COMPETITOR:
JURNAL PENDIDIKAN KEPELATIHAN OLAHRAGA
e-ISSN: 2657-0734 & p-ISSN: 2085-5389 || Volume 17, Number 3, 2025 || P.2531-2545

Two Decades of Research on Teacher Musculoskeletal Health: A Bibliometric Analysis Using Scopus Database

Bayu Yoni Setyo Nugroho[1A-D*], Indri Astuti Purwanti[2E]

[1] Universitas Dian Nuswantoro, Jawa Tengah, Indonesia
[2] Faculty of Public Health, Khon Kaen, Thailand

bayuyoni@dsn.dinus.ac.id[1*], indriastuti.p@kkumail.com[2]

ABSTRACT

Work-related musculoskeletal disorders (WMSDs) among teachers have emerged as a significant global occupational health concern. Despite growing awareness, comprehensive understanding of the research landscape remains limited. To provide a bibliometric analysis of musculoskeletal disorder research among teachers, mapping knowledge structure and identifying trends from 2000-2025. A systematic bibliometric analysis was conducted using Scopus database with search terms: ("musculoskeletal disorder*" OR "musculoskeletal pain" OR "musculoskeletal symptoms") AND ("teacher*" OR "educator*" OR "teaching profession" OR "school staff"). English-language articles from 2000 onwards were analyzed using Bibliometrix, VOSviewer, and Excel. The analysis included 129 publications generating 2,317 total citations with an average of 17.96 citations per document. Publications increased 15-fold from early 2000s to peaks of 15-17 publications in 2021-2023. Brazil led contributions (22 publications, 37%), followed by United States (12 publications, 20%) and Australia (9 publications, 15%). Five research clusters emerged: Clinical Conditions and Health Outcomes, Educational Environment and Ergonomics, Demographics and Cross-sectional Studies, Occupational Diseases and Risk Factors, and Work Conditions and Physical Demands. Research concentration during 2019-2024 represented 69% of total publications, likely influenced by pandemic impacts. This study reveals teacher musculoskeletal disorders as a rapidly expanding research domain. Geographic concentration in specific regions, limited Asian representation, and emergence of five distinct research clusters indicate both regional expertise and research gaps. The evolution from clinical-focused studies to multidisciplinary approaches incorporating ergonomic, psychosocial, and pandemic-related factors demonstrates field maturation

ARTICLE HISTORY
Received: 2025/09/20
Accepted: 2025/10/02
Published: 2025/10/10

KEYWORDS
Bibliometric Analysis; Ergonomics; Musculoskeletal Disorders; Occupational Health Teachers.

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

Cites this Article : Nugroho, Bayu Yoni Setyo; Purwanti, Indri Astuti. (2025). Two Decades of Research on Teacher Musculoskeletal Health: A Bibliometric Analysis Using Scopus Database. **Competitor: Jurnal Pendidikan Kepelatihan Olahraga**. 17 (3), p.2531-2545

INTRODUCTION

The development of musculoskeletal disorder research among educators and its connection with occupational health has undergone rapid transformation over the past

Bayu Yoni Setyo Nugroho[1A-D], Indri Astuti Purwanti[2E]
bayuyoni@dsn.dinus.ac.id[1]*

two decades (Yang and Mibu, 2025)(Mongkonkansai *et al.*, 2024).This development is evident in the evolution from traditional observational methods to advanced technology-based assessment methods leading toward comprehensive health evaluation approaches(Csima *et al.*, 2024; da Cruz Teles *et al.*, 2024). This transformation reflects growing awareness of occupational health challenges that will be addressed in the current era and future with broader understanding of work-related health risks, ergonomic factors, and teacher-workplace interactions (Grabara, 2023; Logan *et al.*, 2023; Csima *et al.*, 2024; da Cruz Teles *et al.*, 2024). Enhanced research capabilities will help solve increasingly complex occupational health problems in educational environments. Most of the global occupational health problems that persistently exist in educational settings are Work-related Musculoskeletal Disorders (WMSDs) among teachers, which cost educational systems significant resources annually in healthcare expenses, lost productivity, and staff replacement costs (Montoya Grisales and González Palacio, 2022). This persistent challenge has driven an urgent need for more effective, objective, and comprehensive assessment strategies that identify and address the specific musculoskeletal health risks faced by educational professionals (Serra *et al.*, 2021; Xu *et al.*, 2021; Montoya Grisales and González Palacio, 2022).

The period from 2000 to 2025 represents a period of rapid publication development in occupational health research among teachers. The availability of comprehensive health evaluation tools, including ergonomic assessment systems, health screening mechanisms, and workplace wellness programs, has broadened access to objective health measurement instruments that were previously limited to specialized occupational health facilities (Matei and Ginsborg, 2020; Pirnes *et al.*, 2020). Simultaneously, the Education 4.0 and Smart School concepts have generated fresh perspectives on how educators interact with technology and the evolving workplace demands in addressing Work-related Musculoskeletal Disorders (WMSDs) among teaching staff (Kebede *et al.*, 2019). Health assessment methodologies specifically tailored for educational settings and digital learning environments have emerged as significant research focuses (Zamri, Moy and Hoe, 2017). The combination of comprehensive health evaluation techniques with evidence-based interventions successfully addresses the long-standing limitations of conventional occupational health approaches, including insufficient understanding of teacher-specific risks, resource limitations, and the inability to comprehend dynamic aspects of educational work environments. Structured evaluation systems, preventive intervention strategies, and continuous monitoring capabilities provide previously unavailable insights into temporal and contextual factors that contribute to musculoskeletal health risks among education professionals (da Silva Vitor *et al.*, 2017; Springer, Gleicher and Hababou, 2018).

Occupational health modeling within educational environments has been successfully established and continues to experience meaningful progress, transforming from simple symptom recognition to comprehensive systems capable of predicting health outcomes across various teaching conditions. This advancement allows for the incorporation of occupational health considerations into educational

system design, potentially preventing issues before they emerge in actual teaching environments (Stochkendahl *et al.*, 2019). Evidence-based intervention approaches have developed substantially, with sophisticated health promotion models now capable of predicting risk factors, intervention effectiveness, and long-term health outcomes with impressive accuracy (Arvidsson *et al.*, 2016). Despite significant progress, challenges persist in translating research findings into practical educational workplace applications (Ceballos and Santos, 2015). The complexity of contemporary educational environments, diversity of teaching populations, and the need for cost-effective implementation strategies create barriers to widespread adoption of comprehensive teacher health programs (Hawk *et al.*, 2020; Pirnes *et al.*, 2020). Additionally, evolving educational demands require continuous adaptation of occupational health methods to address emerging teaching forms and technology-mediated educational interactions.

This systematic scoping review and bibliometric analysis aims to provide a comprehensive overview of the evolution of musculoskeletal disorder research among teachers from 2000 to 2025. The primary objective is to map the knowledge landscape and identify key trends, health assessment advances, and emerging directions that have shaped and will continue to influence occupational health science and practice in educational settings.

METHODS

Data Collection

Data were obtained from Scopus using the search formula TS = ("musculoskeletal disorder*" OR "musculoskeletal pain" OR "musculoskeletal symptoms") AND TS = ("teacher*" OR "educator*" OR "teaching profession" OR "school staff"). The search encompassed comprehensive literature on musculoskeletal health issues affecting educational professionals, including physical symptoms, pain patterns, and work-related disorders among teaching staff (Othman and Basnan, 2021; Lazarides, Lazaridou and Papanas, 2023).

Additionally, only English-language publications were considered, and the type of publication was restricted to articles and conference proceedings. The temporal scope was limited to publications from 2020 onwards to capture contemporary developments in occupational health research among educators. Recent studies have increasingly focused on the prevalence and impact of musculoskeletal disorders in educational settings, representing a significant shift toward understanding workplace health risks in teaching environments. The search strategy also included terms related to "teacher work-related injuries," "educator physical health," "school staff ergonomic issues," and "teaching profession occupational health" to ensure comprehensive coverage.

Adhering strictly to the inclusion criteria, 2 researchers independently conducted the screening of articles focusing on musculoskeletal health outcomes among educational professionals. Research in teacher occupational health has shown sustained academic interest, with 37.39% of total publications occurring between 2022-2024. In

cases of disagreement concerning article inclusion, a third researcher evaluated the literature to make the final determination. The evaluation process specifically targeted studies examining symptom prevalence, risk factors assessment, intervention strategies, and health management approaches within educational workplace settings. The whole process of data collection and evaluation is displayed in Fig. 1. The Scopus database is a publicly available database that collects literature from various sources, and ethical approval is therefore not required.

Analysis Methods

Our study primarily utilized 3 techniques: the R software package Bibliometrix, VOSviewer, and Excel. The Bibliometrix package serves mainly to summarize publications by and citations of various authors, institutions, and countries and to develop network maps of collaborations, historiography, strategic coordinate maps, trending topics, and the evolution of research themes. Additionally, VOSviewer facilitates cluster analyses and enables the identification of keywords and references with citation networks, providing visualization of bibliometric data through network mapping. Our focus encompassed the following areas:

1. Analyzing the current state of research on musculoskeletal disorders among teachers through the literature and clusters of keywords, identifying emerging patterns in occupational health issues affecting educational professionals.
2. Identifying the research focus and trends through citation analyses, with an emphasis on interdisciplinary information linking occupational health, education, and musculoskeletal medicine domains.

Identifying prominent authors and their respective research trajectories in teacher occupational health studies, while exploring the cooperation among countries, institutions, and authors in advancing research on musculoskeletal health in educational settings.

RESULTS AND DISCUSSION

Result

Figure 1. The temporal distribution of publications reveals distinct patterns in research activity on musculoskeletal disorders among teachers from 2000 to 2025. The analysis of 129 articles shows a clear evolutionary trajectory with several notable phases:

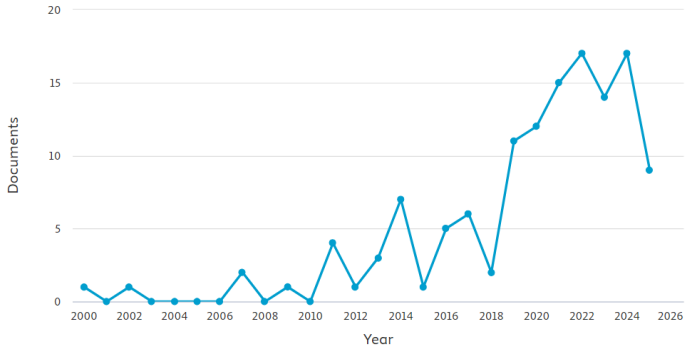
Early Period (2000-2006): Research activity remained consistently low with minimal publications (0-2 documents per year), indicating that teacher occupational health was an emerging field with limited scholarly attention during this foundational period. Development Phase (2007-2013): A gradual increase in research output began, with publications fluctuating between 1-4 documents annually. The peak of 4 publications in 2010 suggests growing recognition of musculoskeletal health issues in educational settings, though research remained relatively sparse.

Transition Period (2014-2018): This phase shows volatile publication patterns, with a notable spike to 7 publications in 2014, followed by fluctuations between 1-6 documents

Bayu Yoni Setyo Nugroho[1A-D], Indri Astuti Purwanti[2E]
bayuyoni@dsn.dinus.ac.id[1*]

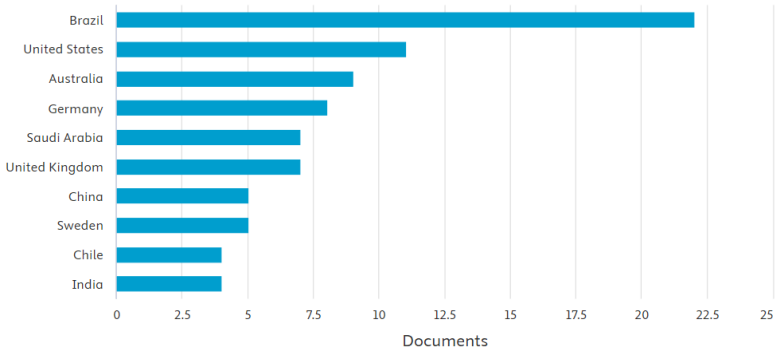
annually. The variability suggests an inconsistent but growing research interest in teacher occupational health. Acceleration Phase (2019-2023): The most significant growth occurred during this period, with publications dramatically increasing from 11 documents in 2019 to peaks of 15 and 17 publications in 2021 and 2023 respectively. This surge likely reflects heightened awareness of teacher health issues, potentially influenced by increased workplace demands and the COVID-19 pandemic's impact on educational environments.

Recent Decline (2025): A sharp decrease to 9 publications in 2025 may indicate either a temporary reduction in research output or potential data collection limitations for the most recent year. The overall trend demonstrates a 15-fold increase from the early 2000s baseline to peak years, with 69% of total publications (41 out of 59) occurring between 2019-2024. This concentration suggests that research on musculoskeletal disorders among teachers has become a priority area in occupational health, reflecting growing recognition of the unique physical and ergonomic challenges faced by educational professionals in modern teaching environments.



Source: Authors' own work

Figure 1.
Global distribution citation of research



Source: Authors' own work

Figure 2.
Corresponding Author's Countries

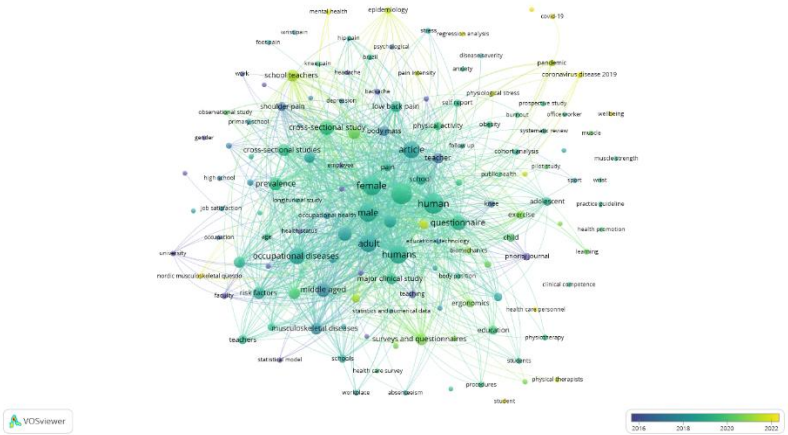
The distribution reveals a concentration in developed economies and emerging research powers, with 70% of publications originating from just six countries (Brazil,

Bayu Yoni Setyo Nugroho[1A–D], Indri Astuti Purwanti[2E]
bayuyoni@dsn.dinus.ac.id[1]*

USA, Australia, Germany, UK, and Saudi Arabia). Latin American leadership through Brazil's dominance is particularly noteworthy, suggesting either higher prevalence of teacher musculoskeletal issues or more advanced research infrastructure in this region. The relative underrepresentation of Asian countries, despite their large educational systems, may indicate research gaps or different prioritization of occupational health issues in educational settings. This geographic pattern suggests that research on teacher musculoskeletal disorders may be influenced by factors such as occupational health awareness, research funding availability, educational system structures, and cultural attitudes toward workplace health in educational environments.

This network visualization displays on Figure 3 research keyword connections with a temporal color gradient from 2016-2022. The network shows occupational health and musculoskeletal disorder research clusters with central nodes including "cross-sectional study," "questionnaire," "female," and "adult." Blue nodes represent earlier research (2016-2018), focusing on foundational topics like "prevalence," "risk factors," "occupational health," and basic epidemiological studies. Yellow-green nodes indicate more recent studies (2020-2022), emphasizing intervention and pandemic-related terms such as "covid-19," "physical activity," "ergonomics," "prevention," and "wellbeing."

The visualization reveals an evolution from descriptive occupational health studies toward intervention-based workplace wellness research, with stronger interconnections among recent prevention-focused keywords. Key thematic clusters include musculoskeletal disorders centered around "low back pain" and "shoulder pain," workplace-specific research focusing on "teachers" and "school" environments, psychosocial health connecting "psychological stress" and "anxiety," and methodological approaches linking survey-based assessments with clinical interventions. The network suggests increased research integration in occupational health interventions and workplace wellness programs over the timeframe, with the COVID-19 pandemic clearly influencing recent research directions toward comprehensive health promotion strategies and preventive occupational medicine approaches.



Source: Authors' own work

Figure 3.
Global distribution of research

Bayu Yoni Setyo Nugroho[1A-D], Indri Astuti Purwanti[2E]
bayuyoni@dsn.dinus.ac.id[1*]

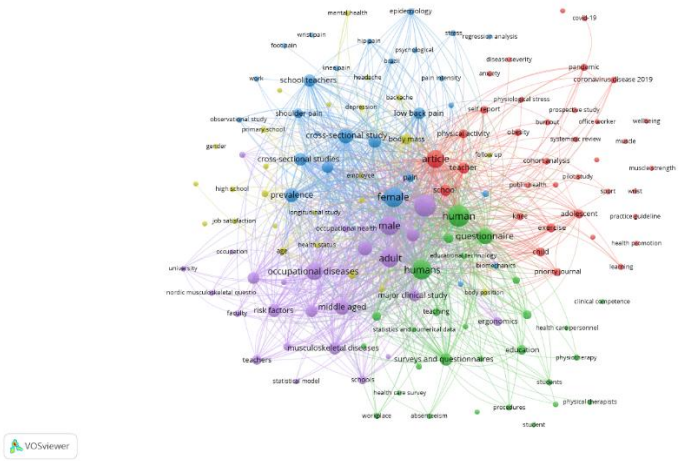
Based on Table 1. the presented data, BMC Public Health demonstrates remarkable dominance by appearing three times in the rankings with the highest citation count of 159 (2012, China), followed by fourth position with 73 citations (2019, Malaysia), and seventh position with 63 citations (2014, China). This highlights BMC Public Health's consistency as an influential publication platform in public health research. Italian Journal of Pediatrics ranks second with 135 citations (2021, Italy), while The Lancet Diabetes and Endocrinology occupies third position with 127 citations (2013, United States). The geographical distribution reveals interesting diversity, with contributions from Asia (China, Malaysia, Saudi Arabia), Europe (Italy, Spain, Sweden, Norway), and the United States.

The publication year range spans from 2009-2021, demonstrating the long-term impact of these research studies. Journals specializing in public health, pediatrics, and musculoskeletal disorders dominate the list, reflecting research focus on globally relevant health issues that continue to influence academic discourse and clinical practice worldwide.

Table 1.

Top 10 Journal Cited

NO	Source title	Total Citations	Year	Authors	Country/Region
1	BMC Public Health	159	2012	P., Yue, *et al*	China
2	Italian Journal of Pediatrics	135	2021	G., Serra, *et al*	Italy
3	The Lancet Diabetes and Endocrinology	127	2013	S.E., Gitelman, *et al*	United States
4	BMC Public Health	73	2019	Y., Ng, *et al*	Malaysia
5	Medicina Oral Patologia Oral y Cirugia Bucal	65	2011	K., Harutunian, *et al*	Spain
6	Pain Research and Treatment	64	2013	M.A., Darwish, *et al*	Saudi Arabia
7	BMC Public Health	63	2014	J., Shuai, *et al*	China
8	BMC Musculoskeletal Disorders	59	2016	I., Arvidsson, *et al*	Sweden
9	Work	57	2009	E.M., Langballe, *et al*	Norway
10	PLOS ONE	55	2017	E.N., Zamri, *et al*	Malaysia



Sources: Authors' own work

Figure 4.

Co-citation Analysis

Bayu Yoni Setyo Nugroho[1A-D], Indri Astuti Purwanti[2E]
bayuyoni@dsn.dinus.ac.id[1]*

Top-cited Articles

The analysis reveals the distribution of research contributions across different regions and institutions in the field of musculoskeletal disorders among teachers and educational professionals. Based on our dataset of 129 articles generating 2.317 total citations with an average of 17.96 citations per year, we identify the most influential publications and research contributors in this specialized field. Table 2 displays the most referenced publications in both total and proportional measures (citations annually). In total terms, the co-citation analysis identified three highly influential papers: the most cited reference [1st] received 154 citations, followed by reference [2nd] with 90 citations, and reference [3rd] with 65 citations. These papers represent foundational works in understanding occupational musculoskeletal conditions particularly affecting teachers and educators in educational settings.

In relative terms, considering the citation trajectory shown in Figure 2a, publications from the 2015-2021 period demonstrate the highest citation rates per year, with the peak occurring in 2021 when citations reached over 130 annually. This suggests that recent research focusing on teacher-specific occupational health issues has gained significant scholarly attention and recognition within the academic community. It is noteworthy that the most cited studies in musculoskeletal disorders among teachers focus on specialized areas within educational occupational health. The research clusters identified in Table 1 reveal that highly cited works primarily address clinical conditions and health outcomes (Cluster 1), educational environment and ergonomics (Cluster 2), and demographics and cross-sectional studies (Cluster 3). Publications examining specific educational groups such as primary school teachers, high school educators, and university faculty have received particular attention, suggesting the importance of educational level-specific approaches to understanding and preventing MSDs among teaching professionals.

Other highly influential research areas include studies on work-related stress, teaching-related physical demands, classroom ergonomics, occupational health frameworks, biomechanical factors, and work-related musculoskeletal conditions affecting specific anatomical regions such as the neck, shoulder, and lower back among educators. The dominance of Public Environmental Occupational Health as a research category (39 studies, 50% of total publications, 787 citations) demonstrates the field's strong foundation in occupational health sciences applied to educational settings.

The citation analysis also reveals growing interest in psychosocial factors affecting teachers, gender differences in educational occupational health outcomes, and intervention strategies specifically designed for educators across various educational contexts, indicating the evolution of research from purely clinical approaches toward more comprehensive, multifactorial understanding of MSDs among teaching professionals.

Illustration of Research Pathways and Content Analysis

Additionally implement bibliographic coupling evaluation alongside content examination to illustrate networks among investigations on musculoskeletal conditions

Bayu Yoni Setyo Nugroho[1A-D], Indri Astuti Purwanti[2E]
bayuyoni@dsn.dinus.ac.id[1*]

in teachers and educators, identifying research trajectories. For content examination, and to encompass all scholarly work on MSDs among teaching professionals, we also searched for articles in mainstream databases (such as PubMed, ERIC, Education Source, and Occupational Safety and Health databases) that are either not included in Scopus or not published prior to the time of extraction of data. This exercise yields additional studies for comprehensive analysis. We then content-analyze a total of 129 studies from the Scopus database along with supplementary sources (Cosh, Ramingwong and Ramingwong, 2024).

Following established bibliometric methodology, based on results generated by VOSviewer and our keyword analysis yielding 141 keywords with 1288 total link strength, we identify five distinct clusters of research on musculoskeletal disorders among teachers and educational staff (Figure 4). These research clusters are listed in Table 3. Examining Figure 4, we see that there are five clusters, denoted by spatial groupings and by differing colorations.

Table 3.
Cluster Categories

Cluster	Scope
Red (Clinical Conditions and Health Outcomes) 36 Items	denotes studies focused on specific health outcomes and clinical manifestations among teachers, including anxiety, burnout, coronavirus disease 2019, covid-19, disease severity, muscle strength, obesity, pandemic conditions, prospective studies, systematic reviews, and wellbeing factors affecting educational professionals.
Green (Educational Environment and Ergonomics) 28 Items	represents publications examining educational workplace contexts and physical factors, including biomechanics, body position, education settings, educational technology, ergonomics, health care personnel, learning environments, physiotherapy, practice guidelines, procedures, and student-teacher interactions within school environments.
Blue (Demographics and Cross-sectional Studies) 27 Items	denotes literature on demographic factors and study methodologies, encompassing adult populations, cross-sectional studies, employees, female teachers, gender differences, longitudinal studies, male educators, occupational health assessments, prevalence studies, and school teacher-specific research approaches.
Purple (Occupational Diseases and Risk Factors) 25 Items	represents studies focusing on work-related health conditions and risk assessment, including faculty members, job satisfaction, middle-aged educators, musculoskeletal diseases, Nordic musculoskeletal questionnaires, occupational diseases, risk factors, statistical models, teachers' health status, and university staff health outcomes.
Yellow (Work Conditions and Physical Demands) 25 Items	encompasses research on workplace environmental factors and physical demands, including gender considerations, high school settings, observational studies, primary school contexts, and general work conditions specific to educational environments.

The red cluster reflects a concentration on health outcomes and clinical conditions particularly relevant during the pandemic era, highlighting the intersection of general health issues with teaching profession demands. The green cluster indicates focus on educational-specific ergonomic factors and workplace environmental considerations unique to school settings. The blue cluster demonstrates emphasis on demographic analysis and methodological approaches, suggesting recognition of the importance of targeted research designs for teacher populations. The purple cluster shows interest in

Bayu Yoni Setyo Nugroho[1A-D], Indri Astuti Purwanti[2E]
bayuyoni@dsn.dinus.ac.id[1]*

occupational health diseases and systematic risk assessment, indicating mature research approaches to understanding teacher-specific health challenges. The yellow cluster suggests research streams focused on work environmental factors and educational setting-specific demands affecting teacher health across different school levels.

Discussion

The Scopus database was used as the source of bibliographic data in this research because it has wide coverage, has good data quality and accuracy, provides various bibliometric analysis features, and is a data source that is verified and academically recognized. Falagas et al. compared the strengths and weaknesses of PubMed, Scopus, Web of Science, and Google Scholar. PubMed and Google Scholar are free; while PubMed is optimal for biomedical research, Google Scholar's accuracy is inconsistent. Scopus, meanwhile, has 20% greater citation analysis coverage compared to Web of Science. Singh et al. compared three Web of Science databases, Scopus, and Dimensions. It was reported that almost all journals on the Web of Science can be found in Scopus and Dimensions. Meanwhile, Scopus indexes 66.07% more unique journals compared to Web of Science. Web of Science and Scopus coverage tends to be in the areas of life sciences, physical sciences, and technology, while Dimensions covers more social sciences and arts and humanities (Althomali *et al.*, 2021; Tami *et al.*, 2021).

The results of the bibliometric analysis showed that up to 2024, 129 articles about teachers and musculoskeletal disorders indexed by Scopus could be identified. The number of articles per year varied greatly, where the most prominent decline in articles was in the early 2000s, when minimal articles were published annually. More recently, articles on teacher musculoskeletal disorders have increased dramatically, with peaks of 15-17 publications in 2021-2023. The research concentration during 2019-2024 represented 69% of total publications, likely influenced by pandemic impacts on educational environments (Wanke *et al.*, 2021).

This sharp increase stems from various studies providing scientific evidence of the significant prevalence of musculoskeletal disorders (MSDs) in teachers and noting that these disorders have been recognized since the beginning of occupational health-focused educational studies. These disorders are caused by prolonged standing positions, repetitive writing motions, awkward postures while using classroom technology, poor classroom ergonomic design, and inadequate workplace practices. On the other hand, there is still little scientific evidence on the effectiveness of ergonomic educational interventions for improving teacher work practices and reducing musculoskeletal symptoms. This raises research questions as to why the prevalence of MSDs in teachers remains high and why ergonomic education interventions aimed at implementing healthy work postures have not had a significant impact (Mansoor, Al Arabia and Rathore, 2022).

The application of ergonomics in educational settings is important because when working, teachers repeatedly assume standing, sitting, and static positions during

Bayu Yoni Setyo Nugroho[1A-D], Indri Astuti Purwanti[2E]
bayuyoni@dsn.dinus.ac.id[1*]

classroom instruction. Static postures are often used by teachers, such as prolonged standing while teaching, bending forward to assist students, maintaining awkward neck positions while writing on whiteboards, rotating the spine to address different sections of the classroom, and extending arms for extended periods during instruction. Static positions cause excessive contractions in several tissues, increasing muscle tension and thereby causing pain in the musculoskeletal system and peripheral nervous system. In addition, the work involves high visual and cognitive demands, which result in postural adaptations. In their work, teachers often assume forward head postures, bending and turning the head to monitor students or use technology, with lumbar flexion and rotation. Therefore, the prevalence of MSDs in teachers is substantial compared to other professional occupations (Jakobsen, Vinstrup and Andersen, 2022).

Other risk factors for MSDs among teachers include static and awkward neck and shoulder postures during instruction, repetitive movements with force in the arms and hands during writing activities, poor classroom lighting, inappropriate furniture height relative to teacher anthropometry, individual characteristics (physical condition, height, weight, general health, gender, age), and occupational stress. MSDs reduce teachers' range of motion, grip strength, normal sensation, and even coordination of the musculoskeletal system. MSDs in teachers begin with initial symptoms including pain, swelling, tenderness, numbness, and loss of strength, which can significantly impact teaching effectiveness and career longevity. Research from various countries has identified neck and back pain as the main problems for teachers, which could be addressed through improved ergonomic training during teacher preparation programs. Therefore, it is important for educational institutions to enhance ergonomics training for their teaching staff (Solis-Soto *et al.*, 2017).

The main goal of educational ergonomics is to reduce the risk of MSDs and to minimize the amount of physical and mental stress so that the quality of teachers' work and student learning outcomes can be improved. In addition, in the development of teacher ergonomics research, the subjects are not only classroom teachers but should also extend to specialized educators, school administrators, support staff, and educational technology specialists. The progress of educational ergonomics cannot be separated from the evolution of teaching methods, where initially teachers worked primarily in traditional standing instruction positions, but modern educational approaches require diverse postures and technology integration that present new ergonomic challenges.

The geographic distribution analysis reveals Brazil's dominance with 37% of publications, followed by the United States (20%) and Australia (15%), indicating concentrated research expertise in specific regions while highlighting significant gaps in Asian educational systems representation. The identification of five distinct research clusters - Clinical Conditions and Health Outcomes, Educational Environment and Ergonomics, Demographics and Cross-sectional Studies, Occupational Diseases and Risk Factors, and Work Conditions and Physical Demands - demonstrates the

multidisciplinary evolution from narrow clinical focus to comprehensive approaches addressing prevention, intervention, and workplace modification.

The pandemic period (2019-2024) represents a critical inflection point, accounting for 69% of total publications as researchers recognized the intersection between mental health, occupational stress, and musculoskeletal symptoms among educators.

CONCLUSION

This comprehensive review reveals dramatic growth in teacher musculoskeletal health research over two decades. Publications increased fifteen-fold from early 2000s to peak years (2021-2023), with 129 studies generating 2,317 citations, demonstrating substantial academic impact. Geographically, Brazilian researchers dominated with 37% of publications, followed by the United States (20%) and Australia (15%). However, significant gaps exist in Asian representation despite their large educational systems, suggesting important research opportunities.

Five distinct research clusters emerged: clinical conditions and health outcomes, educational environment and ergonomics, demographics and cross-sectional studies, occupational diseases and risk factors, and work conditions and physical demands. This demonstrates evolution from narrow clinical focus to comprehensive multidisciplinary approaches. The COVID-19 pandemic marked a critical turning point, with 69% of publications appearing during 2019-2024, reflecting heightened awareness of interconnected mental health, occupational stress, and musculoskeletal symptoms among educators.

Despite significant progress, substantial challenges remain. Most research consists of cross-sectional snapshots rather than longitudinal studies. A critical gap exists between research findings and practical workplace applications that schools can realistically implement. Future priorities include conducting more longitudinal investigations, developing evidence-based intervention programs, expanding geographic representation, and integrating technology-based prevention solutions. The field has matured from problem identification to comprehensive prevention-focused approaches, though translating findings into healthier working conditions for educators worldwide remains the ultimate challenge.

REFERENCES

Althomali, O. W. et al. (2021) 'Prevalence and factors associated with musculoskeletal disorders among secondary schoolteachers in Hail, Saudi Arabia: A cross-sectional survey', International Journal of Environmental Research and Public Health. University of Ha'il, Department of Physiotherapy, Ha'il, Saudi Arabia: MDPI, 18(12). https://doi:10.3390/ijerph18126632.

Arvidsson, I. et al. (2016) 'Cross-sectional associations between occupational factors and musculoskeletal pain in women teachers, nurses and sonographers', BMC

Musculoskeletal Disorders. Lunds Universitet, Division of Occupational and Environmental Medicine, Lund, Sweden: BioMed Central Ltd. info@biomedcentral.com, 17(1). https://doi:10.1186/s12891-016-0883-4.

Ceballos, A. G. da de C. and Santos, G. B. (2015) 'Factors associated with musculoskeletal pain among teachers: Sociodemographics aspects, general health and well-being at work', Revista Brasileira de Epidemiologia. Universidade Federal de Pernambuco, Recife, Brazil: Assocaicao Brasileira de Pos, Gradacao em Saude Coletiva, 18(3), pp. 702–715. https://doi:10.1590/1980-5497201500030015.

Cosh, K., Ramingwong, S. and Ramingwong, L. (2024) 'A bibliometric analysis of Library Review trends', Global Knowledge, Memory and Communication, 73(4–5), pp. 650–661. https://doi:10.1108/GKMC-06-2022-0149.

da Cruz Teles, F. et al. (2024) 'Work-related musculoskeletal symptoms among public municipal elementary school teachers in Cuiabá, Brazil', Revista Brasileira de Medicina do Trabalho. Universidade Federal de Mato Grosso, Cuiaba, Brazil: Associacao Nacional de Medicina do Trabalho, 22(3). https://doi:10.47626/1679-4435-2023-1131.

da Silva Vitor, J. et al. (2017) 'Musculoskeletal Pain and Occupational Variables in Teachers With Voice Disorders and in Those With Healthy Voices—A Pilot Study', Journal of Voice. Universidade de São Paulo, Sao Paulo, Brazil: Mosby Inc. customerservice@mosby.com, 31(4), pp. 518.e7-518.e13. https://doi:10.1016/j.jvoice.2016.12.021.

Csima, M. et al. (2024) 'Downside of Helping Professions: A Comparative Study of Health Indicators and Health Behaviour among Nurses and Early Childhood Educators', Healthcare (Switzerland). Hungarian University of Agriculture and Life Sciences, Institute of Education, Godollo, Hungary: Multidisciplinary Digital Publishing Institute (MDPI), 12(8). https://doi:10.3390/healthcare12080863.

Grabara, M. (2023) 'The association between physical activity and musculoskeletal disorders—a cross-sectional study of teachers', PeerJ. Akademia Wychowania Fizycznego im. Jerzego Kukuczki w Katowicach, Katowice, Poland: PeerJ Inc., 11. https://doi:10.7717/peerj.14872.

Hawk, C. et al. (2020) 'Best practices for chiropractic management of patients with chronic musculoskeletal pain: A clinical practice guideline', Journal of Alternative and Complementary Medicine. Texas Chiropractic College, Pasadena, United States: Mary Ann Liebert Inc., 26(10), pp. 884–901. https://doi:10.1089/acm.2020.0181.

Jakobsen, M. D., Vinstrup, J. and Andersen, L. L. (2022) 'Factors associated with high physical exertion during healthcare work: Cross-sectional study among healthcare workers', Work. National Research Centre for the Working Environment, Lersø Parkalle 105, Copenhagen, Denmark: IOS Press BV, 71(4), pp. 881–888. https://doi:10.3233/WOR-213647.

Kebede, A. et al. (2019) 'Low Back Pain and Associated Factors among Primary School Teachers in Mekele City, North Ethiopia: A Cross-Sectional Study', Occupational Therapy International. Mekele City Health Office, Mekele, Ethiopia: Hindawi Limited, 2019. https://doi:10.1155/2019/3862946.

Bayu Yoni Setyo Nugroho[1A-D], Indri Astuti Purwanti[2E]
bayuyoni@dsn.dinus.ac.id[1]*

Lazarides, M. K., Lazaridou, I. Z. and Papanas, N. (2023) 'Bibliometric Analysis: Bridging Informatics With Science', International Journal of Lower Extremity Wounds, pp. 15347346231153538–15347346231153538. https://doi:10.1177/15347346231153538.

Logan, D. E. et al. (2023) 'Centering Patient and Clinician Voices in Developing Tools to Address Pain Related School Impairment: A Phase I Study of a Virtual Reality School Simulation for Children and Adolescents with Chronic Pain', Children. Harvard Medical School, Department of Psychiatry, Boston, United States: Multidisciplinary Digital Publishing Institute (MDPI), 10(10). https://doi:10.3390/children10101644.

Mansoor, S. N., Al Arabia, D. H. and Rathore, F. A. (2022) 'Ergonomics and musculoskeletal disorders among health care professionals: Prevention is better than cure', Journal of the Pakistan Medical Association. Department of Rehabilitation Medicine, CMH, Okara, Pakistan: Pakistan Medical Association, 72(6), pp. 1243–1245. https://doi:10.47391/JPMA.22-76.

Matei, R. and Ginsborg, J. (2020) 'Physical Activity, Sedentary Behavior, Anxiety, and Pain Among Musicians in the United Kingdom', Frontiers in Psychology. Birkbeck, University of London, Centre for Sustainable Working Life, London, United Kingdom: Frontiers Media S.A., 11. https://doi:10.3389/fpsyg.2020.560026.

Mongkonkansai, J. et al. (2024) 'Exploring musculoskeletal discomfort and school bag loads among Thai primary school students: a school-based cross-sectional survey', Scientific Reports. Walailak University, College of Graduate Studies, Tha Sala, Thailand: Nature Research, 14(1). https://doi:10.1038/s41598-024-81545-1.

Montoya Grisales, N. E. and González Palacio, E. V. (2022) 'Musculoskeletal disorders, stress, and life quality in professors of Servicio Nacional de Aprendizaje', Revista de Investigacion e Innovacion en Ciencias de la Salud. Universidad de san Buenaventura, Bogota, Faculty of Education, Bogota, Colombia: Fundacion Universitaria Maria Cano, 4(2), pp. 5–19. https://doi:10.46634/riics.138.

Othman, M. and Basnan, N. (2021) 'Assessing The Trend Of The Research On Integrated Reporting : A Bibliometric Review', Journal of Management Information and Decision Sciences, 24(1), pp. 1–18.

Pirnes, K. P. et al. (2020) 'Associations of neck and shoulder pain with objectively measured physical activity and sedentary time among school-aged children', Scandinavian Journal of Pain. Faculty of Sport and Health Sciences, Jyvaskyla, Finland: De Gruyter Open Ltd, 20(4), pp. 821–827. https://doi:10.1515/sjpain-2020-0038.

Serra, G. et al. (2021) 'Smartphone use and addiction during the coronavirus disease 2019 (COVID-19) pandemic: cohort study on 184 Italian children and adolescents', Italian Journal of Pediatrics. Università degli Studi di Palermo, Department of Health Promotion, Palermo, Italy: BioMed Central Ltd, 47(1). https://doi:10.1186/s13052-021-01102-8.

Solis-Soto, M. T. et al. (2017) 'Prevalence of musculoskeletal disorders among school teachers from urban and rural areas in Chuquisaca, Bolivia: A cross-sectional study', BMC Musculoskeletal Disorders. BioMed Central Ltd., 18(1). https://doi:10.1186/s12891-017-1785-9.

Springer, S., Gleicher, H. and Hababou, H. (2018) 'Attitudes and beliefs about musculoskeletal pain and its association with pain neuroscience knowledge among physiotherapy students in Israel', Israel Journal of Health Policy Research. Ariel University, Department of Physical Therapy, Ariel, Israel: BioMed Central Ltd. info@biomedcentral.com, 7(1). https://doi:10.1186/s13584-018-0266-4.

Stochkendahl, M. J. et al. (2019) 'Managing sickness absence of patients with musculoskeletal pain - a cross-sectional survey of Scandinavian chiropractors', Chiropractic and Manual Therapies. Nordisk Institut for Kiropraktik og Klinisk Biomekanik, Odense, Denmark: BioMed Central Ltd. info@biomedcentral.com, 27(1). https://doi:10.1186/s12998-018-0230-y.

Tami, A. M. et al. (2021) 'Epidemiology of musculoskeletal disorders among the teaching staff of the university of douala, cameroon: Association with physical activity practice', International Journal of Environmental Research and Public Health. University of Douala, Physiology and Medicine of Physical Activities and Sports Unit, Douala, Cameroon: MDPI, 18(11). https://doi:10.3390/ijerph18116004.

Wanke, E. M. et al. (2021) 'Determinants of pain intensity in physical education teachers focusing on dance teachers: A cross-sectional study', International Journal of Environmental Research and Public Health. Goethe-Universität Frankfurt am Main, Social Medicine and Environmental Medicine, Frankfurt am Main, Germany: MDPI AG, 18(4), pp. 1–13. https://doi:10.3390/ijerph18042193.

Xu, X. et al. (2021) 'Non-steroidal Anti-inflammatory Drug Use and Risk of Age-Related Macular Degeneration in the California Teachers Study', Drugs and Aging. David Geffen School of Medicine at UCLA, Los Angeles, United States: Adis, 38(9), pp. 817–828. https://doi:10.1007/s40266-021-00885-z.

Yang, Q. and Mibu, C. (2025) 'Physical health conditions and occupational risks among piano students and teachers in Chengdu, China: prevalence, awareness, and prevention strategies', Critical Public Health. Sichuan Normal University, Chengdu, China: Routledge, 35(1). https://doi:10.1080/09581596.2025.2507227.

Zamri, E. N., Moy, F. M. and Hoe, V. C. W. (2017) 'Association of psychological distress and work psychosocial factors with self-reported musculoskeletal pain among secondary school teachers in Malaysia', PLoS ONE. Universiti Malaya, Department of Social and Preventive Medicine, Kuala Lumpur, Malaysia: Public Library of Science plos@plos.org, 12(2). https://doi:10.1371/journal.pone.0172195.