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Trends in Health Education Provision in Chronic Kidney Disease Patients A Bibliometric Analysis

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Abstract

Chronic kidney disease (CKD) is characterized by a gradual decline in kidney function due to kidney damage, necessitating patient education. Education helps patients understand and manage their condition, follow treatment plans, and prevent complications. Nurses are key in delivering education and support to improve patient's quality of life. This research contributed to understanding trends in CKD patient education through bibliometric analysis, aiming to support the development of more effective interventions. The study used the Scopus database to identify publications related to dialysis and depression from 2004 to 2024. A total of 200 relevant publications were analyzed using VOSviewer software version 1.6.20. The analysis included visualization, keyword co-occurrence, and trends in health education research. The United States emerged as the top contributor, with 72 publications (36%). The interventions frequently discussed included health education, self-care, and patient education. This article provides a comprehensive overview of global trends in CKD patient education. It presents overall findings and highlights key themes such as the shift toward patient-centered education, the growing use of digital tools in health education, and the importance of early-stage interventions to enhance patient outcomes.

Keywords: *Bibliometric Analysis; Chronic Kidney Disease; CKD; Health Education*

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1. Introduction

Globally, chronic kidney disease (CKD) has become one of the leading causes of death and serious illness in the 21st century, with millions of people living with the disease (Macrae et al., 2021). CKD is an evolving condition that is often exacerbated by other diseases, such as diabetes, high blood pressure, and cardiac disorders, further worsening the patient's condition (Sirimalla et al., 2023). Effective management of CKD requires an integrated approach, focusing on clinical aspects and including health education to increase patient awareness, understanding, and compliance with disease management (Kovesdy et al., 2022).

Educational programs are necessary for patients with advanced chronic kidney disease to understand treatment options for kidney failure and participate in shared decision-making (Koch-Weser et al., 2021). CKD patient education can improve patients' perception of kidney disease, improve Quality of Life (QOL), and delay the progression of kidney disease (Sarker et al., 2022). In the last two decades, the mortality rate from CKD has increased as the number of sufferers has grown globally. This has led to the importance of health education as a response to public health challenges. Previous research on health education offers insights to address this issue. At the same time, bibliometric analysis helps evaluate trends, publication distribution, author contributions, and leading journals while mapping topic development and the influence of frequently cited publications (Yuan et al., 2024).

Bibliometrics was introduced by Pritchard in 1969 and later enriched with infographics by Van Raan in 2004. With sophisticated software, scholars can quickly understand the nuances and emerging trends in a particular field, especially in the medical field (Chen et al., 2006). Thus, this study aims to explore research trends in CKD patient education through bibliometric analysis. The results of this study are expected to provide a more comprehensive insight into the dynamics of research in this field, including identifying the most influential institutions and publications and providing guidance for future research and policy development. This study contributes to understanding CKD patient education

trends through bibliometric analysis to support the development of more effective interventions. Nurses play an important role in providing education and support to patients so that they can improve their quality of life.

2. Method

In this study, a bibliometric mapping analysis was conducted. All procedures for conducting bibliometric mapping analysis in this study, including data collection, screening, extraction, and synthesis, are presented in this article. The method used is VOSviewer 1.6.20 bibliometric software. The data source used in this study is Scopus, with the analysis procedures used being co-authorship analysis, keyword co-occurrence analysis, and citation analysis (Chen et al., 2021).

Data Sources

In this article, the Scopus database was chosen as the publication source. Scopus is an abstracting and indexing database with full-text links produced by Elsevier Co (Burnham et al., 2006). Scopus is considered a more comprehensive database for bibliometric analysis and covers the social sciences and humanities. Its unique characteristics, such as author identification, improve tracking and evaluating the influence of academics on a particular topic. By offering filtering and sorting options, Scopus facilitates the discovery of relevant research (Samah et al., 2023).

Search Strategy

In this review the first literature search was conducted on the Scopus database. Scopus Engine integrated relevant words related to CKD and health education. The search strategy consisted of a combination of keywords strung together with AND and OR operators. A symbol ("") was used to narrow down the search terms. The following search formula was defined: (TITLE-ABS-KEY ("health education") AND TITLE-ABS-KEY ("chronic kidney failure") OR TITLE-ABS-KEY ("chronic kidney disease") AND TITLE-ABS-KEY ("CKD")) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , 're')) AND (LIMIT-TO (SRCTYPE , 'j')) AND (LIMIT-TO (LANGUAGE , 'English')) AND (LIMIT-TO (PUBSTAGE , 'final')). The search focused on the articles' titles, abstracts, and keywords to ensure the research was relevant to the main topic. The search process was completed on November 21, 2024, to avoid inconsistent results due to database updates.

Time Period

This study covers publications published between 2004 and 2024 to provide a complete picture of trends in health education for patients with chronic renal failure. This period was chosen because, since the beginning of 2004, health education in patients with chronic kidney disease was first published and then showed progress every year, along with the increasing need for innovative self-management approaches and health technologies (Pham et al., 2024). This publication does not specify a date range because it is important to recognize early trends in the field and when the first discussions among scholars began.

Eligibility Criteria

Inclusion and exclusion criteria were included to ensure that the analysis focused on relevant, quality publications and the focus of bibliometric research so that the analysis results are more valid and can provide a clear picture of research trends on the topic under study. Inclusion criteria: articles that discuss health education in chronic renal failure patients, written in English, all publication dates, articles in journals and exclusion criteria: articles with a publishing stage of "in press," publications in the form of books, book series, conference proceedings, and articles that are not in English.

Data Selection

In the first stage, the correct database was selected using Scopus. Then set the existing keywords, the publication time frame, and the inclusion and exclusion criteria. Then, for the search results obtained, title and abstract screening is carried out to identify relevant articles and by the inclusion criteria. Irrelevant articles were excluded during this process. Then, the relevant articles were exported in formats that support bibliometric analysis, such as RIS, to be processed with bibliometric analysis software such as VOSviewer 1.6.20 and Excel data to be extracted, including title, year of publication, author, country, institution, number of citations, journal, keywords, and references.

Data Synthesis

VOSviewer is used to create network maps that illustrate the relationships between terms identified in titles or abstracts and cross-country cooperation. VOSviewer is a free Java-based software developed by van Eck and Waltman (Van Eck & Waltman, 2014). This software is widely used for bibliographic visualization, especially for visual analysis of complex co-citation networks, such as relationships between co-authors, widely cited references, and keyword co-occurrence analysis (Chen et al., 2020). In this study, the software was used for visual analysis of country/author/institution collaboration networks, journal co-citation analysis, and keyword co-citation analysis, where node size indicates the number of publications, line thickness indicates the strength of the relationship, and node color indicates various clusters or times.

3. Results and Discussion

Evolution and growth of publications

Based on the flowchart diagram of literature selection in Figure 1, the initial search according to the

keywords on the Scopus database amounted to 255. Then, screening was carried out according to the inclusion and exclusion criteria. The total number of articles by the inclusion criteria in this article amounted to 200 articles on health education in patients with chronic renal failure from 2004 to 2024. The number is by the inclusion criteria: 165 articles and 35 reviews. The excluded articles amounted to 55.

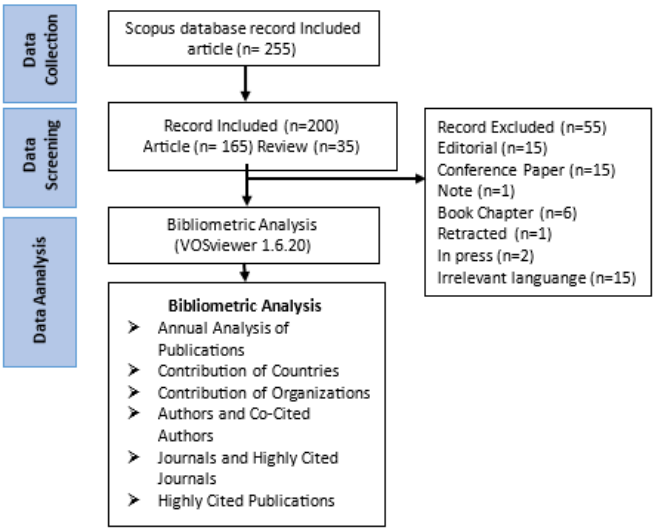

Figure 1. Flowchart of Literature Selection

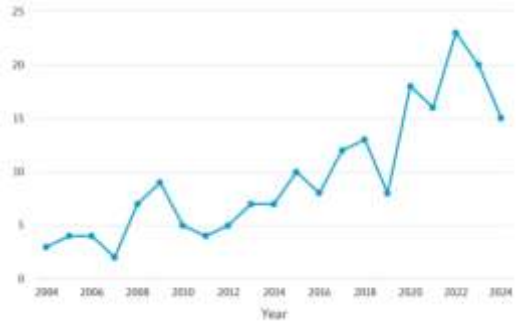

Figure 2. Document by year
Source: Scopus Data Analysis

Figures 2 and 3 present annual publications. The health education publications in chronic renal failure patients started in the first year, 2004, and the last publication was in 2024. This trend shows a significant evolution in research on health education in patients with chronic renal failure from a phase of less attention to a topic of global importance. The spike continues to increase but is unstable, reflecting technological advances and the urgent need to support patients through education-based interventions. Figure 4 shows that the blue color has 165 articles, and the red color has 35 reviews.

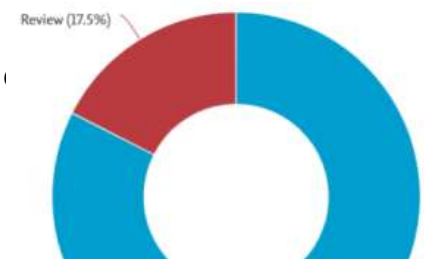

Figure 3. Document by type
Source: Scopus Data Analysis

Top Active Countries Table I and Figure 4 shows that the countries that contributed to the publication of health education in chronic renal failure patients amounted to 47. The United States reflects its leading position in research and development in this field with 72 publications with a percentage (36%) in this study. Australia ranked second with 23 publications (11.5%), followed by Canada with 20 publications (10%).

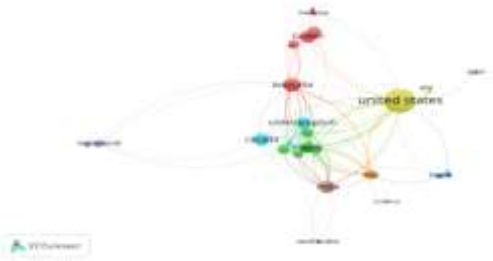

Figure 4. Visualization of the network of international research collaboration on health education in CKD among 47 countries with a minimum research output of 1 document.

Top Contributing Affiliations/Institutions

Table II analyzes the contribution of various educational and research institutions in publishing related articles. The table displays the top 10 institutions or affiliations contributing to research publications on health education in chronic kidney disease. The University of Sydney in Australia ranked first with 16 publications (8%), followed by The University of Sydney School of Public Health with 12 publications (6%). The Chinese University of Hong Kong and the University of Nigeria were ranked third and fourth, respectively, contributing 10 publications (5%). Furthermore, Prince of Wales Hospital Hong Kong and The Children's Hospital at Westmead in Australia each contributed nine publications (4.5%). Other institutions, such as Cairo University in Egypt,

Aristotle University of Thessaloniki, University General Hospital of Thessaloniki AHEPA in Greece, and Children's Hospital at Westmead, Center for Kidney Research, had eight publications each (4%). These contributions reflect these institutions' important role in developing research in health education for patients with chronic kidney disease.

Table I. 10 active countries ranked by articles on health education in GGK from 2004 to 2024

Rank	Country	Total publication	Percentage (%)
1	United States	72	36
2	Australia	23	11.5
3	Canada	20	10
4	India	20	10
5	Taiwan	18	9
6	China	15	7.5
7	United Kingdom	15	7.5
8	Nigeria	13	6.5
9	Hong Kong	12	6
10	Italy	12	6

Top Contributed Funding Sponsors

Table III shows the top 10 institutions or affiliates that contributed the most publications related to health education in chronic kidney disease (CKD) from 2004 to 2024. The National Institute of Diabetes and Digestive and Kidney Diseases from the United States ranked first with 19 publications (9.5%), followed by the National Institutes of Health (17 publications, 8.5%) and the U.S. Department of Health and Human Services (12 publications, 6%). Fourth and fifth place went to the Canadian Institutes of Health Research and the National Health and Medical Research Council from Australia, with five publications each (2.5%). Meanwhile, the Ministry of Science and Technology, Taiwan, the National Center for Research Resources, and the National Institute on Minority Health and Health Disparities contributed four publications (2%). Health Services Research and Development of the United States and Kidney Foundation of Canada has three publications (1.5%). This data reflects the significant contributions of global health institutions in advancing research related to health education in CKD.

Top Document per year by source

Figure IV shows the significant increase in publications related to health education in CKD over the last two decades. This graph illustrates how the trend of publications related to health education in chronic kidney disease (CKD) patients evolved over the analyzed period (2004-2024). The most publications on health education in patients with chronic kidney disease (CKD) occurred in 2022. Journals with high IF are important in disseminating relevant and high-impact research results.

Table III. Top 10 funding sponsors with the most publications in health education in CKD-related research from 2004 to 2024

Rank	Affiliations/ instituations	Country	Total Publication	Percentage (%)
1	National Institute of Diabetes and Digestive and Kidney Diseases	United States	19	9.5
2	National Institutes of Health	United States	17	8.5
3	U.S Departement of Health and Human Services	United States	12	6
4	Canadian Institutes of Health Research	United States	5	2.5
5	National Health and Medical Research Council	Australia	5	2.5
6	Ministry of Science and Technology, Taiwan	Taiwan	4	2
7	National Center for Research Resources	United States	4	2
8	National Institute on Minority Health and Health Disparities	United States	4	2
9	Helath Services Research and Development	United States	3	1.5
10	Kidney Foundation of Canada	Canada	3	1.5

Top Citation Analysis

Table VI shows the 10 most frequently cited publications in research on health education in chronic kidney disease (CKD) from 2004 to 2024. The article with the highest citation was by Coresh et al. (2005) entitled "Chronic Kidney Disease Awareness,

Prevalence, and Trends among U.S. Adults, 1999 to 2000," published in the Journal of the American Society of Nephrology, with 711 citations and an impact index per article of 28.7. The second most cited article was by Hsu et al. (2006) with 185 citations, discussing the low awareness of CKD in Taiwan. Other publications, such as Levey et al. (2009) and Plantinga et al. (2010), focused on public health strategies and patient and healthcare provider awareness of CKD. Some articles, such as Cockwell & Fisher's (2020), had a high impact index (77.5), although their citations were relatively low compared to others. Overall, these publications cover a range of important topics, such as family perspectives of patients, educational interventions, and the global burden of CKD, providing great insight into CKD-related health education.

Research themes in the literature on health education in patients with chronic kidney disease

Figure Based on bibliometric analysis, figure 5 presents information on health education trends in patients with chronic kidney failure (CKD). The visualization illustrates the relationship between various terms, themes, or topics frequently appearing in the relevant scientific literature. Using a color cluster approach, this map shows how the research field is divided into several main themes; the green color focuses on health education related to chronic renal failure, and the topics that appear and influence the provision of health education are the factors of "knowledge, 'aged', "patient education", and "quality of life". Blue color focuses on the medical management of chronic renal failure; the topics that appear are "hemodialysis," "kidney transplantation," "self-care" and "renal replacement therapy." The red color relates to factors that affect health conditions in chronic renal failure, namely the factors of "hypertension," "smoking," "diabetes mellitus," "health program," "prevalence," and "risk factors", "health survey", "health program", "public health", "health care access" and "follow-up."

Table IV. The top 10 journals in research related to health education in CKD

Rank	Source/Journal	Total Publication	Persentage (%)	IF	Publisher
1	American Journal Of Kidney Diseases	17	8.5	3.1	Elsevier
2	BMC Nephrology	13	6.5	0.7	Springer Nature
3	International Journal Of Environmrntal Research and Public Health	7	3.5	3.7	Multidisciplinary Digital Publishing Institute (MDPI)
4	Nephrology Dialysis Trasplantation	7	3.5	10.1	Oxford University Press
5	Advances in Chronic Kidney Disease	5	2.5	5.9	Elsevier
6	BMJ open	5	2.5	4.2	BMJ Publishing Group
7	Clincal Journal Of the American Society of Nephrology	5	2.5	11.2	Wolters Kluwer Health
8	Pediatric Nephrology	5	2.5	4.6	Springer Nature
9	Plos One	5	2.5	5.1	Public Library of Science
10	Clinical Nephrology	4	2	1.7	Dustri-Verlag

Future research direction analysis

Figure 6 is a bibliometric network visualization that illustrates the relationship between various concepts or keywords frequently appearing in chronic kidney failure research. The colors of the nodes indicate the time distribution of the studies, with purple and blue reflecting earlier studies (2014-2016), green for the middle period (2017-2018), and yellow for more recent studies (2019-2020). The largest nodes, such as "health education", "chronic kidney failure," and "hypertension", indicate keywords that appear most frequently and have many connections with other keywords. The relationships between keywords are depicted by connecting lines, where thicker lines indicate stronger relationships. This figure shows the importance of health education in chronic disease management, the role of hypertension as a significant risk factor, and the relevance of medical aspects such as dialysis, kidney transplantation, and quality of life. In addition, attention to self-care is also an important part of recent research.

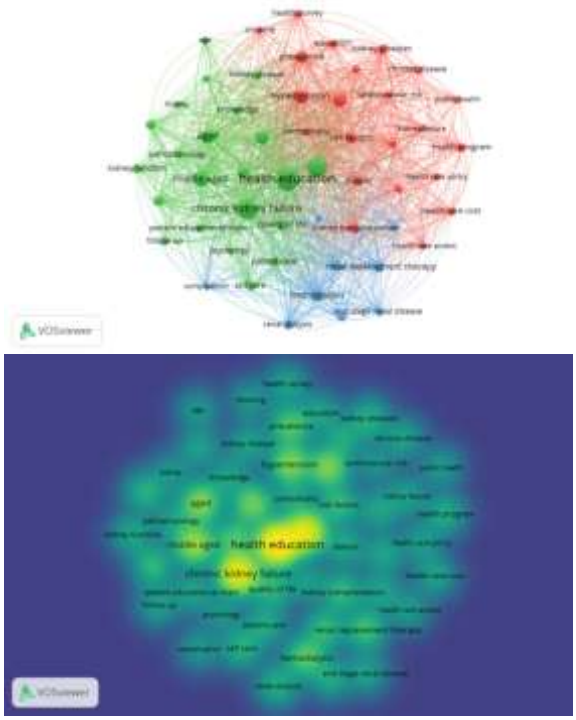

Figure 5. Density visualization map and VOSviewer overlay of keywords in the ventricular remodeling field. (A) VOSviewer keyword density visualization map. (B) VOSviewer keyword overlay visualization

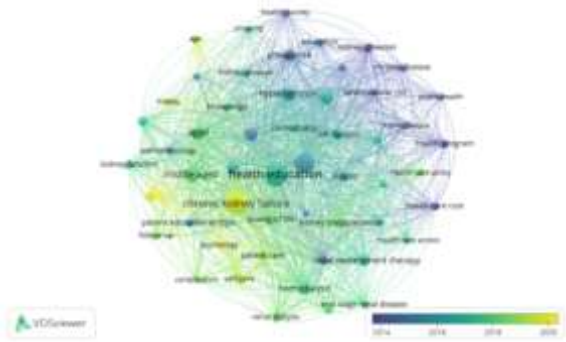

Figure 6. Map of overlay visualization analysis of terms in titles and abstracts based on frequency of appearance

Bibliometric analysis is an effective method to evaluate global research and provide insight into the development of health education in patients with chronic renal failure (Samah et al., 2023). This study comprehensively analyzed the current state of research on health education in patients with CKD using bibliometric analysis, with the help of VOSviewer 1.6.20 software, to evaluate collaboration between authors, institutions, and countries. The study graphically analyzed data trends from 2004 to 2024.

Table VI. Top 10 most cited publications in research related to health education in CKD from 2004 to 2024

Rank	Author	Tittle	Source Tittle	Country	Cited by	Impact Index per Artikel
1	(Coresh et al., 2005)	Chronic Kidney Disease Awareness, Prevalence, and Trends among U.S. Adults, 1999 to 2000	Journal of the American Society of Nephrology	United States	711	28.7
2	(Hsu et al., 2006)	High Prevalence and Low Awareness of CKD in Taiwan: A Study on the Relationship Between Serum Creatinine and Awareness From a Nationally Representative Survey	American Journal of Kidney Diseases	United States	185	8.5
3	(Levey et al., 2009)	Comprehensive Public Health Strategies for Preventing the Development, Progression, and Complications of CKD: Report of an Expert Panel Convened by the Centers for Disease Control and Prevention	American Journal of Kidney Diseases	United States	175	8.5
4	(Planting a et al., 2010)	Awareness of Chronic Kidney Disease Among Patients and Providers	Advances in Chronic Kidney Disease	United States	146	9.0
5	(Cockwell & Fisher, 2020)	The global burden of chronic kidney disease	Ethnicity and Disease	United States	132	77.5

6	(Tong et al., 2010)	Parental perspectives on caring for a child with chronic kidney disease: an in-depth interview study	Child: Care, Health and Development	United Kingdom	119	5.9
7	(Leehey et al., 2009)	Aerobic exercise in obese diabetic patients with chronic kidney disease: A randomized and controlled pilot study	Cardiovascular Diabetology	United Kingdom	115	5.9
8	(Lopez-Vargas et al., 2016)	Educational Interventions for Patients With CKD: A Systematic Review	American Journal of Kidney Diseases	United States	112	12.1
9	(Ayodele & Alebiosu, 2010)	Burden of Chronic Kidney Disease: An International Perspective	Advances in Chronic Kidney Disease	United States	106	6.2
10	(Tong et al., 2008)	Support interventions for caregivers of people with chronic kidney disease: A systematic review	Nephrology Dialysis Transplantation	United Kingdom	102	5.1

Source: The Impact Index Per Article is presented based on Reference Citation Analysis.

The data is increasing overall, although there are some fluctuations. The overall increase in the trend of health education delivery is due to the high level of public awareness contributing significantly to the effectiveness of health education provided (Ariani et al, 2020). Increasing public awareness about CKD and its complications is essential for optimal management to prevent disease progression and health complications in the long term (Lightfoot et al., 2024). In addition, the increase in education trends is also due to significant advances in mobile technology that offer potential solutions for delivering health services digitally. This new way of providing patient education can influence the increase in health education trends (Graham et al., 2023).

In this bibliometric study, the country that contributed the most to the publication of health education in chronic renal failure patients was the United States. This finding is in line with the most cited publications in research related to health education in CKD patients, namely (Ayodele & Alebiosu, 2010; Cockwell & Fisher, 2020; Coresh et al., 2005; Hsu et al., 2006; Levey et al., 2009; Lopez-Vargas et al., 2016; Plantinga et al., 2010). Furthermore, the United States stands out as the country that contributes the most publications in this study, accounting for seven out of the top ten funding sponsors who have published research on health education in CKD from 2004 to 2024. These affiliations/institutions are the National Institute of Diabetes and Digestive and Kidney Diseases, National Institutes of Health, US Department of Health and Human Services, Canadian Institutes of Health Research, National Centre for Research Resources, National Institute on Minority Health and Health Disparities, and Health Services Research and Development. Various factors have led to the United States making significant contributions to the field of education and research on CKD. One of the main reasons is strong funding from government agencies such as the National Institutes of Health (NIH), which supports research that advances the understanding and treatment of CKD (Evans et al., 2011). In addition, the National Kidney Foundation and the American Society of Nephrology are working together to advocate for increased funding for the National Institute of Diabetes and Digestive and Kidney Diseases. The long-term goal is to reduce the burden of kidney disease in the US population and improve the quality of life of patients living with it (Murray et al., 2021). This study was also primarily published in reputable journals such as the top 3 journals, namely the American Journal of Kidney Diseases, BMC Nephrology, and the International Journal of Environmental Research and Public Health.

The University of Sydney in Australia ranked as the top contributing affiliation/institution in the publication related to health education for patients with CKD. The study revealed that developed countries significantly contributed to providing health education. This trend of improving health education for CKD patients is more common in developed countries due to factors such as stronger healthcare infrastructure, better access to resources, and higher public health awareness. These countries often have well-established research institutions, funding mechanisms, and public health policies that promote educational programs. In addition, they invest in improved healthcare literacy and disease prevention, leading to a greater emphasis on patient education regarding CKD management and prevention (Luyckx et al., 2020). In addition to developed countries, developing countries have also contributed to this educational trend, as the increasing prevalence of

CKD in these regions has spurred research to address local challenges, such as limited access to specialized care, socioeconomic factors, and health disparities, driving the need for tailored educational programs (Ameh et al., 2020).

Chronic kidney disease patients need therapy to improve their quality of life. The blue cluster focuses on the medical management of chronic renal failure. Based on previous research, there are three types of kidney replacement therapy, namely Continuous Ambulatory Peritoneal Dialysis (CAPD), Continuous Renal Replacement Therapy (CRRT), and Haemodialysis (HD) (Rini et al., 2021). The red color corresponds to factors that impact health conditions in chronic renal failure, such as hypertension, health programs, and prevalence. The green hue concentrates on topics related to health education in chronic renal failure, specifically knowledge, age, and patient education. Information or education, along with factors such as knowledge, gender, and age, can significantly influence patient knowledge (Solihatin et al., 2020). Alternative education delivery is experiencing a shift from face-to-face to application-based methods, coinciding with the increasing use of technology to improve health outcomes. This transformation represents a significant shift in the delivery of health education, aligning with individual needs and evolving technological advancements (Marinho et al., 2023). Therefore, the development of trends in education provision has a significant impact on patient health and disease management.

4. Conclusions and Suggestions

This study reveals global trends in health education for chronic kidney disease (CKD) patients through bibliometric analysis. Based on the data analyzed, this study's focus topic is health education from 2004 to 2024. The number of 200 publications shows a change in the trend of education focus over time, which is a growing concern for the role of health education in managing CKD. This report proposes future research directions. Exploring and identifying the most effective educational strategies for CKD patients undergoing hemodialysis is imperative.

5. Acknowledgments

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