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Visual Analysis of Nursing Research on Children with Kawasaki Disease based on CiteSpace

Xiaoli Ma[1], Ping Li[2], Xingzhu Liu[3], Na Fan[3*]

[1]DaLi University, DaLi 671000, Yunnan Province, China
[2]Meishan Pharmaceutical College, Meishan 620200, Sichuan Province, China
[3]Department of Nursing, Kungming Children's Hospital, KungMing 650000, Yunnan Province, China

[*]***Corresponding author:*** Na Fan, 2325942412@qq.com

Abstract: *Objective:* This study aims to analyze the research hotspots and trends in nursing care for children with Kawasaki disease. *Methods:* The study utilized the CiteSpace 6.1.R6 software to visualize nursing-related research on Kawasaki disease in children, drawing from articles published in the CNKI and Web of Science core collection databases from January 1, 2014, to January 1, 2024. Key analysis components included authors, institutions, and keywords, supported by the creation of a corresponding knowledge map. *Results:* Literature Publications: Over the past decade, the analysis encompassed a total of 309 Chinese articles on nursing care for children with Kawasaki disease, with an average annual publication rate of 30.9 articles. Additionally, 251 foreign language articles were scrutinized, exhibiting an average annual publication rate of 25.1 articles. Author and Institution Analysis: In Chinese literature, the notable figure of Huang Rimei emerged as a prolific author, with the Children's Hospital Affiliated with Zhengzhou University standing out as a high-yielding institution. Conversely, in English literature, the prolific authors Burns and Jane C were prominent, alongside the University of California, San Diego, which emerged as a high-yielding institution. Keyword and Research Hotspots Analysis: The focal points of research in Chinese literature revolved around continuous nursing, cardiovascular complications, clinical nursing pathways, rehabilitation effects, holistic nursing, and gamma globulin. Conversely, English literature emphasized research hotspots such as cardiovascular complications, treatment modalities, diagnostic approaches, long-term management strategies, gamma globulin therapy, steroid pulse therapy, and pediatric multisystem inflammatory syndrome. *Conclusions:* The quantity of Chinese literature concerning nursing care for children with Kawasaki disease appears comparatively scant, underscored by an uneven distribution of issuing institutions and a lack of influence. To address this, future endeavors should prioritize bolstering collaboration across diverse regions and institutions, conducting multi-center, cross-regional research, implementing clinical nursing pathways, and augmenting the continuity of care. Conversely, the upsurge in English literature publications regarding nursing care for children with Kawasaki disease signals a burgeoning interest, primarily concentrated on treatment modalities. This trend advocates for the integration of medical and nursing care and emphasizes the importance of remaining abreast of advancements in managing Kawasaki disease in children.

Keywords: Children Kawasaki disease; Bibliometrics; Visualized analysis; CiteSpace; Nursing care

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1. Introduction

Kawasaki disease (KD) is a common acute systemic vasculitis in children under the age of 5 years old. Systemic inflammatory response can lead to multiple organ dysfunction, and serious complications such as cardiovascular damage, shock syndrome and macrophage activation syndrome may occur [1]. The incidence of pediatric KD is increasing year by year worldwide, especially in Asia [2]. In Japan, the incidence rate is the highest, and the latest statistics show that the incidence rate of children aged 0–4 years old is 359/100,000. In some regions of China, the incidence rate of children aged 0–4 years old is (69–110)/100,000 [1]. KD is more common in male children and the high incidence season is spring and summer, with April–June being the most common [3]. KD causes immense suffering and burden to children and their families, including but not limited to persistent fever, generalized rash, eye redness, changes in oral mucosa, and heart inflammation. These symptoms severely impact the quality of life for children and also bring psychological and economic pressures to their families. Early identification of KD by healthcare providers, along with appropriate treatment and care, is crucial for the long-term prognosis of children [4]. Medical staff should focus on research in areas such as the determination and optimization of early identification diagnostic criteria, comparison and effectiveness analysis of different treatment options, prevention of complications, and influencing factors. This will enhance the quality of care for patients, improve recovery rates, reduce the occurrence of complications, and improve the quality of life for both children and their families. Currently, scholars like Cui (2023) have already made contributions [5]. Che (2022) made a quantitative analysis of foreign literature on KD research, and the current status and hot spots of KD research were reviewed [6]. In the past 10 years, KD research showed an upward trend, especially since the outbreak of COVID-19 in 2019, children infected with the novel coronavirus showed multiple system inflammatory syndrome, which exhibited clinical symptoms similar to KD [7]. It has attracted widespread attention from researchers. Moreover, it is worth noting that there has been a lack of systematic analysis and visualization studies on relevant literature in the field of pediatric KD care. Therefore, this study plans to use CiteSpace software for the visual analysis of research related to pediatric Kawasaki disease care. Conducting such research can help summarize previous findings, identify weak points in studies, analyze development trends and research hotspots in this area, and provide guidance and basis for further in-depth research.

2. Data and methods

2.1. Literature search and screening

Chinese Search: The search database is CNKI, the search field is “Subject” (precise), the search formula is (“Kawasaki disease” + “KD”) AND “nursing,” the search time is from January 1, 2014, to January 1, 2024, and the literature type is limited to published journal articles in Chinese. A total of 323 articles were retrieved. The screening of these articles was independently conducted by two researchers with relevant background knowledge and experience within the research team. They read the abstracts and full texts of the articles and screened them according to pre-set inclusion and exclusion criteria. The inclusion criteria include articles discussing pediatric Kawasaki disease nursing; content involving “Kawasaki disease (KD)” and “nursing” related topics. The exclusion criteria include articles not focusing on full texts of Kawasaki disease nursing; and content not discussing nursing methods or measures. Unrelated articles such as conference papers and newspaper articles were excluded, leaving a final total of 309 articles.

English Search: The Web of Science Core Collection database was searched, the search field is “Subject,”

and the search formula is ("Mucocutaneous Lymph Node Syndrome" OR "Kawasaki Syndrome" OR "Lymph Node Syndrome, Mucocutaneous" OR "Kawasaki Disease") AND (Nurse OR "Pediatric care" OR intervention), the search time is from January 1, 2014, to January 1, 2024, the literature type is "Article," and the language is "English." After review by researchers, and screening according to the Hena Pai standard, 251 articles were finally included.

2.2. Data analysis tools and methods

This study uses CiteSpace 6.1.R6 for visualization analysis. CiteSpace is a visualization software developed by Professor Chen Chaomei's team, which can analyze the literature records of a certain research field from multiple perspectives and present the structure, regularity and distribution of knowledge [8]. The literature retrieved from the database, the Chinese literature incorporated in the CNKI database was exported in the Refworks format, and the English literature included in the Web of Science Core Collection database was exported in plain text format. The literature records containing Full Record and Cited References were selected to export TXT text documents. The downloaded files were renamed in the form of "download_" for unified naming and placed in the CNKI and Wos folders respectively. These data, after undergoing format conversion through CiteSpace, can be directly utilized for CiteSpace analysis. The data was imported into CiteSpace 6.1.R6 for analysis, with the time slicing set from 2014 to 2024. Since there were no publications in 2024, the software automatically set the time span to January 2014 to December 2023. The time slice (years per slice) defaulted to 1, the threshold was set to the system default of Top 50, the association strength was set to the system default value, and the pruning method was set as required according to the selected nodes. The analysis and mapping were conducted respectively with authors, institutions, and keywords as nodes.

2. Results

2.1. Document volume analysis

From January 2014 to December 2023, a total of 309 Chinese articles were published on pediatric KD care over the past decade, with an average annual publication rate of 30.9 articles. In 2017, there was one peak with 39 publications. For foreign language literature, a total of 251 articles were published on pediatric KD care, with an average annual publication rate of 25.1 articles. In 2022, there was another peak with 44 publications. Since the outbreak of COVID-19, clinical symptoms similar to KD in affected children have drawn attention from researchers both domestically and internationally, leading to an overlap in publications in 2020. An exponential line is introduced in the graph, where the fitting function results for Chinese literature are not significant, indicating a stable trend in domestic pediatric KD care research. The fitting function results for foreign language literature are more significant, suggesting an upward trend in international pediatric KD care research. The number of publications is shown in **Figure 1**.

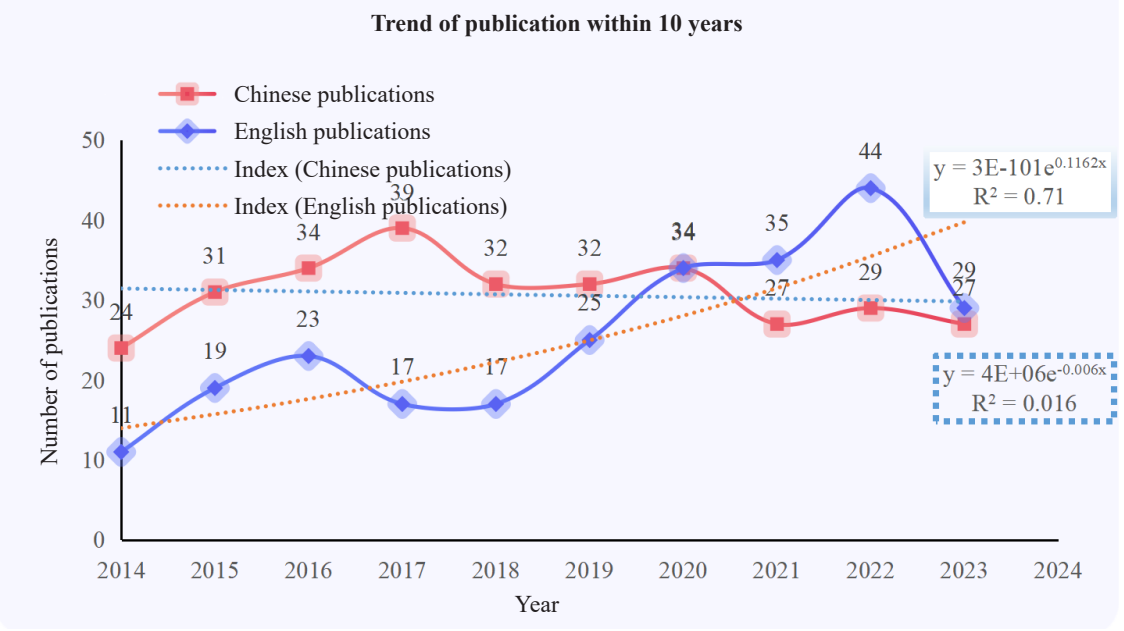

Figure 1. Analysis of the number of publications.

2.2. Author analysis

CiteSpace can generate an author network map by analyzing the author information of literature, showcasing the cooperative relationships and influence among different authors. The author network map shows that each node represents an author, with lines connecting nodes indicating collaborations between authors. Authors sharing the same color are co-authors in the same study. Among Chinese literature, the authors with the highest number of publications are represented by Huang Rimai, Zhou Chuanen, and Feng Dongling. Huang Rimai has published 5 papers, while the author team represented by Huang Rimai and Zhou Chuanen published before 2016, and Feng Donglings team has been highly active since 2022, with no evidence of collaboration among high-productivity authors; among English literature, the authors with the highest number of publications are represented by Burns, Jane C, Tremoulet, Adriana H, Newburger, Jane W, Friedman, and Kevin G. The high-productivity author Burns JC has published 12 papers, indicating collaboration among high-productivity authors, and their network maps show close interconnections (**Figure 2**).

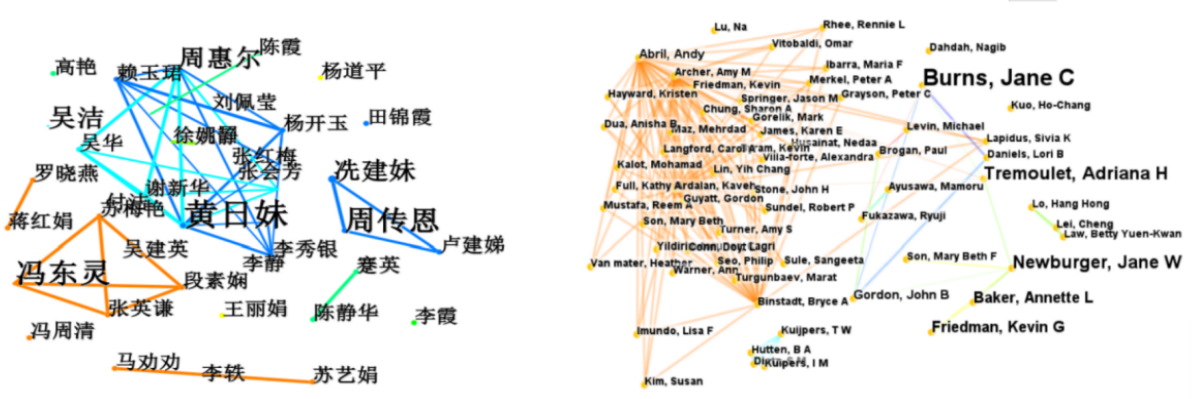

Figure 2. Analysis of authors. Chinese publications (left) and English publications (right).

2.3. Institutional analysis

By analyzing the institutional information of literature, a network map of institutional cooperation is generated to illustrate the cooperative relationships and influence among different institutions. The analysis chart of institutional cooperation in the literature shows that each node represents an institution, with connected nodes indicating collaborations between institutions. Institutions with a higher volume of Chinese literature publications include the Children's Hospital affiliated with Zhengzhou University, where closely collaborating units are mostly sister institutions, such as the Nursing Department of the First Affiliated Hospital of Zhengzhou University, Quality Control Department of the First Affiliated Hospital of Zhengzhou University, Cardiovascular Internal Medicine Department of the Children's Hospital affiliated with Zhengzhou University / Henan Provincial Children's Hospital. However, their centrality is all 0, lacking multi-center research institutions. Institutions with a higher volume of English literature publications include the University of California, San Diego, and Boston Children's Hospital, where collaborating units are more dispersed but closely connected. For detailed institutional analysis, see **Figure 3**, while for the top 5 institutions in terms of publication volume, see **Table 1** and **Table 2**.

Figure 3. Analysis of institutions. Chinese publications (left) and English publications (right).

Table 1. Top five publishing institutions of pediatric KD nursing research (WOS)

Ranking	Number of publications	Centrality	Institution
1	13	0.11	University of California San Diego
2	10	0.04	Boston Children's Hospital
3	6	0	National Cerebral & Cardiovascular Center
4	6	0.01	Northwestern University
5	6	0.02	Rady Children's Hospital of San Diego

Table 2. Top five publishing institutions of pediatric KD nursing research (CNKI)

Ranking	Number of publications	Centrality	Institution
1	4	0	Children's Hospital Affiliated to Zhengzhou University Henan Zhengzhou
2	4	0	Department of Cardiology, Hebei Children's Hospital
3	4	0	Department of Cardiovascular Medicine, Children's Hospital of Wuxi, Jiangsu Province
4	3	0	Hunan Provincial Children's Hospital
5	3	0	Children's Hospital Affiliated to Zhejiang University School of Medicine

2.4. Analysis of research hotspots

2.4.1. Keyword co-occurrence analysis

Draw a keyword co-occurrence network knowledge map, removing the same keywords related to pediatric KD care, such as Kawasaki disease in children, nursing, Kawasaki disease, and children. The keyword co-occurrence network knowledge map of Chinese literature shows that the most frequently occurring keywords are complications, gamma globulin, clinical nursing pathways, nursing interventions, continuous care, health education, nursing outcomes, comfort care, and satisfaction. Keywords with high centrality include influencing factors, anxiety, nursing interventions, complications, clinical nursing pathways, and continuous care. For English literature, the most frequently occurring keywords are diagnosis, coronary artery aneurysm, percutaneous coronary intervention, intervention, healthcare professionals, and long-term management. Keywords with high centrality are diagnosis, coronary artery aneurysm, intervention, management, and cardiovascular diseases. See **Figure 4** for the keyword co-occurrence analysis. **Table 3** and **Table 4** show the top 20 high-frequency keywords in the field of pediatric KD care research, while **Table 5** and **Table 6** show the top 10 high-frequency keywords by centrality.

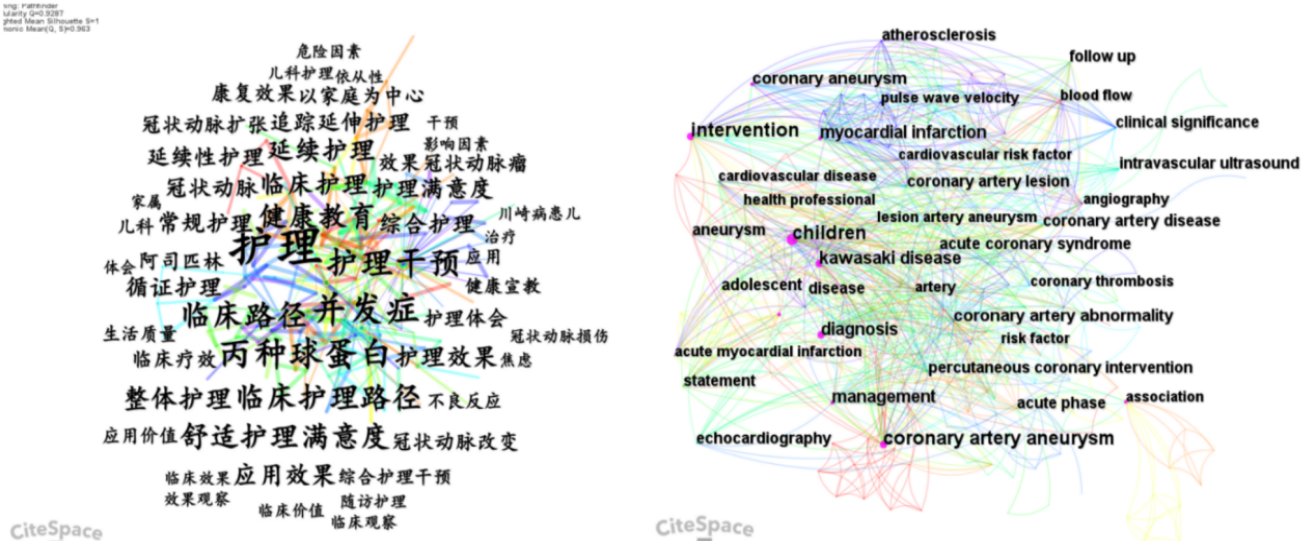

Figure 4. Keyword co-occurrence analysis. Chinese publications (left) and English publications (right).

Table 3. Top 20 high-frequency keywords in the field of pediatric KD care research (CNKI)

Ranking	Frequency	Centrality	Keywords
1	21	0.35	Complication
2	19	0.1	Gamma globulin
3	17	0.4	Nursing intervention
4	14	0.04	Clinical pathway
5	13	0.21	Clinical care pathways
6	11	0.18	Comfort care
7	11	0.12	Health education
8	11	0.33	Satisfaction
9	9	0.04	Holistic care
10	9	0.09	Continuing care
11	9	0.07	Clinical care
12	8	0.14	Nursing effect
13	8	0.13	Application effect
14	7	0.02	Nursing satisfaction
15	7	0.2	Evidence-based care
16	7	0.06	Comprehensive care
17	7	0	Routine care
18	6	0.15	Continuing care
19	6	0.14	Coronary artery
20	6	0.04	Track extended care

Table 4. Top 20 high-frequency keywords in the field of pediatric KD care research (WOS)

Ranking	Frequency	Centrality	Keywords
1	34	0.18	Diagnosis
2	27	0.15	Coronary artery aneurysm
3	26	0.11	Management
4	25	0.06	Percutaneous coronary intervention
5	20	0.12	Intervention
6	19	0.06	Coronary aneurysm
7	17	0.03	Long term management
8	17	0.03	Health professional
9	16	0.09	Myocardial infarction
10	15	0.03	Coronary artery disease
11	14	0.03	Statement
12	13	0.03	Multisystem inflammatory syndrome
13	13	0.04	Case report
14	12	0.04	Lesion
15	12	0.04	Aneurysm
16	11	0.04	Risk factor
17	9	0.04	COVID-19
18	9	0.01	Prevalence
19	9	0.05	Acute coronary syndrome
20	9	0.05	Young adult

Table 5. Top 10 high-frequency keywords by centrality (CNKI)

Ranking	Centrality	Keywords
1	0.74	Affecting factor
2	0.41	Anxiety
3	0.4	Nursing intervention
4	0.35	Complication
5	0.33	Satisfaction
6	0.29	Coronary artery aneurysm
7	0.21	Clinical care pathways
8	0.2	Evidence-based care
9	0.18	Comfort care
10	0.15	Continuing care

Table 6. Top 10 high-frequency keywords by centrality (WOS)

Ranking	Centrality	Keywords
1	0.18	Diagnosis
2	0.15	Coronary artery aneurysm
3	0.12	Intervention
4	0.11	Management
5	0.1	Cardiovascular disease
6	0.09	Myocardial infarction
7	0.07	Mucocutaneous lymph node syndrome
8	0.06	Percutaneous coronary intervention
9	0.06	Coronary aneurysm
10	0.05	Acute coronary syndrome

2.4.2. Keyword clustering analysis

Cluster ranking is based on the number of document keywords; the smaller the number, the more keywords it contains. CiteSpace provides two metrics that are modularity (Q-value) and average silhouette (S-value), to evaluate the effectiveness of graph mapping, considering both network structure and clustering clarity. Generally, a Q-value > 0.3 indicates significant clustering structure, an S-value > 0.5 suggests reasonable clustering, and an S-value > 0.7 signifies convincing clustering [8]. The knowledge graph of the keyword clustering analysis for Chinese literature shows that there are currently 8 clusters in Chinese literature, namely #0 Nursing, #1 Kawasaki disease in children, #2 Intravenous immunoglobulin, #3 Clinical pathways, #4 Coronary arteries, #5 Nursing interventions, #6 Influencing factors, and #7 Extended care. The Q-value is 0.5511, and the S-value is 0.8707; English literature has a total of 9 clusters, namely #0 Percutaneous coronary intervention, #1 Multisystem inflammatory syndrome in children, #2 Multi-scale model, #3 Long-term management, #4 Kawasaki disease, #5 Atopic dermatitis, #6 Steroid pulse therapy, #7 Intravenous immunoglobulin treatment, and #8 Fontan surgery. The Q-value is 0.4969, and the S-value is 0.8243. This indicates that the keyword clustering results for both Chinese

and foreign literature are reliable and highly credible. See **Figure 5** for the keyword clustering analysis.

Figure 5. Keyword clustering analysis. Chinese publications (left) and English publications (right).

2.4.3. Keyword time evolution analysis

The emergence time of keywords can reveal the evolution process of hot topics in pediatric KD care research. The time-evolution analysis map of Chinese literature keywords shows that nursing measures for pediatric KD have been continuously under focus from 2014 to 2023; the application effects of nursing interventions were noted from 2015 to 2023; coronary artery changes caused by cardiovascular complications due to KD gained attention from 2016 to 2023; factors affecting children with KD were highlighted from 2014 to 2023; and continuous care for children with KD has been consistently emphasized since 2016, making it a current research hotspot in pediatric KD care, including parent education, key points of care, treatment compliance, and extended services through internet platforms. The time-evolution analysis map of English literature keywords shows that long-term management has been a persistent focus from 2014 to 2023. In 2014, researchers began using intravascular ultrasound to examine cardiovascular injuries and performed percutaneous coronary intervention. In 2020, researchers introduced a new surgical technique, the great artery bypass grafting procedure, to reconstruct blood flow in children with KD coronary artery injuries [9]. Due to the outbreak of COVID-19, multisystem inflammatory response syndrome began in 2020 [10]. It has attracted attention as an inflammatory disease affecting multiple organ systems. Studies have shown that it may be associated with novel Coronavirus infection. Atopic dermatitis has been of concern from 2016 to 2022, while steroid pulse therapy and gamma globulin for KD treatment have received sustained attention from 2014 to 2022. The time evolution analysis of keywords is shown in **Figure 6** and **Figure 7**.

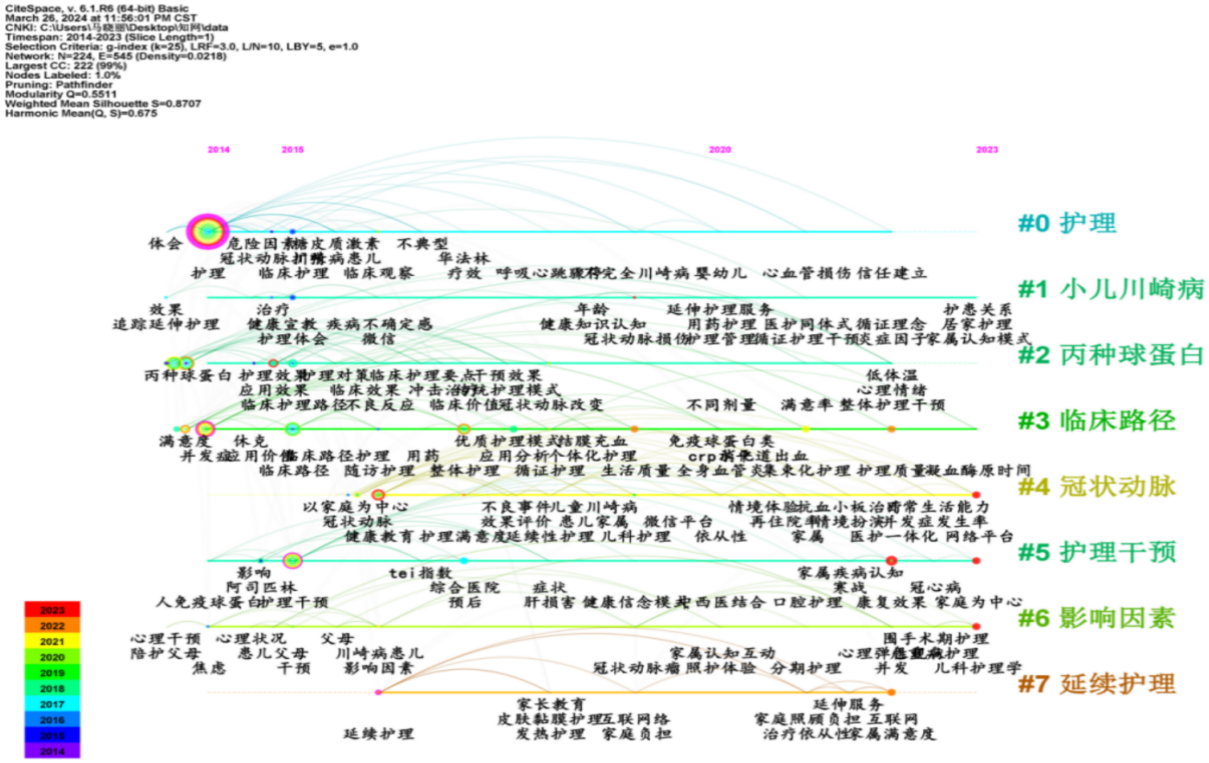

Figure 6. Time evolution analysis of keywords (Chinese publications).

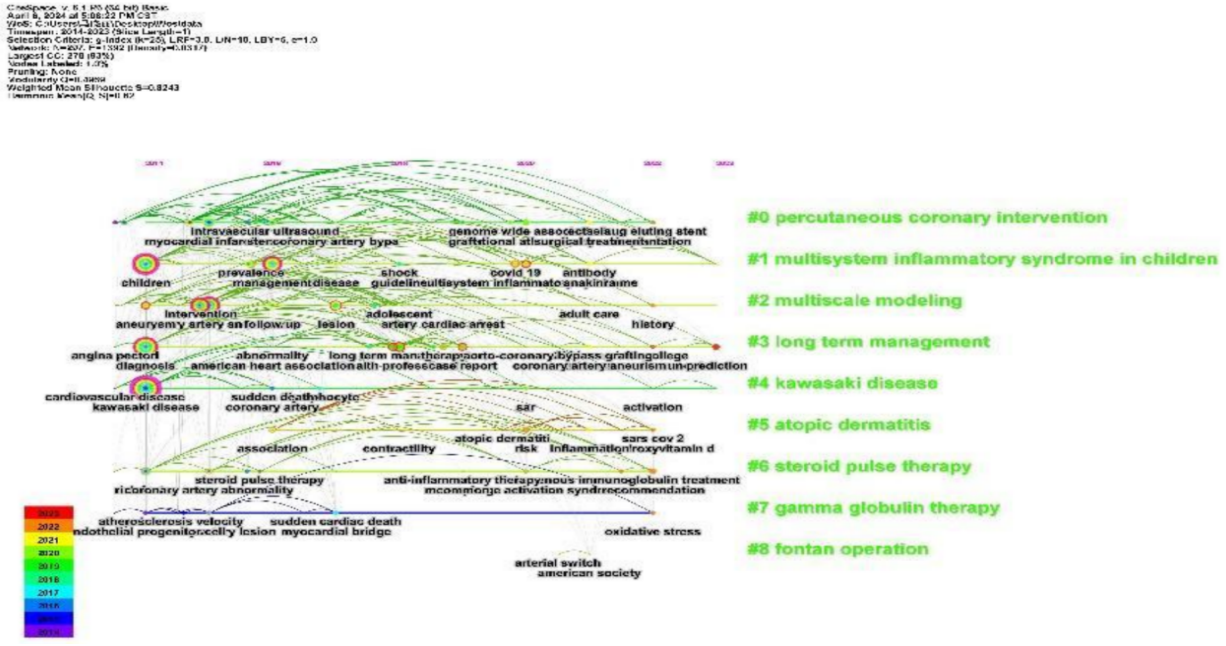

Figure 7. Time evolution analysis of keywords (English publications).

2.4.4. Keyword analysis

Keyword emergence can help analyze the development frontiers in pediatric KD care (**Figure 8**). The red area indicates the time periods when emergent words appear, clearly and intuitively showing the sustained attention

and development trends of different keywords. A total of 15 emergent words were identified from Chinese literature, among which coronary artery changes are common complications in pediatric KD [11]. It should be classified as one category. The cardiovascular complications of KD mainly include coronary artery dilation, valve disease, coronary artery aneurysm, giant coronary artery aneurysm, coronary artery stenosis and acute myocardial infarction [12]. In the early stages of research, emergent terms in clinical nursing and nursing experiences mainly reflected the practical experience and case reports of healthcare professionals. These experiences were of great significance for inspiring and guiding the research. As the research progressed and expanded, academic studies gradually evolved from case reports to more systematic research papers. In this process, terms such as clinical nursing and nursing experiences may be gradually replaced by more specific and scientific terminology. In actual clinical practice, as patients' families' demand for nursing services continues to rise, medical institutions and nursing staff also need to adjust and improve their nursing models continuously. Nursing personnel began to focus on the needs of patients' families to better meet high-quality patient care. New nursing models and concepts have emerged with the deepening and development of research in disease nursing. The emergence of follow-up care may indicate that healthcare professionals have discovered more effective nursing methods in practice, which need to be discussed and promoted in academia. Complications and continuity care received attention in 2019 and have continued to this day. English literature analyzed a total of 25 emergent terms, among which the diagnosis, clinical symptoms, and treatment of cardiovascular complications have always been key areas of focus for researchers. Since the outbreak of COVID-19, the clinical symptoms of KD-like conditions have attracted significant attention from researchers, leading to a research boom from 2020 to 2022The research frontier of the tide is a multi-system inflammatory syndrome and intravenous immunoglobulin, which has certain reference values.

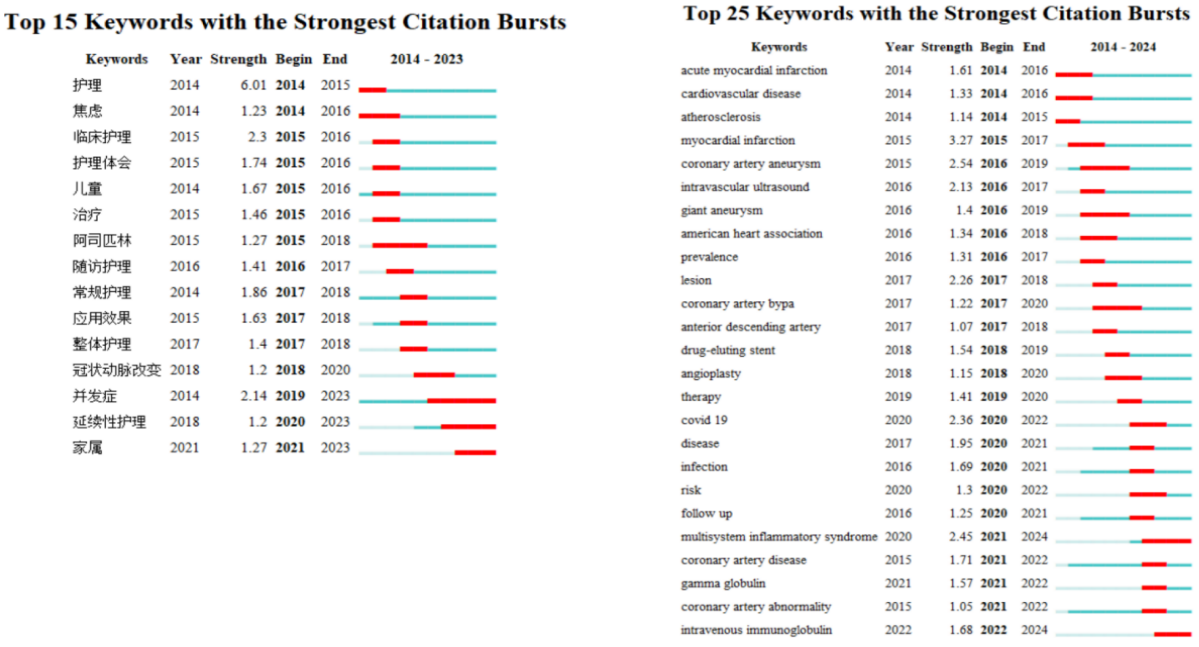

Figure 8. Keywords with citation bursts. Chinese publications (left) and English publications (right).

3. Discussion

3.1. Current status of nursing care for children with Kawasaki disease

Childhood KD is a common systemic vasculitis in infants and young children, and its incidence has been increasing in recent years. However, diagnosis, treatment and nursing still face challenges [13]. In terms of early diagnosis, there are difficulties because of the diverse clinical manifestations and atypical initial symptoms, which can be misdiagnosed or missed. Such children are called incomplete Kawasaki disease [14]. The key to early care is to control the progression of the disease and prevent complications. However, due to the difficulty in diagnosis, the accuracy and timeliness of early care are challenged. If timely treatment and care are not provided, KD may lead to serious complications such as coronary artery lesions and myocarditis. Coronary artery damage caused by KD has become one of the common causes of acquired heart disease in children, even endangering the lives of children [15]. Currently, in clinical practice, intravenous immunoglobulin combined with aspirin and anti-inflammatory drugs is primarily used to treat KD patients, which helps alleviate symptoms, suppress inflammatory responses, and prevent complications. After the acute phase of treatment, children still require long-term follow-up care, which faces numerous challenges, including continuous monitoring of their condition, medication management, and preventing complications. To effectively address these challenges, it is necessary to enhance healthcare providers' early recognition and diagnosis of KD and establish standardized care protocols; additionally, establishing a comprehensive follow-up care system is also crucial to improve treatment outcomes and quality of life for patients.

3.2. Authors and institutions of pediatric Kawasaki disease nursing

The analysis of authors and institutions in the field of pediatric KD care shows some key characteristics. In Chinese journals, there are relatively few core articles on pediatric KD care, and the overall trend of publications is stable, with insufficient influence. Among high-producing authors, Huang Rimai is the most prominent [16–21], which is represented by Zhengzhou University Children's Hospital, which is a representative of the main research direction of integrated nursing services in hospitals and communities. Despite a high volume of publications, there is a lack of extensive collaboration between authors and publishing institutions, mostly among sister units, indicating a lack of centrality. In contrast, in English literature, Burns JC is among the most prominent ones [22–25]. He is a highly influential author, primarily focusing on the treatment and long-term management of cardiovascular complications in KD. He collaborates with multiple authors and institutions on multicenter projects, consistently producing research outcomes in recent years. The visualization analysis of author institutions reveals that overall, research on pediatric KD care in Chinese journals still needs to be strengthened, with low centrality in related studies. More institutions and authors need to participate to foster more collaboration and exchange. In the future, research in pediatric KD care can enhance cooperation between authors and institutions, increasing the centrality and impact of studies. At the same time, it is necessary to guide more experts and scholars to focus on the field of KD care, working together to improve diagnostic and therapeutic standards, and providing better support and outcomes for children with KD.

3.3. Trends in nursing care of children with Kawasaki disease

A key indicator of development trends is the frequency of keywords [26]. The keywords of the Chinese literature on KD all revolve around nursing. First, with increasing societal attention to children's health and continuous advancements in medical technology, more precise and efficient diagnostic tools and methods for early diagnosis of KD may emerge in the future, helping healthcare professionals detect and treat the condition earlier. Second,

as information technology develops and patient needs change, early tracking has gradually shifted towards personalized extended care and internet-based extended care [27–29]. This may include clinical care pathways [30,31], further optimization, as well as the use of information technology to provide telecare support [32]. To make it easier for parents of children with KD to access medical resources and information, research on the factors affecting complications of KD and nursing care will become a future focus. As understanding of subsequent impacts such as cardiovascular complications in KD deepens, nursing staff will place greater emphasis on preventing and treating complications to reduce health risks for children, while also promoting a family-coordinated care model [33]. The promotion and application will become a crucial direction for future nursing care. Through home-based care guidance and support, it helps patients and their families better cope with the disease and rehabilitation process. Moreover, as people place greater emphasis on health management and prevention, preventive nursing will become an essential part of future KD care. By enhancing health education and awareness campaigns, public understanding of KD can be improved, and the importance of follow-up visits can be recognized, which is expected to effectively reduce the incidence and complication rates of KD. The future development trends in KD care will focus on improving diagnostic and therapeutic levels, optimizing nursing services, increasing attention to complications, and promoting the implementation of preventive nursing measures, providing more comprehensive and effective support and protection for children's health.

4. Summary

This study, due to the limitations of CiteSpace software, has specific requirements for database and literature format, only including information from CNKI and Web of Science core collection databases. This may lead to incomplete information bias when analyzing domestic and international literature. However, through this study's visual analysis of pediatric KD care literature, reliable, true, and objective data information has been obtained, providing a reference for future research directions and offering valuable insights for further standardizing pediatric KD care. In the future, cooperation between different regions and institutions should be strengthened, conducting multicenter, cross-regional studies, implementing clinical care pathways, and improving continuity of care. This will help reduce severe complications of KD, promote integration of medical and nursing practices, and advance long-term management in line with current trends, all contributing to better outcomes for patients.

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Disclosure statement

The authors declare no conflict of interest.

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