Trend of Artificial Intelligence in Nursing from 2004 to 2024: A Bibliometric Analysis Based on the Web of Science

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ABSTRACT

This study aims to conduct a bibliometric analysis of studies related to artificial intelligence (AI) in the field of nursing, accessed from the Web of Science database. The search was conducted using the keywords "artificial intelligence OR ChatGPT OR Chatbot AND nursing OR nursing care AND practice OR innovation OR machine learning OR deep learning" between January 1-20, 2024. A total of 164 studies related to artificial intelligence in nursing were identified through the search. It was found that 65.85% of these studies were research articles, with the majority being published in the Journal of Nursing Management (nine studies), and the highest number of studies being published in 2023. The most prolific author, with seven studies, was identified as Rozzano Locsin, while the United States was determined to be the country with the highest number of publications, and Florida Atlantic University and Tokushima University were the institutions with the most studies. The most frequently used keyword was "artificial intelligence," with a total citation count of 1010 and an h-index of 20. The study indicates an increasing interest in AI-related nursing research, particularly in recent years, with a trend toward quantitative growth.

Keywords: Artificial intelligence, bibliometric analysis, nursing

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2004'ten 2024'e Hemşirelikte Yapay Zeka Trendi: Web of Science'a Dayalı Bibliyometrik Bir Analiz

ÖZ

Bu çalışma hemşirelik alanında yapay zeka ile ilgili yapılan çalışmaların bibliyometrik analiz yöntemiyle incelenmesini amaçlamaktadır. Çalışma verilerine ulaşmak için Web of Science kullanılmıştır. Çalışma 01- 20 Ocak 2024 tarihleri arasında "artificial intelligence OR ChatGPT OR Chatbot AND nursing OR midwifery AND practice OR innovation OR machine learning OR deep learning" anahtar kelimeleri ile taranarak elde edilmiştir. Yapılan tarama sonucunda hemşirelik alanında yapay zeka ile ilgili toplam 164 çalışmaya ulaşılmıştır. Yapılan çalışmaların %65.85'inin araştırma makalesi olduğu, en fazla Journal of Nursing Management (dokuz çalışma) adlı dergide ve en fazla çalışmanın 2023 yılında yayınlandığı belirlenmiştir. En fazla çalışması olan yazar (yedi çalışma) Rozzano Locsin, en fazla yayının yapıldığı ülke Amerika Birleşik Devletleri ve en fazla çalışmanın yapıldığı kurumlar Florida Atlantic University ve Tokushima University olarak belirlenmiştir. En fazla kullanılan anahtar kelime ''artificial intelligence'', toplam atıf sayısı 1010 ve h- indeksi 20 olarak belirlenmiştir. Hemşirelik alanında yapay zeka ile ilgili çalışmalara olan ilginin gittikçe arttığı ve özellikle son yıllarda çalışmaların nicelik bakımından gittikçe artış gösterdiği saptanmıştır.

Anahtar Kelimeler: Yapay zeka, bibliometrik analiz, hemşirelik

1 Introduction

Artificial intelligence (AI) was first defined by John McCarthy as "the science and engineering of making intelligent machines, especially intelligent computer programs" (Ahuja, 2019). Additionally, AI is defined as the ability of a machine to mimic cognitive functions such as perception, reasoning, problem-solving, and decision-making of humans (Jeong, 2020). With the invention of computers and technological advancements, interest in AI-related studies has increased, and since the 1960s, AI has been used in various sectors including finance, defense industry, control systems, computer and video games, automotive, and telecommunications systems (Akgerman, Özdemir Yavuz, Kavaslar, & Güngör, 2022).

The first applications of AI in the healthcare sector began in the 1970s. AI and robotic technologies in healthcare are used for early diagnosis, decision-making, research, treatment, education, and the maintenance of health (Büyükgöze & Dereli, 2019). A wide range of technologies such as electronic health records, prescription-writing tools, telehealth, online appointment scheduling, mobile applications, medical devices, portable monitors, smart patient beds, wearable biosensors, etc., are also utilized (Şendir & Kabuk, 2020). The rapid advancement of technology and the digitalization process in healthcare also affect nursing profession and practices, which are at the forefront of healthcare services (Çobanoğlu & Oğuzhan, 2023). Nurses play a key role in shaping and guiding the evolution of modern AI in nursing. AI in nursing is widely used in care services and education, ranging from electronic health records to mobile health, telehealth, remote patient monitoring, and patient tracking sensors (Karakaya, Akyol, & Doğan Merih, 2022). AI technologies will also help nurses integrate different types of relevant data (such as environmental, genomic, health, and socio-demographic data) and enhance nurses' capacity to provide multifaceted care (Ronquillo et al., 2021). As new and improved AI tools are developed, nurses are expected to fulfill their practitioner role, ensuring continuity of care anytime, anywhere.

The integration of AI based technologies into nursing applications has led to concerns about AI replacing human-human interaction in care and disregarding care ethics, as well as fears that it will replace nurses in clinical practice (Stokes & Palmer, 2020). Technology will change the duration nurses spend on care, but the need for nurses will always continue (Robert, 2019). One of the most effective measurement techniques in evaluating the AI trend in nursing studies is bibliometric analysis. Bibliometrics enables macroscopic and microscopic analyses of a large number of publications (research and review articles, conference papers, books, book chapters, notes, letters, errata, etc.) to obtain new information (Kokol & Vošner, 2019). Bibliometric analysis can identify the most productive authors, institutions, countries, and journals within scientific disciplines, analyze the dynamics of the literature, and examine communication and collaboration patterns among authors, as well as study its history and structure (De Bellis, 2009; Kokol & Vošner, 2019; Kokol, Vošner, & Železnik, 2017). Moreover, this method also helps identify existing gaps in research disciplines or topics (Hall et al., 2018). This study aims to provide a comprehensive overview of AI research in nursing and guide healthcare professionals in their future work.

2 Methodology

This study was conducted to examine the studies related to AI in the field of nursing using bibliometric analysis method. In line with this objective, the following questions were addressed:

•What is the type and citation characteristic of the published studies?

•What are the author characteristics of the published studies?

•What are the author keywords in the published studies?

•How is the distribution of published studies over the years?

•How is the distribution of published studies by countries and institutions?

•How is the distribution of published studies by journals?

The study data was obtained by searching with the keywords "(artificial intelligence OR ChatGPT OR Chatbot) and (nursing OR nursing care) and (practice OR innovation OR machine learning OR deep learning)" between January 01-20, 2024. The obtained studies without a year limitation were recorded in the data collection form. A total of 164 studies related to AI in nursing were reached. The studies obtained from the search results were examined based on their titles and abstracts.

2.1   Data Evaluation

Bibliometric analysis method was used in the evaluation of the data. The data obtained on publication trends and citation network were analysed using Excel program. Number and percentage were used in the analysis of the data. Bibliometrics is a quantitative tool used to analyse bibliographic data and has gained popularity with its applications in various fields (Ellegaard & Wallin, 2015). Databases such as Web of Science, Google Scholar, PUBMED, Scopus, and EMBASE are used. While Web of Science, Scopus, and Google Scholar cover all scientific disciplines, PUBMED and EMBASE only cover scientific data in medical sciences (Burmaoğlu, Kıdak, Haydar, & Demir, 2016; Khare, Leaman, & Lu, 2014; Özkaya & Körükcü, 2023). VOSviewer software was used to visualize the network structure of keywords. VOSviewer is a frequently used tool to create bibliometric networks of different elements such as authors, institutions, or countries using various network analysis methods such as co-citation, keyword, and bibliographic coupling (Van Eck & Waltman, 2010). The program provides a visualization option that allows for the detailed examination of bibliometric maps and has zoom, scroll, and search functions that facilitate the detailed examination of the map (Van Eck & Waltman, 2010). In

our study, keywords, citation analysis, types of articles, distribution of studies over the years, institutions and authors with the most publications were examined through bibliometric analysis.

3   Results

When examined in terms of publications, it was determined that out of the 164 studies related to AI in the field of nursing, 65.85% were research articles, 20.12% were reviews, and 8.54% were letters to the editor. Among the included 164 studies, they were published in 103 different journals, with the highest number of publications (nine studies) being in the Journal of Nursing Management (Figure 1).
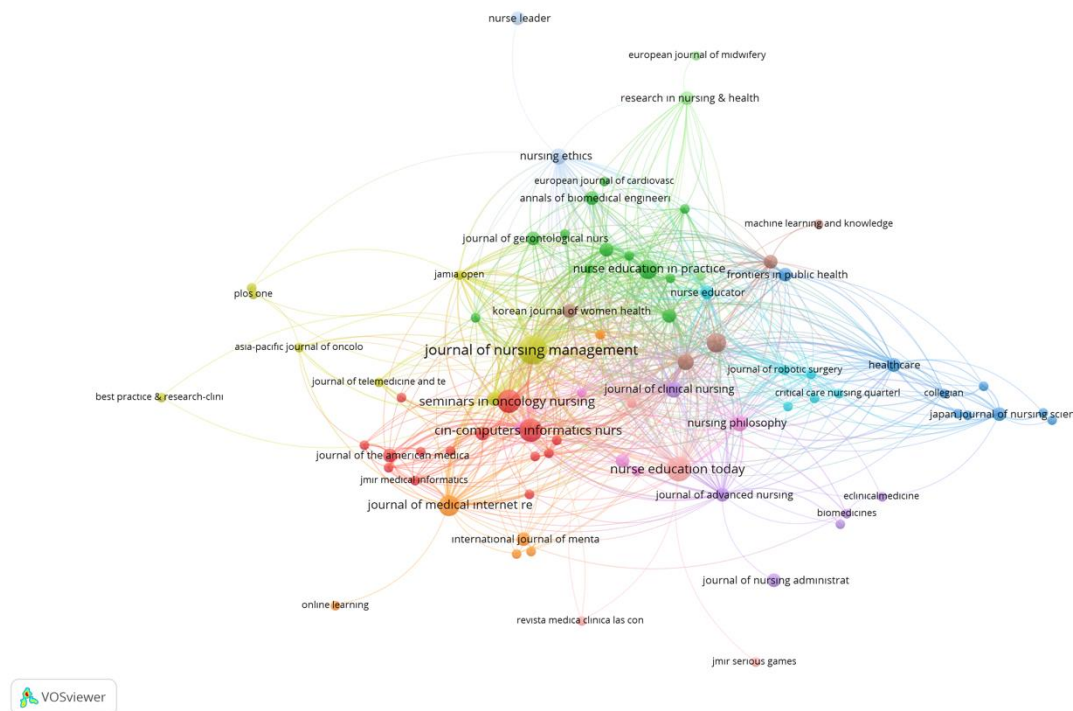

Figure 1: *Journals with the highest number of publications*

Studies related to AI in the field of nursing began in 2004, with the number of publications fluctuating between zero and one until 2017. Starting from 2017, there has been an increase in the number of publications, peaking in 2023 with the highest number of publications (Figure 2).
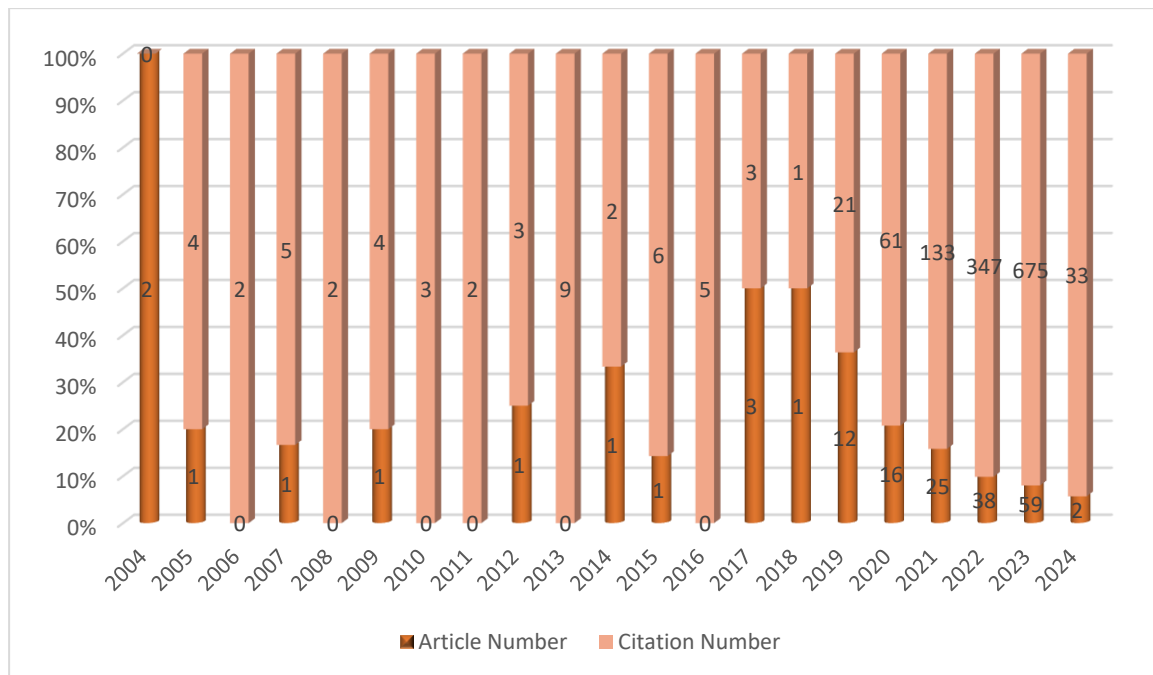
Figure 2: *Number of articles and citations over the years*

A total of 1010 citations have been made to studies related to AI in nursing, with an h-index of 20. Citations to the studies have increased proportionally with the number of publications each year. The top ten most cited studies are shown in Table 1.

Table 1: *Most Cited Articles*

Number	Name of the study	Citation Number
1	Open artificial intelligence platforms in nursing education: Tools for academic progress or abuse?	150
2	Nurse-Physician Communication Team Training in Virtual Reality Versus Live Simulations: Randomized Controlled Trial on Team Communication and Teamwork Attitudes	59
3	A Virtual Counseling Application Using Artificial Intelligence for Communication Skills Training in Nursing Education: Development Study	58
4	Can nurses remain relevant in a technologically advanced future?	53
5	Data mining as a tool for research and knowledge development in nursing	42
6	Artificial intelligence in nursing: Priorities and opportunities from an international invitational think-tank of the Nursing and Artificial Intelligence Leadership Collaborative	41
7	Development and Assessment of an Artificial Intelligence-Based Tool for Skin Condition Diagnosis by Primary Care Physicians and Nurse Practitioners in Teledermatology Practices	40
8	Artificial Intelligence -based technologies in nursing: A scoping literature review of the evidence	34
9	Promoting students' learning achievement and self-efficacy: A mobile chatbot approach for nursing training	34
10	The Co-Existence of Technology and Caring in the Theory of Technological Competency as Caring in Nursing	34

According to the analysis, a total of 164 studies related to AI in nursing were authored by 718 individuals. It was determined that the author with the highest number of publications (seven studies) is Rozzano Locsin (Figure 3).
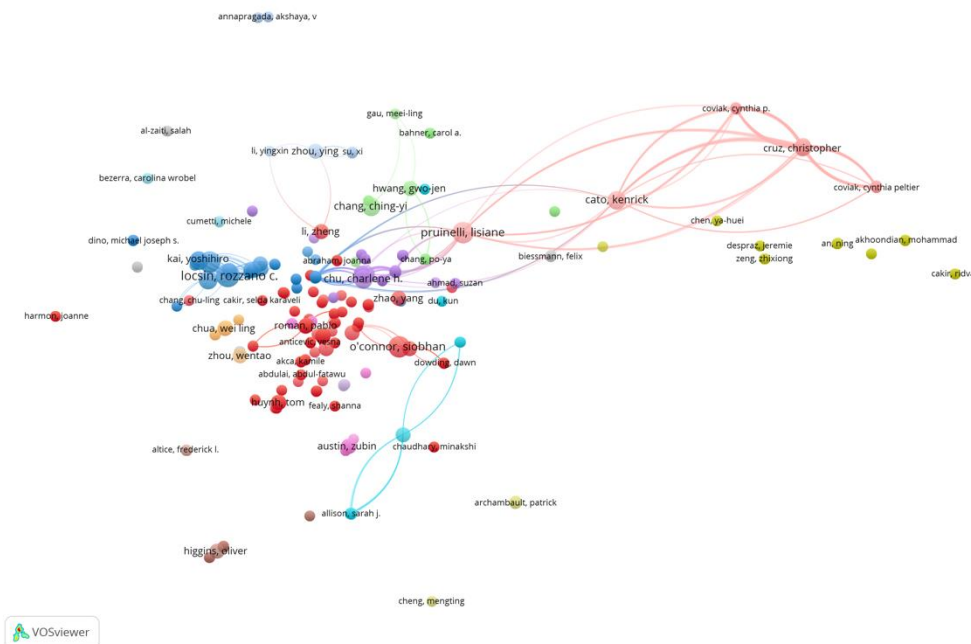

Figure 3: *Authors with the most publications*

When examined according to the institutions where the studies were conducted, it was found that a total of 387 institutions were involved in the research. The institution with the highest number of studies (seven studies each) was Florida Atlantic University and Tokushima University (Figure 4).
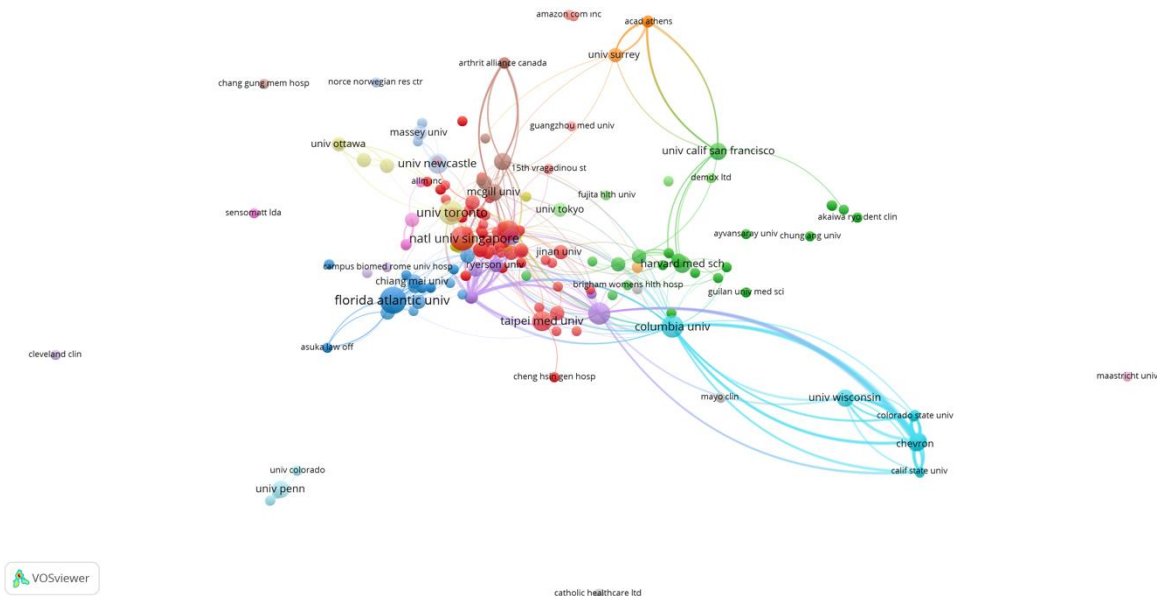

Figure 4: *Institutions with the most publications*

When examined according to countries, it was determined that 35.37% of the studies were conducted in the United States, 10.98% in China, 9.15% in Japan, 7.93% in Canada, and 36.57% in 47 different countries (Figure 5).
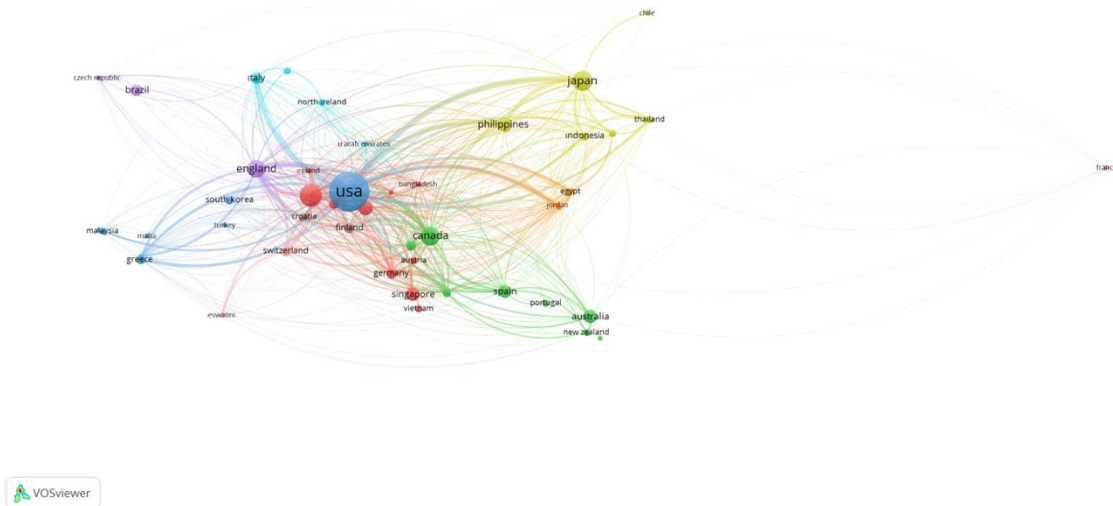

Figure 5: *Countries with the most publications*

In studies related to AI in nursing, a total of 481 keywords were used, and the most commonly used keywords were determined to be "artificial intelligence" (90), "nursing" (40), "machine learning" (24), "deep learning" (13), and "big data" (10) (Figure 6).
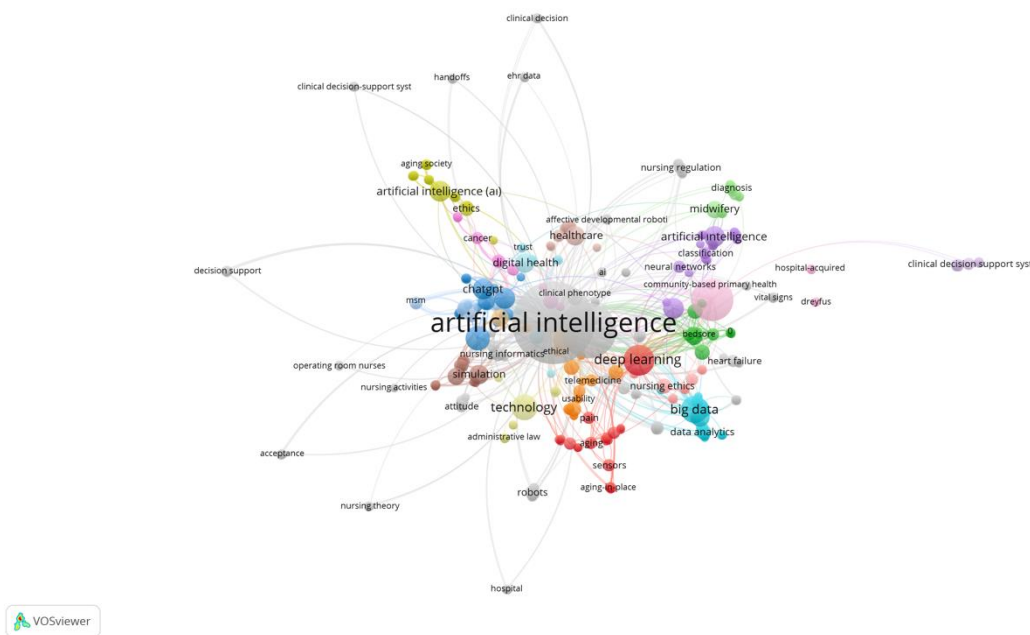

Figure 6: *Most used keywords*

4   Discussion

The bibliometric analysis conducted in this study aimed to examine studies related to AI in nursing using the Web of Science database. This study provided insights into citation trends, institutions, prolific authors, and journals publishing articles related to AI in nursing.

Our findings indicate a growing interest in studies related to AI in nursing over the past five years, with the highest number of publications observed in 2023, primarily in the form of research articles. This trend of increasing interest aligns with previous studies (Chang, Jen, & Su, 2022; Shi et al., 2023), which also noted a rise in the number of studies related to AI in nursing between 2017 and 2022. The rapid advancement of technology and its application in the healthcare sector have likely contributed to this increase, reflecting a shift in focus towards AI research in nursing.

When analyzing the journals, it was determined that the journal with the most publications is "Journal of Nursing Management," while the journal with the most citations is "Journal of Medical Internet Research.". (2022), In the study conducted by Shi et al. (2023), the "CIN-Computers Informatics Nursing" journal was identified as the journal publishing the most studies related to AI in nursing, while in the study conducted by Chang et al. (2022) the "Nurse Education Today" journal was determined to have the most publications. Although our study ranks "Journal of Nursing Management" first, "Nurse Education Today" ranks second, and "CIN-Computers Informatics Nursing" ranks third. It is thought that the changing interest in AI in nursing over time, as well as the increasing interest in studies related to AI in nursing, may have led to changes in the journals where these studies are published. Additionally, the publication trends of journals may change based on their target audience, which could also influence the shift towards publications focusing on AI in nursing within nursing journals.

Although there was variability in citation counts between 2004 and 2024, a consistent increase in citation counts has been observed from 2019 onwards, corresponding to the increase in the number of articles. Specifically, citation counts for the years 2019, 2020, 2021, 2022, and 2023 were 21, 61, 133, 347, and 675, respectively, indicating a steady rise. It was determined that the article with the highest number of citations was published in 2023, receiving 150 citations. As of the beginning of 2024, the articles had received 33 citations since the data were retrieved from Web of Science. Similar to previous studies, it has been observed that citation counts consistently increase, with the highest citation counts occurring in the years when the data were retrieved (Chang et al., 2022; Shi et al., 2023). Therefore, our study aligns with existing literature (Chang et al., 2022; Shi et al., 2023), indicating that the rapid growth of the literature on AI in nursing reflects the increased interest of authors in this field.

The H-index was developed by JE Hirsch in 2005 to evaluate scientific productivity and effectiveness. According to Hirsch, "If a researcher has h publications that have each been cited at least h times, and the remaining publications (N - h) have been cited no more than h times each, the researcher's H-index is h." (Erbağcı, 2009). In our study, the H-index of the included works was determined to be 20. This implies that at least 20 of the works have received a minimum of 20 citations each. It's noteworthy that in previous studies on AI in nursing, no findings regarding the H-index were encountered (Chang et al., 2022; Shi et al., 2023). The rapid increase in publications and citations related to AI in nursing over the past five years has also led to an increase in the H-index of the studies.

Access to technology is more easily facilitated in developed countries compared to developing and underdeveloped ones. In our study, when we looked at the distribution by countries, we found that 58 articles were produced in the United States, followed by China and Japan. The institutions with the highest number of publications, Florida Atlantic University and Tokushima University, are also located in these countries. In previous studies, while the United States ranked first in terms of the country with the highest number of publications, it was found that the rankings of other countries varied (Chang et al., 2022; Shi et al., 2023). It is believed that the ease of access to technology and the availability of financial support for research activities are facilitated by the fact that these top three countries with the highest number of publications were among the top five countries in the 2023 World Gross Domestic Product (GDP) Map.

It has been observed that 53 authors have contributed to the literature with more than two studies in the field of AI in nursing. In the past five years, with the emergence of a trend in studies related to AI in nursing, 665 authors have contributed to the literature with a single study. In total, the 164 articles included in our study were written by a total of 718 authors. Rozzano Locsin has been identified as the author with the highest number of articles (seven studies), and it is believed that the fact that the author works in the most productive country and institution facilitates the conduct of their studies, leading to a higher number of publications.

In bibliometric analyses, keywords are commonly considered fundamental elements representing concepts of information and are widely used to reveal the knowledge structure of research fields (Al, Şahiner, & Tonta, 2006). The frequent use of keywords indicates a strong trend in the topic under consideration (Kantek & Yesilbas, 2020). In our study, the most frequently used keyword was determined to be "artificial intelligence." While in previous years, the keyword "machine learning" was ranked first, in our study, it is ranked third (Chang et al., 2022; Shi et al., 2023). It is believed that the different results obtained from the literature may be due to variations in the years of the searches conducted and the continuous increase in studies related to AI in nursing.

5 Conclusions

The research covers studies related to AI in nursing from 2004 to 2024. The number of studies on AI in nursing has been increasing steadily in the past five years. The rise in studies indicates a growing interest in AI applications in the nursing field, particularly in developed countries. This study identified a total of 164 articles on AI in nursing, with more than half being research articles. It was found that 65.85% of these studies were research articles, with the majority being published in the Journal of Nursing Management (nine studies), and the highest number of studies being published in 2023. The most prolific author, with seven studies, was identified as Rozzano Locsin, while the United States was determined to be the country with the highest number of publications, and Florida Atlantic University and Tokushima University were the institutions with the most studies. The most frequently used keyword was "artificial intelligence," with a total citation count of 1010 and an h-index of 20. This suggests that AI applications in nursing are being implemented in clinical settings and continue to increase quantitatively. In future studies, readers can use the findings of this research to guide their own studies on AI in nursing. This study provides in-depth information about the current state of AI in nursing from 2004 to 2024 and offers readers/authors additional insights.

6 Declarations

6.1 Study Limitations

The research data is limited to articles scanned only in the Web of Science database. If another database is used, the results of the study may vary. Additionally, the citation numbers provided in this study indicate the numbers at the time of the search. In a different time frame, the numbers and rankings may differ.

6.2 Acknowledgements

6.3 Funding Source

6.4 Competing Interests

There is no conflict of interest in this study.

6.5 Authors' Contributions

Corresponding Author Meltem ÖZKAYA: Conceptualization, Methodology, Software, Data curation, Writing- Original draft preparation, Visualization, Investigation, Writing- Reviewing and Editing, Software, Validation

2. Öznur KÖRÜKCÜ: Conceptualization, Methodology, Software, Data curation, Writing- Original draft preparation**,** Visualization, Investigation, Writing- Reviewing and Editing, Software, Validation

7   Human and Animal Related Study

7.1   Ethical Approval

Since the article was written as a bibliometric analysis, no ethical approval is required in our study within the framework of ethical rules and policies.

7.2   Informed Consent

Since this study was a bibliometric analysis, informed consent was not required.

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