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REVİEW ARTICLE

Bibliometric Profile of Research on Physical Activities in Special Education

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Abstract

The aim of the research is to understand the bibliometric profile of physical activity research in special education. The researchers first decided on the database to be searched. Then, keywords were determined and the data were converted into a form suitable for analysis. Then, data analysis was carried out. As a result of the research, a series of keywords were decided to ensure that publications containing research on physical activity in special education were included: "(AB= ("special education")) AND AB= ("sport" or "physical activity" or "exercise") In the first search, 255 articles were reached. After excluding the excluded articles, 137 articles were analysed. Using the restriction options of the WoS database, the search was restricted to consist only of articles and to be between 1992 and 2024. Articles and early access were selected and all languages were selected as the language of publication. VOSviewer, Microsoft Excel 2016 and the open source Biblioshiny package program created in R programming language for bibliometric analyses were used in the analysis of the research data. In this study, the number of publications was taken into account to determine the effective journals in the field, and the number of local and global citations was evaluated to determine the effective publications. In order to evaluate the historical development of research on physical activity in special education, the frequency of publication by years was used. Likewise, in order to determine the publication efficiency of the countries, the number of publications of the relevant authors according to their countries was evaluated. Common word analyses and strategic diagrams were used to identify thematic research areas.

Keywords
Physical Activity, Special Education, Exercise

INTRODUCTION

Special education practices aim to enable individuals with special needs to gain the skills that will enable them to live as an independent individual and then to adapt to their environment. One of the most effective education programmes carried out in line with these objectives is physical activity programmes in special education (Verschuren et al., 2007). Physical activity can be defined as all physical movements that lead to energy consumption as a result of the activity of the muscles on the skeletal system and exceed the pulse level at rest (Department of Health, 2011).

Physical activities in special education play a critical role in the development of individuals with special needs. Physical activity is important for the health and psychological well-being of individuals with special needs at all ages, including childhood and adolescence. The benefits of such activities for individuals with special needs may be even more striking. Because adapting physical activities to individuals with special needs can play a critical role in their education and rehabilitation processes. Such programmes designed by considering individual differences and needs support the social, emotional and physical development of individuals with special needs (Healy et al., 2016; Mcnamara et al., 2022; Burhaein et al., 2024).

Special education practices involving physical activities increase the self-efficacy, self-esteem and quality of life of individuals with special needs and reduce their stress levels (İlhan, 2008). Especially since individuals with special needs who

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participate in inclusive education participate in education in the same environment with their typically developing peers, their social interactions with their typically developing peers are at the forefront (Bakkaloğlu et al., 2019). Physical activities in inclusive classrooms develop both the physical and social skills of students with special needs and reveal interaction and social harmony with peers with typically development. As in all education programmes prepared for individuals with special needs, physical activities should be adapted to individuals with special needs and arranged according to their needs (Hutzler, 2011).

Physical education is an indispensable part of education programmes specially designed for students with special needs. For this reason, physical activity programmes in special education are recommended to be offered in special education schools. Physical education programmes offered in special education institutions aim to increase the abilities of students according to their developmental areas, taking into account the biological age and physical skills of the student. Although it is very important to improve the skills of individuals with special needs through physical activity, it is very important to have expert personnel to carry out these activities, suitable place for activities and tools and equipment to be used (Takahashi et al., 2023; Yılmaz & Soyer, 2018).

Research shows that individuals with special needs who regularly perform physical activity positively affect their health status. At the same time, it is known that the social skills of individuals with special needs who regularly perform physical activities also improve (Aljadeff-Abergel et al., 2012; Alpözgen & Özdinçler, 2016; Görgün & Melekoğlu, 2016). It is emphasised that physical activities in special education have positive effects especially on communication skills, social interaction and behavioural adaptation (American Psychiatric Association, 2013).

It is recommended that children and young people with special needs engage in moderate or vigorous physical activity for at least 60 minutes a day (Baran, et al., 2020). This level of activity is very important not only for improving physical health, but also for improving cognitive function, increasing muscle strength and general well-being. Participation in physical activities can also promote greater social participation and reduce feelings of isolation by establishing better social interactions and relationships (American Academy of Pediatrics, 2021; Jacob et al., 2020).This is because when individuals with special needs have access to special education environments with physical activities that support their individual differences and maximise their potential, significant improvements are observed in their social, emotional and physical development (Gabler-Halle et al., 1993). In addition, physical activities provide important gains in areas such as self-confidence, self-esteem and independence for individuals with special needs. The use of such activities in the special education process improves individuals' motor skills and general physical health, while improving their social skills and providing stress management (Ochsner Health, 2020; Pan, 2010).

Physical activity programmes, whether in the field of special education or for individuals with typically development, also positively affect academic skills. Academic studies suggest that evidence-based physical activities increase general academic achievement. In the study conducted by Latino & Tafuri (2023), the effect of physical activity on individuals' cognitive functions and academic skills was examined. According to the results obtained, physical activities support individuals' brain health and increase their cognitive development. It is stated that these results can increase the academic performance of individuals. The results of the research emphasise that the health to be achieved through physical activities will positively affect the cognitive achievements of individuals (Latino & Tafuri, 2023).

Considering the differences and types of needs of individuals with special needs, their participation in physical activities may also differ. Individuals with special needs often encounter different environmental and social barriers. These barriers may greatly restrict individuals with special needs who are not very willing to participate in physical activities. For this reason, it is seen that individuals with special needs are not willing to participate in physical activities in the society in general (Kirchner et al., 2008).

With the special efforts and support of special education institutions and teachers working in these institutions, individuals with special needs can provide a healthy and more active participation in physical activities (Kirchner et al., 2008; Lambert et al., 2001). In this respect, studies on physical activities in special education are considered important. However, there is no research on

bibliometric analysis of studies on physical activities in special education. The aim of this study is to reveal the bibliometric profile of the studies on physical activities in special education.

In this direction, it is not to interpret the quality of research or the definitions of certain terms, but to contribute to a comprehensive understanding of the literature. In this study, answers to the following research questions were sought regarding the literature on physical activity in special education:

What is the distribution of studies according to years?, What are the top 10 journals according to the number of publications and local citations?, What is the author productivity according to Lotka's law?, What is the distribution of author publications related to physical activity in special education? , What are the ten countries where publications related to physical activity in special education are the most productive?, What are the 10 most cited articles among publications on physical activity in special education?, What are the trending topics among publications on physical activity in special education?, What is the network of interconnected terms in studies on physical activity in special education?

With this research, it is expected to increase the awareness of educators, parents and society in general about the studies on physical activity in special education. It is thought that the compilation and bibliometric analysis of the studies on physical activities in special education will provide important contributions to special education specialists and researchers who conduct research in the field of special education. By revealing the researches on physical activities in the education of individuals with special needs, the studies conducted in this field will become clearer.

MATERIALS AND METHODS

Keyword Identification and Screening

In the research, bibliometric methods are included in order to examine previous research on physical activity in special education. Bibliometric methods allow a research study to be examined objectively without making any subjective judgement based on bibliographic data and to understand the existing gaps in that field (Zupic & Čater, 2015). However, bibliometric analysis differs significantly from systematic reviews and meta-analyses. Systematic reviews and meta-analyses cover a relatively limited number of studies. Bibliometric methods are more advantageous for analysing comprehensive data. In addition, since bibliometric analysis is based on objective data and objective measurements, it contains reproducible results (Kacmaz & Kaçmaz, 2024; Kaçmaz et al., 2024). In the analysis of the articles examined within the scope of the research, the strategies recommended in the literature were used (Fahimnia et al., 2015). The researchers first decided on the database to be searched. Then, keywords were determined and the data were transformed into a form suitable for analysis. Afterwards, data analysis was carried out. As a result of the research, a set of keywords was decided to ensure that publications containing research on physical activity in special education are included: "(AB=("special education")) AND AB=("sport" or "physical activity" or "exercise") In the first scan, 255 articles were reached. After the excluded articles were removed, 137 articles were analysed.

Firstly, a trial study was carried out using search titles, keywords, abstracts and topics. As a result of the search, it was decided to use the keywords "(AB=("special education")) AND AB=("sport" or "physical activity" or "exercise") because it includes relevant and comprehensive studies. The researchers reached 255 articles as a result of the first search. The screening process was finalised on 27.04.2024. Using the restriction options of the WoS database, it was limited to consist of only articles and to be between 1992 and 2024. Articles and early access were selected and all languages were selected as the language of publication. The titles and keywords of the articles were analysed in detail by two researchers and the articles related to physical activity in special education were included in the study. Articles related to psychological well-being, migrant culture, sports coaching, healthy living and obesity, but not related to physical activity in special education were excluded. As a result of these analyses, 137 articles remained. Thus, the bibliographic data of these articles (title, keywords, abstract, year of publication, authors, references and countries) constitute the data set of the study.

Analysing and Controlling the Data

In order to improve the data, the bibliographic data of 137 articles were downloaded from the WoS database as a simple text file. Afterwards, the data file was converted to CSV format and missing data were checked in detail by analysing author names,

publication titles, country names and keywords. A thesaurus and keywords file was created to be used in the analyses and saved to the computer as a .txt file. Afterwards, the data were made ready for analysis.

Analysing the Data

In the analysis of the research data, VOSviewer, Microsoft Excel 2016 and the open source Biblioshiny package program created in R programming language for bibliometric analyses were used. It is known that the number of publications and citations and keyword frequency are frequently used measures in bibliometric analyses (Ucar et al., 2023). VOSviewer is compatible with the WoS database and is used for visualisation in data analysis (Van Eck & Waltman, 2010). In this study, the number of publications was taken into account to determine the effective journals in the field, and the number of local and global citations was evaluated to determine the effective publications. In order to evaluate the historical development of research on physical activity in special education, publication frequency by years was used. Local citation refers to the citations made to the study in the articles included in the analysis, while global citation refers to the total number of citations in the relevant database (Sabancı Baransel et al., 2023). In the research, co-author analysis, which allows the determination of international collaboration networks, was used (Sun & Rahwan, 2017). Likewise, in order to determine the publication productivity of countries, the number of publications of the relevant authors according to their countries was evaluated. Trend analyses can identify more current topics in a research area (Aria & Cuccurullo, 2017). Common word analyses and strategic diagrams were used to identify thematic research areas. Keyword frequencies and trend analyses were used to identify commonly studied topics and current research trends.

RESULTS

General information about the publications related to 137 articles on physical activity in special education between 1992 and 2024 is given in Table 1. Considering the research data, findings are obtained from various sources in the field of physical activities in special education, covering a wide time period. The annual growth rate of articles was 4.81%, indicating a consistent expansion of research over time. It is seen that an average of 9,341 citations are made per article. The number of references totalled 8333.

Table 1. Table of general information about publications on physical activity in special education

Description	Results
Main Information About Data	
Timespan	1992:2024
Sources (Journals, Books, etc)	178
Documents	255
Annual Growth Rate %	4,81
Document Average Age	8,15
Average citations per doc	9,341
References	8333
Document Contents	
Keywords Plus (ID)	455
Author's Keywords (DE)	678
Authors	
Authors	771
Authors of single-authored docs	36
Authors Collaboration	
Single-authored docs	38
Co-Authors per Doc	3,33
International co-authorships %	10,98
Document Types	
Article	249
Article; early access	6

It is seen that single-authored and co-authored articles are included in the researches. Together with all these, the participation of 771 authors shows the status of research in this field. The

international co-authorship percentage of 10.98% indicates the co-operation of research in the field of physical activity in special education.

Figure 1. Distribution of publications on physical activity in special education by years

Figure 1 shows the distribution of publications on physical activity in special education between 1992 and 2024. While there were only 2 publications in 1992, it is seen that 10 publications were reached in 2010 and 15 publications in 2020. It is seen that the total number of publications in 2023 is 30. It is seen that publications on physical activity in special education are increasing very rapidly after 2019.

Table 2. Top 10 journals according to the number of publications and local citations related to physical activity in special education

Journal	Number of publications	Journal	Local citation
Palestra	9	Adapted Physical Activity Quarterly	191
RETOS. Nuevas Tendencias en Educación Física, Deporte y Recreación	7	Research in Developmental Disabilities	123
Research in Developmental Disabilities	6	Journal of Autism and Developmental Disorders	95
International Journal of Disability, Development and Education	5	Developmental Medicine & Child Neurology	81
Physical Education and Sport Pedagogy	5	Medicine & Science in Sports & Exercise	79
Adapted Physical Activity Quarterly	4	Thesis	78
Disability and Health Journal	4	Exceptional Children	50
Ankara University Faculty of Educational Sciences Journal of Special Education	3	Disability and Rehabilitation	49
Comunicacoes	3	Sport, Education and Society	44
International Journal of Developmental Disabilities	3	Research in Autism Spectrum Disorders	40

Looking at the number of publications and citations in Table 2, it is seen that journals such as Palestra, Adapted Physical Activity Quarterly and RETOS contribute to research in the field of physical activities in special education. However, while the number of publications in Research in Developmental Disabilities and International Journal of Disability, Development and Education is high, the number of citations in Research in Developmental Disabilities and Journal of Autism and Developmental Disorders is high.

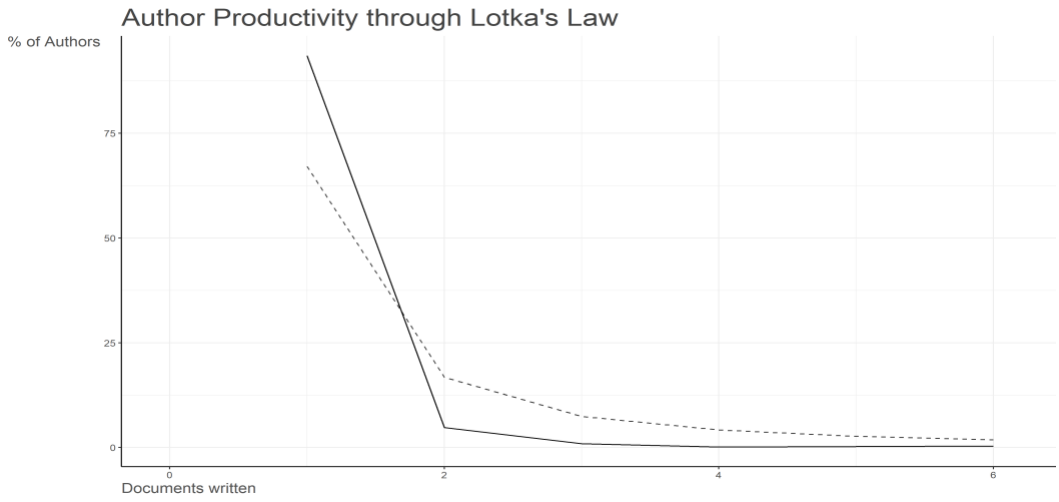

Figure 2. Author productivity according to Lotka's law for publications on physical activity in special education

When Lotka's law author productivity is analysed in Figure 2, it is seen that the majority of the authors have written a single article on physical activity in special education. However, it is seen that a very small number of authors have publications between 2 and 6 articles.

Table 3. Distribution of author publications related to physical activity in special education

Documents written	N. of Authors	Proportion of Authors
1	721	0,935
2	37	0,048
3	7	0,009
4	1	0,001
5	2	0,003
6	3	0,004

Table 3 shows information about the distribution of articles according to the number of authors. The majority of the publications (721) are single-authored and constitute approximately 93.5% of the total. This shows that there is a widespread tendency towards single-author studies in the field of research on physical activity in special education There are 37 articles with two authors. Articles with 2 authors constitute approximately 4.8% of the total. Collaborative studies with three authors are present in 7 articles. Articles with 3 authors constitut approximately 0.9% of the distribution. It is seen that articles with four authors (1 article, 0.1%), five authors (2 articles, 0.3%) and six authors (3 articles, 0.4%) are quite few. In general, the data show the intensity of single-authored studies in the literature.

Table 4. Ten countries with the most productive publications on physical activity in special education

Country	Articles
USA	75
BRAZIL	23
SPAIN	23
TURKEY	21
CHINA	9
GERMANY	8
NETHERLANDS	8
UNITED KINGDOM	6
AUSTRALIA	4
CHILE	4

Table 4 shows the top ten most productive countries for research in the field of physical activities in special education. The United States of America has the highest number of publications with 75 articles. This is followed by research conducted in Brazil and Spain with 23 articles each. Researchers in Turkey have written 21 articles on physical activity in special education.

Table 5. Ten highly cited articles among publications on physical activity in special education

Author(s)	Title	Publication date	Number of local citations	Method
Verschuren, O., Ketelaar, M., Gorter, J. W., Helders, P. J., Uiterwaal, C. S., & Takken, T.	Exercise training program in children and adolescents with cerebral palsy: a randomized controlled trial	2007	201	Experimental
Vuijk, P. J., Hartman, E., Scherder, E., & Visscher, C.	Motor performance of children with mild intellectual disability and borderline intellectual functioning	2010	114	Cross-sectional
Frey, G. C., & Chow, B.	Relationship between BMI, physical fitness, and motor skills in youth with mild intellectual disabilities	1993	113	Cross-sectional
Williams, D., & Coles, L.	Teachers' approaches to finding and using research evidence: An information literacy perspective	2007	109	Mixed research
Lin, J. D., Lin, P. Y., Lin, L. P., Chang, Y. Y., Wu, S. R., & Wu, J. L.	Physical activity and its determinants among adolescents with intellectual disabilities	2010	93	Cross-sectional
Wei, X., Wagner, M., Christiano, E. R., Shattuck, P., & Yu, J. W.	Special Education Services Received by Students with Autism Spectrum Disorders from Preschool through High School	2014	75	Cross-sectional
Borovoy, A.	Japan's hidden youths: mainstreaming the emotionally distressed in Japan	2008	75	Review research
Yarımkaya, E., & Esentürk, O. K.	Promoting physical activity for children with autism spectrum disorders during Coronavirus outbreak: benefits, strategies, and examples	2020	65	Review research
Block, M. E., & Rizzo, T. L.	Attitudes and attributes of physical educators associated with teaching individuals with severe and profound disabilities	1995	57	Cross-sectional
Gabler-Halle, D., Halle, J. W., & Chung, Y. B.	The effects of aerobic exercise on psychological and behavioral variables of individuals with developmental disabilities: a critical review	1993	45	Critical review

Table 5 provides information on various aspects of the 10 most cited publications in the field of physical activities in special education. At the beginning of Table 5 is a randomised controlled trial by Verschuren et al. (2007) investigating the effectiveness of an exercise training programme for children and adolescents with cerebral palsy. It is followed by studies examining motor performance in children with mild intellectual disabilities (Vuijk et al. 2010), the relationship between BMI, physical fitness and motor skills in young people with mild intellectual disabilities (Frey & Chow, 1993) and teachers' motor skills. Approaches to the use of research evidence in education (Williams & Coles, 2007), physical activity research in adolescents with intellectual disabilities (Lin et al. 2010) and special education services received by students with autism spectrum disorders (Wei et al. 2014) are also among the most cited studies.

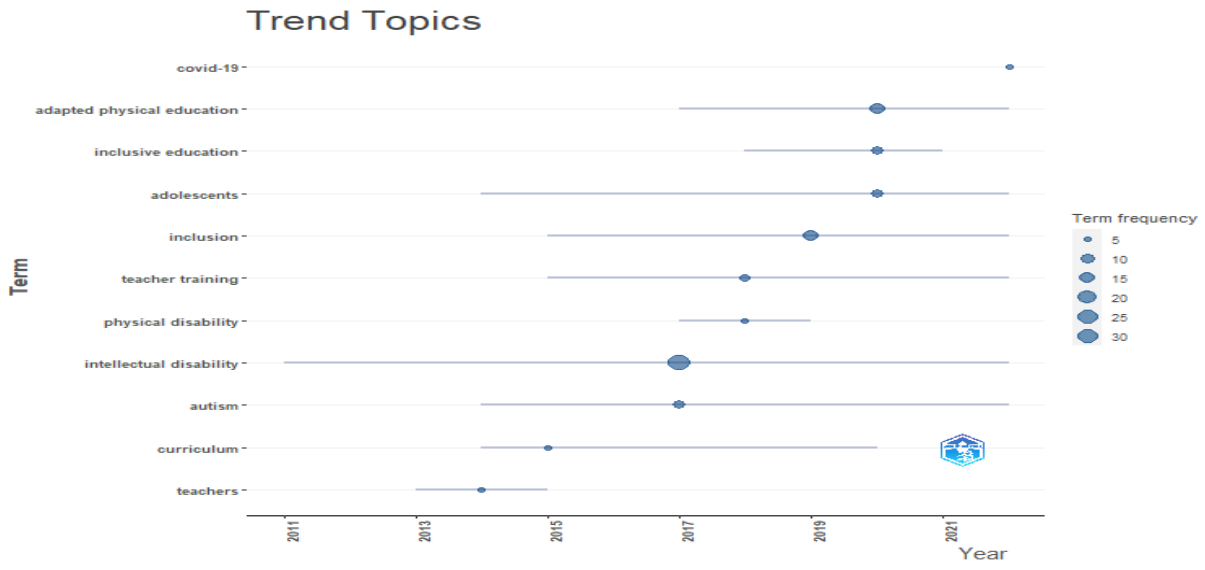

Figure 3. Trending topics among publications on physical activity in special education

The graph in Figure 3 shows the bibliometric analysis of publications related to physical activities in special education from 2011 to 2021. It is seen that there are various terms related to the field, such as "COVID-19", which is on the rise in 2021 and indicates a significant increase in discussions or studies. "Adapted physical education" has been consistently present in the literature over the years.

There is an increase in interest in "inclusive education" and this term seems to have peaked in 2019. Other terms such as "adolescents", "inclusion" and "teacher education" are similarly prominent. The terms "physical disability", "intellectual disability" and "autism" each have different trends and frequencies. The terms "curriculum" and "teachers" were trending in 2013 and 2015.

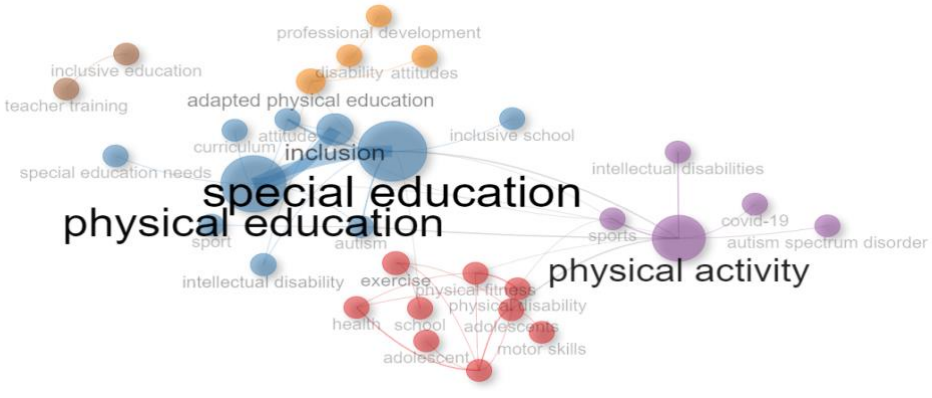

Figure 4. Network of interconnected terms in studies on physical activity in special education

Figure 4 shows an interconnected network of terms. Terms such as "special education" and "physical education" are clearly visible. Other related terms such as "physical activity", "inclusion" and "adapted physical education" are interconnected and indicate a focus on inclusion in physical education for special needs. Terms such as "intellectual disability", "autism" and "COVID-19" indicate specific areas of interest in this field.

DISCUSSION

In this study, bibliometric information about research in the field of physical activities in special education is presented. In the research findings, the top 10 journals according to the number of publications and local citations related to physical activity in special education were expressed. The 4.81% annual growth rate of the research shows that the scientific outputs in this field have increased consistently over time. The average of 9,341 citations per article emphasises the impact and

importance of research within the academic community. In addition, the presence of 455 unique Keywords Plus and 678 Author's Keywords shows the rich diversity of topics and terminologies addressed in the research.

When the findings of the study are analysed, it is seen that certain journals in the field of physical activities in special education play important roles in disseminating research and promoting scientific discussions. It is understood that these journals contribute greatly to the research in this field with the number of publications and local citations. These journals play important roles in expanding the knowledge on physical activity in special education and supporting academic studies in this field.

It is seen that publications on physical activity in special education have increased very rapidly after 2019. This situation shows that issues related to physical activities in special education are among the trend topics of recent years. When the Lotka law author productivity in the research findings is examined, it is seen that the majority of the authors related to physical activity in special education have written a single article. This situation shows that most of the researchers do not specialise in the subject of physical activity in special education. Researches indicate that there is a tendency towards multi-authorship in scientific communication, although there are differences between disciplines (Al, 2005). It is understood that this situation has not yet been reflected in the research on physical activities in special education.

These findings show that the research culture in the field of physical activity in special education is largely progressing with independent studies. It reflects that the studies conducted in the field are less preferred to be carried out in a collaborative manner. Publications to be made in this field should be enriched by carrying out more cooperation and interdisciplinary studies. Only in this way can the quality and innovation potential of publications be increased. Because co-authorship can enable individuals to think from different perspectives and will also help to minimise possible errors that may be overlooked by a single person. Especially researchers who do not have much research experience collaborating with people who have specialized in this type of research for years will contribute to the quality of future research (Al, 2005).

The research findings show the most cited articles on physical activities in special education. The prominent study is the research conducted by Verschuren et al., (2007). Vuijk et al., (2010) on motor performance in children with mild intellectual disabilities, Frey & Chow (1993) on the relationship between BMI, physical fitness and motor skills in young people with intellectual disabilities are important topics related to physical activities in special education and are among the most cited articles. These articles will make significant contributions to the field of physical activities in special education. They are considered as important resources for the practices and studies of special education experts and researchers.

In the research findings, the geographical distribution of publications in the field of physical activity in special education was included. The geographical distribution is concentrated in certain countries. The United States of America plays a leading role in research in this field. It is known that this situation is similar in research on different topics (Karaca et al., 2023). Afterwards, it is seen that the intensity of research on physical activities in special education is in Brazil and Spain. Turkey also makes significant contributions to research on physical activities in special education. It is seen that other countries either have limited or no studies in this field. In order to better understand the situation in these countries, it is recommended to intensify studies on physical activity in special education. Since scientific research requires a certain budget, funding or other support may affect the quantity and quality of research in certain fields. Providing funds and resources for scientific research in developed countries may have contributed to more research. In addition, the political priorities of countries, for example, the importance given to special education, may have led to more intensive research in this field.

Research trends of terms related to physical activity in special education are included in the research findings. The term "COVID-19", which came to the fore in 2021 in connection with the COVID-19 pandemic and experienced a significant increase in research, emphasises the importance of research on physical activity practices in special education. It is seen that the term "Physical Education Adapted for Individuals with Special Needs" has experienced a continuous increase over the years. This may indicate that this term is an important topic in special education programmes. It

is known that the term "inclusive education" is an important issue in special education (Karaca, 2018). This term reached its peak in 2019, underlining its important understanding in the field of special education. In addition, the research findings reveal the changing interest levels of terms such as "inclusion", "adolescents" and "teacher education" over time. The prominence of these terms may lead to policy and practice changes needed to make physical activities in special education more effective and inclusive.

In the research findings, a visual network diagram of the relationships between the basic concepts and terms in the field of physical activity in special education is presented. It is seen that the central terms such as "special education" and "physical education" have a great importance in the studies. Especially in inclusive and separate special education practices, physical education activities involving individuals with special needs come to the fore. The importance of physical education practices for individuals with special needs is known (Cristea et al., 2020; Wu et al., 2021). Concepts such as "physical activity", "inclusive education" and "adapted physical education", which are shaped around these terms, provide information on how physical activities can be made more inclusive and accessible in special education. Especially in special education practices, instructional adaptations through Individualised Education Programmes are considered extremely important (Vural & Yıkmış, 2008). Terms such as "autism", "COVID-19", which deals with pandemic situations, and "intellectual disability" indicate special interest or concern in these areas. This visual structure in the research findings suggests disciplinary approaches to researchers from various disciplines by revealing how to establish multidimensional collaborations.

Conclusion

The findings of this study show that scientific studies on physical activity in special education are gaining more and more importance. The annual growth rate and high number of citations reveal that the studies in this field are widely recognised and valued in the academic community. Research trends indicate changes in terms related to physical activity in special education over time and necessary changes in policies and practices in this field. Especially after the COVID-19 pandemic, it is seen that studies in this field have increased.

In conclusion, studies on physical activity in special education increase the knowledge of the field and provide important resources to academics and practitioners working in this field. Enriching research with more collaboration and interdisciplinary approaches will increase the quality and innovation potential of scientific studies in this field. This approach will contribute to making physical activity practices in special education more inclusive and effective.

Limitations

This research was conducted using only Web of Science (WoS) database. Therefore, data from other large databases (e.g. Scopus, PubMed) were not collected. The fact that there are different articles that can be included in this scope in different databases limits the generalisability of the findings.

Conflict of Interest

No conflict of interest is declared by the authors. In addition, no financial support was received.

Ethics Committee

This is a review article. There was no need to apply to the ethics committee for this article.

Author Contributions

Study Design, OTÇ, MAK; Data Collection, MAK, OTÇ, Statistical Analysis, MAK, OTÇ; Data Interpretation, MAK OT; Manuscript Preparation, MAK, OT; Literature Search, MAK, OTÇ. All authors have read and agreed to the published version of the manuscript.

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