field has been exponentially increasing. Meanwhile, according to Figure 2, the diversity and breadth of study areas in the considered field are expanding, which could be a great vision for interdisciplinary studies of future. These suggest the necessity of conducting bibliometric research to obtain knowledge of the chosen field.

In the current study, the researcher used Publish or Perish 8 software[25] to reach this field, the top authors of the field, and the general theoretical literature for this article.[26] Then, an informetric gap was found in PA and the cognition area. As a result, the main concern of the author has been to conduct a bibliometric review of studies that combined two variables of PA and cognitive function to provide an overview of top sources, most active organizations, most prolific authors, most common keywords, most effective countries as well as to come up with network analysis of keywords, organizations cooperation, co-authorship, countries collaboration, which are significantly helpful and practical in following studies that are related to this area. Until the date of writing this article, no specific bibliometric analysis about this field has yet been performed.

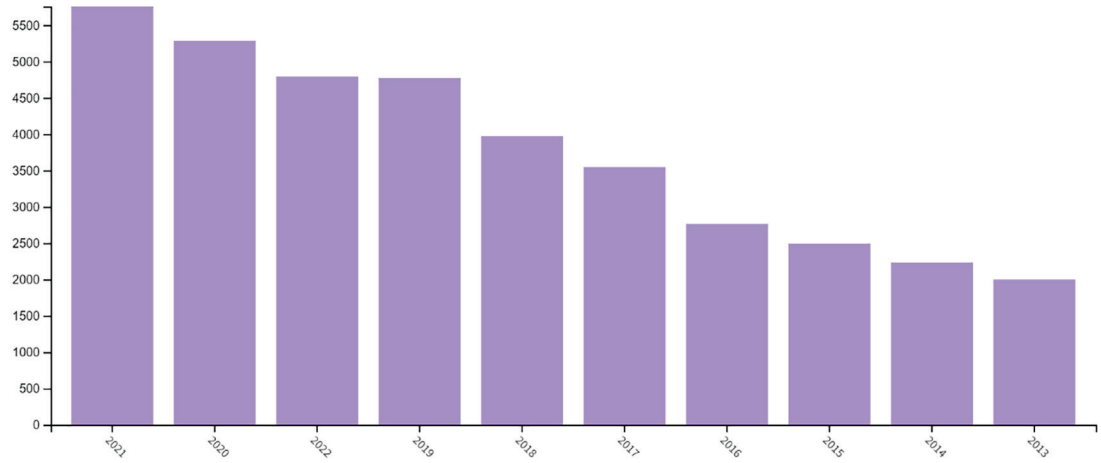

Figure 1: Documents Frequency in the past few years (data from the Web of Science).

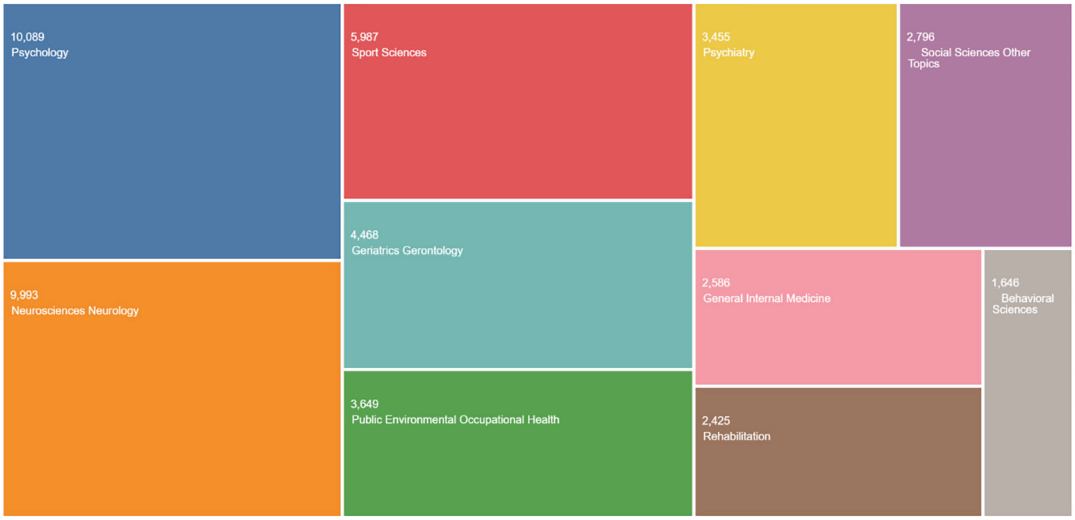

Figure 2: Documents by subject area (data from the Web of Science).

Methods

Study Design

This study used the bibliometric method to analyze and review quantitative as well as qualitative articles in the considered area. Bibliometrics uses statistical and mathematical methods to evaluate various components of the knowledge domain[27] and comprises quantitative techniques to analyze a large amount of literature.[28]

Search Strategy and Data Source

The database was taken from the Web of Science (WOS) Core Collection, which contains high-quality and comprehensive documents; this dataset is regarded as the best for bibliometric analysis.[28] It is known as one of the most extensive and comprehensive bibliographic databases covering a wide range of disciplines.[29]

According to Figure 1, which displays the increasing trend of scientific articles, the researcher should select relevant and suitable keywords and a specific search strategy that has a direct effect on the findings and results.[30] To reach this goal, we considered four components (Figure 3).[26] This study search has been created based on two main variables of "physical activity" and "cognitive function". As such, we combined some synonyms of these variables with Quotation marks, Boolean operators, and Truncation to achieve a reliable search strategy, which are reported in Table 1. The selected search strategy was restricted to the topic field (title, abstract, or keywords). This study took into account all languages and document types. The obtained publications were exported as "plain text" with the "full record and cited references" included.

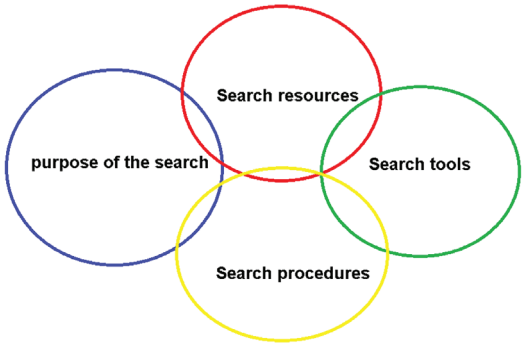

Figure 3: Search strategy's components.

Data Analysis

On December 22nd, 2022, 50790 scientific documents were exported based on the considered keywords, from the WOS database "plain text", during the period of 1970 to 2023. We identified the most influential authors, organizations, journals, and countries (descriptive analysis) in the selected field. Also, the most effective patterns of co-citation, co-authorship, and co-occurrence author keywords

Table 1: Search procedures and criteria

Items	Description
Database	Web of Science
Keywords	"Physical activity" and "Cognitive Function"
Search fields	Topic (Title, Abstract, Keywords)
Search strategy	("physical activit*" OR "physical inactivit*" OR "physical exertion" OR "exercise*" OR "aerobic exercise" OR "anaerobic exercise" OR "sport*" OR "fitness" OR "motor activity") AND ("cognitive function*" OR "executive function*" OR "cogn*" OR "memory" OR "attention* control" OR "executive control" OR "inhibit* control" OR "working memory" OR "cognitive flexibility")
Timespan	1970 to 2023

(network analysis) were evaluated. Microsoft Excel version 2021 is used to draw different charts. At the same time, VOSviewer (version 1.6.18.0), created by the Centre for Science and Technology Studies at Leiden University, was applied to construct and display bibliometric networks among documents. Finally, R language (version 4.2.2) with its R studio Macros was installed on 64-bit Windows. Then, the Bibliometrix R-package (version 4.0.0) was utilized to reach an appropriate network analysis, structural information, and visual display.

Results

Before evaluating the results of the descriptive and network analysis, a general analysis of the selected and included documents is presented.

According to the chosen search strategy, Table 2 shows that between 1970 and 2023, 50790 documents were published in 6795 sources. The average number of citations per document has been 30.14%, while the yearly growth rate for scientific output has been 7.58%. In general, research findings confirmed that documents published in the topics growing received more citation. Indeed, a relationship was found between the number of citations and growing topics.[31]

The table also reveals that 58959 different keywords were employed by the scholars to classify their findings. In addition, among the 140925 authors in the selected field, about 2.6% of the publications were single-authored. Among international collaborations with a rate of 24.15%, 4236 studies were single-authored and the remaining 46554 studies were written with a collaboration rate of 5.17 authors. It suggests that this field requires a high number of collaborators with different knowledge to reach a good interdisciplinary article. Higher visibility and the author's networks usually stem from the research collaboration. Also, articles with more than one author have more citations than single-author articles, indicating the great impact of international collaboration on article citation.[31]

Descriptive Analysis

Most Active Authors

In a bibliometric analysis, the scientific production of authors should not be neglected as a quantitative indicator. Also, it should be examined which authors have the highest share of scientific production in a field.

Table 2: Main Information About Data.

Description	Results
Timespan	1970:2023
Sources (Journals, Books, etc)	6795
Documents	50790
Annual Growth Rate %	7.58
Document Average Age	6.81
Average citations per doc	30.14
Document contents	
Keywords Plus (ID)	43217
Author's Keywords (DE)	58959
Authors	
Authors	140925
Authors of single-authored docs	3733
Authors collaboration	
Single-authored docs	4236
Co-Authors per Doc	5.17
International co-authorships %	24.15

According to Table 3, Kramer AF with a total number of 221 studies, Hillman CH with a total number of 242 studies, and McAuley E with a total number of 192 studies are among the top authors in this field. It can be seen that although Hillman has more scientific productions than Kramer, but total citations and some parameters such as h-index, g-index, etc make the difference between them. On the other hand, according to Figure 4., the top three authors were more active in 2019 and 2020, but their activity diminished in the past two years. Also, almost all of these ten authors have conducted long-term research contributing to PA and cognitive functions ranging from 20 to 30 years.

Most Active Journals

Table 4 reports the top ten journals that have had the greatest impact in terms of scientific production on PA and cognitive function research. Nevertheless, it should be noted that there are many criticisms about ways (such as journal self-citations, etc.) to increase the impact factor and the number of citations of journals to boost their ranking.[32]

Table 3: Top 10 Authors Contributed to physical activity and cognitive function Research.

Authors	h_index	g_index	TC*	NP**
Kramer AF	69	157	24956	221
Hillman CH	57	116	14197	242
Mcauley E	55	125	15757	192
Erickson KI	49	128	16631	159
Motl RW	44	71	5907	173
Courneya KS	40	71	5221	91
Voss MW	40	61	9190	61
Bennett DA	38	78	6129	86
Yaffe K	38	88	8368	88
Rhodes RE	37	62	4006	92

*Total citations; **Number of publications

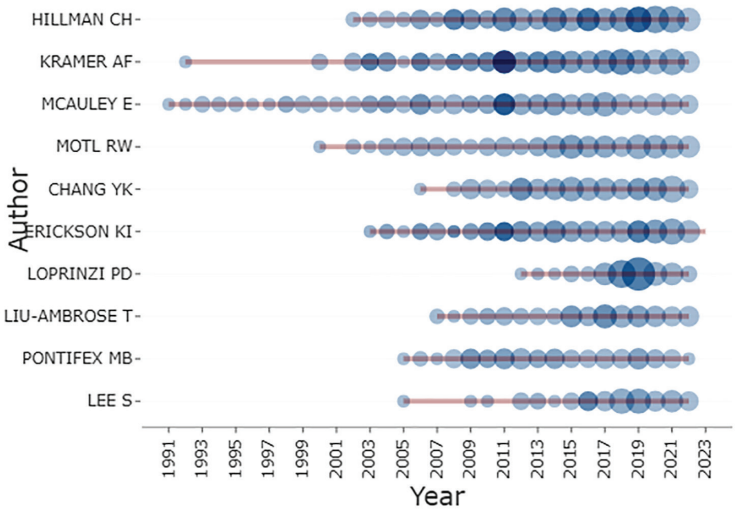

Figure 4: Top 10 authors' productivity on the topic of physical activity and cognitive function.

Table 4: Top most active journals contributed to physical activity and cognitive function research.

Sources	Researches
Frontiers in Psychology	764
International Journal of Environmental Research and Public Health	728
PLOS One	682
Medicine and Science in Sports and Exercise	612
Journal of Sport & Exercise Psychology	475
Psychology of Sport and Exercise	410
Frontiers in Aging Neuroscience	333
Journal of Alzheimer's Disease	329
BMC Public Health	300
Scientific Reports	294

"Frontiers in Psychology" is at the top of this list with 764 published documents. This is an open-access peer-reviewed academic journal that covers all aspects of psychology. Frontiers Media was founded in 2010 and publishes it. There is also an active journal called "The International Journal of Environmental Research and Public Health". It is an open-access journal and is posted online by MDPI every two months. Also, the mentioned journal covers various scientific fields in environmental science and engineering, public health, global health, etc. It has high visibility in different databases such as Scopus, Web of Science, PubMed, Embase, etc. The third top journal, is "PLOS One". The research considered for journal publication is multidisciplinary and, in many cases, interdisciplinary. PLOS One publishes research in over 200 subject areas, including science, engineering, medicine, and the social sciences and humanities. The top 10 mentioned journals published about 4932 publications. Between 294 and 764 papers were published in the top 10 journals.

Figure 5 indicates the linear growth of scientific productions of journals in comparison with each other. As seen, Journal of Exercise and Sport Psychology has been on the top between 1996 and 2015 and has claimed the largest share of scientific productions. However, with a volume of document production in this sector, Frontiers in psychology has been ranked first since 2019.

Top 10 Most Productive Organizations

Among the top ten active organizations, four were located in the US, three in Canada, two in Australia, and one in Sweden. Figure 6 demonstrates that the University of Illinois and the University of Toronto had the most scientific productions with a significant difference compared to other organizations. Both of these are from Northern American countries and according to the information on www.scimagoir.com, they are registered as Q1 universities. University of Illinois is one of the most important public universities in the United states of america, and its various faculties are mostly in the top 200 universities.[33] Although University of Toronto has a higher rank compared to University of Illinois, it is the second most active and productive organization in the field of physical activity and cognitive function. Also, according to Figure 6, except for the top four universities, other universities have had moderate and steady activity in the production of scientific documents in the chosen field in recent years.

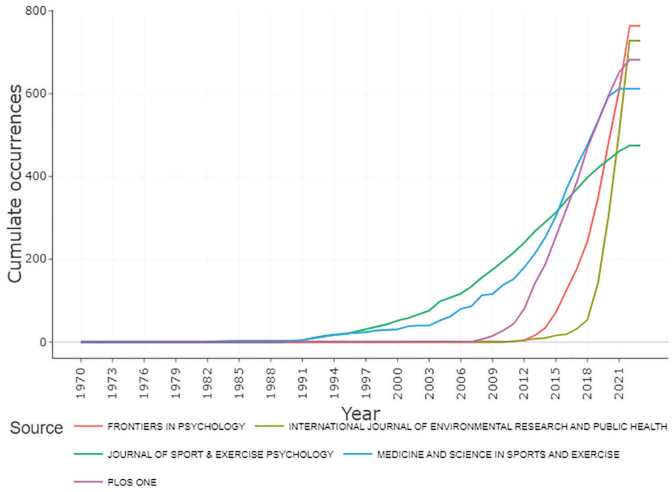

Figure 5: The growth of scientific production contributed to physical activity and cognitive function in journals.

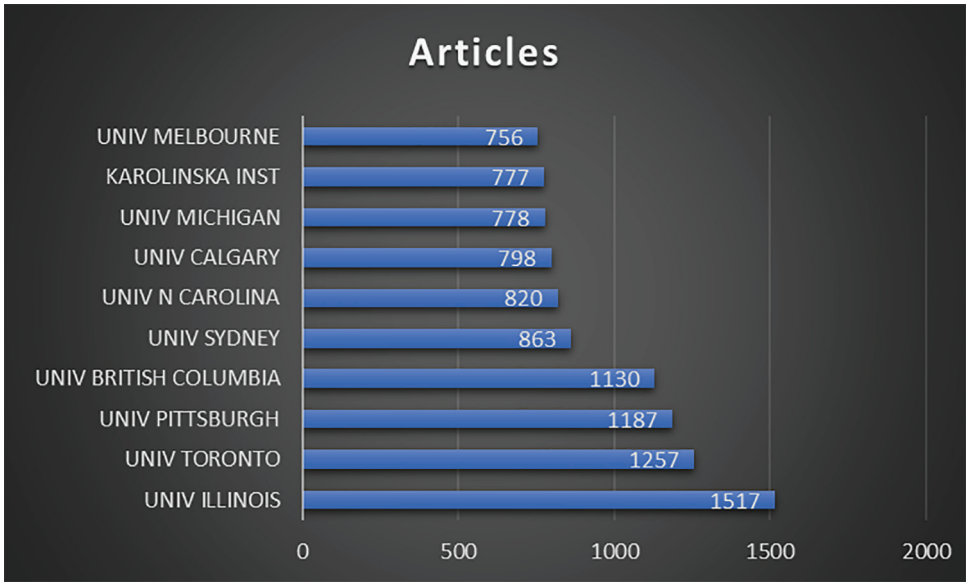

Figure 6: Top ten productive organizations contributed on physical activity and cognitive function.

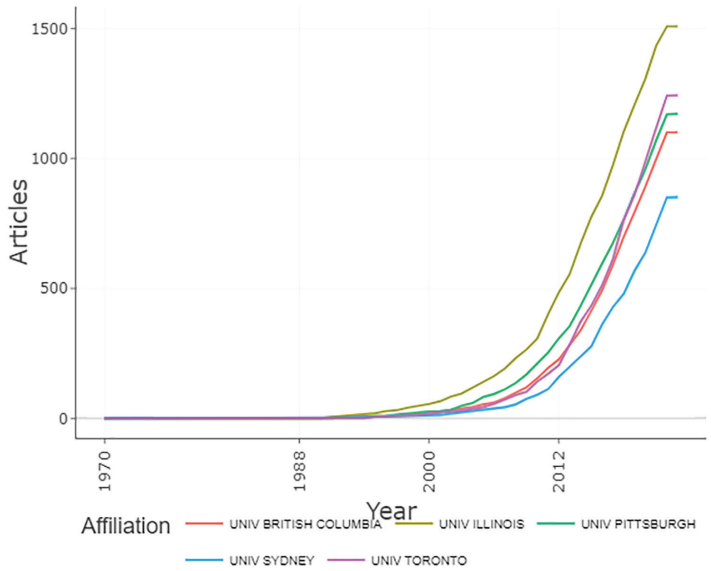

Figure 7: The linear trend of the growth of scientific production contributed to physical activity and cognitive function by organizations.

On the other hand, the University of Illinois and the University of Toronto have had the highest rate of production of scientific documents with a very positive steep slope. (Figure 7)

Most Active and Productive Countries

About 125 countries contributed to PA and cognitive function publications. According to Figure 8, five countries the United States, the United Kingdom, Canada, Australia, and Germany have had the most scientific production, with the United States' production being far greater than that of other countries and it is known as the most productive country in this area. On the other hand, based on the total number of citations obtained, Canada has 112771, the UK has 146476, and the United States has 660739, placing them among the top and most productive nations in the area in terms of the caliber of scientific productions. This suggests that these countries are advanced and developed, both in terms of scientific document production and the number of citations received.

Likewise, the participation of researchers from different countries in a study indicates that those studies are at a high level and can pave the way for future international studies.[33] Single-country publications (SCP) and multiple-country publications (MCP) can be seen in Figure 9 for the first 20 countries.

Keyword Analysis

An article's keywords are unique and distinguished as they indicate the words that the author believes are among the most important words in the article. Also, trending research topics in different journals can be detected by analyzing the keywords.

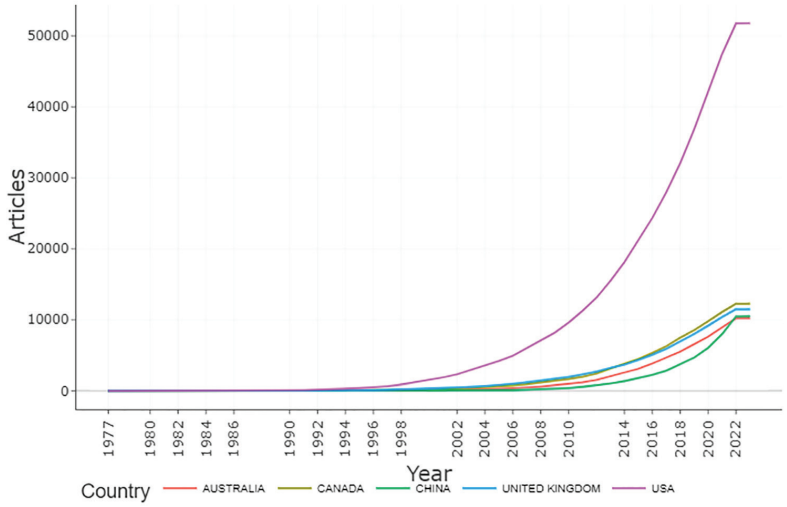

Figure 8: The linear trend of the growth of scientific production contributed to physical activity and cognitive function by countries.

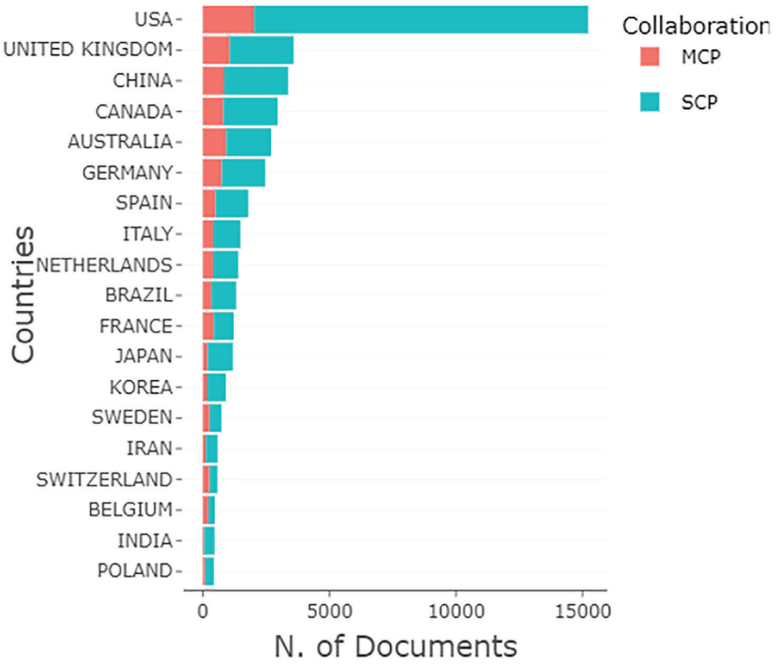

Figure 9: Corresponding Author's Country.

Likewise, it is found that certain keywords are correlated with an increase in the possibility of being cited in other articles.[34]

As depicted in Figure 10 each house represents a unique keyword and its size represents its importance or weight in 50790 documents. Physical activity, exercise and cognition which are the main variables in the selected research area, have claimed the largest share with 17%, 16% and 14%. On the other hand, the treemap indicates that words such as aging, depression, dementia, Alzheimer's disease, and rehabilitation have a direct relationship with keywords in the field of this study. It informs researchers in all fields that these concepts should be considered in future studies.

A thematic map has four quadrants and displays four different categorizations of themes (Figure 11). Motor themes with high centrality and density are shown in the upper-right quadrant. Upper-left quadrant reveals the themes which are unimportant and separated from other themes (Low Centrality).[35] Also, the lower-left quadrant contains the emerging or declining themes which indicates underdeveloped or low centrality and density. Finally, the lower-right quadrant comprises the common topics in various research areas and also indicates the fundamental themes.[36] The themes of this study are mainly found in the upper-left and lower-right quadrants. The most developed themes in the PA and cognitive function studies are "physical activity", "depression" and "rehabilitation". Meanwhile, "memory", "hippocampus" and "learning" are located in a separate and distinct quadrant and the future literature is less likely to deal with this theme.

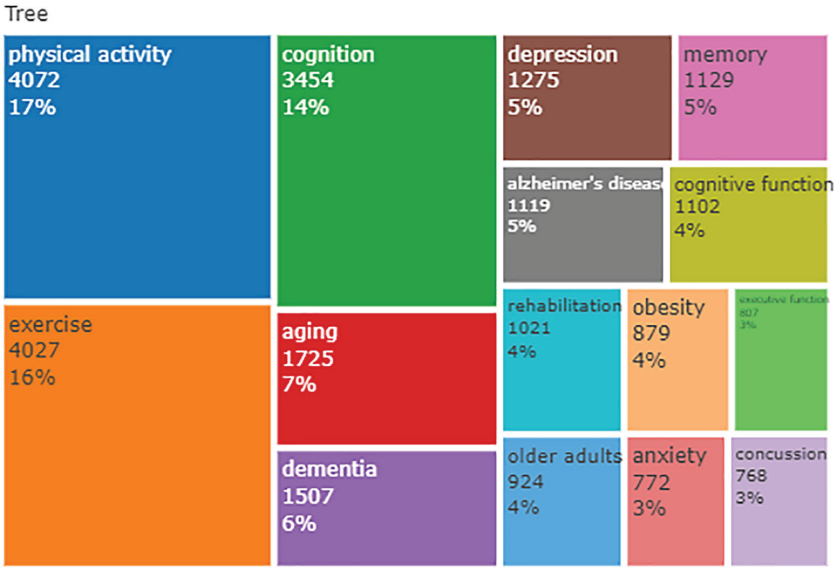

Figure 10: Treemap chart of author's keywords.

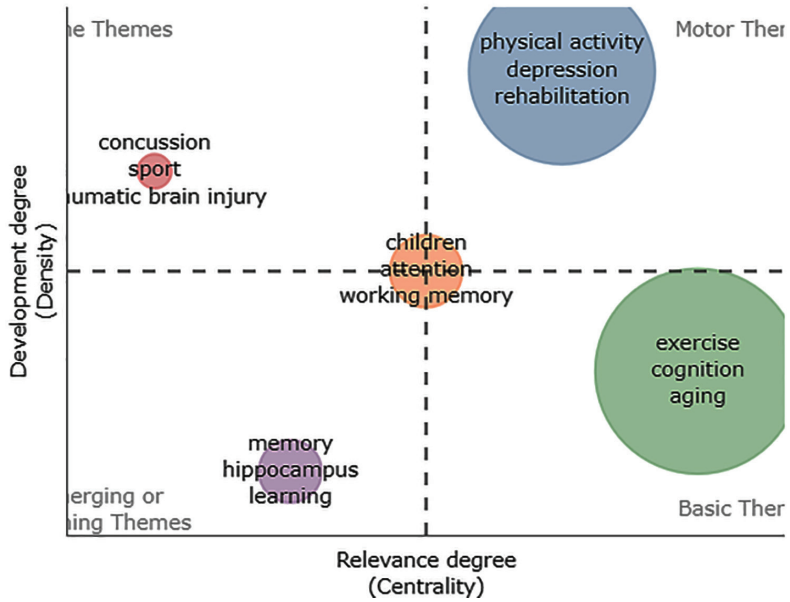

Figure 11: Thematic map of physical activity and cognitive function studies.

On the other hand, as expected, "exercise", "cognition", "aging", and "depression" are among the transversal themes.

Network Analysis

One of the main important parts of bibliometric research is scientific mapping. It helps gain access to representations of intellectual connections with the dynamic changes and structural aspects of scientific knowledge.[37] In other words, bibliometric mapping demonstrates the scientific connection of scientific literature and citation paths based on individual researchers in their documents.[38] Science mapping is a kind of interdisciplinary field derived from science technology. Also, analysis of modeling of a wide range of scientific and informetric activities can be visualized by scientific mapping and computational techniques. Different mapping results and tools are available for researchers, analysts, scholars, and investigators in various and distinct domains.[39]

Analyzing the co-occurrence of keywords can determine the research focus, achievements, and important parts of the research area. As a result, authors can attain a specific direction to solve the problems in their fields.[28] The co-occurrence of the map of the author's keywords with minimum occurrences of five included 50 keywords, 3783 links, 5 clusters, and a total link strength of 44066. This indicates that there are 22033 pairs of author's keywords between which there is a co-occurrence link, among the selected keywords. For instance, PA and cognitive function co-occur together and make a co-occurrence link. There cannot be more than one link between two nodes. Each link has a strength that indicates the number of publications where the two keywords co-occurred.[40] The size of the label and the circle are considered as weight and the repetition of that item. A larger circle or label represents the high weight of that item. According to Figure 13 the most frequent keywords were visualized. The keyword "physical activity" was used 4071 times followed by "cognition" (3452 times), "cognitive function" (1101 times), "exercise" (4025 times), and "rehabilitation" (1019 times). The keywords which have the same cluster color indicate that they usually co-occur in documents. For example, the red cluster contains "physical activity", "obesity", "anxiety", "stress", "mental health" and so on, which have close relationships, meaning that they are usually listed together in articles. Likewise, the green cluster indicates the keywords on rehabilitation and stroke, and Parkinson's disease. Also, the blue cluster comprises keywords including "exercise", "memory", "learning", "aging", "neuroplasticity", "cognitive function", and "schizophrenia". The yellow cluster covers the keywords such as "sport", "executive function", "concussion", "cognitive performance", "fmri" and "neuroimaging". On the other hand, the purple cluster was based on "alcohol", "diet", "health", "nutrition" and "smoking".

The size of each circle in this map is proportional to the number of publications from the related organizations. Nodes with similar common characteristics, such as co-authorship, are grouped together and colored the same.[28] The thickness of the line indicates the degree of global cooperation.

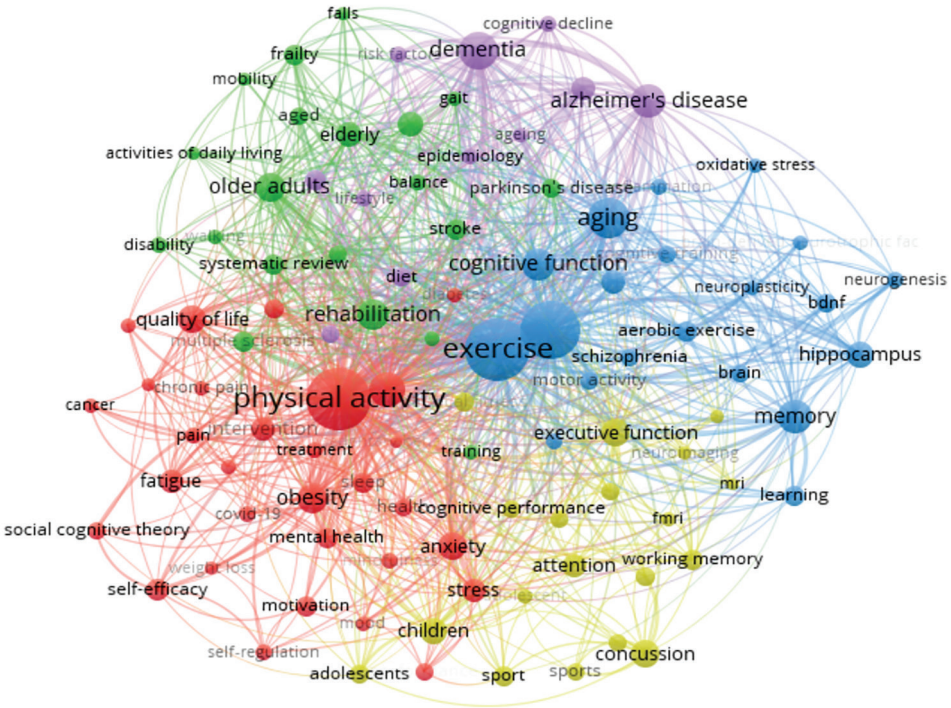

Figure 12: Cooccurrence map of author's keywords.

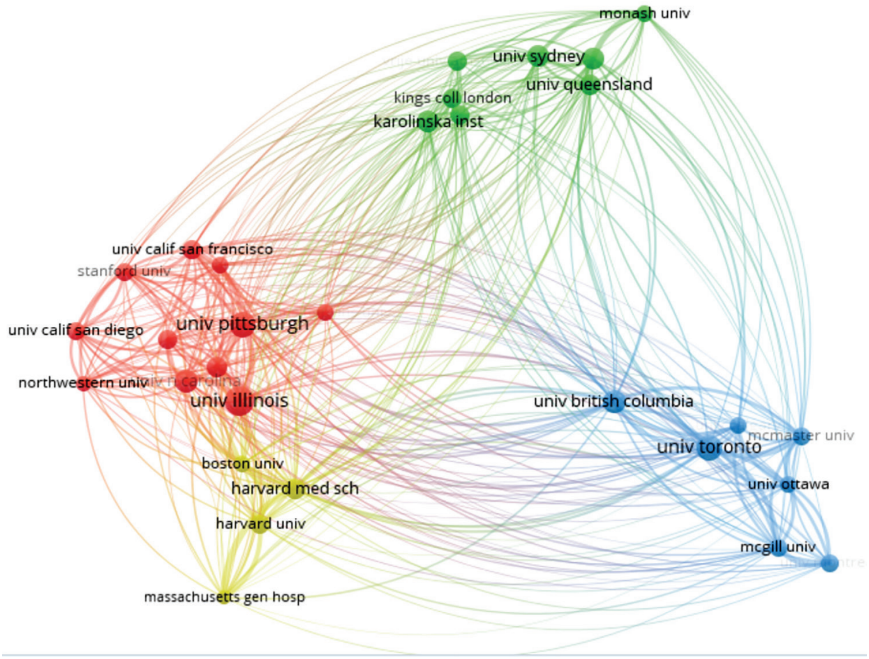

Figure 13: Cooperation network of institutions.

As indicated in Figure 6, the University of Illinois possessed the strongest global collaboration network. This university with total link strength of 304 had 958 documents (Figure 13). Also, the next prolific organization with a total link strength of 450 produced 685 scientific researches.

The analysis of the cooperation network among scholars with five or more documents was considered, where top twenty active researchers were selected. We omitted the authors who did not have any connection with the others. The author's name is represented in each node. The size of the node indicates how many papers each author has published, and the link between authors illustrates co-authorship (Figure 14).

This network comprises five clusters, 56 links, and a total link strength of 738. The first cluster (red) included five authors with Teresa Liu-Ambrose (Canada), with 107 documents, as a member of this cluster. The second cluster (green) consists of four authors Robert Motl (US), with 154 documents, as a member of this cluster. Also, the third cluster (blue) comprises four authors with Charles Hillman (US), with 220 documents, as a member of a blue cluster. The fourth (yellow) with two authors has a total 255 documents which were produced by Chang (Taiwan) and Erickson (US). Eventually, the fifth cluster (purple) includes two authors with Esteban (US), with 45 documents, as a member of a purple cluster.

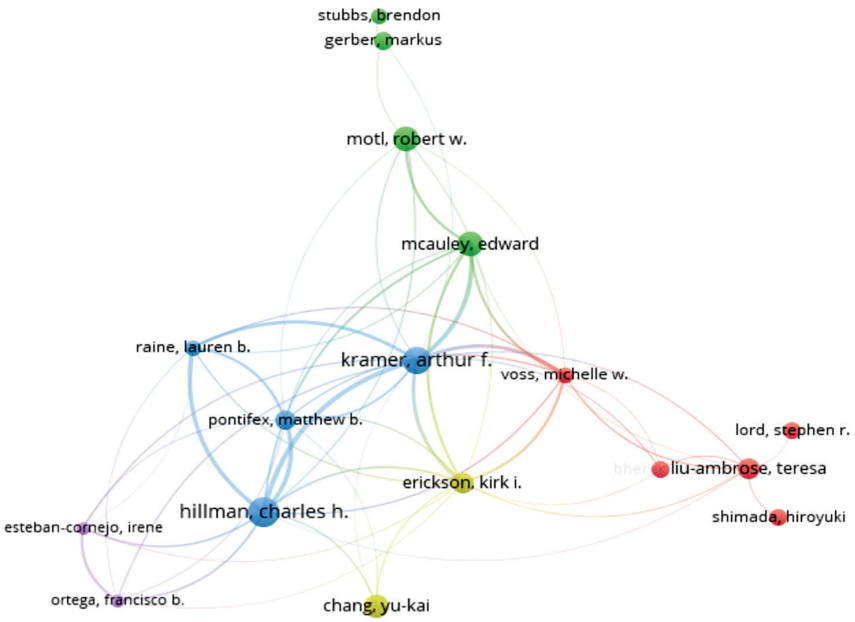

Figure 14: Cooperation network of authors.

The number of articles published in different countries or regions is a great indicator of concern and the research intensity of a specific research field. The cooperation network of countries' contributions to PA and cognitive function studies is shown in Figure 15 Only countries with at least five documents are shown on the map. It can be seen that there is significant cooperation between the United States China, Australia, and Canada. Also, there is a good relationship between England and the US, the Netherlands, as well as Germany. On the other hand, based on Figure 16, there are many collaborations for scientific productions in the chosen field among the continents of Asia, Oceania, Europe, and America. Nonetheless, a cooperation network of countries with a wide range of developments can help promote PA and cognitive function research from various regions of the world[41] (Figures 15 and 16).

Discussion

Physical activity and cognitive function research constituted the subject of a bibliometric analysis for this study, which used 50790 scientific documents from the WOS database to map out its findings. These findings offer thorough and practical insights into the intellectual framework of the chosen field of PA and cognitive function. Using Excel, VOSviewer, and the bibliometrix R-package, we were able to present a general overview of the evolution of PA and cognitive

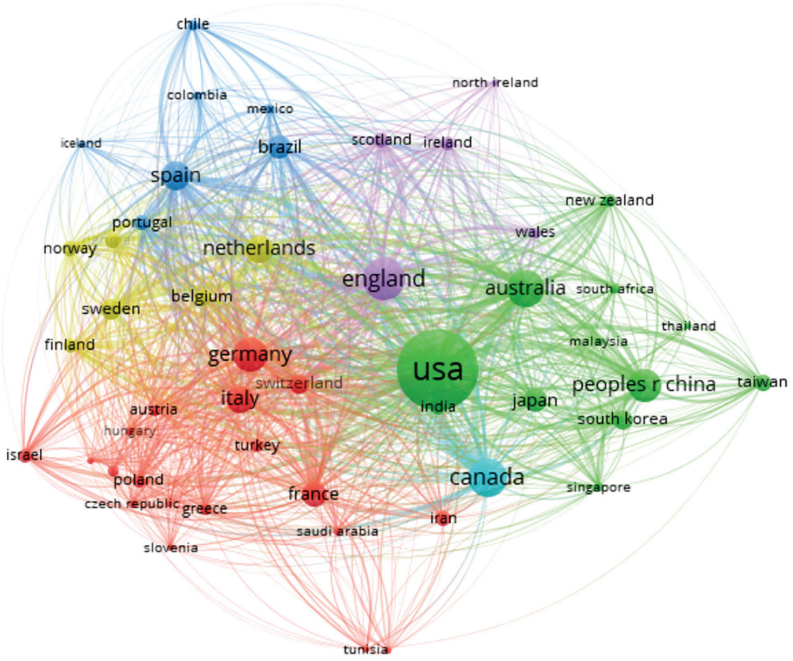

Figure 15: Cooperation network of countries engaged in research.

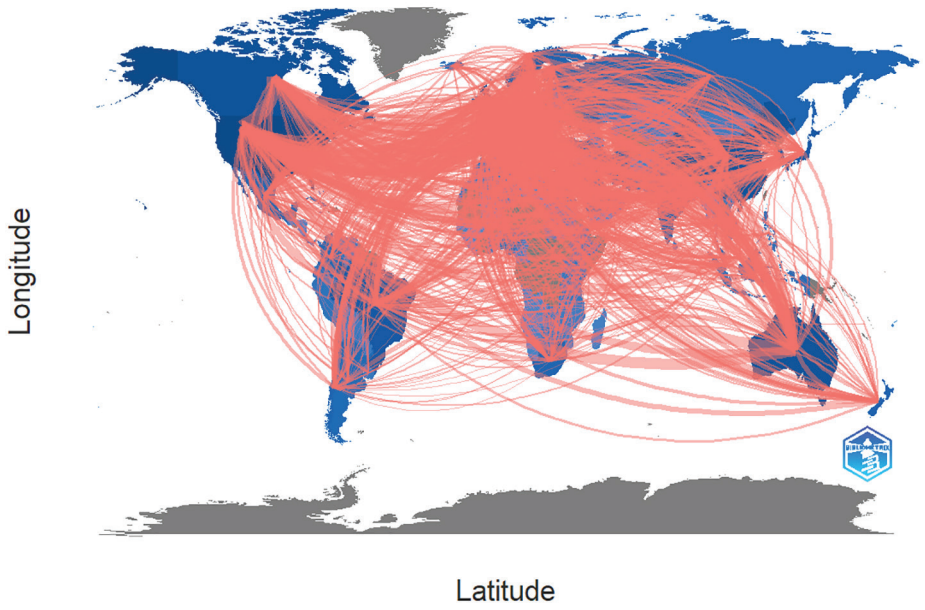

Figure 16: Geographical collaboration of publications on physical activity and cognitive function.

Table 5: Top 10 most countries that contributed to physical activity and cognitive function.

Country (n=163)	TC*	Average Article Citations
USA	660739	43.43
United Kingdom	146476	40.86
Canada	112771	38.16
Australia	85819	31.81
Germany	60919	24.71
Netherlands	54255	38.98
China	43848	13.04
France	35198	28.92
Italy	34331	23.13
Spain	31915	17.82

*Total Citations

function records between 1970 and 2023. A considerable number of papers were discovered over this time period, indicating that numerous journals and authors have paid special attention to this research field. Also, our results indicated that the number of documents increased slowly between 2013 and 2016, and then rapidly grew between 2017 and 2021. In other words, it should be said that scientific productions in this field have increased every year (7.58%), these are primarily restricted to developed countries. This rise may be related to an increasingly wide variety of journals. As long as PA and cognitive function is an interdisciplinary field, the desire of scholars of different sciences to do research in considered research fields has increased. The article suggests that this field is considered a popular field because it receives almost 30 citations on average. Also, this area provides an opportunity for interdisciplinary and international cooperation.

According to data in this article, Arthur F. Kramer from Northeastern University in Massachusetts, US, is known as a top-cited and most active author in the selected research field. He often examines the relationship between fitness, exercise and physical activity with cognitive function and memory. Meanwhile, the "Plos One" and the "International Journal of Environmental Research and Public Health", respectively, contributed 764 and 728 papers each to the field of PA and cognitive function research. As a result, the contribution from the most active and productive journals was effective and facilitated the issuance of scientific production related to PA and cognitive function.

The top ten productive organizations and institutions supporting research on PA and cognitive function were categorized in the United States (four universities), Canada (three universities), Australia (two universities), and Sweden (one university). It can be seen that the United States has had the most productive organizations among the other developed countries. For instance, based on Figure 6, the University of Illinois and the University of Pittsburgh were the top three institutions in the world. The prominence of the University of British Columbia, University of Sydney, University of North Carolina, and the University of Calgary was crucial as they jointly published about 3611 documents in the WOS between 1970 and 2023. More specifically, Oceania, America, and Europe dominated in all categories such as authorship, organization representation, and author's co-citation in the WOS database. A large percentage of the world population is still unrepresented in PA and cognitive research, and it is necessary to develop research findings from developing countries, particularly Asian countries. These findings imply that the majority of the people in developing countries is understudied in PA and cognitive research. As a result, it is possible that current knowledge regarding diagnosis profiles and treatment outcomes could not be applicable globally. This finding suggests that more study on combining PA and cognition from developing countries is needed. The limited done and the results of developing countries can be attributed to inadequate research facilities, sources of funding, and trained labor. As a result, we must strengthen these countries' research output. This will entail a commitment on the part of the government to improve resources and on the part of professionals in mental health to develop their own possibilities for conducting and publishing research. This finding is similar to Sandeep Grover's research.[42]

Most publications on the research combination of PA and cognitive function were from the USA, UK, Canada, Australia and Germany. The United States was the most productive country in this field of research, but other developed countries in Table 5 have great production and consideration of PA and cognitive function studies. The recommendations and guidance of developed countries and their investments in the physical activity of their people as well as the special attention of universities and organizations to this issue have sparked extensive research in the field of physical activity.[40] In total, 163 countries contributed to research evidence on PA and cognitive function.

The published documents in the WOS were clustered mostly under psychology, neurosciences neurology, sport sciences, and geriatrics gerontology (Figure 2). The visualization of keywords revealed that the majority of theme keywords have qualities related

to physical activities, cognition and mental diseases. The terms such as "physical activity", "exercise", "cognition", "aging", "dementia", "depression", and "Alzheimer's disease" were among the conceptualized constructs demonstrated in research combining PA and cognitive function.

The productivity of scientific documents released over the last years has never been more thoroughly analyzed than in this study, which is the first bibliometric analysis of studies that combined the two variables of PA and cognitive function. The results of this retrospective study touch on the distribution of research contributions on PA and cognitive function, and they provide the reader with useful details on the practical applications of research and widen their perspectives on the study's findings.

Conclusion

In this study, the most notable authors, publishing journals, productive organizations, nations, and most popular keywords were highlighted and analyzed along with combined physical activity and cognitive function research. This study revealed that over the last ten years, integrated research on physical activity and cognitive function has expanded dramatically. On research relating to physical activity and cognitive function, we discovered a significant contribution from a wide range of authors, organizations, and journals from developed nations including the United States, the United Kingdom, Canada, Australia, and European countries such as Germany. By highlighting common themes in this field of study, the outcome will make a significant contribution to upcoming interdisciplinary papers. Future research is still very interested in the relationship between PA and cognitive function.

Limitation and Suggestion

Several limitations were found in the study. First, this study reviewed articles that exist only in the WOS database. This database does not include all journals that have published physical activity and cognitive function research. Likewise, there can be a small variation in the number of citations in the report. Meanwhile, one way to increase the citations of articles is to turn to the self-citation approach, in which authors cite their previous articles.[43] Further research should evaluate the frequency of self-citation in the selected research area and its impact on the articles. Moreover, this study concentrated on journal articles and excluded other scientific literature such as books, conference works, and textbook chapters. Future research should consider a wider range of academic sources.

As explained in the Methods section, searching and extracting physical activity and cognitive function documents in the WOS database was restricted to specific keywords. Given the expansive nature of this research area, future researchers should consider a more diverse set of terms.

Authors' Contribution

MS, RS, and ZP contributed to the study design and data collection. MS and RS drafted the manuscript and made critical revisions to the manuscript. All authors read and approved the final manuscript.

Availability of Data and Material

The raw data and material analysed during the current study are available as a supplementary file 1.

Conflict of Interest: None declared.

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