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Visualizing The Knowledge Structure of Geriatric Rehabilitation: A Bibliometric Analysis

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Abstract

This study undertakes a comprehensive bibliometric analysis to visualize the knowledge landscape of geriatric rehabilitation. Utilizing the Web of Science and Scopus databases from 1947 to 2023, a meticulous bibliometric analysis was executed. The research was facilitated through ScientoPy and VOSviewer tools, enabling meticulous scrutiny and insightful visualization of the research network. A total of 5120 papers were identified through the search strategy. The outcomes reveal the United States as the foremost contributor to geriatric rehabilitation research, with the Archives of Physical Medicine and Rehabilitation emerging as a highly active journal. Among the most significant author's keywords, "rehabilitation", "aged" and "hip fracture" are prominent, underscoring pivotal domains for targeted interventions within geriatric care. Furthermore, this analysis highlights noteworthy keywords such as "sarcopenia," "physical activity," and "virtual reality," offering essential insights into core themes within geriatric rehabilitation. Consequently, this study presents a valuable resource for scholars and researchers alike. It serves as a foundational tool for identifying prevalent research trends, addressing existing gaps, and embarking on new explorations in the dynamic realm of geriatric rehabilitation. The findings provide a holistic understanding of the knowledge landscape, paving the way for informed decision-making, innovative research endeavors, and the enhancement of geriatric rehabilitation practices.

Introduction

Geriatric rehabilitation has gained significant global recognition due to the growing need to address the unique healthcare requirements of the aging population (Ayoubi-Mahani *et al*., 2023). Rehabilitation of geriatric patients has a positive effect on outcomes for functioning, relative risk for nursing home admission, and relative risk for mortality (Tijsen *et al*., 2019). The mounting frequency of age-related maladies such as musculoskeletal disorders, neurological disorders, and chronic diseases among the elderly population is the stimulus behind the requirement for geriatric rehabilitation (Becker & Achterberg, 2022). In addition, research suggest that 54,1% of the elderly are at risk of developing cardiovascular disease (Magnussen *et al*., 2023). Frequent challenges encountered by people with dementia and their caregivers in using HCBS include limited awareness of dementia and lack of information about available services (Bieber *et al*., 2019). Geriatric rehabilitation is defined as multidimensional approach of diagnostic and therapeutic interventions (Lubbe *et al*., 2023). Geriatric Rehabilitation (GR) is defined as 'a multidimensional approach of diagnostic and therapeutic interventions, the purpose of which is to optimize functional capacity, promote activity and preserve functional reserve and social participation in older people with disabling impairments (van Balen *et al*., 2019). The core objective of geriatric rehabilitation is to maximize functional autonomy, augment quality of life, and heighten general welfare for the aged population (Goldman & Schafer,

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2011; Grund *et al*., 2020). GR can be offered as a home-based service or as an inpatient care trajectory within hospitals, rehabilitation hospitals, skilled nursing facilities or nursing homes with rehabilitation units (Grund *et al*., 2020). This because people who enter old age will be threatened by health problems (Feng *et al*,. 2022). Patients in GR are mostly of old age (i.e. 75 years and older), are often frail and have several comorbidities, including cognitive dysfunctions and communication problems. However, they want to achieve self-dependence after a medical event (Pel-Littel *et al*., 2021). In terms of patterns, there is a growing emphasis on community-based and home-based geriatric rehabilitation programs globally (Wang *et al*., 2021). These programs aim to promote aging in place and enable older adults to maintain independence within their own homes and communities (Achterberg *et al*., 2019). Geriatricians are exclusively in charge of the treatment in post-acute geriatric rehabilitation units (Rapp *et al*., 2022). Home-based rehabilitation facilitates bespoke interventions that are carefully tailored to the unique needs of individuals. In contrast, community-based programs offer a route to social support and engagement. These patterns align with the shift towards person-centered care, enabling older adults to receive rehabilitation services in familiar environments (Jeste *et al*., 2020).

Globally, there has been a discernible shift towards a multidisciplinary approach in geriatric rehabilitation concerning trends (Verstraeten *et al.,* 2024). The approach towards geriatric rehabilitation has undergone a global shift with an increasing trend towards a multidisciplinary approach (Loveland *et al.,* 2022). The amalgamation of numerous disciplines guarantees a holistic approach to meeting the intricate needs of the elderly population and enhancing their overall outcomes (Rudnicka *et al.,* 2020). There is a paucity of data concering structured multicomponent exercise programs of geriatric patients on are habilittaion ward and the content of the geriatric rehabilitation processes are different across countries (Xin *et al*., 2022). Of significant importance in geriatric rehabilitation is physiotherapy, which offers a distinctive perspective and a broad range of scopes to improve the health and functional outcomes of older adults (Wilson *et al*., 2022). Physiotherapy plays a significant role in geriatric rehabilitation as a part of a multidisciplinary approach involving cooperation among health professionals to offer comprehensive care to elderly individuals (Jacobs *et al*., 2024). They employ evidence-based techniques and interventions to improve mobility, strength, balance, endurance, and overall physical function (Mh *et al*., 2018). The domain of physiotherapy in geriatric rehabilitation transcends the confines of clical settings (van Dijk *et al*., 2021). Physiotherapists can participate in community outreach programs, educational initiatives, and research endeavors to propel the field's knowledge and foster healthy aging (Liu-Ambrose & Li, 2022). By incorporating technological advancements and telerehabilitation, physiotherapy services can extend to seniors residing in remote areas, expanding access to care and amplifying desirable outcomes (Khan *et al*., 2022). As the aging population continues to grow, the role of physiotherapy in geriatric rehabilitation will remain vital in maximizing functional independence, improving quality of life, and promoting healthy aging globally (Martini *et al.,* 2023).

However, geriatric rehabilitation also faces several challenges on a global scale (Kraaijkamp *et al*., 2021). One major challenge is the shortage of trained healthcare professionals specializing in geriatric rehabilitation (Abdullah & Azizan, 2024). The aging population is growing rapidly, leading to an increased demand for geriatric rehabilitation services (Fulmer *et al*., 2021). It is crucial to address this workforce shortage by promoting geriatric rehabilitation education and training programs to meet the rising needs of older adults (Puts *et al*., 2020). Additionally, issues related to access to care, resource allocation, and reimbursement policies pose challenges in delivering comprehensive geriatric rehabilitation services across different regions (Lynch *et al*., 2017). Research on the developmnet of geriatric care is currently developing rapidly, but research collaboration between countries/regions and institutuons is still very limited (Wang *et al.,* 2019). This paper aims to map and graphically analyze comprehensive physiotherapy for geriatric

rehabilitation from a bibliometric standpoint. Bibiometric analysis as a quantitative statistical tool for academic literature analysis (Zyoud & Al-Jabi, 2020). This bibliometric study also identifies the publication patterns and intellectual framework of this field. The research questions (RQs) that are addressed include the following:

RQ1: How has the publication growth in the field of geriatric rehabilitation evolved, and are there any notable trends or spikes in research output?

RQ 2: Which countries have been at the forefront of research in geriatric rehabilitation, and how have their contributions evolved over the years?

RQ 3: Which journals have been central to disseminating research in geriatric rehabilitation, and how does their influence manifest in terms of citations and impact factors?

RQ 4: What are the prevalent author keywords used in publications related to geriatric rehabilitation, and how have their frequencies changed over time?

The remainder of the paper is organized as follows: The first section will emphasize a review of the literature on the perspective of geriatric rehabilitation, followed by the methodologies employed in this investigation. The analysis and findings are presented next, followed by the final section, which will discuss and conclude the paper.

Method

Bibliometricanalysis is a pioneering and meticulous technique for investigating and analyzing scientific evidence. It assists in exploring the subtleties of a discipline's evolutionary history while also illuminating the newly discovered area of study (Kokol *et al*., 2020; Azizan, 2024). Secundo, Del Vecchio, and Mele (2021) argue that bibliometric assessment is a scientific way to analyze published reading materials, such as books, journals, and other publications, using appropriate statistical tools (Secundo *et al*., 2021). Its specialized analytical tool, "Citation Analysis", is a component of the bibliometric method based on citation graph creation, effectively referring to a network or graph representation of document citations. It is widely used in libraries and information science (Pan *et al.*, 2018).

On May 31, 2023, data for publications in this study were taken straight from the Web of Science (WoS) and Scopus databases. This dataset comes from the Web of Science (WoS) and Scopus databases and involves research papers on geriatric rehabilitation. Referring to Table 1, initially, 9,219 papers were collected. But after excluding papers with certain document types (21.10% of the total), the dataset was refined to 7,270 papers for analysis. From these databases, 44.70% (3,252 papers) came from WoS, and 55.30% (4,018 papers) came from Scopus. Duplicates were a concern, and 2,150 duplicates (29.60%) were identified. Among them, 27 duplicates (0.80% of WoS papers) were removed from WoS, and 2,123 duplicates (52.80% of Scopus papers) were removed from Scopus. Additionally, 1,387 documents had duplicate content but different "cited by" counts. After duplicates were handled, there were 5,120 unique papers. After duplicate removal, the distribution was 63.00% (3,225 papers) from WoS and 37.00% (1,895 papers) from Scopus.

Table 1. Pre-Process Data

Info	Number	Percentage
Loaded papers	9219	
Omitted papers by document type	1949	21.10%
Total papers after omitted papers removed	7270	
Loaded papers from WoS	3252	44.70%
Loaded papers from Scopus	4018	55.30%
Duplicated removal results:		
Duplicated papers found	2150	29.60%
Removed duplicated papers from WoS	27	0.80%
Removed duplicated papers from Scopus	2123	52.80%
Duplicated documents with different citations by	1387	64.50%
Total papers after rem. dupl.	5120	
Papers from WoS	3225	63.00%
Papers from Scopus	1895	37.00%

Source: Data from ScientoPy

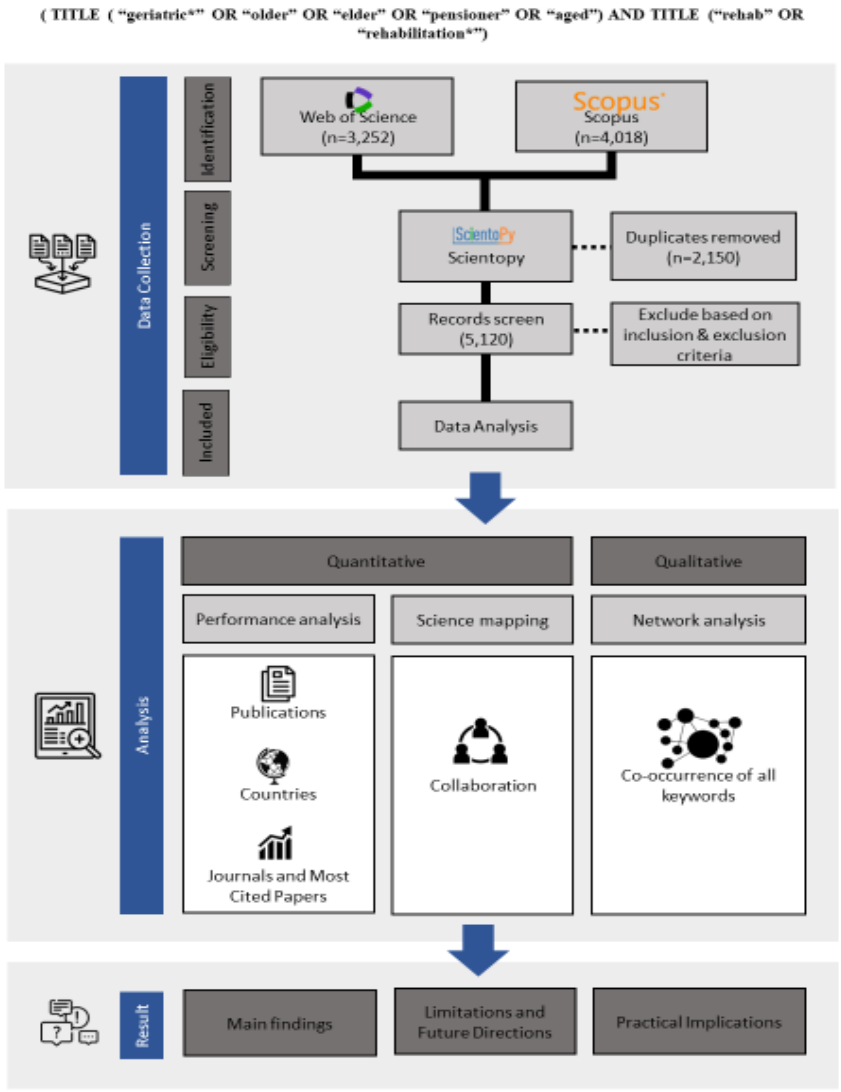

Figure 1. Diagram of the Search Process Adapted from the Previous Study (Azizan *et*

In short, this dataset combines efforts from the WoS and Scopus databases to gather geriatric rehabilitation research papers. After addressing duplicates and exclusions, the dataset consists of 5,120 distinct papers. This dataset can support detailed analyses to uncover the structure of knowledge in geriatric rehabilitation. See Table 1. For the analysis procedure, two key tools, ScientoPy and VOSviewer, were employed to delve into the dataset's contents and map out the knowledge structure of geriatric rehabilitation based on a previous study (Azizan *et al.*, 2024). The study framework is exhibited in Fig. 1.

Result and Discussion

The publication growth trends in geriatric rehabilitation in Fig. 2 show that, as documented in the Web of Science (WoS) database, they provide valuable insight into the evolution of research in this field from 1947 to 2023. The early years, spanning the late 1940s to the mid-1950s, showcased a gradual but steady rise in publications. This initial uptick might signify the nascent exploration of rehabilitation strategies tailored for the elderly population. As the 1960s unfold, there's been a more pronounced increase in publications, suggesting a growing recognition of the importance of geriatric rehabilitation. This upward trend persists through the 1970s and 1980s, perhaps

indicating the escalating attention given to elderly care and rehabilitation methods within the medical and research communities. During the 1990s, a significant escalation in the growth of publications was observed, whereby the quantity of published materials nearly doubled in comparison to the prior decade. This surge aligns with the demographic shifts towards aging populations and the heightened emphasis on addressing healthcare concerns specific to the elderly. The path of development maintains a high degree of consistency throughout the early two-thousand and ten-year period, albeit at a slightly moderated pace relative to the preceding decade of the nineteen-nineties. However, a discernible shift emerged around 2013, marked by a decline in growth rates. While the exact reasons for this decline could be multifaceted, they may reflect a maturation of the field, a potential saturation of specific research angles, or changing research priorities.

The Scopus database offers parallel insights into the growth of geriatric rehabilitation research from 1947 to 2023. The earlier years, spanning from the late 1940s to the 1960s, demonstrate a gradual but steady upward trajectory in publications. This aligns with the exploration and development of strategies catering to the rehabilitative needs of the elderly. The late 1960s through the mid-1990s saw a pronounced increase in publications, possibly mirroring the growing recognition of geriatric rehabilitation's significance within medical and research circles. The period of the late 1990s and early 2000s saw noteworthy growth, which was marked by a considerable surge in published works. This surge could reflect a heightened awareness of the aging population's healthcare needs and a corresponding surge in research efforts in geriatric rehabilitation.Similar to WoS data, Scopus data also shows a moderation in growth rates during the 2010s, potentially indicating a shift in research focus or the field reaching a certain level of saturation.

Fig. 3 offers a comprehensive panorama encompassing the top ten countries that significantly contribute to the landscape of geriatric rehabilitation research. This assemblage serves to illuminate the global distribution of scholarly endeavors while underscoring the intrinsic importance of addressing the healthcare exigencies of the elderly population on a global scale. Foremost, the United States (USA) takes precedence by securing the vanguard position with an impressive corpus of 879 research papers. This preeminence accentuates the nation's substantive involvement as a propellant in the domain of geriatric rehabilitation research. This pervasive presence is emblematic of the United States' unwavering commitment to scientific inquiry, technological progress, and pioneering healthcare resolutions tailored to the complex requirements of the aging demographic.

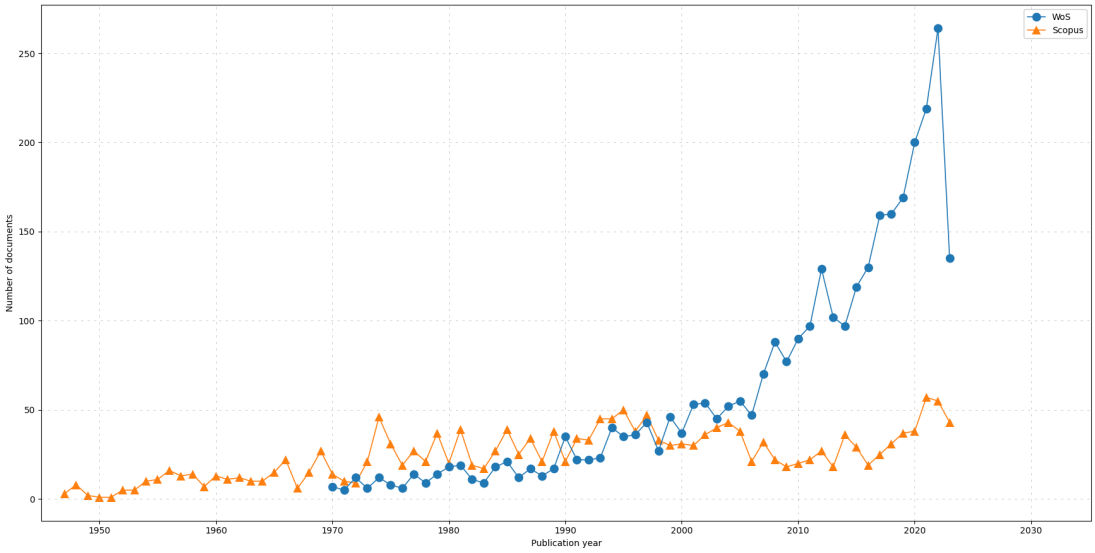

Figure 2. Total Yearly Publications from WoS and Scopus Database (1947-2023)

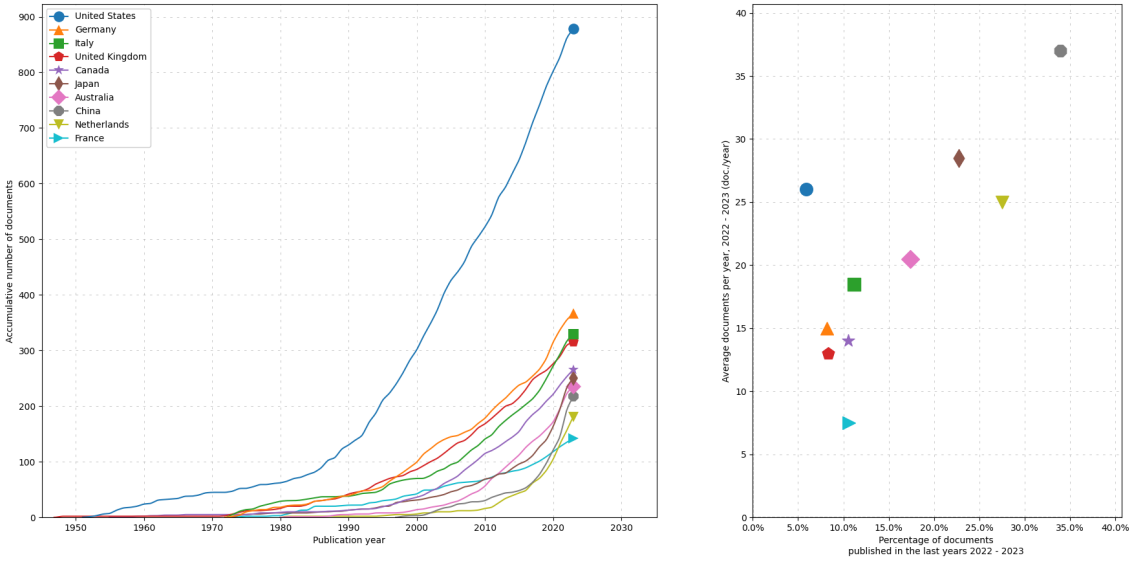

Figure 3. Top 10 Contributing Countries in Geriatric Rehabilitation Research (1947-2023)

Secondly, Germany's proximate position emerges with 367 research papers, consolidating its pivotal role as a significant participant in the landscape of geriatric rehabilitation research. Germany's substantial contribution serves as a compelling testament to its unswerving dedication to fostering healthcare innovations aimed at ameliorating the quality of life for its aging populace. Similarly, Italy's scholarly output, amounting to 330 research papers, elucidates its palpable engagement in geriatric rehabilitation research pursuits. This notable involvement underscores Italy's earnest investment in healthcare advancements, particularly in the context of confronting the distinctive healthcare requisites of the elderly population through pioneering rehabilitation methodologies. In contrast, the United Kingdom (UK), ranking fourth with 315 research papers, robustly exemplifies its earnest commitment to geriatric rehabilitation research. This substantive commitment is consonant with the UK's established renown for healthcare excellence, amplifying efforts to elevate healthcare standards for the aging demographic.

Continuing along this trajectory, Canada's contribution of 266 research papers underscores its meritorious role in advancing geriatric rehabilitation research. This representation serves to underscore Canada's dedicated exploration of innovative healthcare strategies and interventions tailored to enhancing the overall well-being and quality of life for its elderly population. Shifting focus to Japan, its research output comprising 251 research papers positions it prominently within geriatric rehabilitation research. Japan's prolific scholarly output is indicative of its characteristic technological prowess and proactive disposition in addressing the healthcare imperatives of its aging populace. Similarly, Australia's participation is evidenced through 236 research papers, providing a clear depiction of its active involvement in geriatric rehabilitation research pursuits. Australia's contributions resonate with its commitment to fostering health, well-being, and optimal aging through meticulous rehabilitation paradigms. Meanwhile, China's corpus of 218 research papers underscores its burgeoning influence within the domain of geriatric rehabilitation research. This burgeoning contribution accentuates China's recognition of the pivotal role research assumes in the advancement of bespoke healthcare solutions tailored to meet the needs of a burgeoning aging population.

In contrast, the Netherlands' substantial contribution of 182 research papers is emblematic of its noteworthy imprint in geriatric rehabilitation research. The nation's resolute participation underscores its concerted endeavors in pioneering high-caliber healthcare interventions addressing the needs of its elderly citizens. Lastly, France's scholarly offering, totaling 142 research papers, underscores its

pivotal role within the landscape of geriatric rehabilitation research. This engagement harmoniously aligns with France's distinguished commitment to healthcare innovation, substantiating its pursuit of augmented well-being for its aging population.

Table 2 presents the list of top journals related to geriatric rehabilitation publications and highlights influential sources contributing significantly to the field. These journals are pivotal in disseminating research findings and advancing knowledge in geriatric rehabilitation. The Archives of Physical Medicine and Rehabilitation leads the list with 124 publications. Despite a slight negative growth rate of -1.5%, its h-index of 35 underscores its strong citation impact. Published by W.B. Saunders Ltd., this journal holds a robust position in physical medicine and rehabilitation.

The Journal of the American Geriatrics Society follows closely with 112 publications. Its steady annual publication rate, coupled with an h-index of 31, reflects its influence on geriatric rehabilitation. Wiley-Blackwell Publishing Ltd. serves as its platform for sharing insights on geriatrics and aging. Topics in Geriatric Rehabilitation offers 93 publications and demonstrates a growth rate of 0.5%. With an h-index of 9, it holds a niche influence within geriatric rehabilitation. The journal's discussions are channeled through Lippincott Williams and Wilkins Ltd. Disability and Rehabilitation presents 75 publications with a growth rate of 0.5%. Its wide coverage, encompassing geriatric rehabilitation, contributes to an h-index of 21. Informa Healthcare serves as the journal's publisher, focusing on research that enhances the lives of individuals with disabilities.

The Giornale Di Gerontologia provides 66 publications, primarily in the Italian context. Its modest growth rate and h-index make it valuable in the Italian gerontological landscape. PaciniEditores.r.l. facilitates its contributions to Italian-language literature. ZeitschriftfürGerontologie Und Geriatrie showcases 65 publications and caters to the German-speaking sphere. Its h-index of 10 denotes its significance in German gerontology. Published by D. Steinkopff-Verlag, it fosters German research exchange. Geriatrics contributes 51 publications addressing geriatric care and rehabilitation. With a slight negative growth rate and an h-index of 4, it informs healthcare professionals. Advanstar Communications Inc. is its platform for dissemination.Aging Clinical and Experimental Research features 50 publications focusing on aging and clinical practice. Its steady publication rate, coupled with an h-index of 15, advances knowledge. Springer Verlag serves as its conduit.

BMC Geriatrics offers 50 publications despite a -2.5% growth rate. Its h-index of 16 signifies open-access contributions. BioMed Central Ltd. promotes accessibility and collaboration. The Journal of the American Medical Directors Association concludes the list with 50 publications. Its h-index of 17 indicates its role in geriatric healthcare discourse. Published by Elsevier Inc., it addresses clinical, administrative, and policy aspects. In essence, these top journals collectively contribute to geriatric rehabilitation's growth and dissemination. Their diverse growth rates, focus areas, and citation impacts enrich the field's discourse, fostering collaboration and knowledge advancement in elderly care and well-being.

We also ran the keyword co-occurrence analysis in VOSViewer to build the network map (Fig. 4). We picked fractional counting with at least twenty (20) occurrences of terms in publications. 51 keywords met the criteria of 5770 keywords. Therefore, we decided to create a network map that only shows keywords related to each other. The co-occurrence patterns of the author's keywords reveal the prevalence of several terms, indicating their substantial presence and interconnectedness within the body of research. "Rehabilitation" (Occurrences: 1056) has emerged as the foremost co-occurring term, boasting a significant count of 1056 occurrences. This prevalence underscores the research's central concentration on the multifaceted process of restoring and augmenting functional capacities, enhancing quality of life, and promoting overall well-being among elderly individuals. Next, "Aged" (Occurrences: 613) prominently appears with 613 occurrences, signifying a foundational emphasis on the elderly population as the

Table2. The Most Productive Journals with the Most Cited Articles are Basedon the ScientoPySoftware.

No	Journal	TP	AGR	ADY	PDLY	h-Index	Publisher	Most Cited Article
1	Archives of Physical Medicine and Rehabilitation	124	-1.5	1	1.6	35	W.B. Saunders Ltd	*Cognitive status at admission: Does it affect the rehabilitation outcome of elderly patients with hip fractures?(Heruti et al., 1999)*
2	Journal of the American Geriatrics Society	112	-1	2.5	4.5	31	Wiley-Blackwell Publishing Ltd	*Exercise training for rehabilitation and secondary prevention of falls in geriatric patients with a history of injurious falls (Hauer et al., 2001)*
3	Topics in Geriatric Rehabilitation	93	0.5	1	2.2	9	Lippincott Williams and Wilkins Ltd.	*Evaluation of a vision rehabilitation program for older adults with visual impairment (Pankow et al., 2004)*
4	Disability and Rehabilitation	75	0.5	6	16	21	Informa Healthcare	*Communication and psychosocial consequences of sensory loss in older adults: overview and rehabilitation directions (Heine & Browning, 2002)*
5	Giornale Di Gerontologia	66	0	0	0	2	Pacini Editores.r.l.	*Clinical severity and comorbidity: Their impact on geriatric rehabilitation (Colombo et al., 2003)*
6	Zeitschrift Fur Gerontologie Und Geriatrie	65	-0.5	1.5	4.6	10	D. Steinkopff-Verlag	*Combined whole body vibration and balance training using Vibrosphere (R) Improvement of trunk stability, muscle tone, and postural control in stroke patients during early geriatric rehabilitation (Merkert et al., 2011)*
7	Geriatrics	51	-0.5	0.5	2	4	Advanstar Communi cations Inc.	*What Influence Does Age Have on the Rehabilitation Of Amputees (Kerstein et al., 1975)*
8	Aging Clinical and Experimental Research	50	0	5.5	22	15	Springer Verlag	*Effect of nutritional status on clinical outcome in a population of geriatric rehabilitation patients (Donini et al., 2004)*
9	BMC Geriatrics	50	-2.5	4.5	18	16	BioMed Central Ltd.	*Effectiveness and feasibility of early physical rehabilitation programs for geriatric hospitalized patients: a systematic review (Kosse et al., 2013)*
10	Journal of the American Medical Directors Association	50	-2	2.5	10	17	Elsevier Inc.	*Delirium Superimposed on Dementia Strongly Predicts Worse Outcomes in Older Rehabilitation Inpatients (Morandi et al., 2014)*

Notes: TP= Total Publication; AGR= Average Growth Rate; ADY=Average Publication per Year; PDLY=Publications in the Last Year.

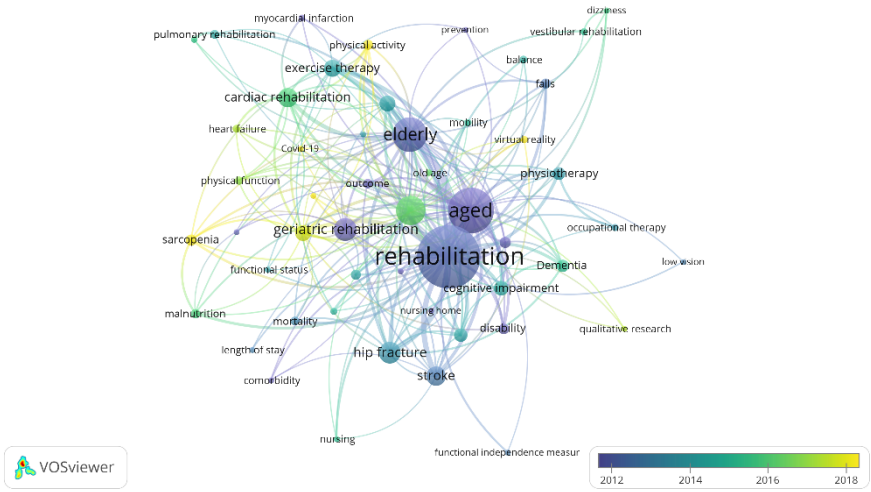

Figure 4.OverlayVisualization Map of Co-Occurrence of All Keywords from the VOSviewer.

principal focus of interest. This prevalence highlights the research's steadfast commitment to addressing the distinctive healthcare requisites of older adults comprehensively.

"Hip Fracture" (Occurrences: 176) in 176 instances signifies a notable concentration on this specific health concern within the geriatric demographic. This prevalence sheds light on research endeavors dedicated to comprehending, averting, and managing hip fractures among the elderly, with potential implications for rehabilitation strategies. "Stroke" (Occurrences: 147) has emerged significantly with 147 occurrences, indicating substantial exploration of its effects on the elderly population. This underscores the focus on rehabilitation interventions to facilitate recovery and enhance post-stroke quality of life among the elderly. In addition, "Cardiac Rehabilitation" (Occurrences: 145) with 145 occurrences underscores pronounced attention to cardiovascular health and related rehabilitation approaches within the geriatric context. The prevalence of this keyword accentuates the integration of comprehensive methodologies to enhance heart health and overall well-being among the elderly.

"Exercise Therapy" (Occurrences: 117) was noted with 117 occurrences, denoting a robust consideration of physical activity interventions as pivotal components of geriatric rehabilitation. This emphasis aligns with the acknowledgment of exercise's crucial role in maintaining functional capabilities and holistic well-being in the elderly population. The prevalence of "frailty" in 109 instances underscores the significant interest in exploring the concept's impact on the elderly population. Research within this domain is likely focused on identifying effective strategies to address and manage frailty, thereby contributing to comprehensive and tailored rehabilitation approaches.Collectively, these terms offer a comprehensive portrayal of the research landscape centered on geriatric rehabilitation. The co-occurrence of these keywords highlights the adoption of a multidisciplinary approach, encompassing aspects of physical health, medical conditions, intervention strategies, and the multifaceted challenges and opportunities that accompany the aging process.

Conclusion

In conclusion, this bibliometric analysis has provided a comprehensive overview of the knowledge structure and research trends in geriatric rehabilitation, shedding light on growth patterns, top contributing countries/institutions/journals, prevalent author keywords, clusters, and themes. The findings reveal priority areas for future research endeavors and practical implications for enhancing rehabilitation practices, fostering collaborations, tailoring healthcare solutions to elderly needs, and ultimately improving outcomes and quality of life. As the aging

population expands globally, the insights from this analysis serve as an evidence-based foundation for advancing geriatric rehabilitation through translational research and strategies that enable older adults to age with optimal well-being and independence.

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