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Analysis of the Clinical Interventions for Falls in Elderly Patients in the Community From 2002 To 2022: A Bibliometric Analysis

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Abstract: *Objective:* To analyze and provide a comprehensive overview of the knowledge structure and research hotspots of clinical interventions for falls in elderly patients in the community. *Methods:* The search for publications related to clinical interventions for falls in elderly patients in the community from 2002 to 2022 was conducted on the Web of Science Core Collection (WoSCC) database. VOSviewers, CiteSpace, and the R package "bibliometrix" were used to conduct this bibliometric analysis. *Results:* 2091 articles from 70 countries, primarily the United States and Australia, were included. The number of publications related to clinical interventions for falls in elderly patients is increasing yearly. The main research institutions in this field were the University of Sydney, Harvard University, and the University of California. BioMed Central (BMC) Geriatrics was the most popular journal in this field and Journals of the American Geriatrics Society was the most co-cited journal. These publications came from 8984 authors among which author Lord SR had published the most papers and author Tinetti Me had the most co-citations. The main keywords in this research field were "balance," "exercise," and "risk factor." *Conclusion:* This was the first bibliometric study that comprehensively summarized the research hot spots and development of clinical interventions for falls in elderly patients in the community. This paper aims to provide a reference for scholars and researchers in this particular field.

Keywords: Bibliometrics; Vosviewer; Clinical intervention; Falls; Community

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1. Introduction

As a global public health concern, falls account for 30% of annual injuries and commonly affect adults above 60 years of age [1,2]. Falls can result in catastrophic repercussions, including fractures, injuries, depressive disorders, loss of independence, traumatic brain damage, and imposing burdens on the healthcare system [3–6]. Recently, many researchers have studied treatment interventions for falls in the elderly population and have shown varying degrees of success [7]. Bibliometrics is a method of literature analysis that examines the production and status

of publications in a certain field of study from both quantitative and qualitative aspects [8]. It also outlines the current status of knowledge and highlights new developments in a specific area of research [9]. However, clinical therapies for unintended falls in community-dwelling elderly have not been studied using bibliometric methodologies despite the recent increase in research trends. This study aims to undertake a bibliometric analysis of the treatment interventions for falls among community-dwelling elderly during the past 20 years. This will allow us to identify significant contributors, outline the current status of research, and anticipate future developments and trends in this field.

2. Methods

2.1. Data source and search strategy

Journals in the fields of social sciences, technology, and sciences were available online via the Web of Science (WOS). In this study, research data was collected from WOS via a literature search on the Web of Science Core Collection (WoSCC) database [10].

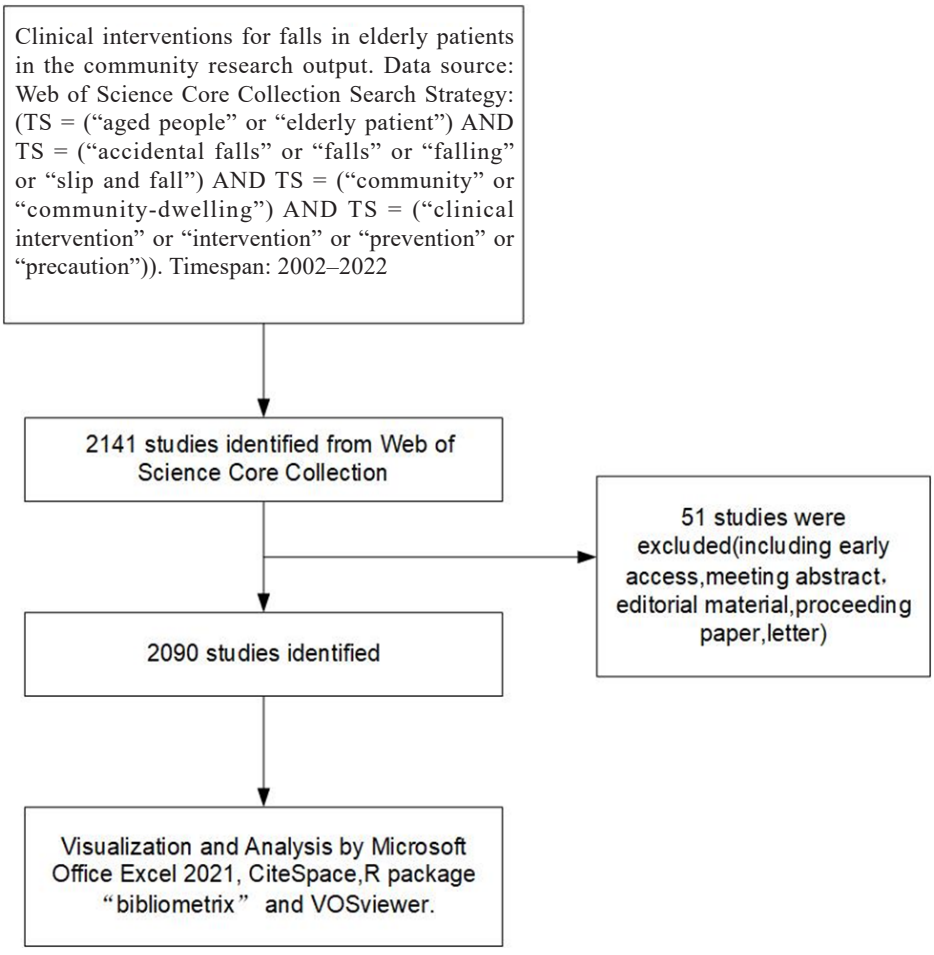

Figure 1. Publications screening flowchart.

The search formula was (TS = "aged people" or "elderly patient" or "older adults" AND TS= "accidental falls" or "falls" or "falling" or "slip and fall" or "fall and slip" AND TS = "community" AND TS = "clinical intervention" or "intervention" or "prevention" or "precaution.") The literature types were limited to articles and reviews, with the specific exclusion criteria shown in **Figure 1**.

2.2. Data analysis

VOSviewer (version 1.6.19) is a bibliometric analysis tool that is frequently used to create networks of co-occurrence, collaboration, and citation from a large number of publications [11]. In our study, software analysis was mainly carried out on the country, journals and co-cited journals, authors and co-cited authors, and keyword co-occurrence. CiteSpace was created by Prof. Chen and is a metrological analytic program for bibliometric analysis and visualization [12]. In this study, CiteSpace was used to analyze the most prominent citation bursts of co-cited references. Using the R package "bibliometrix" (version 4.3.1), a worldwide distribution network of treatment interventions for falls among community-dwelling elderly was created and a theme evolution analysis was performed [13]. The impact factor of the journals was obtained from Journal Citation Reports 2022. Additionally, Microsoft Office Excel 2021 was used to conduct a quantitative analysis of the publications.

3. Results

3.1. Publication outputs and trends

According to our search strategy, there were 2090 published studies of treatment interventions for falls in community-dwelling elderly in the past two decades, including 1844 articles and 246 review articles. Of these articles, 2057 were published in English, 10 were published in Spanish, 7 in Portuguese, 6 in German, 5 in Korean, 2 in Japanese, and 1 each published in Italian, French, and Hungarian.

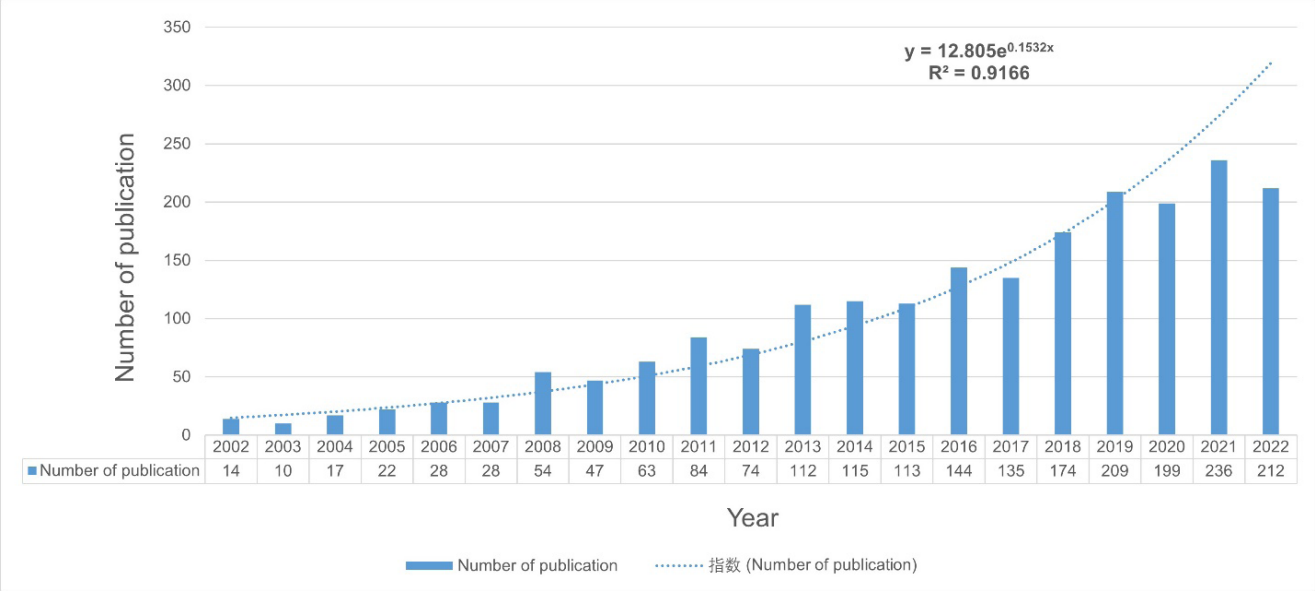

Figure 2. The number of publications from 2002 to 2022.

As shown in **Figure 2**, an upward trend was observed in the amount of published literature on treatment interventions for falls in community-dwelling elderly. Moreover, to evaluate the changing trend of these studies, the index function $y = 12.805e^{0.1532x}$ ($R^2 = 0.9166$, X is the year, Y is the annual number of publications) of the annual publication trend was generated.

3.2. Most productive countries/regions and institutions

These publications originate from 70 countries (**Figure 3A**). The US has the greatest number of articles (n = 823), accounting for 39.38% of the total, followed by Australia (n = 269), and Canada (n = 205).

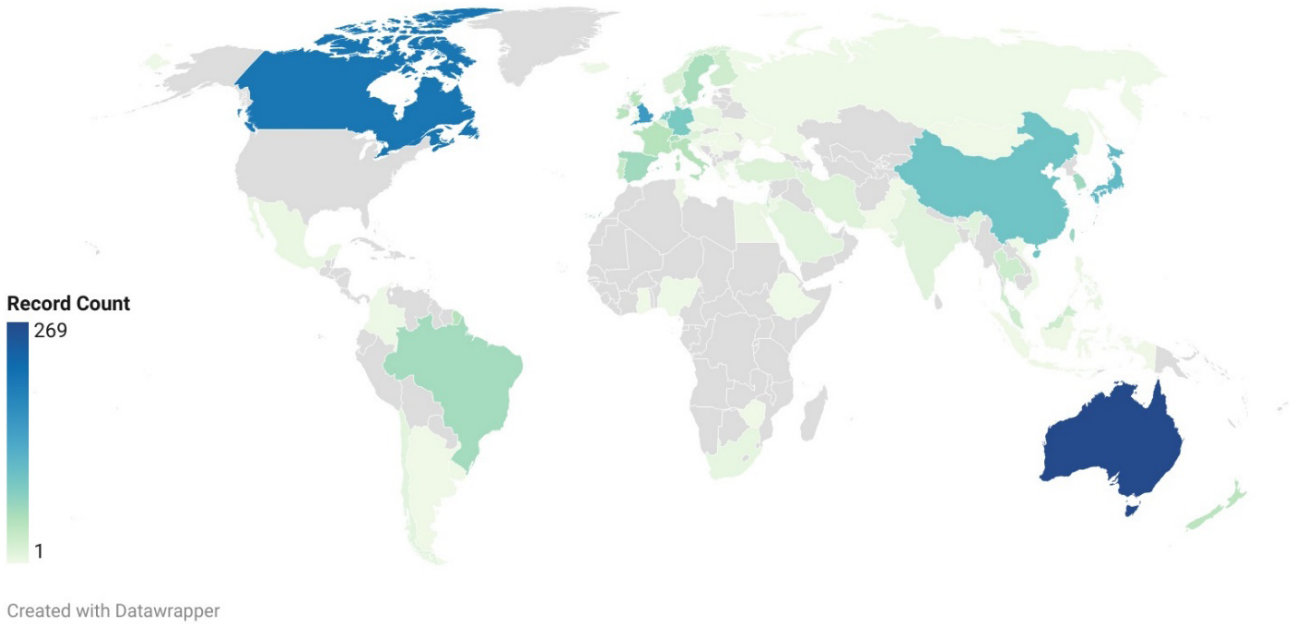

Figure 3A. The geographical distribution of research on clinical interventions for falls in elderly people in the community

As seen in **Table 1**, the US has the highest H-index of 80 among the 10 most productive countries. Nevertheless, South Korea (57.63), England (44.14), and Japan (41.12) are ranked first through fourth, respectively, according to the average number of citations per document.

Table 1. Top 10 most productive countries

Rank	Country	Np	H-index	Average citation of each document
1	USA	823	80	34.57
2	Australia	269	46	29.42
3	Canada	205	40	29.67
4	England	154	41	44.14
5	Japan	110	26	41.12
6	China	160	34	38.63
7	Germany	87	30	31.57
8	Netherlands	85	33	38.49
9	South Korea	62	19	57.63
10	Spain	61	21	19.66

Abbreviations: Np, number of publications

The overlay visualization map of the country co-authorship analysis was conducted by VOSviewer (**Figure 3B**). There were 35 nations and regions that provided publications and at least 10 documents from each were chosen. Every country was represented by a node, whose size varies according to the total number of publications. A co-authorship connection was represented by a link between two nodes. The color gradient in the lower right corner was used to determine the color of each node. It should be noted that there was a great deal of active international cooperation. For example, the US has actively cooperated with Canada, England, and Australia. **Table 2** displays the institutions with the highest yields. Six US universities, 3 Australian

institutions, and 1 institution from the UK were among the top 10 productive institutions. The US Department of Veterans Affairs (n = 61), Harvard University (n = 71), the University of California System (n = 65), and the University of Sydney (n = 79) had the greatest number of publications.

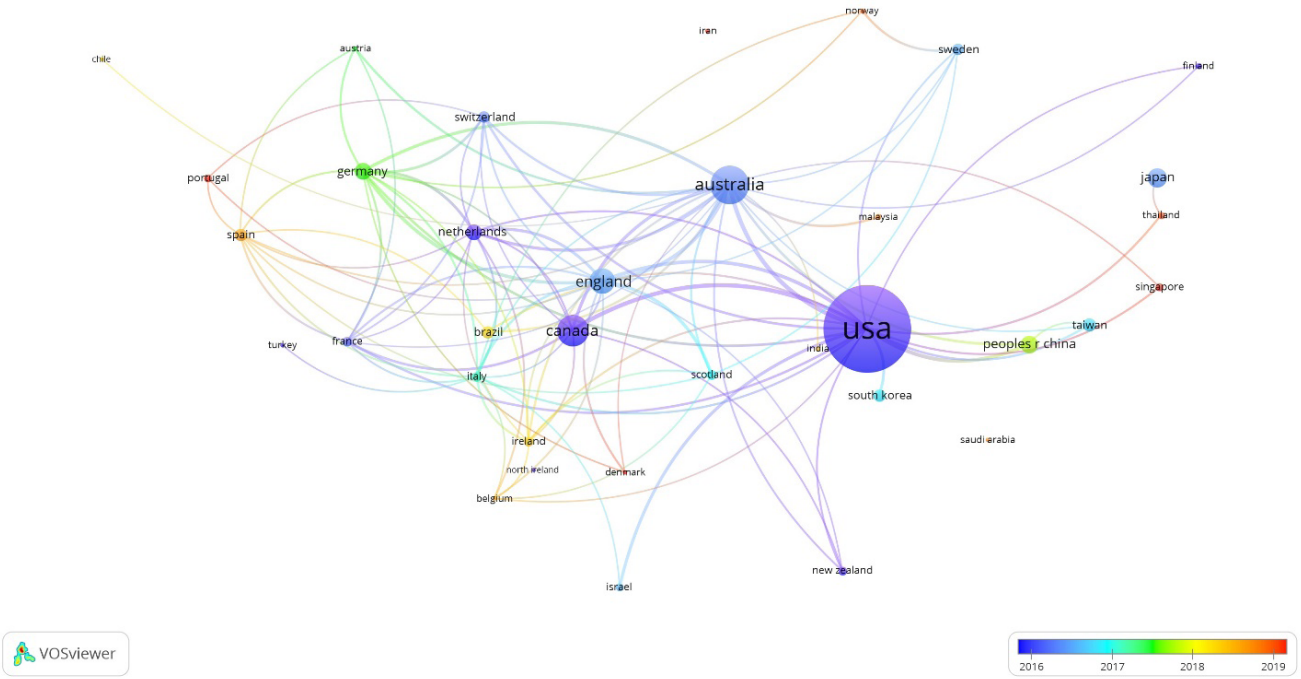

Figure 3B. The visualization of countries on the research of clinical interventions for falls in elderly people in the community

Table 2. Top 10 institutions with the highest publications

Rank	Country	Institution	Np
1	Australia	University of Sydney	79
2	USA	Harvard University	71
3	USA	University of California system	65
4	USA	US Department of Veterans Affairs	61
5	USA	Veterans' Health Administration (VHA)	61
6	Australia	Monash University	57
7	USA	Pennsylvania Commonwealth System of Higher Education (PCSHE)	56
8	UK	University of British Columbia	55
9	Australia	University of New South Wales Sydney	52
10	USA	University of Illinois System	50

3.3. Analysis of cited journals

The articles on treatment interventions for falls in elderly patients in the community were published in 548 journals. BMC Geriatrics had the most publications (n =105), followed by Journals of the American Geriatrics Society (n = 73), and the Journal of Geriatric Physical Therapy (n = 55). The journal with the highest impact factor (IF) was the Journals of the American Geriatrics Society (IF = 7.54), followed by the Journal of Age and Ageing (IF = 6.7), Archives of Physical Medicine and Rehabilitation (IF = 4.3) and BMC Geriatrics (IF = 4.1).

The journal network was subsequently mapped and 31 journals were filtered using the criterion whereby the minimum number of pertinent articles should be equal to 15.

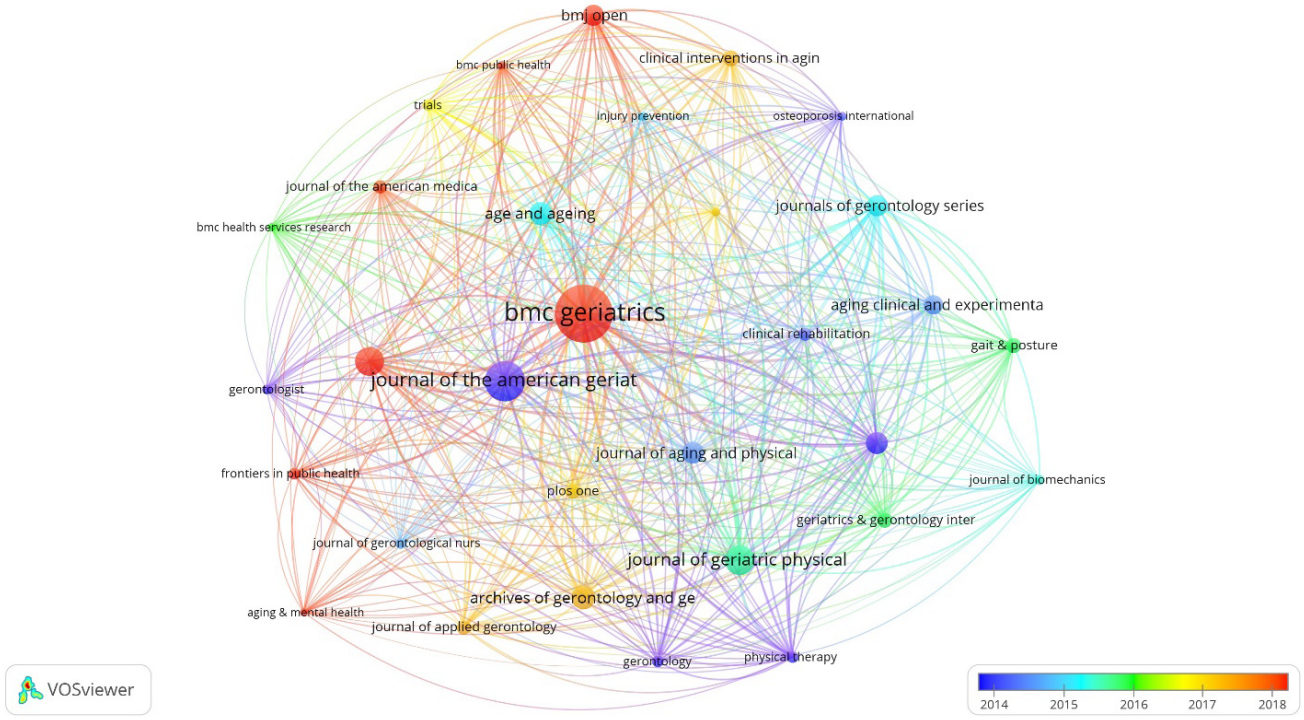

Figure 4A. The visualization of journals

Figure 4A demonstrates the active citation links that BMC Geriatrics has with the Journal of Age and Ageing, Journals of the American Geriatrics Society, and other publications. **Table 3** illustrates that out of the top 10 co-cited journals, 3 journals received over 3,000 citations. The most cited journal was the Journals of American Geriatrics Society (*n* = 6867), followed by the Journal of Age and Ageing (*n* = 3533), the Journal of Gerontology Series A-biological Sciences and Medical Sciences (*n* = 3117), and the Archives of Physical Medicine and Rehabilitation (*n* = 1963). Furthermore, the New England Journal of Medicine has the greatest IF (158.5), followed by the American Medical Association's Jama-Journal (IF = 120.7).

Table 3. Top 10 journals and co-cited journals

Journal	Fq	IF (2022)	JCR	Co-cited Journal	Co-citation	IF (2022)	JCR
BMC Geriatrics	105	4.1	Q2	Journals of the American Geriatrics Society	6867	7.54	Q1
Journals of Geriatric Physical Therapy	55	3.19	Q2	Age and Ageing	3533	6.7	Q1
Journals of the American Geriatrics Society	73	7.54	Q1	Journals of Gerontology Series A-biological Sciences and Medical Sciences	3117	5.1	Q1
Archives of Gerontology and Geriatrics	44	4	Q2	Archives of Physical Medicine and Rehabilitation	1963	4.3	Q1
Archives of Physical Medicine and Rehabilitation	40	4.3	Q1	Physical Therapy	1764	3.2	Q1
International Journal of Environmental Research and Public Health	39	3.39	Q2	Journal Of the American Medical Association	1288	120.7	Q1

Table 3 (Continued)

Journal	Fq	IF (2022)	JCR	Co-cited Journal	Co-citation	IF (2022)	JCR
Journal of Aging and Physical Activity	53	1.5	Q4	New England Journal of Medicine	1102	158.5	Q1
Age and Ageing	41	6.7	Q1	BMC Geriatrics	1101	4.1	Q2
Aging Clinical and Experimental Research	42	4	Q2	Gait and Posture	1033	2.4	Q2
Plos one	36	3.7	Q2	British Medical Journal	998	17.2	Q1

Abbreviations: Fq, frequency

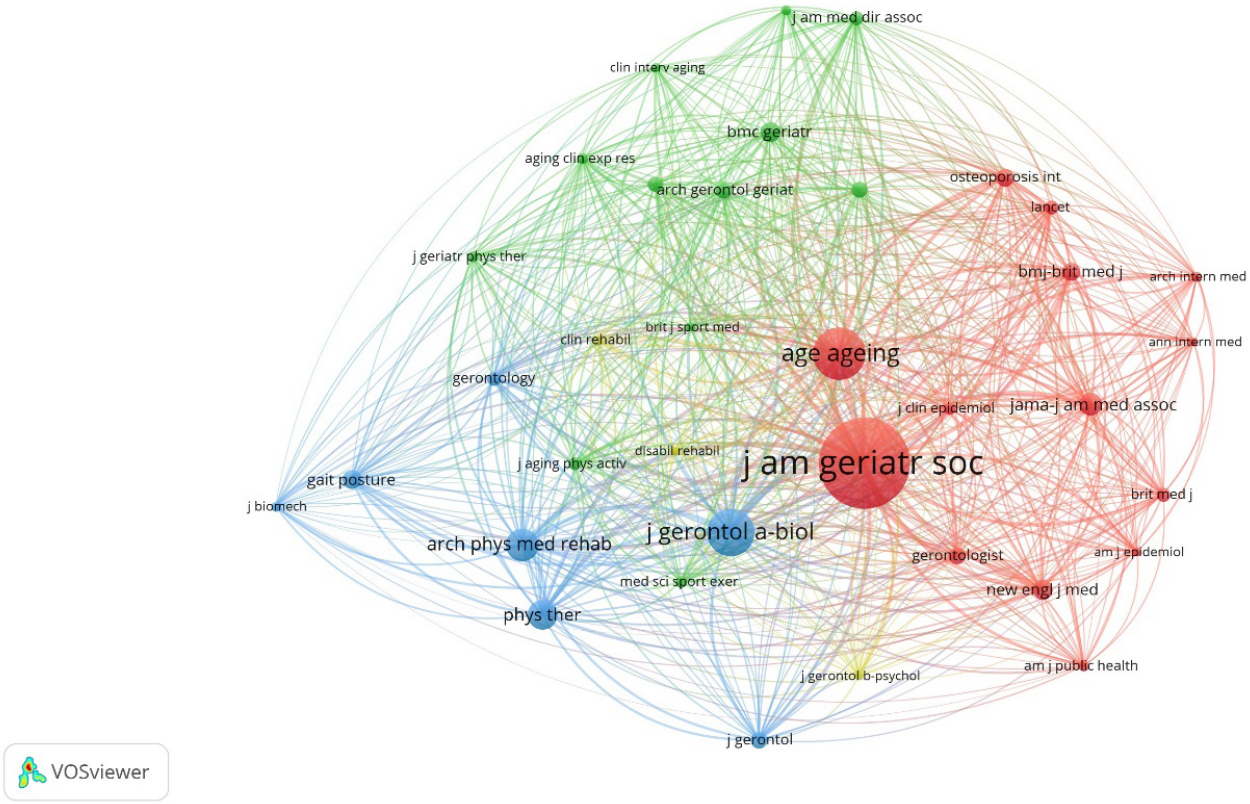

Figure 4B. The visualization of co-cited journals

The Journals of the American Geriatrics Society have positive co-citation relationships with the Journal of Age and Ageing, the Journal of Gerontology Series A-Biological Sciences and Medical Sciences, Clinics in Geriatric Medicine, etc. Journals with a minimum co-citation of 300 were filtered to map out the co-citation network (**Figure 4B**).

3.4. Analysis of authors

There was a total of 8984 authors in the research on treatment interventions for falls in community-dwelling elderly individuals. As shown in **Table 4**, among the top 10 authors, all of them published more than 20 papers.

Based on authors with ≥ 5 publications, a collaborative network was generated (**Figure 5A**). Several authors were observed to be close collaborators. For example, Haines TP worked closely with Day L and Lee DCA, whereas Hill KD actively collaborated with Hill AM. Four writers out of the 29197 co-cited authors

received more than 500 co-citations, as shown in **Table 4**. Tinetti Me (n = 1344) was the most cited author, followed by Campbell Aj (n = 529) and Lord Sr (n = 586).

Table 4. Top 10 authors and co-cited authors

Rank	Authors	Country	Count	Co-cited Authors	Citations
1	Lord SR	Australia	36	Tinetti Me	1354
2	Hill KD	Australia	31	Lord Sr	586
3	Smith ML	USA	26	Campbell Aj	529
4	Clemson L	Australia	25	Rubenstein Lz	506
5	Liu-ambrose T	Canada	25	Sherrington C	467
6	Haines TP	Australia	23	Shumway-cook A	371
7	Sherrington C	Australia	23	Li Fz	325
8	Delbaere K	Australia	22	Podsiadlo D	350
9	Skelton DA	UK	21	Stevens Ja	385
10	Davis JC	UK	20	Yardly L	358

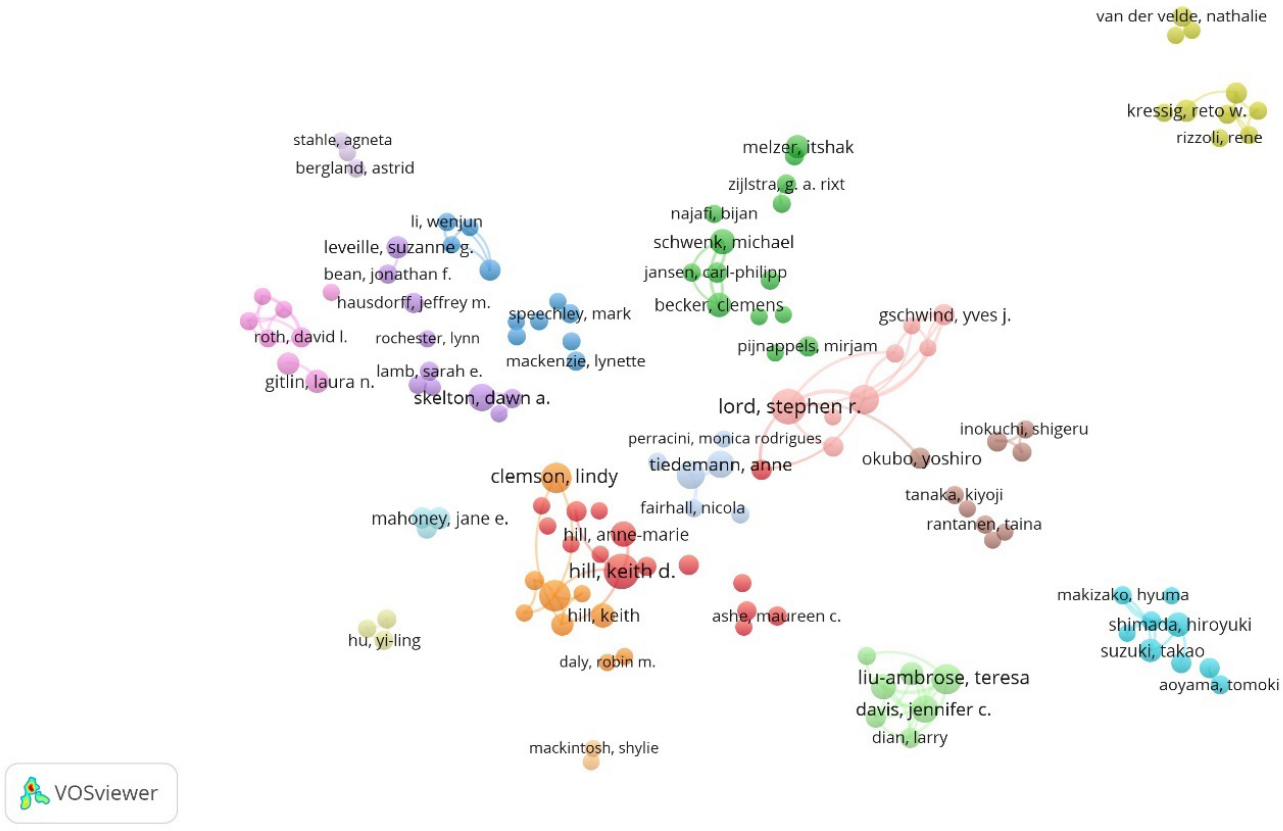

Figure 5A. The visualization of authors

To create co-citation network graphs, authors with a minimum of 120 co-citations were filtered. There were also ongoing partnerships between several co-cited writers, like Tinetti Me and Lord Sr, Sherrington C, and Campbell Aj, as seen in **Figure 5B**.

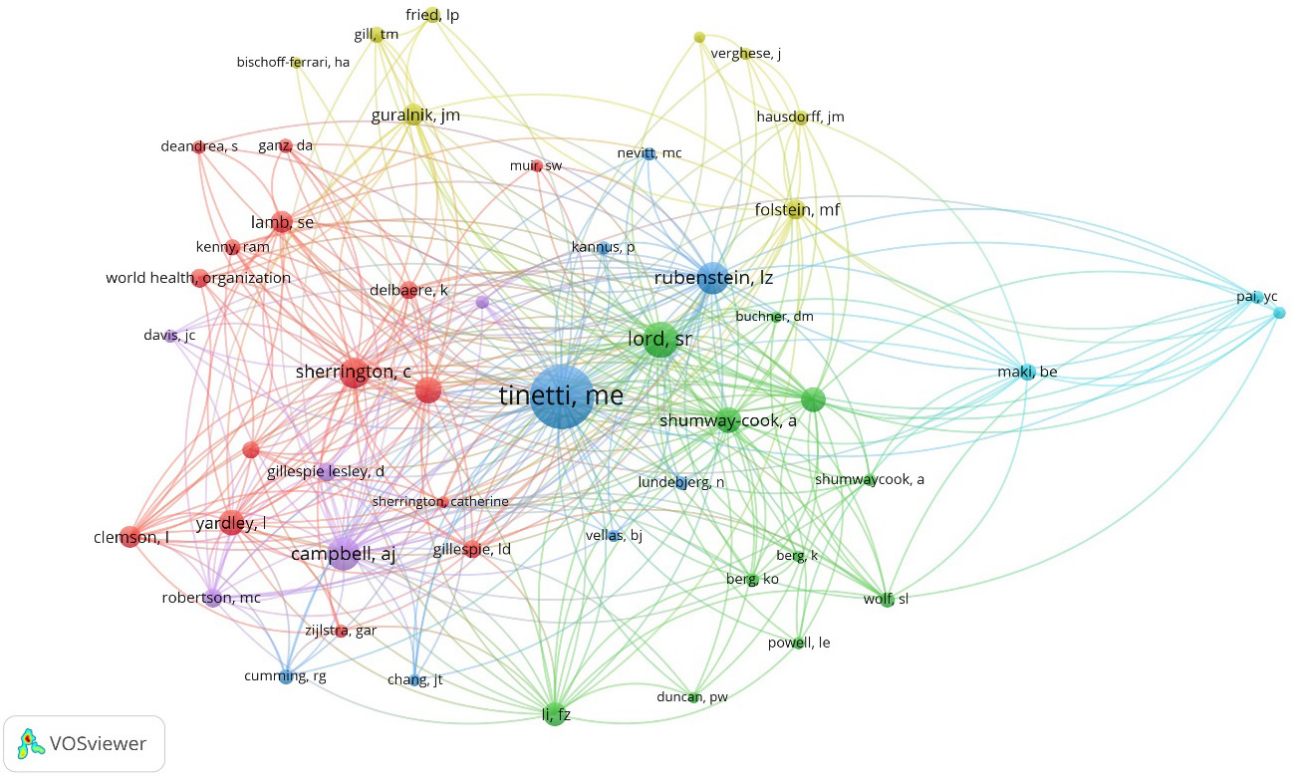

Figure 5B. The visualization of co-cited authors

3.5. Analysis of document citation

An effective way to evaluate the most highly cited papers is by citation analysis [14]. The influence of papers in a particular field of study may be shown in the frequency of citations [15]. **Table 5** displays the top 10 most referenced articles. The top-ranked article was published in the Journal of The American Medical Directors Association in 2014 [16]. It presented a consensus report that collected the best available evidence of sarcopenia research from Asian countries to establish the consensus for sarcopenia diagnosis. The next one was published in the British Medical Journal in 2004, which was a systematic review and meta-analysis of randomized clinical trials about the interventions for the prevention of falls in older adults [7]. Among the top 10 most cited publications, 1 was from the British Medical Journal [7], 1 was from the Journals of the American Geriatrics Society [17], 2 were from the Journals of Gerontology Series A-Biological Sciences and Medical Sciences, and 2 were from the Journal of The American Medical Association [18–21]. It is crucial to note that the top 4 journals mentioned above were all highly co-cited, which increases the validity of the findings in **Table 5**.

Table 5. Top 10 cited references

Rank	Title	First author	Journal	Year	Citations
1	Sarcopenia in Asia: Consensus Report of the Asian Working Group for Sarcopenia	Chen LK	Journal of The American Medical Directors Association	2014	2508
2	Interventions for the Prevention of Falls in Older Adults: Systematic Review and Meta-Analysis of Randomized Clinical Trials	Chang JT	British Medical Journal	2004	738
3	The Epidemiology of Falls and Syncope	Rubenstein LZ	Clinics in Geriatric Medicine	2002	698
4	Falls and Fear of Falling: Which Comes First? A Longitudinal Prediction Model Suggests Strategies for Primary and Secondary Prevention	Friedman SM	Journals of the American Geriatrics Society	2002	663

Table 5 (Continued)

Rank	Title	First author	Journal	Year	Citations
5	Quantitative Gait Markers and Incident Fall Risk in Older Adults	Verghese Joe	Journals of Gerontology Series A-Biological Sciences and Medical Sciences	2009	608
6	The Patient Who Falls "It's Always a Trade-off"	Tinetti ME	Journal of The American Medical Association	2010	607
7	The Direct Costs of Fatal and Non-Fatal Falls Among Older Adults - United States	Burns ER	Journal of Safety Research	2016	483
8	Exercise to Prevent Falls in Older Adults: An Updated Systematic Review and Meta-analysis	Sherrington C	British Journal of Sports Medicine	2017	468
9	Hospitalization, Restricted Activity, and the Development of Disability Among Older Persons	Gill TM	Journal of The American Medical Association	2004	445
10	Frailty in Older Adults: A Nationally Representative Profile in the United States	Bandeen-Roche K	Journals of Gerontology Series A-Biological Sciences and Medical Sciences	2015	431

3.6. Analysis of co-cited references and clustered network

Two or more references that were concurrently referenced by one or more articles were referred to as co-cited references [22].

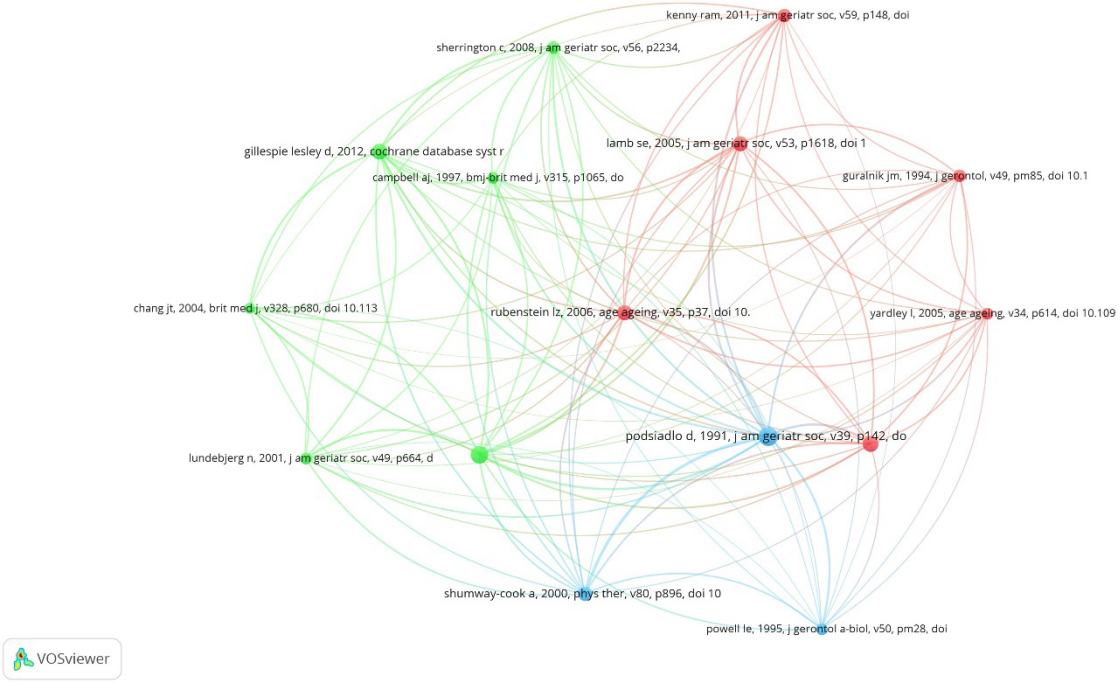

Figure 6. The visualization of co-cited references

Figure 6 displays the first authors of the top 10 most co-cited references, while **Table 6** summarizes the top 10 most co-cited references. CiteSpace was used to analyze a total of 2090 articles and their 47234 references that were retrieved from the WoSCC between 2002 and 2022. The most co-cited references were the most renowned studies on this subject and greatly contributed to the incidences of falls among community-dwelling elderly.

Table 6. Top 10 most co-cited references

Rank	Title	First author	Year	Journal	Citations	DOI
1	Interventions for Preventing Falls in Older People Living in The Community	Gillespie LD	2012	Cochrane Database of Systematic Reviews	158	10.1002/14651858.CD007146.pub3
2	Exercise for Preventing Falls in Older People Living in The Community	Sherrington C	2019	Cochrane Database of Systematic Reviews	93	10.1002/14651858.CD012424.pub2
3	Medical Costs of Fatal and Nonfatal Falls in Older Adults	Florence CS	2018	Journals of the American Geriatrics Society	82	10.1111/jgs.15304
4	Exercise to Prevent Falls in Older Adults: An Updated Systematic Review and Meta-Analysis	Sherrington C	2017	British Journal of Sports Medicine	80	10.1136/bjsports-2016-096547
5	Falls and Fall Injuries Among Adults Aged ≥ 65 Years - United States, 2014	Bergen G	2016	Morbidity and Mortality Weekly Report	76	10.15585/mmwr.mm6537a2
6	The Direct Costs of Fatal and Non-Fatal Falls Among Older Adults - United States	Burns ER	2016	Journal of Safety Research	62	10.1016/j.jsr.2016.05.001
7	Summary of the Updated American Geriatrics Society/British Geriatrics Society Clinical Practice Guideline for Prevention of Falls in Older Persons	Kenny RAM	2011	Journals of the American Geriatrics Society	59	10.1111/j.1532-5415.2010.03234.x
8	Effective Exercise for the Prevention of Falls: A Systematic Review and Meta-Analysis	Sherrington C	2008	Journal of the American Geriatrics Society	57	10.1111/j.1532-5415.2008.02014.x
9	Determining Risk of Falls in Community-Dwelling Older Adults: A Systematic Review and Meta-analysis Using Posttest Probability	Lusardi MM	2017	Journal Of Geriatric Physical Therapy	49	10.1519/JPT.0000000000000099
10	Exercise to Prevent Falls in Older Adults: An Updated Meta-Analysis and Best Practice Recommendations	Sherrington C	2011	New South Wales Public Health Bulletin	49	10.1071/NB10056

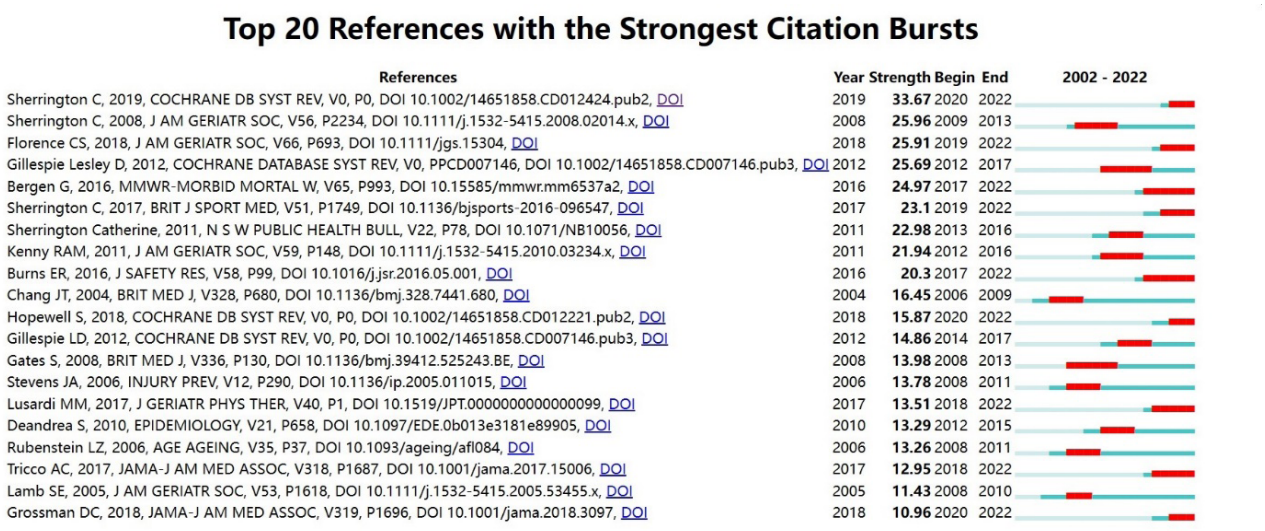

Figure 7. Top 20 references with strong citation bursts. A red bar indicates high citations.

A list of the top 20 references that had the strongest citation bursts were included (**Figure 7**). The terms "Year," "Begin," and "End" denote the publication date, the first citation, and the last citation, respectively. Sherrington published an article in the Cochrane Database of Systematic Reviews with the strongest strength. Studies have demonstrated that balance, gait, and muscle strength exercises can help avoid falls in the elderly, but an updated study with the available data has not yet been conducted. The authors of these articles offered a thorough evaluation of the advantages and disadvantages of exercise programs for preventing falls among community-dwelling elderly [23].

3.7. Analysis of keyword

By performing co-occurrence analysis on keywords, we were able to promptly identify areas of study interest within a given topic [24]. **Table 7** shows the top 20 high-frequency keywords in the study of treatment interventions for falls in elderly patients in the community. Among these keywords, "balance," "risk factor," and "exercise" appeared more than 400 times, representing a major line of research in treatment interventions for falls in community-dwelling elderly.

Table 7. Top 20 keywords

Rank	Keywords	Counts	Rank	Keywords	Counts
1	Balance	455	11	Randomized controlled trial	154
2	Exercise	402	12	Women	151
3	Risk-factors	407	13	Rehabilitation	150
4	Health	267	14	Disability	145
5	Mobility	231	15	Frailty	141
6	Performance	218	16	Fall risk	152
7	Physical activity	207	17	Care	152
8	Gait	175	18	Injuries	141
9	Strength	163	19	Quality of life	129
10	Fear	162	20	Fall risk	122

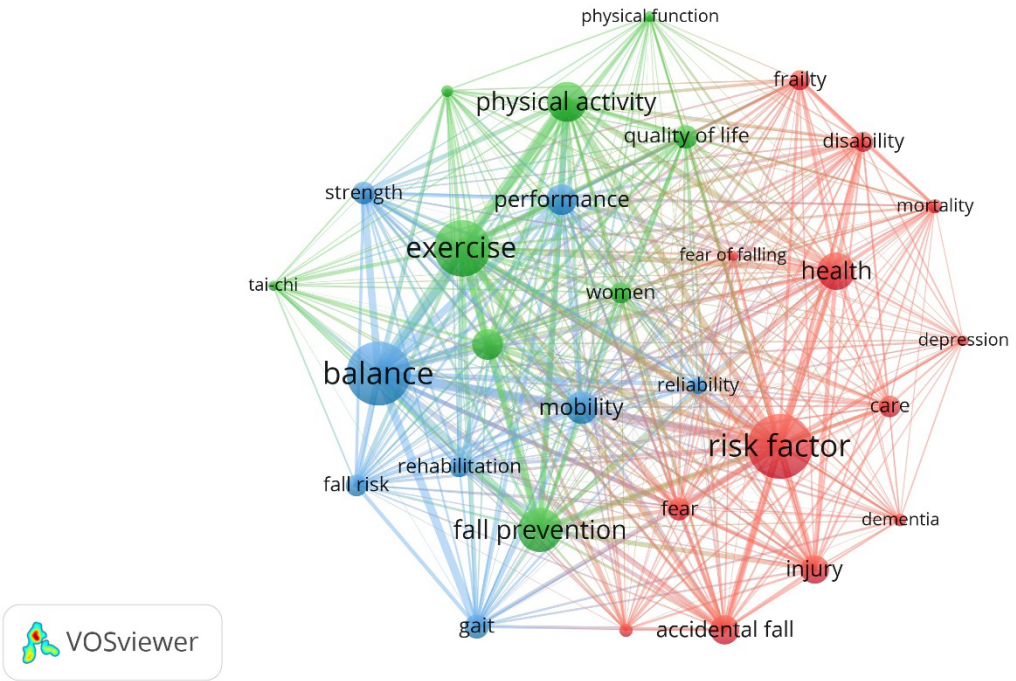

Figure 8A. Keyword cluster analysis

The VOSviewer was used to perform cluster analysis after filtering terms that had ≥ 10 occurrences (**Figure 8A**). The strength of the relationship between the keywords increases with the thickness of the lines connecting the nodes. We were able to acquire three clusters that corresponded to 3 study directions. The keywords in blue clusters were primarily focused on fall risk factors and outcomes for community-dwelling older adults, including gait, mobility, rehabilitation, balance, and fall risk. The keywords in red clusters focused on preventive measures for falls among the elderly in the community, which consists of risk factors, accidental falls, health, injury, etc. The keywords in green clusters consisted of exercise, physical activity, fall prevention, etc**.**

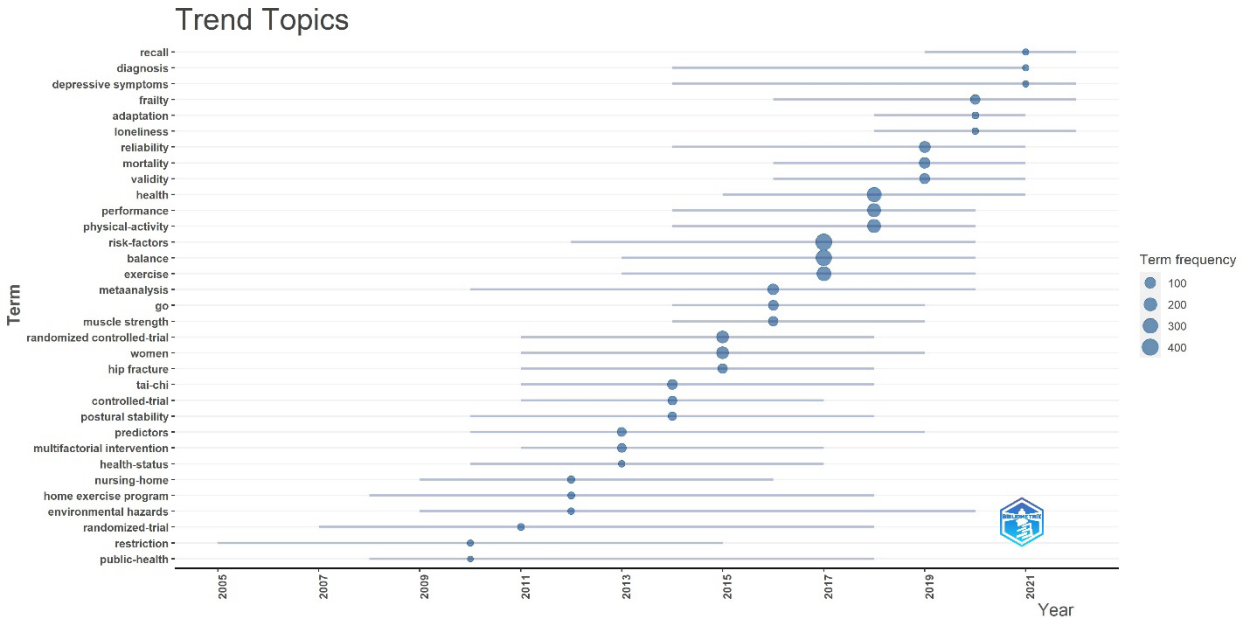

Figure 8B. Trend topic analysis

Figure 8B shows how the size of the circles reflects how frequently a term or keyword was used. The smallest circle shows occurrences 0–100, and the sizes of the circles increase as the occurrences increase. The duration of each term's study is indicated by the gray line [25]. The trend topic analysis of the keywords showed notably that from 2013 to 2020 showed that the keywords "physical activity," "risk factors," and "balance," with 300–400 occurrences.

4. Discussion

In this bibliometric analysis study, we searched the WoSCC for 2090 papers about treatment interventions for falls among the elderly in the community during the past 20 years. Analysis was carried out using Microsoft Office Excel 2021, R package "bibliometrix," and VOSviewer. To enlighten scholars who are interested in this area, our study examined publication trends about treatment interventions for falls among community-dwelling elderly from every perspective.

America was ranked the highest in terms of both the H-index and the number of published articles about treatment interventions for falls among the elderly in the community. As a result, 6 American universities were listed among the top 10 most productive in this field of research, demonstrating the country's leadership in this area of study. In contrast, Australia has 3 institutions ranked top 10 and 6 individuals ranked as the top 10 most prolific authors, ranking second in both the number of publications and the H-index. We noticed the

close cooperation among four countries: the US, Canada, England, and Australia. This implies that cooperation might be the most effective approach to solving scientific challenges in the context of the sustainable growth of research and technology. Eliminating obstacles in academia can promote international academic collaboration and advancements in science.

Among the top 10 cited journals, the Journals of the American Geriatrics Society (IF = 7.54, Q1) and the Journal of Age and Ageing (IF = 6.7, Q1) had the most publications. These journals may have increased chances of attracting high-quality contributions. Excellent articles further enhance the journal's impact, establishing a virtuous circle. Among the co-cited journals, we found that most of them were Q1 journals with a high IF.

In terms of authors, Lord and Hill had the highest publications at 36 and 31 papers, respectively. Professor Lord found that clinical interventions such as angiotensin system-blocking medications, reactive balance training, and home-based exercise programs delivered through a tablet computer were effective in preventing falls among the elderly in the community. Sherrington and Tiedemann co-published 13 papers, consisting of 6 systematic reviews and meta-analyses of exercise interventions for falls in older adults, with 7 randomized controlled trials on fall prevention in older people.

Regarding co-cited authors, Tinetti (n =1354) was the most frequently cited author, followed by Lord (n = 586), and Campbell (n = 529). In 2010, Tinetti published an article focusing on the example of an older person who had multiple falls that resulted in a hip fracture. The consequences and causes of the falls were explored and the evidence on predisposing factors and effective interventions were summarized, laying the groundwork for the incorporation of fall prevention strategies in clinical practice [20].

The article published by Chen had the highest number of citations. He did a consensus report on the evidence of sarcopenia in Asians, which is one of the main causes of falls in the elderly. The consensus provided a diagnostic approach to sarcopenia in Asia, which initialized research on sarcopenia in Asian countries and raised the importance of implementing such measures in clinical practice and community health promotion programs [16].

Co-cited references act as the foundation for a specific study topic since they have been cited several times in other publications. In this bibliometric analysis, the top 10 co-cited references were chosen to determine the therapeutic intervention's scientific foundation for preventing falls among community-dwelling elderly. Gillespie *et al*. published a review in 2012, which had the most co-citations [26]. He assessed the efficacy of fall prevention measures for older adults in the community and concluded that home safety measures, group exercise treatments, and exercise programs might significantly lower fall rates and risk. Home-based exercises remain a hotspot for preventing falls among older adults in the community. Sherrington has four publications in these cited works, all of which discuss how exercise helps prevent falls. Exercise remains the most popular clinical prevention of falls in older among community-dwelling elderly according to the references with citation bursts, which represent emerging topics within a particular research field.

Keywords are an essential indicator in scientific research as they reflect the core content of the paper and keyword co-occurrences in bibliometrics can represent topical areas in the academic field [27]. Excluding keywords such as "older people," and "elderly adults," **Table 7** mainly includes the following keywords: "balance," "risk factor," "exercise," "fall prevention," and "physical activity." According to the keyword clustering analysis and trend topic analysis, we concluded that research on clinical preventive measures for falls in community-dwelling elderly concentrated on the following aspects:

(1) Balance

Balance is defined as remaining upright and stable at rest, such as standing or sitting, or during movement. Loss of balance is a major independent intrinsic factor for falls and enhancing balance can

prevent falls in older adults [28]. Recently, various studies have used clinical interventions to improve balance in older adults for fall prevention and the results showed that most clinical interventions were able to enhance balance in older adults. For example, perturbation-based balance training improved reactive balance control in frail older adults [29] and yoga, video games, and virtual-reality games improved balance in older adults [30–32]. However, it is unknown whether yoga can prevent falls in older adults, and VR games, although they have shown positive clinical outcomes in terms of balance improvement and reduction in fear of falling, are not as good as alternative exercise training to improve standing balance. Progressive resistance training is not recommended for improving balance in older adults due to the lack of evidence. In established clinical trials, fall incidence and fall efficacy scales were commonly used as outcome indicators to assess reactive balance and quiet standing was commonly used to assess static postural control [33–35]. Sherrington *et al*. used 5 indirect measures as measures of balance ability, which were more economically and operationally applicable to community populations than direct measures. However, many clinical trials suffer from missing data and small sample sizes, leading to poor data quality and the need for more randomized controlled trials with larger sample sizes and long-term follow-up in the future [28].

(2) Exercise

Exercise is considered the most significant and promising fall intervention strategy [36]. There is compelling evidence that carefully designed intervention programs helped older adults avoid falling [37] and a systematic review established that exercise programs lowered the rate (the number of falls per person) and risk of falls (the proportion of people who fall one or more times) [38]. Exercise interventions vary. There are eight types: gait, balance, coordination, and functional tasks, strengthening exercises, three-dimensional exercises, general physical activity (walking), general physical activity (cycling), computerized balance training using visual feedback, vibration platforms, and multiple types of interventions including combinations of the above exercises [28]. Reviews have shown that programs that present a higher challenge to balance and involve more than 3 hours of exercise per week have a stronger fall prevention effect and are broadly applicable to older people living in the community [37]. Besides, walking programs are less effective and are not suitable for the elderly with a high risk of falling [39]. Current research has been carried out among healthy older people in the community, but the quality and number of studies carried out among older patients with mobility impairments, physical disabilities, and/or multiple medical conditions is low [40–42]. Hence, future research should be carried out to determine the most effective therapeutic intervention of physical activity for this group of people.

(3) Risk Factor

To reduce the incidence of falls in older people, awareness and early avoidance of relevant risk factors by healthcare professionals play an important part in fall prevention in older people. Jintang classified risk factors into five categories, including physical factors, psychological factors, environmental factors, medication and polypharmacy, and disease factors [43–45]. Pain, particularly foot pain and chronic pain has been suggested as a major risk factor for falls and can be assessed by clinical researchers when undertaking fall risk assessments [46]. Frailty is also a risk factor for falls and caregivers should develop effective fall prevention measures to reduce the incidence of falls [47]. For healthcare professionals, references can be made according to relevant studies to develop population-specific fall risk assessment tools. Furthermore, high-risk groups can be identified to provide reasonable and scientific interventions to address the influencing factors and reduce the incidence of falls among the elderly.

5. Conclusion

The number of articles focusing on community-based fall interventions for older adults has increased significantly from 2002 to 2022, and the United States has been instrumental in this topic in terms of the number of papers published and international collaboration. Current research has focused on balance, exercise, and risk factors, and given the serious consequences of falls for older adults, more large-sample, high-quality randomized controlled trials with long-term follow-up for balance, and the development of fall risk assessment tools and clinical interventions for specific groups of older adults, such as the frail, mobility-impaired, and multimorbid, are needed in the future. Our study provided a comprehensive overview of the clinical interventions for falls in community-dwelling older adults can guide scholars in their subsequent research.

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Disclosure

The authors declare no conflict of interest.

Author Contributions

All authors contributed significantly to the work reported, whether it was through ideation, study design, execution, data acquisition, analysis, and interpretation, or in all of these areas; they all helped draft, revise, or critically review the article; they approved the final version that was published; they all agreed on the journal to which the article was submitted; and they all agreed to take responsibility for the work in its entirety.

References

[1] Montero-Odasso M, van der Velde N, Martin FC, et al., 2022, World Guidelines for Falls Prevention and Management for Older Adults: A Global Initiative. Age Ageing, 51(9): 36.

[2] Montero-Odasso MM, Kamkar N, Pieruccini-Faria F, et al., 2021, Evaluation of Clinical Practice Guidelines on Fall Prevention and Management for Older Adults a Systematic Review. JAMA Netw. Open, 4(12): 15.

[3] Chantanachai T, Sturnieks DL, Lord SR, et al., 2021, Risk Factors for Falls in Older People with Cognitive Impairment Living in the Community: Systematic Review and Meta-Analysis. Ageing Res Rev, 71: 22.

[4] Frighi V, Smith M, Andrews TM, et al., 2022, Incidence of Fractures in People with Intellectual Disabilities Over the Life Course: A Retrospective Matched Cohort Study. E Clinical Medicine, 52: 16.

[5] Iaboni A, Flint AJ, 2013, The Complex Interplay of Depression and Falls in Older Adults: A Clinical Review. Am J Geriatr Psychiatr, 21(5): 484–492.

[6] Burns ER, Stevens JA, Lee R. 2016, The Direct Costs of Fatal and Non-Fatal Falls Among Older Adults - United States. J Saf Res, 58: 99–103.

[7] Chang JT, Morton SC, Rubenstein LZ, et al., 2004, Interventions for the Prevention of Falls in Older Adults: Systematic Review and Meta-Analysis of Randomized Clinical Trials. Br Med J, 328(7441): 680–683.

[8] Lv JY, Li YM, Shi SQ, et al., 2023, Frontier and Hotspot Evolution in Cardiorenal Syndrome: A Bibliometric Analysis From 2003 to 2022. Curr Probl Cardiol, 48(8): 32.

[9] Shi SQ, Lv JY, Chai RN, et al., 2023, Opportunities and Challenges in Cardio-Oncology: A Bibliometric Analysis From 2010 to 2022. Curr Probl Cardiol, 48(8): 31.

[10] Vlase I, Laehdesmaeki T, 2023, A Bibliometric Analysis of Cultural Heritage Research in The Humanities: The Web of Science as a Tool of Knowledge Management. Hum Soc Sci Commun, 10(1): 14.

[11] van Eck NJ, Waltman L, 2010, Software Survey: VOSviewer, A Computer Program for Bibliometric Mapping. Scientometrics, 84(2): 523–538.

[12] Liu XC, Zhao S, Tan LL, et al., 2022, Frontier and Hot Topics in Electrochemiluminescence Sensing Technology Based on Citespace Bibliometric Analysis. Biosens Bioelectron, 201: 113932.

[13] Aria M, Cuccurullo C, 2017, Bibliometrix: An R-tool for Comprehensive Science Mapping Analysis. J. Informetr, 11(4): 959–975.

[14] Azizoglu F, Terzi B, 2024, Research Topics on Pressure Injury Prevention and Measurement Tools From 1997 to 2023: A Bibliometric Analysis Using VOSviewer. Intensive Crit Care Nurs, 80: 103557.

[15] Kokol P, 2021, Meta Approaches in Knowledge Synthesis in Nursing: A Bibliometric Analysis. Nurs Outlook, 69(5): 815–825.

[16] Chen LK, Liu LK, Woo J, et al., 2014, Sarcopenia in Asia: Consensus Report of the Asian Working Group for Sarcopenia. J Am Med Dir Assoc, 15(2): 95–101.

[17] Friedman SM, Munoz B, West SK, et al., 2002, Falls and Fear of Falling: Which Comes First? A Longitudinal Prediction Model Suggests Strategies for Primary and Secondary Prevention. J Am Geriatr Soc, 50(8): 1329–1335.

[18] Verghese J, Holtzer R, Lipton RB, et al., 2009, Quantitative Gait Markers and Incident Fall Risk in Older Adults. J Gerontol Ser A-Biol Sci Med Sci, 64(8): 896–901.

[19] Bandeen-Roche K, Seplaki CL, Huang J, et al., 2015, Frailty in Older Adults: A Nationally Representative Profile in the United States. J Gerontol Ser A-Biol Sci Med Sci, 70(11): 1427–1434.

[20] Tinetti ME, Kumar C, 2010, The Patient Who Falls "It's Always a Trade-Off". JAMA-J Am Med Assoc, 303(3): 258–266.

[21] Gill TM, Allore HG, Holford TR, et al., 2004, Hospitalization, Restricted Activity, and the Development of Disability Among Older Persons. JAMA-J Am Med Assoc, 292(17): 2115–2124.

[22] Luo KH, Chen Y, Fang SZ, et al., 2023, Study on Inflammation and Fibrogenesis in MAFLD From 2000 To 2022: A Bibliometric Analysis. Front Endocrinol, 14: 1231520.

[23] Sherrington C, Fairhall NJ, Wallbank GK, et al., 2019, Exercise For Preventing Falls in Older People Living in the Community. Cochrane Database Syst Rev, 2019(1): 587.

[24] Yuan J, Feng T, Guo Y, et al., 2023, Global Scientific Trends Update on Macrophage Polarization in Rheumatoid Arthritis: A Bibliometric and Visualized Analysis From 2000 to 2022. Heliyon, 9(9): e19761.

[25] Rincón CAM, Rubiano-Ovalle O, Hurtado CD, et al., 2023, Project Portfolio Risk Management. Bibliometry and Collaboration Scientometric Domain Analysis. Heliyon, 9(9): 19.

[26] Gillespie LD, Robertson MC, Gillespie WJ, et al., 2012, Interventions for Preventing Falls in Older People Living in The Community. The Cochrane Database of Systematic Reviews 2012(9): CD007146

[27] Wu FP, Gao JF, Kang J, et al., 2022, Knowledge Mapping of Exosomes in Autoimmune Diseases: A Bibliometric Analysis (2002–2021). Front Immunol, 13: 19.

[28] Howe TE, Rochester L, Neil F, et al., 2011, Exercise for Improving Balance in Older People. Cochrane Database Syst Rev, 2011(11): 296.

[29] Mansfield A, Wong JS, Bryce J, et a., 2015, Does Perturbation-Based Balance Training Prevent Falls? Systematic Review and Meta-Analysis of Preliminary Randomized Controlled Trials. Phys Therapy, 95(5): 700–709.

[30] Youkhana S, Dean CM, Wolff M, et al., 2016, Yoga-Based Exercise Improves Balance and Mobility in People Aged 60 and Over: A Systematic Review and Meta-Analysis. Age Ageing, 45(1): 21–29.

[31] Dermody G, Whitehead L, Wilson G, et al., 2020, The Role of Virtual Reality in Improving Health Outcomes for Community-Dwelling Older Adults: Systematic Review. J Med Internet Res, 22(6): 17.

[32] Montero-Alía P, Miralles-Basseda R, López-Jiménez T, et al., 2019, Controlled Trial of Balance Training Using a Video Game Console in Community-Dwelling Older Adults. Age Ageing, 48(4): 506–512.

[33] Allin LJ, Brolinson PG, Beach BM, et al., 2020, Perturbation-Based Balance Training Targeting Both Slip- and Trip-Induced Falls Among Older Adults: A Randomized Controlled Trial. BMC Geriatr, 20(1): 13.

[34] Okubo Y, Sturnieks DL, Brodie MA, et al., 2019, Effect of Reactive Balance Training Involving Repeated Slips and Trips on Balance Recovery Among Older Adults: A Blinded Randomized Controlled Trial. J Gerontol Ser A-Biol Sci Med Sci, 74(9): 1489–1496.

[35] Bhatt T, Espy D, Yang F, et al., 2011, Dynamic Gait Stability, Clinical Correlates, and Prognosis of Falls Among Community-Dwelling Older Adults. Arch Phys Med Rehabil, 92(5): 799–805.

[36] Karinkanta S, Piirtola M, Sievänen H, et al., 2010, Physical therapy approaches to reduce fall and fracture risk among older adults. Nat. Rev. Endocrinol. 2010;6(7):396-407 doi: 10.1038/nrendo.2010.70.

[37] Sherrington C, Michaleff ZA, Fairhall N, et al., 2016, Exercise to Prevent Falls in Older Adults: An Updated Systematic Review and Meta-Analysis. J Aging Phys Act, 24: S15.

[38] Finnegan S, Seers K, Bruce J, 2019, Long-term Follow-Up of Exercise Interventions Aimed at Preventing Falls in Older People Living in the Community: A Systematic Review and Meta-Analysis. Physiotherapy, 105(2): 187–199.

[39] Okubo Y, Osuka Y, Jung S, et al., 2016, Walking Can be More Effective than Balance Training in Fall Prevention Among Community-Dwelling Older Adults. Geriatr Gerontol Int, 16(1): 118–125.

[40] de Vries NM, van Ravensberg CD, Hobbelen JSM, et al., 2012, Effects of Physical Exercise Therapy on Mobility, Physical Functioning, Physical Activity and Quality of Life in Community-Dwelling Older Adults with Impaired Mobility, Physical Disability and/or Multi-Morbidity: A Meta-Analysis. Ageing Res Rev, 11(1): 136–49.

[41] Takano E, Teranishi T, Watanabe T, et al. Differences in the Effect of Exercise Interventions Between Prefrail Older Adults and Older Adults Without Frailty: A Pilot Study. Geriatr. Gerontol. Int, 17(9): 1265–1269.

[42] Alhambra-Borrás T, Durá-Ferrandis E, Ferrando-García M, 2019, Effectiveness and Estimation of Cost-Effectiveness of a Group-Based Multicomponent Physical Exercise Programme on Risk of Falling and Frailty in Community-Dwelling Older Adults. Int J Environ Res Public Health, 16(12): 15.

[43] Wang JT, Chen Z, Song YT, 2010, Falls in Aged People of The Chinese Mainland: Epidemiology, Risk Factors, and Clinical Strategies. Ageing Res Rev, 9: S13–S17.

[44] Biswas I, Adebusoye B, Chattopadhyay K, 2022, Risk Factors for Falls Among Older Adults in India: A Systematic Review and Meta-Analysis. Health Sci Rep, 5(4): 16.

[45] Ashari A, Hamid TA, Hussain MR et al., 2021, Prevalence, Circumstances, and Risk Factors of Falls Among Community-Dwelling Members of University of the Third Age. Front Public Health, 9: 7.

[46] Stubbs B, Binnekade T, Eggermont L, et al., 2014, Pain and the Risk for Falls in Community-Dwelling Older Adults: Systematic Review and Meta-Analysis. Arch Phys Med Rehabil, 95(1): 175–187.

[47] Cheng MH, Chang SF, 2017, Frailty as a Risk Factor for Falls Among Community-Dwelling People: Evidence from a Meta-Analysis. J Nurs Scholarsh, 49(5): 529–536.