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Review

Advances in applying somatosensory interaction technology in geriatric care: A bibliometric analysis

Changle Pei [a], Weibo Lyu [a], Jingxia Liu [a], Yan Wang [b], Wenjia Ye [a], Zhou Zhou [a], Kangyao Cheng [a, *]

[a] School of Nursing, Shanghai University of Traditional Chinese Medicine, Shanghai, China
[b] Department of Nursing, Tangzhen Health Community Center, Shanghai, China

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Objectives: Somatosensory Interaction Technology (SIT) is used in various aspects of geriatric care. We aimed to conduct a bibliometric analysis to summarize relevant publications and visualize publication characteristics, current hotspots, and development trends, thereby inspiring subsequent researches.
Methods: We searched the Web of Science Core Collection database for publications on the application of SIT in geriatric care. Bibliometric visualization and clustering analysis were performed using VOSviewer V1.6.18 Software, while keywords burst detection analysis was conducted with CiteSpace 6.1.R6 Software.
Results: After screening, a total of 1,019 publications were included. The number of publications on SIT in geriatric care is gradually increasing, exhibiting a rapid growth rate. The United States, Canada, and Australia led in terms of publication volume. Keyword clustering analysis identified major research hotspots: crisis warning, somatic abilities, rehabilitation training and psychosocial support. Initial studies primarily explored themes such as recovery, movement, systems, and later shifted towards gait analysis, muscle strength, parameters, and home-based care. More recently, research themes have evolved to dementia, machine learning, and gamification.
Conclusions: SIT is innovative for promoting active aging, advancing intelligent healthcare, and elevating the daily quality of life for older adults in clinical and domestic settings. Applications of SIT can be categorized into early warning systems for crises, detailed analyses of physical conditions, rehabilitation enhancement, and support for psychosocial health. Research trends have transitioned from whole-body recognition to precise feedback, from a focus on physical health to mental health, and from technical feasibility to user-friendliness. Future research should focus on developing accessible and user-friendly devices, fostering interdisciplinary collaborations for innovation, expanding research to address both the physical and mental health needs of diverse older adults, and integrating emerging technologies to enhance data precision and accelerate the development of intelligent platforms.

What is known?

- Somatosensory interaction technology provides advanced technical support for innovating the methods of gamified exercise and physiological monitoring for geriatric caring practice.

What is new?

- The research hotspots of somatosensory interaction technology in geriatric care included exercise risk assessment, somatic condition analysis, rehabilitation enhancement, and support for mental health and cognitive-behavioral research.
- Research trends have evolved from whole-body recognition to precise feedback, from physical to mental health, and from technical feasibility to user-friendliness.

1. Introduction

By 2030, the global older adults is expected to reach 1.4 billion [1], with up to 75% suffering from chronic diseases, experiencing

* Corresponding author.
E-mail address: chengkangyao@163.com (K. Cheng).
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declines in intrinsic capacity and quality of life, and facing complex health challenges [2]. Recent systematic reviews by the American Geriatrics Society have indicated that the inability to monitor health in real-time, difficulty in providing personalized treatment plans, and the lack of daily age-friendly technology are unavoidable issues in the field of geriatric care [3]. Traditionally, health monitoring for the older adults has mostly relied on manual records and yearly physical examinations, making real-time health status monitoring impossible and limiting healthcare professionals' ability to respond promptly to emergencies [4]. Additionally, personalized treatment plans are usually implemented through face-to-face therapy, text-based rehabilitation manuals, and annual follow-up adjustments. Manual records of health data make it difficult to analyze the overall health status of the older adults, and healthcare professionals find capturing subtle daily performance changes challenging, thus hindering clinical decisions on adjusting treatment plans and complicating the provision of personalized treatment [3]. Finally, compensating for the daily living abilities of the elderly mainly relies on spousal care or hired home caregivers, with less application of highly convenient and barrier-free elder-friendly equipment. This indicates that current geriatric care often requires extensive direct involvement of professionals, which is challenging to sustain long-term in resource-limited or cost-saving situations [5]. Given these traditional challenges, the introduction of innovative technological solutions in the field of geriatric care is imperative. Such technology can significantly enhance the responsiveness and service efficiency of the entire geriatric healthcare system, effectively addressing key challenges in elderly health management [6]. The recently emerged somatosensory interaction technology (SIT), with its technical characteristics closely aligning with the ideas to solve the above-mentioned issues, provides advanced technological support to overcome the challenges in geriatric care practices [6].

SIT enables users to interact directly with computer systems or smart devices through body movements, voice commands, or eye movements. Key technologies include motion capture, gesture recognition, voice recognition, eye-tracking, and haptic feedback, characterized by active user participation and efficient interactive data feedback [7]. In the field of geriatric care, demonstration cases of SIT applications are increasing annually. For instance, in health monitoring, SIT, which uses motion capture technology and wearable devices, can provide real-time data feedback, effectively observing the behavior patterns and potential health problems of the elderly [8]. Examples include the detection of abnormal gait and posture, sudden height changes, and unnatural movements through floor sensors and wearable devices, thereby predicting potential fall risks [9]. Additionally, SIT can be seamlessly integrated into home automation systems, allowing elderly individuals with mobility issues to easily control smart home devices such as lighting, televisions, and air conditioning through simple gestures and voice commands. This significantly enhances the convenience and safety of nighttime activities for elderly individuals who live alone [10]. Increasing research supported the enormous potential of SIT in geriatric care. For example, Guazzin [11] explored the potential of SIT's gesture control device L Motion in assessing and monitoring patients with Alzheimer's disease and mild cognitive impairment. Penichet et al. [12] used SIT devices to detect emotional changes in the older adults undergoing rehabilitation training, attempting to develop training programs based on the emotional profiles of the older adults. Gür and Basar [13] employed a virtual stair game projected by the Kinect device to intervene with elderly patients after total knee arthroplasty, reducing pain scores and movement fears and avoiding pain catastrophizing in elderly female patients during the early postoperative stages. This immersive rehabilitation scenario also enhanced the training motivation and participation of elderly patients [14]. However, some researchers have emphasized the need to strengthen safety monitoring for the older adults in virtual games and have suggested that SIT devices could be linked with artificial intelligence (AI) prediction systems to assess patients' rehabilitation progress in real-time, thereby intelligently adjusting the difficulty and type of rehabilitation games to provide more personalized treatment plans [15,16].

SIT can play a significant role in geriatric care, and related research is continuously evolving and advancing. This study employs bibliometric analysis to provide a comprehensive overview of SIT applications in geriatric care. Through this method, we can explore specific publication characteristics, research hotspots, and development trends deeply, offering valuable insights for identifying research challenges [17]. This analysis will support researchers and healthcare professionals in promoting the development and practical application of SIT in geriatric care.

2. Methods

2.1. Search strategy

We used the Web of Science Core Collection (WoSCC) database as our data source. A comprehensive search strategy is detailed as follows: ((TS=(somatosensory interact* OR somatic sense interact* OR motion sensing interact* OR space touching OR recognition of human action* OR motion tracking OR motion sensing OR motion recognition OR gesture recognition OR capture motion OR exergame* OR recognition of human action OR Tangible Interaction OR pose estimation OR pose recognition) OR TS=(Wii OR Eyetoy OR Kinect OR Leap motion OR Gmail motion OR PS Move OR PlayStation Move OR 3D motion analysis system OR balance board)) AND TS=(medic* OR nurse* OR rehab* OR health OR disease* OR patient*) AND TS=(old* OR elderly OR senile OR aging OR senior citizen OR geriatric OR seniors OR older adult)) NOT WC=(engine* OR material*). The detailed search strategy for SIT in geriatric care is presented in Appendix A.

"TS" indicates that these terms appeared in the title, abstract, author keywords, or keywords plus of the retrieved articles. "WC" stands for the WoSCC subject category. Two researchers conducted a literature search on the same day, and the time span was from the establishment of the WoSCC database to Dec 31, 2022.

2.2. Document selection

The inclusion criteria were: 1) involvement of SIT; 2) relevance to geriatric care; 3) articles and reviews. We filtered the initial search results of 3,393 documents according to the following exclusion criteria: 1) non-English literature; 2) editorial materials, corrections, letters, conference proceedings, and abstracts. Two researchers independently reviewed the titles and abstracts, and for those uncertain literatures, the full texts were reviewed. Disagreements were resolved through discussion between the two researchers or consultation with a third researcher. Finally, 1,019 publications were included. The flowchart detailing the screening process is presented in Appendix B.

2.3. Data analysis

The included literature records were exported to VOSviewer V1.6.18 Software in tab-delimited file format to analyze publication volumes and trends, generate co-occurrence networks for countries, institutions, authors, academic journals, and references, and conduct high-frequency keyword clustering analyses. We adopted the H-index to evaluate the academic influence of authors, which indicates that an author's publication has been cited at least H times. The H-index takes into account the "quality" and "quantity" of academic results, which makes it objective and accurate [18]. To simplify the co-occurrence network, we set the minimum filtering values as the number of author publications $\geq$ 3, the number of country/institution publications $\geq$ 5, and the frequency of keyword occurrence $\geq$ 30. Selecting attraction = 2, Layout repulsion = −1, Cluster repulsion = 1 for the keyword clustering graphs and Method = node size in the co-occurrence and clustering diagrams indicates the frequency of occurrence. The lines between nodes indicate the existence of a particular relationship; the thickness of these lines represents the closeness of the connection. Different colors indicate that the nodes are classified into different clusters. We used Citespace 6.1.R6 Software for burst detection of keywords, $\gamma = 1$ and minimum duration = 1 in Burstness, selecting the top 20 keywords in burst strength for analysis.

3. Results

3.1. The number of publications and year trend

Overall, the number of publications on SIT in geriatric care has been increasing annually. As shown in Fig. 1, the number has increased from 3 publications in 2005 to 134 in 2022 (although data for 2022 may be incomplete), totaling 1,019 publications as of Dec 31, 2022. We have divided the publication trend into three phases to analyze the trend. The first phase, from 2005 to 2011, featured a relatively low number and slow growth rate, accounting for only 4.5% of the total publications. The second phase, from 2012 to 2017, saw a rapid increase in the number of publications, from 23 to 86 per year. The third phase, beginning in 2018 and continuing to the present, has seen annual publication numbers stabilize above 100, peaking in 2021 ($n = 141$) and 2022 ($n = 134$). The decrease in 2022 publications could be due to indexing delays in the WoSCC database. In summary, this field of research has received continued interest from scholars over the past 18 years. Given the potential incomplete data in 2022, further monitoring is recommended to determine whether this upward trend will continue in the coming years.

3.2. Countries and institutions analysis

A total of 68 countries have published research on SIT in geriatric care. Appendix C provides details on the top 10 countries/institutions by publication volume. The leading three countries were the United States ($n = 275$), Canada ($n = 90$), and Australia ($n = 72$), with the United States accounting for 27% of the global total and holding a central dominant position. A total of 1,812 institutions have published in this field, with higher education and research institutions in the United States continuing to dominate. The top three institutions are the University of California ($n = 30$), Tel Aviv University ($n = 28$), and Sackler College of Medicine ($n = 25$).

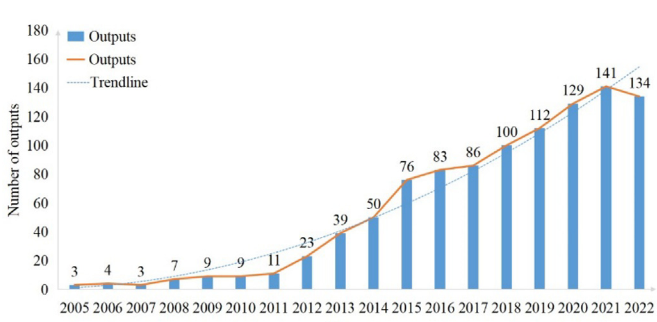

Fig. 1. The number and trend in annual publications on SIT in geriatric care. SIT = Somatosensory Interaction Technology.

We analyzed collaborations among 38 countries and 101 institutions that had five or more publications. Appendix D contains a network graph showing the relationships among these countries and institutions in SIT research for geriatric care. Developed countries, such as the United States, Canada, Australia, the Netherlands, and the United Kingdom, as well as countries with high levels of scientific and technological development, have taken the lead in establishing international collaborative networks. For instance, close collaborations exist between the United States and Israel, Germany and the Netherlands, and Switzerland and Sweden. However, many countries remain poorly connected and lack extensive collaborative networks. The institutional cooperation networks are primarily connected by the various high-yield institutions. We found that only six major collaborative groups (6 clusters) had formed among the 38 countries and nine among the 101 institutions (9 clusters) in this research area, suggesting that cross-country collaboration is insufficient and that cooperation among institutions is not closely knit.

3.3. Productive authors analysis

A total of 5,283 authors contributed to the 1,019 publications on SIT in geriatric care, with an average of 5–6 authors per publication. Appendices E and F provide detailed information on the top 10 prolific authors in this field, along with their collaboration networks. Professor Jeffrey M. Hausdorff ranked first ($n = 13$) and had a very high academic impact, with an H-index of 97. Professor Tiny Jaarsma ($n = 12$) and Professor Anna Stromberg ($n = 12$) were tied for second, with H-indexes of 72 and 43, respectively. All of the most prolific authors in this research area had H-indexes above 30. Additionally, although Sweden and Israel were not among the top 10 countries by publication volume, they both had a significant number of productive authors.

3.4. Productive academic journals analysis

Research on SIT in geriatric care was published in 183 academic journals, predominantly in the fields of geriatrics, sports medicine, medical informatics, and public health. Appendix G lists the top 10 academic journals by number of publications in this field. These ten leading journals, with a total of 284 publications, account for approximately 28% of all publications. The journal with the most publications was *Gait & Posture* ($n = 42$), followed by *Frontiers in Aging Neuroscience* ($n = 40$) and *BMC Geriatrics* ($n = 36$). The *Journals of Gerontology Series A Biological Sciences And Medical Sciences* has an average of 40 citations per publication, indicating substantial academic influence.

3.5. Cited publications analysis

Details of the top 10 most-cited articles on SIT in geriatric care are provided in Appendix H. Alan K. Bourke published the most-cited paper in 2007 in *Gait & Posture*. This study utilized three-axis accelerometer sensors to track the movements of older individuals and identify imminent falls, accumulating 512 citations over 16 years [19]. The second most-cited study explored the application of SIT in video capture, virtual reality (VR), and sports games, covering topics like fall detection, stroke rehabilitation, cognitive training, balance, and depression. Many of these highly cited papers were published in high-impact academic journals, including "*Video capture of the circumstances of falls in elderly people residing in long-term care: an observational study*" by Robinovitch et al. from Canada [20], and *"Addition of a non-immersive virtual reality component to treadmill training to reduce fall risk in older adults (V-TIME): a randomized controlled trial"* written by prolific author Hausdorff et al. from Israel [21]. These papers were all published in the leading medical journal *The Lancet*.

3.6. Research hotspots, trends and frontier analyses

3.6.1. Keywords analysis

Among the 1,019 publications, there are a total of 3,761 keywords (including extended keywords). As shown in Table 1, the keyword with the highest frequency is "rehabilitation" ($n = 182$), followed by "balance" ($n = 171$), "virtual reality" ($n = 152$), "older adults" ($n = 148$), "exercise" ($n = 146$), "gait" ($n = 140$), "people" ($n = 136$), "risk" ($n = 118$), "performance" ($n = 117$), and "dementia" ($n = 117$).

Among the top 10 keywords in terms of centrality, "balance" has the highest centrality at 0.27, indicating its pivotal role and connection to the highest number of publications, suggesting that many similar publications focus on the theme of balance. Other keywords, such as "Alzheimer's disease", "gait" and "exercise", also have high centrality and are pivotal links. Additionally, "rehabilitation", "virtual realit", "performance" and "dementia" despite having high frequencies of occurrence, are less central, possibly because they are spread across many different topics, diluting their centrality.

3.6.2. Keywords clustering analysis

We used VOSviewer V1.6.18 Software to cluster the keywords, resulting in 62 keywords with a frequency of $\geq$ 30 being divided into four clusters, as shown in Fig. 2. Cluster 1 is shown in green, Cluster 2 in blue, Cluster 3 in red, and Cluster 4 in yellow. Cluster 1 includes keywords such as "risk", "mobility", "disease", and "disability", which are primarily related to health crisis warnings. Cluster 2 contains keywords like "balance", "gait", "falls", and "walking", which are primarily related to individual somatic abilities. Cluster 3 includes keywords such as "rehabilitation", "virtual reality", "exercise", and "reliability", which are primarily related to rehabilitation training. Cluster 4 comprises keywords like "performance", "dementia", "impairment", and "Alzheimer's disease", which are primarily related to mental health and cognitive-behavioral improvement.

3.6.3. Keywords burst detection analysis

We used Citespace 6.1.R6 Software to detect the top 20 keywords with the most significant citation bursts in research on SIT in geriatric care, aiming to analyze research hotspots and trends. As shown in Fig. 3, in the early period, "recovery" and "movement" had the longest duration, while "recovery", "system", "variability", "validity" and "movement" showed high burst strengths. More recently, "technology" has had an extended time span, and "machine learning", "therapy", "gait analysis" and "disease" have demonstrated high burst strengths. Additionally, "machine learning", "game" and "dementia" have emerged as highly popular research hotspots in recent years.

Table 1
Top 10 keywords by frequency and centrality in researches on SIT in geriatric care.

Rank	Keywords	Times	Rank	Keywords	Centrality
1	Rehabilitation	182	1	Balance	0.27
2	Balance	171	2	Alzheimer's disease	0.27
3	Virtual reality	152	3	Gait	0.27
4	Older adults	148	4	Executive function	0.27
5	Exercise	146	5	Exercise	0.19
6	Gait	140	6	People	0.18
7	People	136	7	Age	0.17
8	Risk	118	8	Prevention	0.17
9	Performance	117	9	Impairment	0.14
10	Dementia	117	10	Environment	0.14

4. Discussion

The field of SIT in geriatric care has shown notable progression. An early study on fall monitoring with accelerometers and sensors [22] established a foundation for the initially limited scope and low volume of publications in the field's early days. The period from 2012 to 2017 marked a phase of swift growth, likely due to the advent of interactive devices like Kinect and Wii, and advancements in VR and sensor technology [23]. Since 2018, publication numbers have stabilized at a high level, peaking in 2021, indicating a mature research field. Although a slight decline in publication volume was observed in 2022, this could be due to indexing delays in the WoSCC database, necessitating further monitoring to ascertain whether the field can maintain an upward trend in publication output.

Leading institutions in SIT research, predominantly in developed countries such as the United States, Canada, Australia, and Japan, have driven innovation. The University of California stands out with its advancements in markerless motion capture technology, which has significantly improved gait analysis for diagnosing age-related conditions [24]. Meanwhile, developing countries, including China and Brazil, are increasingly contributing to SIT research, likely due to their substantial aging populations and growing investment in geriatric care [25]. Moreover, collaborations among academic leaders have significantly advanced the field of SIT. Notable examples include Professor Jeffrey M. Hausdorff from Tel Aviv University (H-index = 97) and Professor Tiny Jaarsma from Linköping University (H-index = 74), who have significantly contributed to the integration of SIT with VR and AI [26]. Despite these advancements, opportunities for broader collaboration remain, particularly for less-established researchers and institutions. Strengthening these networks could lead to more targeted SIT applications, benefiting global geriatric care by addressing specific regional needs.

The concerted efforts of global SIT researchers have significantly advanced the field, as revealed by VOSviewer analysis, which categorizes current application hotspots into four distinct clusters.

The first cluster is crisis warning (green), which refers to SIT's capability to capture real-time physiological parameters and behavioral patterns of the elderly, providing timely health warnings to caregivers. For instance, motion-sensing cameras can accurately detect falls and trigger alerts, and sensor technology assesses sleep patterns to identify potential sleep disorders [8,27]. Additionally, SIT-based gait analysis monitors variations in walking speed and rhythm, offering crucial insights for early screening of conditions such as sarcopenia and Parkinson's disease [28,29]. Traditional health risk assessments for the older adults, relying on annual physical exams and subjective questionnaires, may fail to detect and respond to health crises promptly [3]. In contrast, SIT enhances the immediacy and precision of risk alerts through continuous monitoring and proactive warning mechanisms. Future advancements could further refine sensor accuracy and predictive stability while also rigorously safeguarding against privacy breaches and data misuse, thereby unleashing the full potential of SIT in older adults crisis detection.

The second cluster, somatic ability (blue), includes applications related to physical strength, balance, and flexibility. The use of SIT in gait analysis allows for a comprehensive assessment of mobility, while simulations of activities such as eating and dressing can evaluate the self-care abilities of the older adults [30]. As SIT

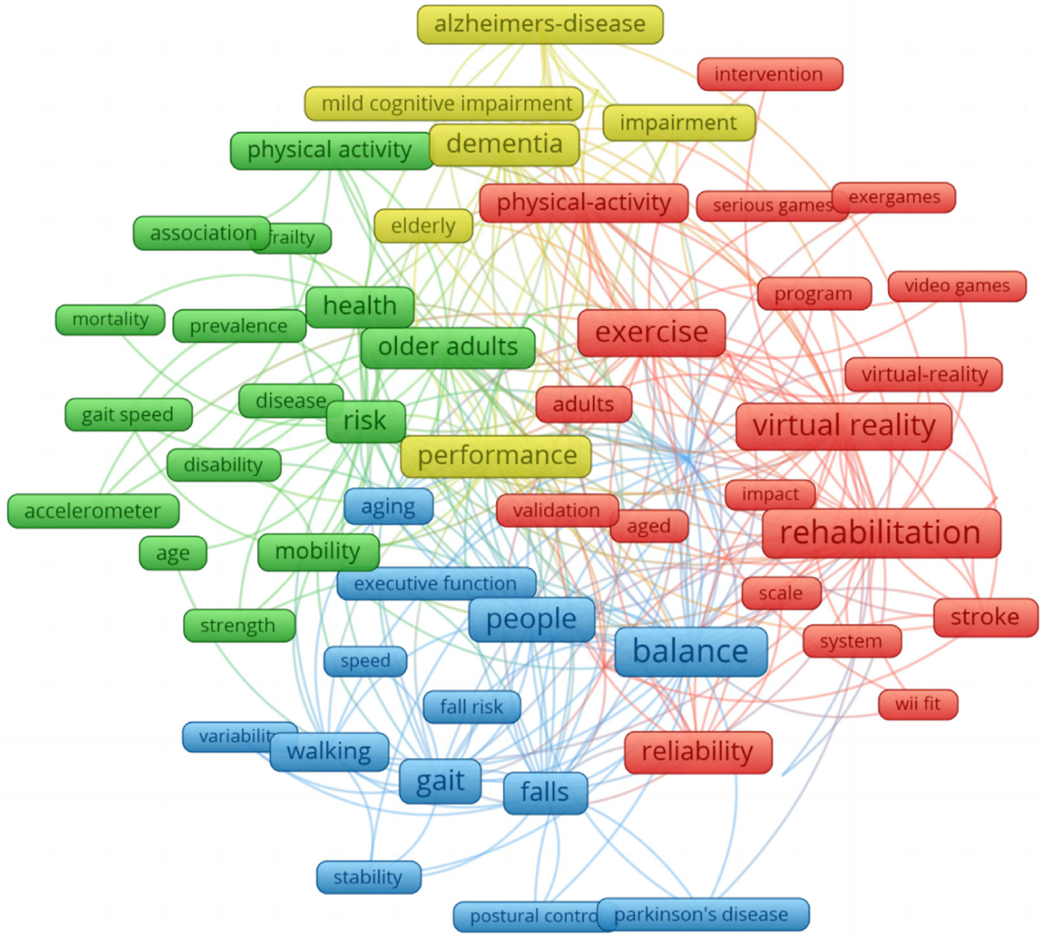

Fig. 2. Clustering analysis graph of keyword co-occurrence in SIT research in geriatric care.

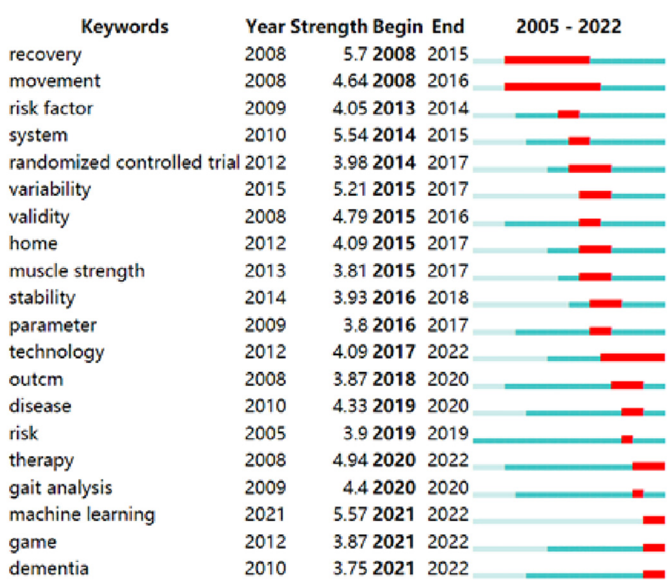

Fig. 3. Top 20 keyword burst detection analysis on SIT researches in geriatric care.

matures, it demonstrates unique advantages in enhancing exercise adherence and ensuring safety and comfort in the daily lives of older adults [31]. To promote physical activity, SIT introduces interactive, game-like exercise programs, which increase the enjoyment and engagement of movement [31]. For instance, by integrating VR, researchers simulate natural environments within the home, creating jogging tasks that are both entertaining and health-promoting for seniors [21]. In terms of daily life assistance, SIT is increasingly integrated into smart, age-friendly home devices. Smart shower systems, for example, adjust shower temperature based on the elderly users' preferences and real-time thermal feedback, thereby enhancing both safety and comfort [32]. While SIT offers innovative ways to improve the physical capabilities and quality of life for the elderly, challenges remain in its broader implementation, including concerns about safety issues such as dizziness or discomfort that may arise from use [33].

The third cluster is rehabilitation training (red), which signifies a transformative role for SIT in standardizing therapeutic movements and personalizing recovery progress. Conventional rehabilitation often relies on manual assessment and guidance from physiotherapists, which is limited by their individual expertise and daily workload, thus making it challenging to provide continuous one-on-one attention to each patient [34]. In contrast, SIT features precise multi-point skeletal recognition and data feedback analysis. For instance, researchers like Polus have developed an SIT-based rehabilitation system for post-hip replacement surgery. This system captures the range of motion of patients' joints to assess the accuracy of their movements, thereby improving rehabilitation efficiency and preventing unnecessary injuries [35]. Additionally, it dynamically adjusts the difficulty of exercises based on physiological parameters such as pain sensation and muscle strength, ensuring that the rehabilitation regimen is tailored to the patient's condition and enhancing their experience [35]. However, the cost of smart motion-sensing devices and rehabilitation systems currently poses a challenge, potentially limiting their broader application in healthcare. Future research and development should aim to enhance the accessibility and affordability of SIT [36].

The fourth cluster, psychosocial support (yellow), indicates an emerging shift in SIT from primarily facilitating physical interactions between the body and computer to addressing the psychological well-being of seniors. Initially, research and applications focusing on the psychological aspects of aging were undervalued. However, SIT is now regarded as an innovative pathway for providing psychological support to the elderly. It analyzes facial expressions, gait, and physiological signals to monitor emotional changes in real-time, offering seniors timely emotional recognition and comfort [37]. Furthermore, by integrating serious games with video components, SIT aids in cognitive function training, including memory, attention, and problem-solving, effectively delaying cognitive decline [38]. Additionally, combining SIT with VR offers indoor exploration experiences of natural environments, such as virtual beaches or forests, aiding in interventions for depression or anxiety disorders [39]. This approach overcomes the limitations of traditional methods related to weather, physical capacity, transportation, and resource availability. However, potential challenges in the widespread adoption of SIT health applications among the older adults include their adaptability to new technologies [40]. There is also a concern that an over-reliance on technology might lead to a loss of emotional interaction or expression. Therefore, future implementations of SIT must balance technological advancements with the human touch of care.

By employing CiteSpace Software, we observed a significant bursting in the frequency of certain keywords, revealing three evolving research trends: shifting from whole-body recognition to precise feedback, expanding from physical to mental health, and moving from technical validation to user experience enhancement. Initially, the focus was on whole-body recognition, with keywords like "movement (2008)" and "system (2014)" highlighting early efforts to roughly monitor basic activities and physical functions in the elderly. Over time, technological progress has allowed for a shift towards precise feedback mechanisms, as evidenced by the rise of keywords such as "gait analysis (2020)" and "machine learning (2021)", indicating a demand for more precise motion capture and personalized feedback. Concurrently, research has expanded its scope from physical health, emphasizing "muscle strength (2015)" and "stability (2016)" to encompass mental health, as seen in the increasing bursting of keywords like "therapy (2020)" and "dementia (2021)". This broadening scope reflects a comprehensive approach to health management, addressing not only the physical capabilities but also the psychological well-being of the elderly. Furthermore, the transition in SIT research has moved from technical feasibility, as indicated by "randomized controlled trial (2014)" and "validity (2015)", towards enhancing user experience, with a growing interest in "game (2021)" related interventions. This shift underscores the importance of user-friendliness and practicality in home environments, improving therapeutic experiences, and extending SIT's applications beyond clinical settings to enhance accessibility and convenience for elderly users. The emerging trends in SIT suggest several implications for future clinical practices. These include providing comprehensive care for the older adults, from disease screening to ongoing health monitoring. SIT advancements are also expected to alleviate the burden on healthcare staff through remote nursing and to enhance healthcare access for elderly patients, especially those with mobility challenges or living in remote areas. Moreover, the integration of SIT with technologies such as VR and AI is set to broaden its application scenarios, innovate intervention pathways, and foster the development of user-friendly systems that integrate care seamlessly into the daily lives of the older adults.

5. Limitations

There are some limitations to this study. First, this study may exhibit language bias, as it was restricted to English-language literature, thereby narrowing its scope. Secondly, the data used for analysis were extracted only from WoSCC and did not include data from other search engines such as Scopus, PubMed, or Google Scholar, potentially impacting the results.

6. Conclusions

This bibliometric analysis of 1,019 publications from the WoSCC database confirms a significant and accelerating trend in scholarly interest in SIT for geriatric care, primarily driven by developed countries. The identified research clusters focus on early warning systems for crises, somatic condition analysis, rehabilitation enhancement, and psychosocial support, highlighting SIT's critical role in advancing intelligent medical care and improving the overall health of older adults. This field has evolved from rough physical health monitoring to a more holistic and user-friendly approach to mental health monitoring. SIT holds immense potential in advancing intelligent healthcare and improving the well-being of older adults. It is recommended that an increasing number of researchers and healthcare providers continue to advance SIT, positioning it as a vital assistive tool in the health management of the older adults globally.

CRediT authorship contribution statement

Changle Pei: Methodology, Formal analysis, Investigation, Writing - Original Draft, Writing - Review & Editing, Data curation, Visualization. **Weibo Lyu:** Conceptualization, Writing - Review & Editing, Supervision, Project administration, Funding acquisition. **Jingxia Liu:** Methodology, Validation, Formal analysis, Investigation, Resources, Data curation, Writing - review & editing. **Yan Wang:** Methodology, Validation, Formal analysis, Investigation, Resources, Writing - review & editing. **Wenjia Ye:** Methodology, Validation, Formal analysis, Investigation, Resources, Writing - review & editing. **Zhou Zhou:** Methodology, Validation, Formal analysis, Writing - review & editing. **Kangyao Cheng:** Conceptualization, Methodology, Supervision, Project administration, Funding acquisition, Writing - Review & Editing.

Data availability statement

The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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Declaration of competing interest

The authors have declared no conflict of interest

Appendices. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ijnss.2024.10.009.

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