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Visual Analysis of Hip Fracture Complicated with Sarcopenia based on Citespace

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Abstract: ***Objective:*** *To analyse the research hotspots and trends of hip fracture complicated with sarcopenia.* ***Methods:*** *The Web of Science Core Collection database was searched from 1 January 2013 to 31 December 2023, and the relevant literature on hip fracture complicated with sarcopenia was searched, with CiteSpace 6.4.R 4 software used for data processing and analysis. Publication trends, keyword co-occurrence and clustering, and emergent word analysis were used to draw a map.* ***Results:*** *A total of 591 articles were retrieved from the Web of Science Core Collection, and the number of papers published in the field of hip fracture complicated with sarcopenia increased year by year. Currently, the research hotspots in this field mainly focus on the identification and diagnosis of hip fracture complicated with sarcopenia, the early intervention and management of key populations, and the promotion of rapid recovery in patients.* ***Conclusion:*** *In recent years, more attention has been paid to the field of hip fracture complicated with sarcopenia both domestically and internationally, and artificial intelligence technology (AI) has played an active role in this field, becoming a frontier trend in research. Predicting individuals with sarcopenia through AI reduces the incidence of hip fracture and sarcopenia. It is of great significance to guide patients with hip fracture and sarcopenia in utilising nursing applications for personalised care and rehabilitation treatment, thus reducing or even preventing the occurrence of sarcopenia. This is of great significance for improving the health level of the elderly population, enhancing the quality of life of older individuals, and achieving healthy aging.*

Keywords: Hip fracture, Sarcopenia, CiteSpace, Visual analytics.

1. Introduction

Hip fracture is a common type of fracture in the elderly, characterised by a high disability and mortality rate, with common types of hip fractures including femoral neck fracture, intertrochanteric fracture, and subtrochanteric fracture [1]. A scoping review suggests that sarcopenia may be associated with adverse outcomes such as longer hospital stays, increased rates of non-home discharge, and increased mortality in older patients with hip disease [2]. The two are among the influencing factors for the healthy life of the elderly. To analyse the research status, research hotspots, and future research trends of hip fracture complicated with sarcopenia more comprehensively and accurately, this study employed Citespace 6.2 R3 software to analyse the relevant English literature in the Web of Science core collection database, hoping to understand the cutting-edge theories, innovative ideas, and new medical technologies in the field of hip fracture complicated with sarcopenia, and provide valuable reference and insights for the research in the field of hip fracture complicated with sarcopenia in China.

2. Information and Methodology

Data sources and retrieval strategies The web of science core collection was used as the search database, and the search query (TS=(sarcopenia OR sarcopenias OR sarcopenic)) AND TS=(hip fracture OR intertrochanteric fracture OR femoral neck fracture OR subtrochanteric) was used in the advanced search fracture OR trochanteric fracture). The search period was set from 1 January 2013 to 31 December 2023.

2.1 Inclusion and Exclusion

2.1.1 Inclusion Criteria

(1) Relevant literature on the topic of "hip fracture complicated with sarcopenia"; (2) English language.

2.1.2 Exclusion Criteria

(1) Exclusion letters; (2) conference papers; recurring publications; (3) Literature that cannot be analysed due to lack of information such as author and year.

2.2 Data Collection and Analysis

2.2.1 Data Collection

In the Web of Science Core Collection, the retrieved bibliographic information is exported in plain text format, and the record content is selected as "Full Record and Cited References". CiteSpace6.2.R3 software was used to select and remove duplicates and save deduplicated records, and 591 articles were finally included.

2.2.2 Data analysis

CiteSpace software was used to visually analyse the relevant literature. CiteSpace 6.2.R3 software parameter settings: The time is set from January 2013 to December 2023, the time slice is divided by 1 year, the node filter mode is g-index, k=25, and other parameters are set by default. The importance of intermediary centrality in the network graph is expressed by intermediary centrality, and the intermediary centrality >0.1 is the key node, and the node types include country/region, institution, and keyword. The higher the frequency, the larger the node and font, and the connection represents the close connection. This paper draws a knowledge graph and interprets and analyses it from the aspects of the number of publications, countries, institutions, cited journals, cited literature, keyword co-occurrence, clustering, and emergent words.

3. Results

3.1 Statistical Analysis of Annual Publications

A total of 591 articles were included in the literature in the field of hip fracture complicated with sarcopenia from 1 January 2013 to 31 December 2023. The number of publications in the field of hip fracture and sarcopenia showed an overall increase, with the largest number of papers published in 2022 (n=98). (See Figure 1)

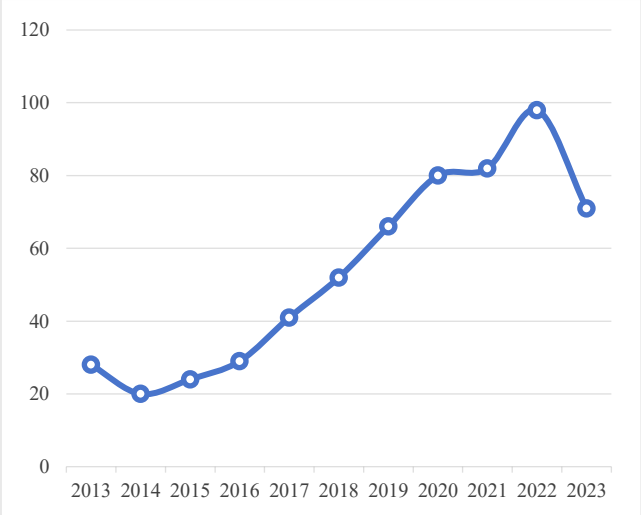

Figure 1: Trend of literature published on hip fracture complicated with sarcopenia

3.2 Analysis of National and Institutional Cooperation Networks

The analysis of national partnerships in related articles on hip fracture complicated with sarcopenia (Figure 2) shows that the number of nodes in the atlas is 54, the number of connections is 179, and the density is 0.1251.

The top three countries in terms of centrality are the USA, England, and Germany; As shown in Figure 3, the number of nodes in the graph is 292, the number of connections is 1089, and the density is 0.0256. The top three in terms of centrality are Inserm, USDA, and Hospital Universitario Ramon y Cajal.

The top three countries in terms of the number of published articles are the United States, Italy, and China; The top three institutions by the number of papers published are the University of Melbourne (28 papers), the Australian Institute for Musculoskeletal Science (24 papers), the Pennsylvania Commonwealth System of Higher Education (23 papers), and the University of Pittsburgh (23 papers). It can be seen that research in the field of hip fracture complicated with sarcopenia in the United States is more prominent, and cooperation between regions and institutions is closer. However, China is also at the forefront in terms of the number of papers published, and in the future, it can deepen exchanges and cooperation with international research institutions and enhance the influence of international research fields.

Figure 2: National co-occurrence map

Figure 3: Institutional co-occurrence map

2.4 Co-citation Analysis

According to the cited literature atlas (Figure 4), there are 474 nodes, and there are 474 cited articles in the field of hip fracture complicated with sarcopenia, and the top 10 cited articles are shown in Table 1. There are 497 nodes and 3987 nodes in the cited journal map, and the top 10 journals are shown in Table 2.

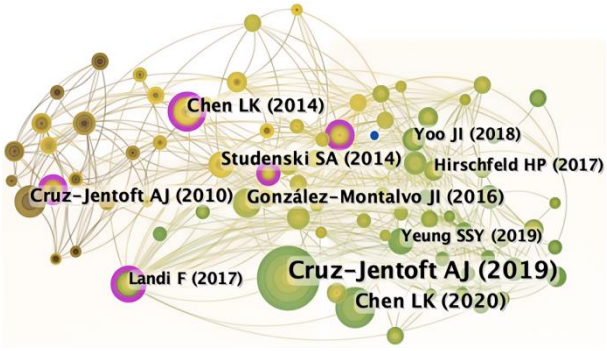

Figure 4: Atlas of Cited Literature

Table 2: Top 10 cited journals

ranking	Citation frequency	Name of the journal
1	453	OSTEOPOROSIS INT
2	405	AGE AGEING
3	380	J GERONTOL A-BIOL
4	353	J AM GERIATR SOC
5	343	J AM MED DIR ASSOC
6	312	J BONE MINER RES
7	270	BONE
8	249	PLOS ONE
9	234	J NUTR HEALTH AGING
10	229	CLIN NUTR

Table 1: Top 10 Cited Articles

ranking	author	year	Number of citations	The name of the document
1	Cruz-Jentoft AJ	2019	136	Sarcopenia: revised European consensus on definition and diagnosis
2	Chen LK	2020	56	Asian Working Group for Sarcopenia: 2019 Consensus Update on Sarcopenia Diagnosis and Treatment
3	Cruz-Jentoft AJ	2010	43	Sarcopenia: European consensus on definition and diagnosis
4	González-Montalvo JI	2016	41	Prevalence of sarcopenia in acute hip fracture patients and its influence on short-term clinical outcome
5	Studenski SA	2014	37	The FNIH Sarcopenia Project: Rationale, Study Description, Conference Recommendations, and Final Estimates
6	Chen LK	2014	36	Sarcopenia in Asia: Consensus Report of the Asian Working Group for Sarcopenia
7	Landi F	2017	31	The association between sarcopenia and functional outcomes among older patients with hip fracture undergoing in-hospital rehabilitation
8	Yeung SSY	2019	30	Sarcopenia and its association with falls and fractures in older adults: A systematic review and meta-analysis
9	Yoo JI	2018	30	Osteosarcopenia in Patients with Hip Fracture Is Related with High Mortality
10	Hirschfeld HP	2017	27	Osteosarcopenia: where bone, muscle, and fat collide

2.5 Keyword Analysis

2.5.1 Keyword co-occurrence analysis

Keywords are commonly used search terms in scientific research academic literature retrieval, which are the focus of the discussion of the literature research centre and its connotation, and are used to express the subject content of the literature and reflect the discipline structure of the literature. According to the keyword co-occurrence analysis graph (Figure 5), there are 376 nodes and 2848 node connections in 591 articles, with a density of 0.0404. In the literature in the field of hip fracture complicated with sarcopenia, the top three frequency were hip fracture (296 times), sarcopenia (227 times), and bone mineral density (142 times), and the top three keywords of centrality were vitamin D (0.09), skeletal muscle (0.08), and body mass index (0.08).

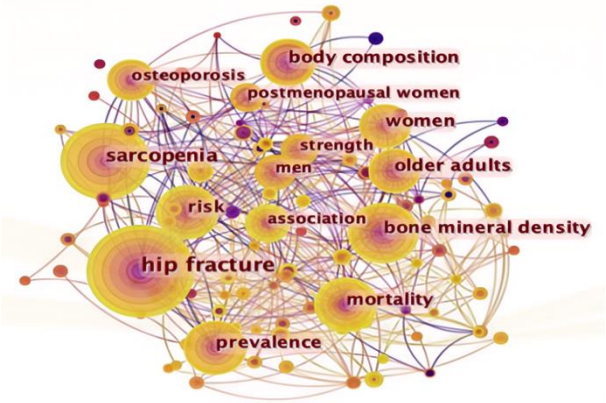

Figure 5: Keyword co-occurrence map

Table 3: Top 10 high-frequency keywords

ranking	fequency	Centrality	keyword
1	296	0.01	hip fracture
2	227	0.02	sarcopenia
3	142	0.04	bone mineral density
4	111	0.07	women
5	111	0.03	prevalence
6	107	0.03	risk
7	105	0.05	body composition
8	99	0.05	mortality
9	94	0.05	older adults
10	87	0.03	osteoporosis

2.5.2 Keyword cluster analysis

After the keyword co-occurrence analysis, the keyword clustering analysis was carried out, and the keyword clustering map (Figure 6) was shown, and the modularity was the module value Q=0.3188>(0.3), indicating that the clustering result structure was significant, and the silhouette was the average contour value S=0.69792>(0.5), indicating that the clustering performance was reasonable. The results of this study showed 8 clusters, #0 activities of daily living, #1 testosterone, #2 hip fracture, #3 vitamin D deficiency, #4 malnutrition, #5 obesity, #6 exercise, and #7 risk factors. The main keywords included in each cluster are shown in the table below.

Figure 6: Keyword clustering map

Table 4: Keyword clustering and clustering of main keywords

Cluster number	Number of nodes	Profile value	year	keyword
#0	65	0.619	2018	Activities of daily living, rehabilitation, cognitive impairment, clinical pathways, geriatrics
#1	56	0.701	2016	testosterone, muscle weakness, physical function, vitamin d, muscle mass
#2	54	0.720	2016	hip fracture, skeletal muscle mass, ageing, lean mass, adipose tissue
#3	53	0.610	2019	vitamin d deficiency, muscle strength, functional outcomes, osteoarthritis, fracture prevention
#4	45	0.735	2016	malnutrition, density, strength, cross-sectional area, psoas muscle index
#5	43	0.765	2017	hip fracture, obesity, dual-energy x-ray absorptiometry, risk factors, long-term care
#6	29	0.724	2015	exercise, obesity, physical activity, health, questionnaire
7	25	0.704	2016	risk factors, fragility fracture, comprehensive geriatric assessment, postoperative delirium, tnf-alpha

2.5.3 Keyword emergence

Burst detection of keyword nodes in the field of hip fracture complicated with sarcopenia can obtain a keyword emergence map (Figure 7). In the figure, the light blue represents the keyword that has not yet appeared, the dark blue represents the keyword that has begun to appear, and the red represents the specific time when the keyword has become a hot spot in academic research. There are a total of 25 emergent keywords in this field, and the strongest strength can be seen to be skeletal muscle mass, with an intensity of 5.57, and the duration starts in 2013 and ends in 2017. At present, the emerging keywords in this field are mainly focused on outcome, people, management, and individuals, and related research contents such as postoperative outcomes and personalised management of patients with hip fracture and sarcopenia.

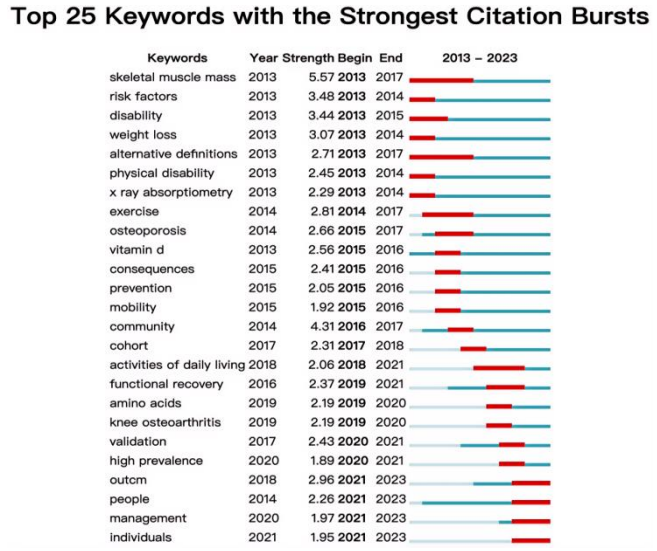

Figure 7: Keyword emergence

4. Discussion

4.1 Literature Feature Analysis

4.1.1 Analysis of the number of publications

As can be seen from the figure, the number of published articles from 2013 to 2016 was relatively stable, and the length of articles began to increase at 11-16 articles per year in 2017, with the largest number of articles published in 2022, totalling 98 articles. It is evident that research on hip fracture combined with sarcopenia has gained increasing attention. Among them, the United States ranked first in terms of the number of papers published by country and the centrality of intermediaries. Among the top 5 institutions regarding the number of papers published by institutions, the number of papers published by research institutions in the United States accounted for approximately 56.7%, indicating that research in the field of hip fracture complicated by sarcopenia in the United States is currently in a leading position, with relatively close collaboration between institutions. China ranked third in the field of hip fracture complicated by sarcopenia, with a centrality of 0.14, suggesting that the number of papers published in this field in China is relatively prominent and holds considerable influence. It is recommended that in the future development of this field, China should continue to strengthen cooperation with international research teams and persist in innovating to enhance China's international influence in the field of hip fracture complicated by sarcopenia.

4.1.2 Analysis of cited articles and journals

According to the citation analysis, the focus of the top 5 cited articles is the definition, diagnosis, treatment, and prevalence of hip fracture and sarcopenia, as well as the prognostic impact of the top 5 cited articles. In the analysis of cited journals, it can be observed that the average impact factor of the top 10 cited journals exceeds 3 points, and the relevant research literature is published in journals with high impact factors, indicating that the published literature is highly representative and innovative. Its research results have a significant guiding force in promoting the research and development of hip fractures complicated by sarcopenia, and the relevant high-frequency cited literature has also become an essential knowledge base for the research and development in this field.

4.2 Research Hotspot Analysis

Skeletal muscle is the driving force of human motor function, composed of a large number of muscle cells. Skeletal muscle, through contraction and relaxation, produces force, facilitating bone movement, including running, jumping, walking, lifting and other sports. With the progression of sarcopenia, skeletal muscle mass declines and muscle strength weakens, resulting in falls, fractures, disability, hospitalization, and even death [3]. According to the expert consensus on the diagnosis and treatment of sarcopenia in the elderly in China (2021) [4], the main parameters for the diagnosis and evaluation of sarcopenia are muscle mass, muscle strength, and physical function. Analysis of high-frequency keywords shows that the current research hotspot focuses on the diagnosis of sarcopenia, and the application of artificial intelligence in the diagnosis of sarcopenia is also becoming a research boom in this field.

4.2.1 Application of artificial intelligence in the diagnosis of sarcopenia.

4.2.1.1 Radiological methods

There are various options for diagnosing sarcopenia. In addition to basic clinical methods such as measuring muscle strength, imaging techniques such as dual X-ray absorptiometry (DXA), magnetic resonance imaging (MRI), computed tomography (CT), and ultrasound can be utilised [5]. At present, artificial intelligence technology is widely used in the field of image measurement and analysis of body composition. The skeletal muscle index (SMI) is a commonly used imaging diagnostic indicator for sarcopenia, but the identification, extraction, and evaluation of skeletal muscle requires specific software, in addition to manual division by radiographers, which is time-consuming and has a great impact on the results [6]. The combination of AI and imaging technology can effectively improve the diagnostic accuracy of sarcopenia. For example, a deep learning method using convolutional neural network algorithms can stably and automatically extract CT-derived muscle mass (L3 or L4

vertebrae level) for sarcopenia assessment, improving the clinical feasibility of imaging technology in the diagnosis of sarcopenia [7]. In fact, the concept of radiology is understood as the transformation of images into large amounts of data and may be the future of imaging assessment of myocytopenia. Until now, radiology has been mainly used in oncology to predict the prognosis of cancer patients, but the use of radiological features to facilitate the diagnosis of sarcopenia may be the subject of future research.

4.2.1.2 Non-radiological methods

Biomarkers can accurately diagnose sarcopenia. The deep neural network-based artificial intelligence model (DSnet-v1) proposed by Chung [8] used random forest (RF), extreme gradient boosting (XGBoost) and adaptive boosting (AdaBoost) algorithms to divide 27 artificial intelligence (AI) characteristic genes into three groups and perform single-cell transcriptome analysis including 17,339 genes, confirming that sarcopenia was successfully and accurately diagnosed through gene-based biomarkers. In addition, the D3-creatine dilution method is also one of the biomarkers for the diagnosis of sarcopenia [9]. The development and exploration of artificial intelligence has created more possibilities for the prevention and improvement of sarcopenia in the elderly. KIM's [10] study found that sarcopenia prediction models built using the LightGBM algorithm in the absence of medical diagnostic equipment through machine learning may help detect sarcopenia in older adults, especially in communities with access to medical resources or facilities. Sarcopenia is harmful to the health of older people, and people with both osteoporosis and sarcopenia are at increased risk of hip fracture. AI is of great significance in the diagnosis, intervention, and prevention of hip fracture complicated with sarcopenia, and it may not always be feasible to diagnose hip fracture sarcopenia according to guideline diagnostic criteria due to the influence of action, pain, and other factors. Artificial intelligence involves medical imaging, image analysis, deep learning methods, prediction model construction, etc., to help hip fracture patients quickly diagnose sarcopenia diagnosis, improve the quality of diagnosis and treatment of patients in the whole medical process, reduce patients' pain while shortening the rehabilitation cycle, improve the overall healthy living standard, and significantly reduce the cost of public health care system, which will inevitably become a research hotspot in the field of hip fracture complicated with sarcopenia.

4.3 Research Frontier Trend Analysis

According to the results of the keyword emergence, from 2021, the emergence of emergent words in this field has appeared outcome, people, management, and individuals, and the reason for the emergence of keywords is that sarcopenia has brought serious adverse outcomes to patients with hip fracture [11] and other chronic diseases [12]. The elderly and postmenopausal women are the main groups of hip fractures and sarcopenia. Age is one of the main causes of sarcopenia, and after menopause, the concentration of oestrogen in the body drops dramatically, resulting in a decline in bone and skeletal muscle function, which predisposes to osteoporosis and sarcopenia, increases the risk of hip fracture, and leads to an increased risk of hip fracture and sarcopenia [13, 14].

The treatment of sarcopenia includes drug treatment and non-drug treatment, but there is no specific drug for the treatment of sarcopenia, which shows that it is particularly important to carry out personalised management of people with sarcopenia. Resistance exercise is the primary choice of prescribing exercise [15,16]. Exercise is the focus of personalised management, but studies have shown that exercise compliance in sarcopenia groups is low [17], and the combination of AI and telemedicine methods makes up for this shortcoming, incorporating nursing guidance into the design of mobile applications, allowing patients to learn scientific nursing methods at different times and places in a flexible and easy-to-understand way, and improve their motivation for exercise. After three months of intervention, the total score of the mobile application for sarcopenia nursing guidance developed by Liang [18] increased from 4.15±2.35 to 6.65±0.85, and the patient's nursing knowledge and awareness were effectively improved. At present, there is no systematic intervention and management programme for patients with hip fracture and sarcopenia. Exploring personalised management solutions for patients with hip fracture and sarcopenia through artificial intelligence technology is the frontier trend of research in this field in the future.

5. Summary

In this study, the visualisation map constructed by CiteSpace was used to analyse the related studies in the field of hip fracture complicated with sarcopenia, and the research on hip fracture complicated with sarcopenia has received more and more attention, with the annual number of published papers showing an upward trend. Nowadays, the application of artificial intelligence technology has promoted the rapid development of the diagnosis and treatment of hip fracture complicated with sarcopenia, with the diagnosis of hip fracture complicated with sarcopenia and the intervention of key populations being research hotspots in this field. Due to the late start of research in the field of hip fracture complicated with sarcopenia in China, there is a lack of standardised, scientific and personalised management programmes in related fields, and there are still many different problems in intervention programmes. Based on artificial intelligence, machine learning is used to predict sarcopenia populations, build personalised management plans, promote multidisciplinary cooperation and exploration of artificial intelligence in the field of hip fracture complicated with sarcopenia, promote the development of the field of hip fracture complicated with sarcopenia, and lead the frontier development of research in this field.

The data analysis source in this paper is limited to the WOS core collection database, and the literature of other databases is not analysed and compared, which may make the results more limited.

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