ORİJİNAL MAKALE / ORIGINAL ARTICLE

Balıkesir Sağlık Bilimleri Dergisi / BAUN Sağ Bil Derg
Balıkesir Health Sciences Journal / BAUN Health Sci J
ISSN: 2146-9601- e ISSN: 2147-2238
Doi: https://doi.org/10.53424/balikesirsbd.1406477

Trends and Current Topics in Artificial Intelligence in Nursing Research: A Bibliometric Analysis and Science Mapping

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Geliş Tarihi / Received: *19.12.2023* ***Kabul Tarihi / Accepted:*** *06.03.2024*

ABSTRACT

Objective: This study aimed to draw a science mapping of research trends, current topics in artificial intelligence in nursing, and the information structure of the literature using bibliometric methods. **Materials and Methods:** This was a bibliometric study. Study data were collected from WoSCC on August 08, 2023. Analyses were made through science mapping, Microsoft Excel, and VOSviewer. **Results:** The study included 316 publications dated 1984-2023. There was a rapid increase in the publications and citations from 2018-2023. Related publications were made by 1148 authors, and CIN-Computers, Informatics, Nursing was the journal published and cited most, among others. Thirty-one countries contributed to the publications, of which 45.2% were produced in the USA. In recent years, the topics have been patient safety, depression, ChatGPT, and Chatbot. **Conclusion:** This bibliometric study shows a synergy between the general policies of countries on Artificial Intelligence in recent years and the increasing number of publications in the last four years. However, this study also reveals that research on artificial intelligence in nursing is nascent. Managers and research nurses should lead the use of AI applications in nursing services management and nursing training and encourage research on the topic.

Key Words: Artificial Intelligence, Nursing, Bibliometric Analysis, Research Trends, VOSviewer.

Hemşirelikte Yapay Zekâ Araştırmalarında Trendler ve Güncel Konular: Bibliyometrik Analiz ve Bilimsel Haritalama

ÖZ

Amaç: Bu çalışma, hemşirelikte yapay zekâ alanında yapılan çalışmaların araştırma trendlerini, mevcut konularını ve literatürün bilgi yapısını bibliyometrik yöntemlerle bilim haritasını ortaya çıkarmayı amaçlamıştır. **Gereç ve Yöntem:** Bu bibliyometrik bir çalışmadır. Çalışmanın verileri, 8 Ağustos 2023 tarihinde Web of Science Core Collection veri tabanından toplandı. Verilerin analizinde bilimsel haritalama analizi yapıldı, Microsoft Excel ve VOSviewer programları kullanıldı. **Bulgular:** Çalışmaya 1984-2023 yılları arasında 316 yayın dahil edildi. 2018-2023 yılları arasında yayın ve atıf sayısında hızlı bir artış olduğu bulundu. Alandaki yayınların 1148 yazar tarafından gerçekleştirildiği ve dergiler arasında en çok yayın ve atıf alan "CIN-Computers, Informatics, Nursing" dergisinin olduğu belirlendi. Yayınlara 53 farklı ülkenin katkı sağladığı ve bu yayınların %45.2'sinin Amerika Birleşik Devletleri'nde üretildiği belirlendi. Son yıllarda güncel konular hasta güvenliği, depresyon, ChatGPT ve Chatbot idi. **Sonuç:** Bu bibliyometrik çalışma, son yıllarda ülkelerin yapay zekâ konusunda belirledikleri genel politikalar ile son dört yılda artan yayın sayısı arasında bir sinerji oluştuğunu göstermektedir. Bununla birlikte, yapay zekâ çalışmalarının hemşirelik alanında yeni ve henüz kuluçka döneminde bir alan olduğunu ortaya koymaktadır. Yönetici ve araştırmacı hemşireler yapay zekâ uygulamalarının hemşirelik hizmetleri yönetiminde ve hemşirelik eğitiminde kullanımına yönelik önderlik etmeli ve konuyla ilgili araştırmaların yapılmasını teşvik etmelidir.

Anahtar Kelimeler: Yapay Zekâ, Hemşirelik, Bibliyometrik Analiz, Araştırma Trendleri, VOSviewer.

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Bu makaleye atıf yapmak için / Cite this article: Çiçek Korkmaz, A. (2024). Trends and current topics in artificial intelligence in nursing research: a bibliometric analysis and science mapping. *BAUN Health Sci J, 13*(2), 324-338. https://doi.org/10.53424/balikesirsbd.1406477

INTRODUCTION

The continuous development of technology and the rapid emergence of artificial intelligence (AI) has significantly impacted several fields, including nursing (Korkmaz et al., 2023; Topol, 2019). AI, typically defined as the development of computer systems capable of performing tasks that require human intelligence (Janiesch et al., 2021), has been increasingly integrated into nursing practices due to its potential to enhance patient care and health outcomes (Konttila et al., 2019).

AI applications in nursing have recently broadened to encompass diverse technologies. This includes machine learning algorithms for predictive analytics, natural language processing for electronic medical records, and robotic systems for patient care (Bates et al., 2020). As Bates et al. (2020) identified, foundational AI technologies such as machine learning, deep learning, expert systems, and robotics have a historical significance in nursing and are pivotal in forging its future. The application of these technologies in nursing care has been noted to have increased recently (Jeong, 2020).

According to Kwon et al. (2019), machine learning, as a critical component of AI, emphasizes data analysis for making precise predictions, paving the way for enhanced clinical decision-making and advancing nursing science. This approach to leveraging clinical data represents just one aspect of AI's application in nursing. Deep learning, an extension of machine learning, employs multi-layered artificial neural networks, contributing to developing "deep" neural networks, a method renowned for its depth and complexity (Jeong, 2020). Additionally, expert systems mimic the decision-making capabilities of human experts by utilizing extensive knowledge bases and inferential reasoning, further broadening AI's application in nursing (Aristoteles et al., 2023). Integrating these AI technologies within nursing yields numerous benefits, directly impacting patient care and the nursing profession. For instance, machine learning and deep learning facilitate the streamlined collection and monitoring of vital signs (Bose et al., 2019; Kwon et al., 2019) and the accelerated diagnosis of conditions such as falls and pressure ulcers (Easton-Garrett et al., 2020; Sullivan et al., 2019). Expert systems enhance decision-making, enabling more accurate and timely nursing diagnoses (Courtney et al., 2008).

ChatGPT has emerged as an innovative tool in nursing education and practice in recent years. It is being used for evaluating student performance in education (Bahroun et al., 2023; Javaid et al., 2023) and as an interactive resource in patient education (Gunawan, 2023). Additionally, it offers significant support in practice by providing nurses with quick access to information on medications and medical interventions (Ahmed, 2023). These innovations can improve clinical decision-making, facilitate administrative duties, simplify patient monitoring, and support patient education and self-management (Davenport & Kalakota, 2019). Furthermore, they can reduce nurses' workloads, simplify their routines, save time for patient care activities, and allow healthier data to be obtained and analyzed faster (Pepito & Locsin, 2019). Considering all these aspects, AI applications will have a significant and positive impact on making nursing applications more efficient and safer, reducing costs, losses, and the duration of hospitalization due to medical errors in nursing services, and improving the quality of nursing care (Robert, 2019). While AI's integration into nursing practices continues to gain momentum, ethical considerations, including its effect on patient confidentiality, data security, and nurse-patient relationships, have emerged (Stokes & Palmer, 2020). Researchers have sought answers to such questions as “What will happen when these robots take part in healthcare?”, “Will robots have the same rights as nurses? " "Will robots be our slaves?” “Will robots be paid for the work they do?” “Will nurses be held responsible for the mistakes made by robots?” and “Can robots be loaded with emotion?” (Şendir et al., 2019). However, the researchers have not found answers to these questions.

Von Gerich et al. (2021) underscored the increasing influence of AI in nursing, highlighting the need to explore the opportunities and challenges presented by AI technologies in this domain. In this context, bibliometric analyses are a robust tool for an in-depth examination of AI research in nursing. Recent such analyses, like those by Shi et al. (2022) and Chang (2022), have provided valuable contributions to the literature. However, there remains a need for an updated and comprehensive analysis of AI's growing role in nursing.

This study addresses this gap by detailing the latest trends, leading domains, and journals in AI research within nursing while shedding light on new research directions and focal points. In an era of rapid technological advancements, this research seeks to understand AI's role in nursing better. Therefore, for researchers and professionals wanting a thorough grasp of the impact of AI in nursing, this study offers a comprehensive perspective, adding to the current knowledge in the literature.

Considering the rising significance of AI in nursing, this study seeks to 1) ascertain current publication trends, 2) pinpoint dominant research domains and leading journals, 3) identify prominent countries, research conglomerates, and researchers, and 4) discern emergent research trends and current topics.

The growing significance of bibliometrics in nursing research

In recent years, bibliometric studies have garnered significant attention from researchers aiming to gauge the quality and volume of research outcomes within nursing. As a quantitative method to dissect scientific publications, bibliometrics holds paramount significance in offering a robust methodology for nursing research (Çiçek Korkmaz & Altuntaş, 2022; Kantek & Yeşilbaş, 2020; Kokol et al., 2018). The reasons for its prominence are manifold:

- ***Mapping research trends and patterns:*** Bibliometric endeavors offer researchers and practitioners invaluable insights, shedding light on

the prevalent research trends, emergent topics, and areas of focus in nursing (Yan et al., 2022). Such insights mirror the discipline's current trajectory and spotlight potential lacunae beckoning further exploration (Kokol et al., 2018).

- ***Evaluating Research Quality and Impact:*** Bibliometric analyses empower scholars to appraise the resonance and caliber of nursing research. This is achieved by sifting through citation patterns and scrutinizing journal impact factors and other pertinent metrics (Downing et al., 2021). Such evaluations play a pivotal role in helping researchers comprehend the ramifications of their scholarly endeavors (Sweileh et al., 2019).
- ***Spotlighting Pioneering Authors, Institutions, and Journals:*** Through bibliometrics, one can unveil the vanguard of nursing research—be it individual scholars, academic institutions, or journals—by probing the volume and influence of their publications (Kantek & Yeşilbaş, 2020; Yanbing et al., 2020). Such revelations are a compass for networking, facilitating collaboration, and drawing comparisons (Downing et al., 2021).
- ***Facilitating interdisciplinary collaboration:*** Nursing, as a discipline, routinely intersects with fields such as medicine, psychology, and public health (Oerman et al., 2019). Bibliometric evaluations can unveil these cross-disciplinary synergies, fostering more prosperous collaboration across varied research domains (Kokol et al., 2018).
- ***Informing decision-making and policy development:*** Policymakers, healthcare strategists, nursing managers, and educators can draw immense value from bibliometric studies (Galetsi & Katsaliaki, 2020). The data extracted serves as a lodestar for informed decision-making in resource allocation, financial planning, or curriculum design, ensuring the nursing sector remains vibrant and responsive (Sweileh et al., 2019).

MATERIALS AND METHODS

Study type

This bibliometric research study was structured to cover the relevant issue by monitoring the following stages described by Öztürk (2021, p.47):

1. Defining the aim of the bibliometric study.
2. Creating a dataset related to the relevant literature (see Figure 1):
   - Selection of the database.
   - Determination of search terms.
   - Application of filtering (inclusion and exclusion criteria).
   - Downloading of the dataset.
3. Conducting the bibliometric analysis and reporting the findings:
   - Performance analysis (summarizing the performance of prolific research constituents using publication, citation, and publication-citation measures).
   - Science mapping (summarizing the bibliometric structure using citation, co-citation, co-authorship, and co-word analysis).
4. Interpretation of the analysis results and findings.

Data collection (identification and selection of the publications)

A comprehensive search was conducted on the Web of Science Core Collection (WoSCC) database on August 08, 2023, using the following search terms: "artificial intelligence*," "machine learning," "deep learning*," "artificial neural networks*," "expert systems*," "natural language processing*," "hybrid intelligence*," and "robotic*." Initially, 853121 publications were retrieved without limitations on publication dates or languages.

According to the PRISMA flow diagram, as presented in Figure 1, publications were filtered by relevance to the nursing field, and the list was reduced to 646. This selection was further refined by considering only those articles indexed in specific citation databases: "Science Citation Index Expanded (SCI-E), "Social Sciences Citation Index (SSCI), "And Emerging Sources Citation Index (ESCI) " bringing the count to 614 publications. Language criteria were applied next, restricting the selection to only English language articles (n=598). To ensure a focus on high-quality and relevant content, criteria were applied to include specific types of works: articles, reviews, and editorial materials. This criterion reduced the list to 566 publications. Upon a detailed review, 250 publications that did not align with the study's goals were excluded, leaving 316 publications for analysis. The entire search and selection process is visually represented in the flowchart provided in Figure 1.

Statistical analysis

The bibliometric data of the selected publications were retrieved in TXT format from the WoSCC database. This data was subsequently imported into Microsoft Excel and VOSviewer software for further analysis. During the initial phase, keywords were standardized to ensure consistency. Variations in spelling or alternative expressions of the same term (for example, "artificial ıntellıgence" versus "artificial intelligence" and "nurse" versus "nurse staffing") were identified and unified. Any irrelevant or nonsensical words (such as "cfır," "cross-") were removed to enhance the accuracy of the analysis. VOSviewer software was employed to generate network visualizations.

Ethical considerations

Given the nature of this bibliometric study, no ethics committee approval was required. Since bibliometric studies use open-access data, they do not require an ethics committee event.

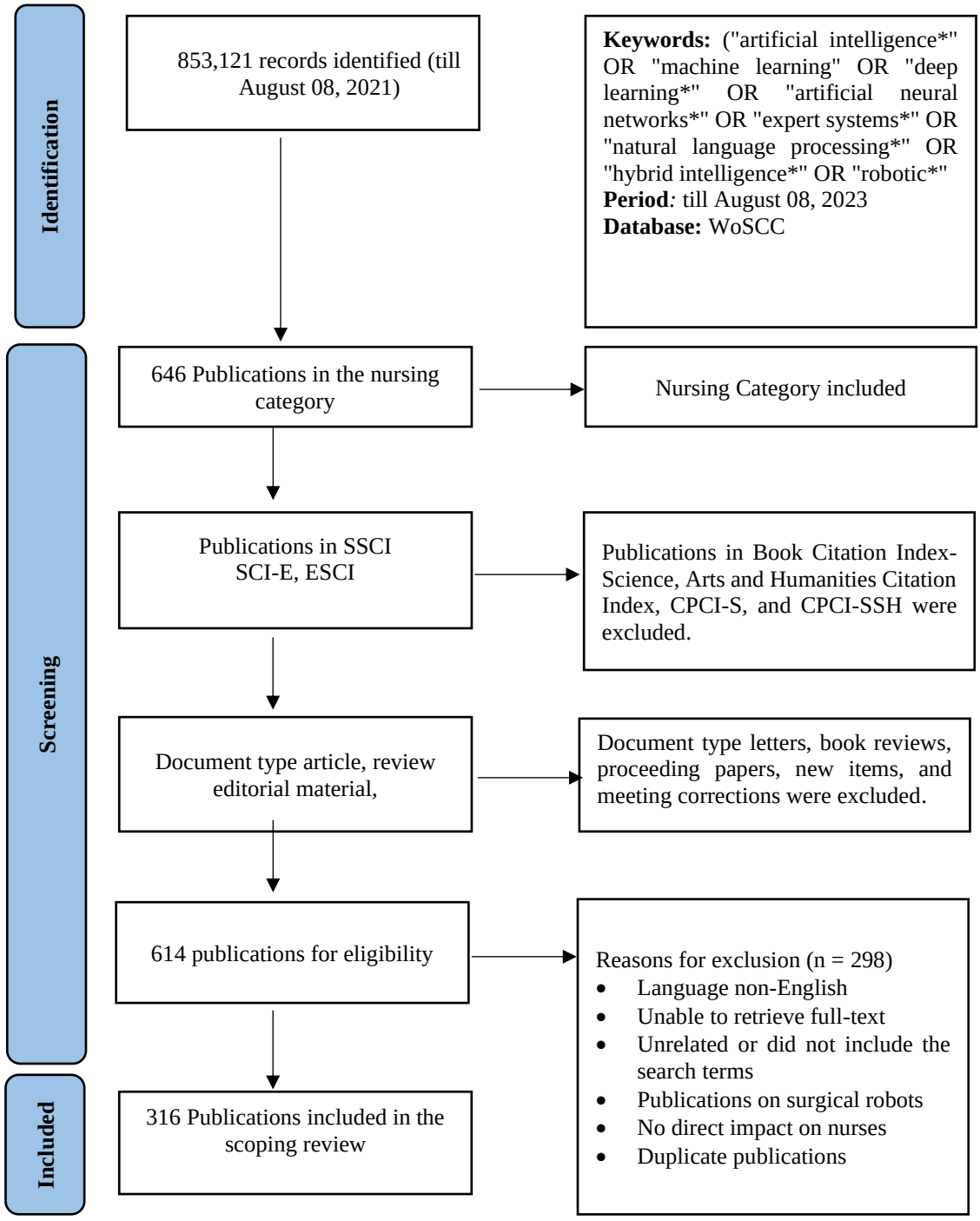


Figure 1. PRISMA flow diagram of the included publications.

RESULTS

The following findings were obtained within the study's purpose. The study findings are shown in the table and figures.

General trends of publications

Reviewing the number of publications is essential to measure the developmental trend of the AI-related research area. In this study, Figure 2 examines the trend in the number of publications and citations of AI-related publications, primarily in nursing, over the years.

The first study on AI in nursing was found to be published in 1984. Although there was no increase in the studies conducted from 1984 to 2015, a gradual increase was observed in the number of AI studies as of 2017, and 272 publications were produced in the last five years (2018-2023) and the year 2022 had the most publications with 71 studies. The publications had 2210 citations; the highest number was achieved in 2022 (609). Moreover, the number of citations gradually increased as of 2017,

and 86.3 of the total citations were carried out in the last four years (2018-2023) (Figure 2).

The studies' publication types from 1984 to 2023 were articles (72.7%) and editorial materials (11.5%).

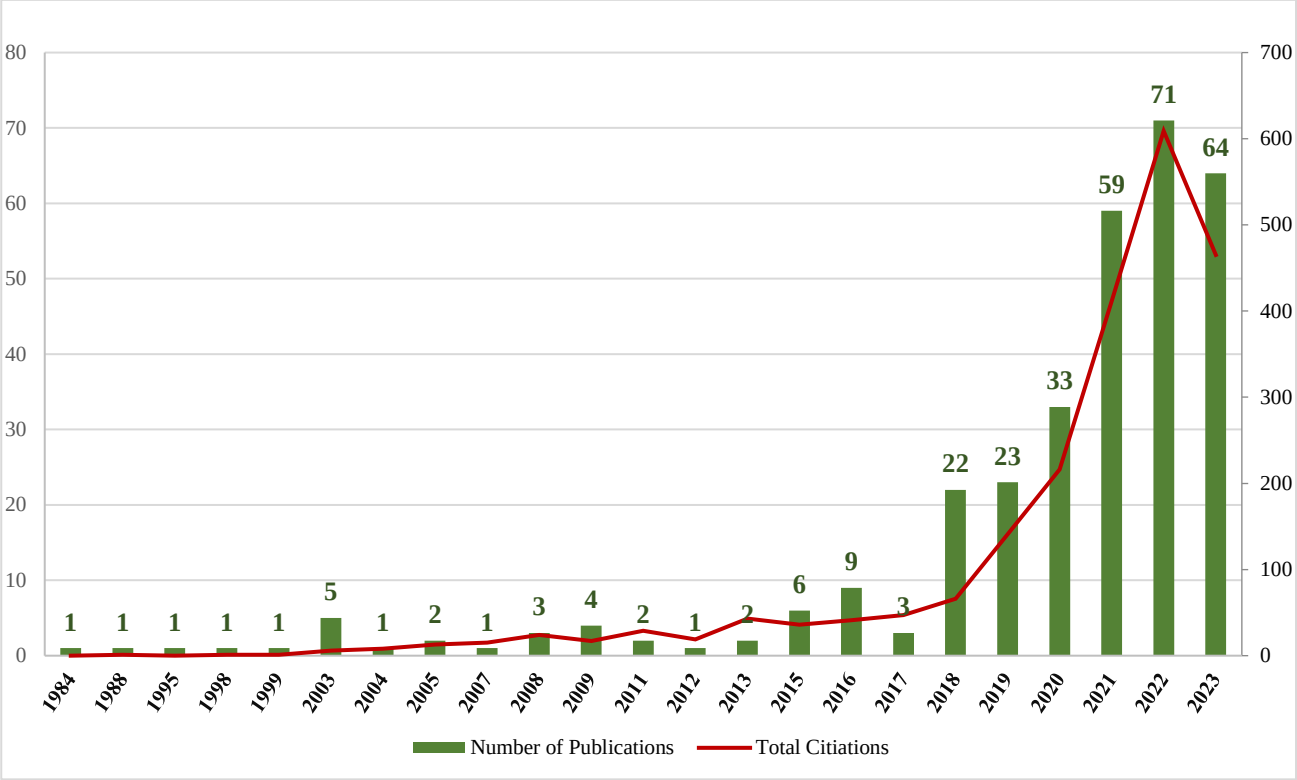


Figure 2. Yearly trend and citation of publications (1984 to 2023).

Dominant research areas and influential journals

The publications were found to have been published in 22 research areas and 100 journals. The nursing field (n=316) was the essential inclusion point of the research. It was followed by Computer Science Interdisciplinary Applications (n=34), Medical Informatics (n=34), Management (n=17), and Education Scientific Disciplines (n=14), respectively.

The relevant publication analysis of the journals was examined, and many journals stood out. Regarding productivity, the top seven journals produced 104 publications, and 32.9% of all publications were produced in these journals. It has been determined that the most prolific journal on AI is "CIN-Computers, Informatics, Nursing," which stands out with 34 publications. "Journal of Nursing Management" ranks second with 17 publications, while 'Nurse Education Today' is third with 14 publications. The first relevant publication was in the "Journal of Nursing Administration." Regarding the journals' number of citations per publication, the publications in these journals were found to be highly cited (see Figure 3). The top three journals that were cited the most were CIN-Computers, Informatics, Nursing (246 citations), Nurse Education Today (245 citations), and Journal of Advanced Nursing (212 citations), respectively.

Influential countries, research groups, and researchers

The most productive countries and collaborations

A total of 53 countries contributed to the publications, and 50.9% of these countries produced three or more publications. The USA produced the highest number of publications (143), and its contribution rate to nursing was 45.2%. Then China (34 publications), Japan (21 publications), South Korea (18 publications), and Australia (16 publications), respectively, were included among the top five countries. The rate of contribution to nursing by these top five countries that produced the highest number of publications was 73.4%. The USA contributed to nursing the most by achieving the highest number of citations (1075 citations). England followed this country (251 citations), followed by Australia (201 citations), Japan (151 citations), China (146 citations), and Finland (142 citations), respectively. Figure 4 presents the collaboration networks among the countries. The general collaboration among the countries was found in three different clusters (in blue, red, and yellow colors), and the TLS was found to be 348. The USA had the most vital collaboration network with maximum link strength (TLS=221). The most robust collaboration networks were between the USA and Japan (TLS= 27) and between the USA and England (TLS=21) (see Figure 4).

The most productive and influential authors and collaborations

1148 authors produced the publications included in the research. Of the publications, 67.4% were produced by three or more authors, and most were produced by two (49 publications) or four (50 publications) authors. There were publications produced by ten or more authors (n=15). For example, 35 authors collaborated on an article published by Papadopoulos et al. (2023). Only 114 authors produced more than one publication. Figure 5 shows the network map of the collaboration among authors with two or more publications (Number of publications on the left, citations on the right of Figure 5). Topaz M. was the most productive author (n=11), followed by Locsin RC. (n=9). O'Connor S. and Tanioka T. had an equal number of publications (n=7) (see Figure 5).

Topaz M. received the most citations (n=109), followed by O'Connor S. (n=95), and then Finnish researchers Coco K. and Rantanen T. with an equal number of citations (n=83) each. Coco and Rantanen were found to have two publications in collaboration.

Research trends and current topics

Co-occurrence and analysis of keywords

The authors used 797 different words in publications. Figure 6 shows the visual network map of the keywords used at least four times (n=43). The most frequently used keywords were AI (76 times), machine learning (54 times), nursing (50 times), robotics (29 times), and natural language processing (15 times).

The keywords were categorized into four clusters (see Figure 6). The first cluster (red color) consisted of the following words: “AI, artificial neural network, chatbot, ChatGPT, decision support, deep learning, education, healthcare, nursing, nursing research, older people, robots, simulation." The second cluster (green color) consisted of the following words: "big data, cancer, data mining, depression, electronic health record, ethics, machine learning, prediction, systematic review.” The third cluster (blue color) consisted of the following words: “aged, anxiety, attitude, care robot, dementia, nurses, nursing robotics, robotics, technology,” while the fourth cluster (yellow color) consisted of the following words: “Decision making, expert systems, mental health, natural language processing, nursing informatics, pressure ulcer.” The last cluster (lilac color) words: “accidental falls, patient safety, risk assessment, supervised machine learning.”

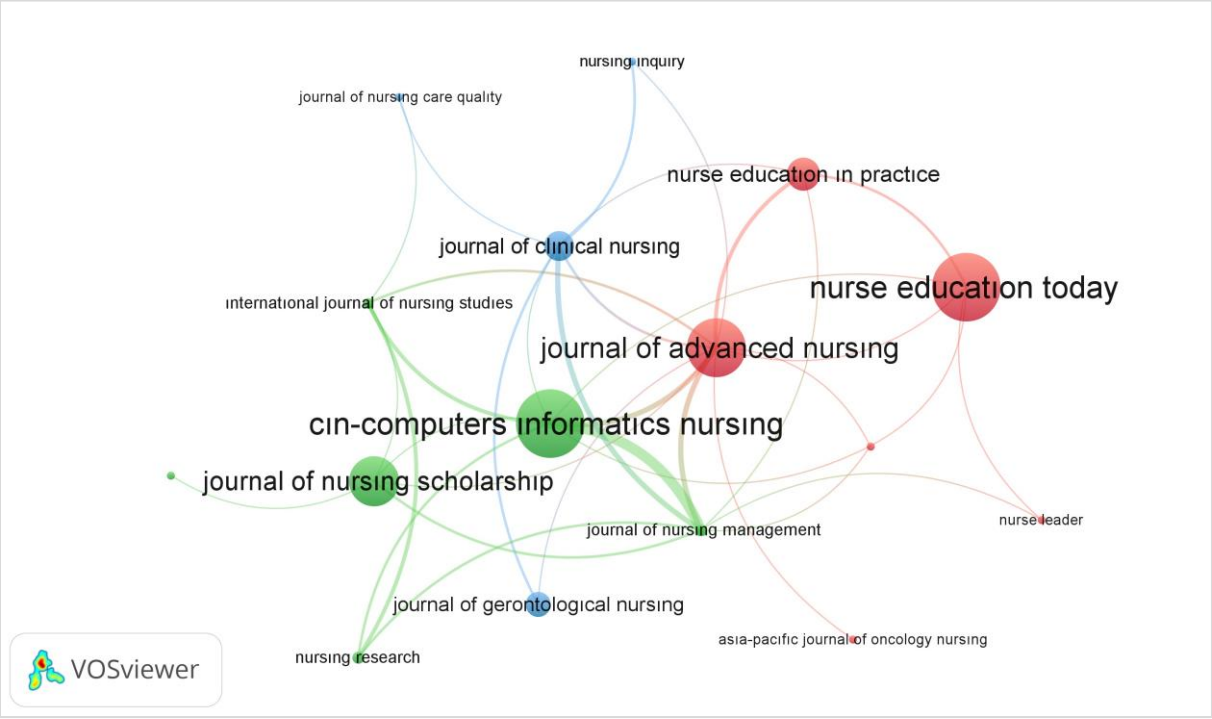


Figure 3. The network of the most influential journals weighted by the number of citations

Figure 6 was created to show the time process of the keywords. The most frequently used keywords toward 2022 were shown in yellow (on the right of Figure 6), whereas the most frequently used keywords toward 2016 were shown in purple (on the left of Figure 6). Regarding the periods, the initial words were "nursing informatics," "expert systems," "decision making," and "data mining." However, the words "patient safety," "depression," "ChatGPT," and "Chatbot" have been updated in recent years.

Highly cited publications

This study found that 11 publications cited were produced by 43 researchers (Table 1). The article entitled "Predicting pressure injury in critical care patients: a machine-learning model " by Alderson et al. (2018) was the most-cited publication (76 citations). In this publication, the authors developed a model using machine learning approaches to predict the risk of pressure injuries in surgical intensive care patients. The publication by O'Connor (2023), which investigated the positive and negative roles of AI chatbots like ChatGPT in nursing education, ranked second with 73 citations. Two publications had the same number of citations. Therefore, the contents of the 11 publications that were cited most were examined. The contents of the 11 most cited publications were examined. Among these publications, six addressed the direct applications of technology and AI in nursing and healthcare, covering areas like machine learning, AI platforms, robotics, data mining, and natural language processing. The remaining five publications delved into the implications and considerations of these technologies for nursing practice and education, encompassing themes such as the future of nursing in a technologically advanced world, simulation-based education, and attitudes towards robotics in healthcare. (Please see the author's word analysis for further detail).

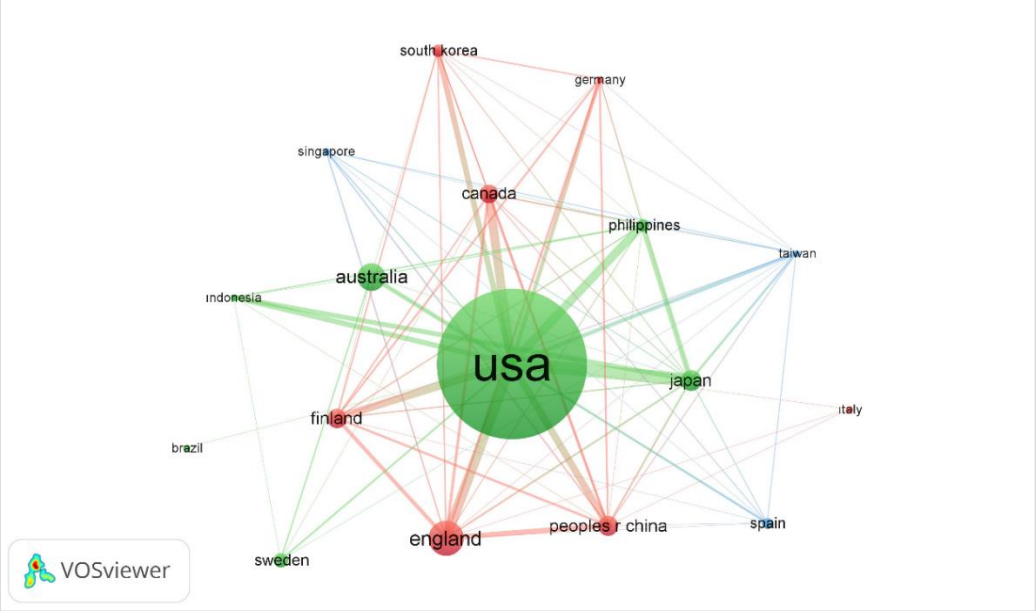


Figure 4. The network of collaboration between countries is weighted by the number of citations (The thicker the line between the two countries, the stronger the research collaboration between them. The closer the two countries are, the closer they are to the research field.)

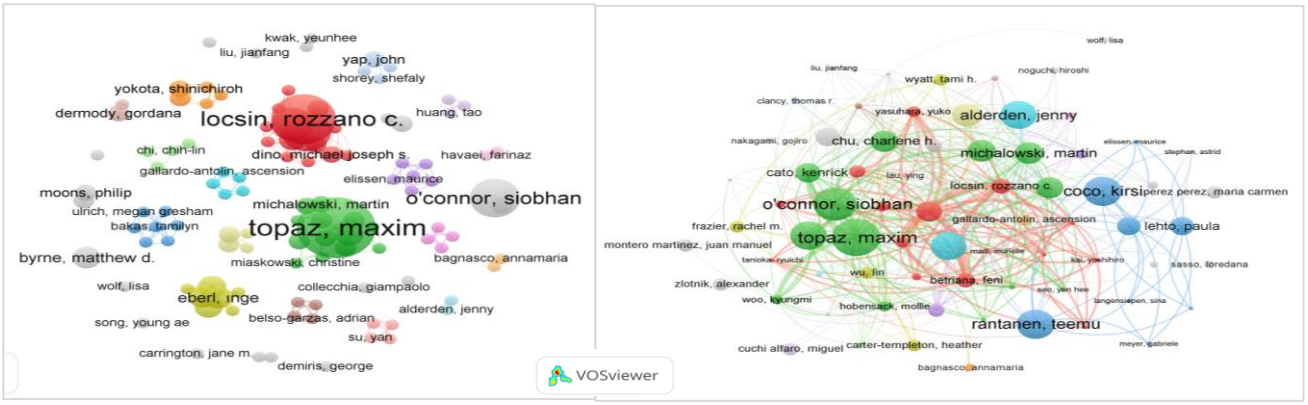
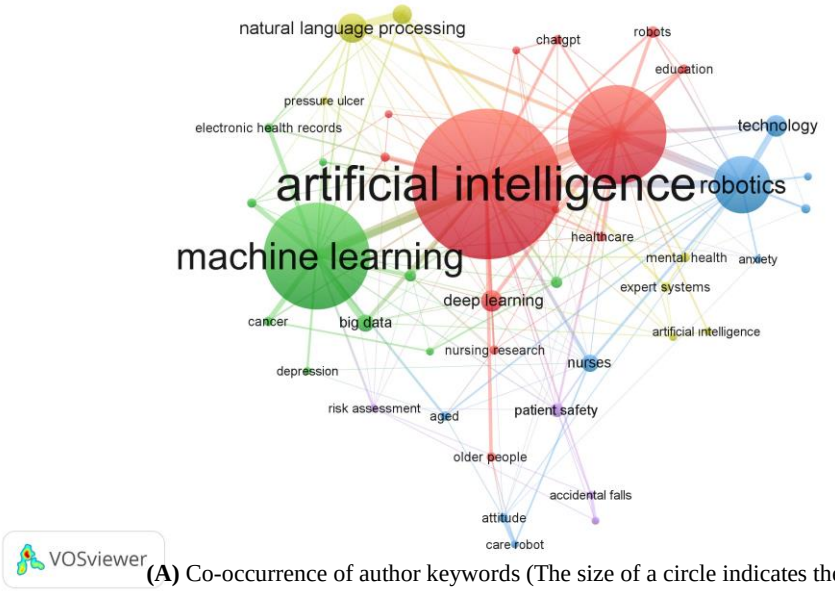
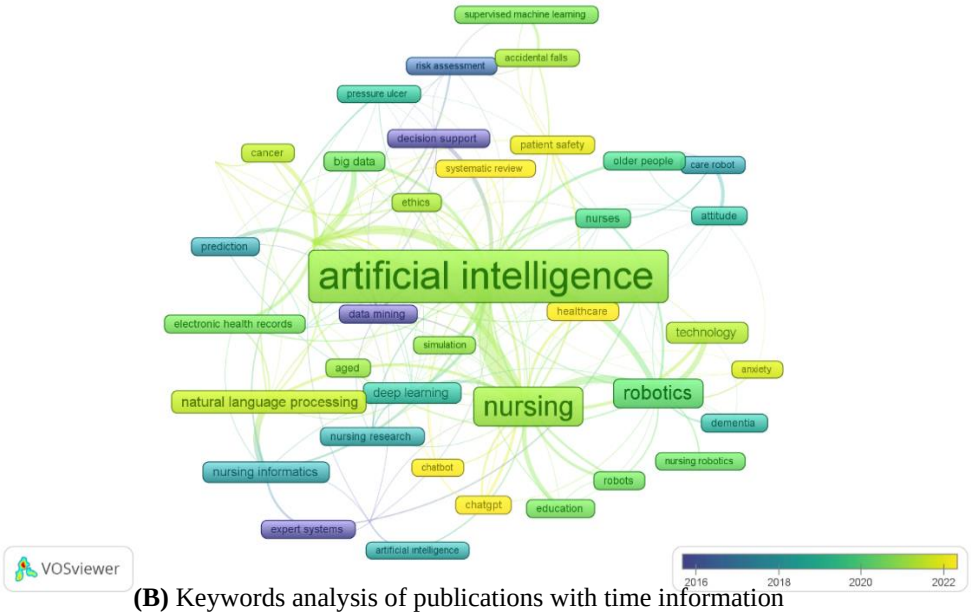


Figure 5. Co-authorship network weighted by the number of documents and citations (The size of a circle is positively correlated with the number of publications or citations. Circle colors and lines between authors indicate co-authorship)



(A) Co-occurrence of author keywords (The size of a circle indicates the frequency of keyword usage. Colors indicate clustering of keywords)



(B) Keywords analysis of publications with time information

Figure 6. Keyword analysis of publications

Table 1. Top-11 of most frequently cited publications (1984 to 2023 (August 08).

No.	Title	Type of AI used (DL, ML, NLP, Chatbot, etc.)	The most obvious results of the research	Original article review or editorial	Author (s), year	Journal	n**
1	Predicting pressure injury in critical care patients: a machine-learning model	ML	Developed a predictive model for pressure injuries in critical care using machine learning (random forest)	Article	Alderden et al., 2018	American Journal of Critical Care	76
2	Open artificial intelligence platforms in nursing education: Tools for academic progress or abuse?	ChatGPT	Explored the potential implications of AI chatbots in nursing education, including their use in student assessments and faculty research, while highlighting ethical considerations and the importance of academic integrity in the face of emerging AI technologies	Editorial	O'Connor, 2023	Nurse Education in Practice	73
3	Futurism in nursing: Technology, robotics and the fundamentals of care	Care robots	Emphasizes the imperative for anticipatory strategies and a posthumanist perspective in integrating advanced technologies within nursing, critically examining the historical trajectory of technology usage in the field and underscoring the necessity for strategic planning in the era of increasing technological integration	Article	Archibald & Barnard, 2018	Journal of Clinical Nursing	65
4	Structured Debriefing in Simulation-Based Education	DL	Emphasizes the critical role of debriefing in simulation-based education for deep learning, highlighting the debriefer's facilitation skills and their importance in creating a safe and supportive learning environment	Article	Palaganas et al., 2016	AACN Advanced Critical Care	55
5	Using a Robotic Cat in Dementia Care: A Pilot Study	Care robots	The study explores the impact of interactive robotic cats on individuals with dementia. It shows reduced agitation and improved quality of life. Interviews with relatives and caregivers reveal positive interaction, communication, and comfort effects. The robotic cat was also found to be user-friendly.	Article	Gustafsson et al., 2015	Journal of Gerontological Nursing	52
6*	Robotics in Nursing: A Scoping Review	Care robots	Identifies rapid evolution in nursing robotics, focusing on assistive and social assistive robots for elderly and disabled care. Emphasizes the need for clear social and legal guidelines to ensure safety and privacy in robot-human interactions and calls for greater collaboration between developers and caregivers for versatile robotic solutions	Review	Maalouf et al., 2018	Journal of Nursing Scholarship	50
	Nurses' needs for care robots in integrated nursing care services	Care robots	The study aims to define nurse expectations for care robots in INCS (inpatient care settings), highlighting that such robots can efficiently support nurses' workload. Results indicate a positive reception towards robotic assistance, emphasizing the necessity of robots working under nurse	Article	Lee et al., 2018	Journal of Advanced Nursing	

			supervision. Suggests future research should focus on enhancing collaborative aspects between care robots, medical professionals, and patients				
7	Can nurses remain relevant in a technologically advanced future?	ML	Emphasizes the role of machine learning in supporting nurses by automating routine tasks, allowing for a greater focus on complex care and critical decision-making, and underscores the importance of integrating this technology into nursing education and practice	Editorial	Pepito & Locsin, 2019	International Journal of Nursing Sciences	47
8	Comfort and Attitudes Towards Robots Among Young, Middle-Aged, and Older Adults: A Cross-Sectional Study	Care robots	It reveals similar attitudes towards robots among younger, middle-aged, and older adults, challenging the notion that older adults are less receptive to robotic assistance. It also highlights implications for nurses in robotic intervention design and use.	Article	Backonja et al., 2018	Journal of Nursing Scholarship	46
9	Data mining as a tool for research and knowledge development in nursing	ML	Highlights the revolutionary impact of data-mining technology in healthcare, similar to how telescopes and microscopes transformed science. Demonstrates data mining's potential in uncovering patterns within large healthcare databases, enhancing inquiry and knowledge. Emphasizes its role in predictive modeling and improving clinical practice through analysis of vast data sets	Article	Berger, & Berger, 2004	CIN-Computers, Informatics, Nursing	42
10	Exploring the Ability of Natural Language Processing to Extract Data from Nursing Narratives	NLP	Evaluate NLP's potential in extracting patient safety, quality measures, and nursing outcomes from narratives, suggesting expansion of MedLEE's (Medical Language Extraction and Encoding) lexicon with nursing terms for enhanced performance.	Article	Hyun et al., 2009	CIN-Computers, Informatics, Nursing	37

*:Publications with the same number of citations; n**:Total Citation
DL:Deep Learning; ML:Machine Learning; NLP:Natural Language Processing

DISCUSSION

The trajectory of AI research in nursing provides a comprehensive understanding of this burgeoning field's evolution and interdisciplinary nature (Galetsi & Katsaliaki, 2020). From its inception in 1984, there was a noticeable stagnation in AI-centric nursing research until 2015. However, a notable uptick in studies began in 2017, resulting in 272 publications between 2018 and 2023. Especially 2022 emerged as a pivotal year with 71 publications, and a high citation count underscored its significant academic impact. This result shows that AI is becoming more and more popular among researchers. Many factors may have influenced this upward trend. First, AI is a recent concept in healthcare, especially nursing interventions (Carroll, 2018). Second, it is believed that humanoid robots equipped with artificial intelligence, developed in and after 2013, could reduce the need for nursing to a certain extent and positively affect the quality of care (Gümüş & Kasap, 2021). These factors may have accelerated AI research, providing new nursing potential. Most contributions, being articles (72.7%), indicate a vibrant empirical investigation buttressed by crucial editorial materials (11.5%).

Furthermore, the current study reveals research categories associated with AI in nursing, specifically Computer Science Interdisciplinary Applications and Medical Informatics. This categorization, characteristic of the WoSCC database, underscores AI research's multifaceted, interdisciplinary character in nursing. This interdisciplinary integration signifies the confluence of nursing with AI and highlights the potential to assimilate insights and methodologies from diverse fields, fostering the expansion and enrichment of nursing research (Oermann et al., 2019). This progressive interdisciplinary convergence underscores AI's transformative and synergistic potential in contemporary nursing research."

The study scrutinized journals focusing on AI within the nursing context. The results revealed that a substantial proportion, approximately 33% of all publications, were contributed by a mere seven prominent journals. This observation indicates that these journals have become central platforms for discourse on AI in nursing. Significantly, 'CIN - Computers, Informatics, and Nursing emerged as a key player. With its 34 publications and an exceptional 246 citations, it is evident that this journal contributes extensively and substantially influences the field (Chang et al., 2021). Such a high citation count emphasizes its esteemed status in the scholarly arena. This understanding can be instrumental in researchers deciding where to channel their attention and manuscript submissions within the domain of AI in nursing.

This research maps out the international landscape of AI in nursing, spotlighting the USA's predominant contribution, accounting for 45.2% of publications and receiving 1075 citations. Their leading position is attributed to notable investments in AI infrastructure, as corroborated by the Federal Register of the USA (2019). Nations like China, Japan, South Korea, and Australia also show robust engagement, propelled by their dedicated AI strategies (Conn, 2018; New Generation of Artificial Intelligence Development Plan, 2017). However, the ranking of countries identified in this study differs from those in AI bibliometric studies in the broader health domain (Tran et al., 2019; Guo et al., 2020; Ho & Wang, 2020). While these rankings may vary over time, they may not comprehensively represent the entire field. Nonetheless, these findings highlight these countries' proactive stance in recognizing and tapping into the potential of AI within the nursing discipline.

This study shows that Turkey still needs to establish a prominent position in AI within nursing research on the international stage. This situation stems from the country's economic and infrastructural constraints. Nonetheless, these challenges highlight the importance of strategic investments in high-growth potential sectors. The scarcity of AI studies in nursing within Turkey necessitates a focused strategy for resource allocation to overcome these fundamental barriers. Emphasizing strategic investment, adopting a multidisciplinary approach to AI development, and enhancing computer literacy from an early educational stage are identified as crucial steps toward leveraging Turkey's potential in this rapidly evolving field. These initiatives aim not only to overcome existing obstacles but also to lay a solid foundation for Turkey to expand its contribution to AI in nursing, keep pace with global advancements, and meet the unique health needs of its population (Ermağan, 2021).

Topaz M. has been identified as the field's most productive and cited author in this study. This outcome signifies the substantial contribution of Topaz M.'s work to nursing research, establishing it as a significant pillar within the domain. With their substantial citation counts, Topaz M., O'Connor S., and Finnish researchers Coco K. and Rantanen T. indicate the broad international impact of nursing research. Despite publishing fewer articles, Finland's substantial citations underscore the essence of research caliber. Collectively, this investigation sheds light on AI's trajectory in nursing, emphasizing global collaboration and the significance of impactful research.

Furthermore, this study underscores the importance of collaboration and cultural diversity in nursing. The research conducted by Papadopoulos and 34 other authors, bringing together nurse academics from various countries, highlights the value of addressing the subject from diverse cultural perspectives. Such collaborations expand the boundaries of research, offering the potential for more comprehensive and practical solutions.

For example, in the relevant study, despite the generally positive views of international nurses and midwives on socially assistive robots (SARs), the technology adoption process encounters resistance and concerns, revealing the significant role of cultural factors in accepting SARs. Specifically, cultural dimensions such as long-term orientation and uncertainty avoidance play a crucial role in attitudes toward technology adoption. These findings emphasize the necessity of considering cultural factors in integrating technologies like SARs into nursing practices (Papadopoulos et al., 2023). Therefore, cultural

considerations must be considered to effectively integrate technological innovations in nursing research and practice (Papadopoulos & Koulouglioti, 2018).

The perspective offered by keyword analysis can aid in understanding the scope and structure of a topic (Galetsi & Katsaliaki, 2020), and such analyses facilitate the identification of primary trends and focal points within the literature (Yan et al., 2022). This study presents an in-depth keyword analysis to identify research trends where AI intersects with nursing. Keywords from one (red) cluster emphasize AI's various types and applications, especially in education. In contrast, another (green) cluster encompasses themes related to the applications of AI technologies in nursing and the ethical considerations these technologies present. A third (lilac) cluster focuses on more specific subjects, such as patient safety and risk assessment associated with AI implementations. In recent years, the rising use of AI technologies, notably robots, in nursing has brought many ethical issues. Both broadly and in the specific context of AI's caregiving roles, concerns center around themes like patient safety and privacy (Stokes & Palmer, 2020; Maalouf, 2018).

Shifting the focus to another keyword (blue) cluster, we observe technology integration in specific healthcare settings, such as elderly care and dementia management. This result shows that researchers are more interested in robotics in nursing. Pepito and Locsin (2019) argue that we have entered an era of robots, which execute tasks and procedures more efficiently and safely than they did in the past. AI-powered healthcare robotics is classified according to target users: doctor healthcare robots, nurse healthcare robots, and home healthcare robots (Alaiad & Zhou, 2014). Some robots help nurses work more efficiently by reducing the number of non-nursing activities that negatively affect patient care. Robots generally fulfill routine and predictable care needs (Booth, 2011). For example, Georgia Tech's "Cody" gives patients bed baths and assists in rehabilitating stroke patients. When nurses are busy, SAM robots can periodically go to patients' rooms and ask them how they are doing (Pepito & Locsin, 2019). Some robots can think like nurses and perform their duties (Şendir et al., 2019). For example, Proficio dispenses drugs accurately and reliably, thus reducing nurses' responsibilities in drug management (Pepito & Locsin, 2019). Robots can also reduce nurses' workload by monitoring the problems that negatively affect the health of dementia patients who require special care and follow-up in care centers. For example, Telepresence robots can assist nurses with tasks by providing audio and visual feedback (Maalouf et al., 2018).

A significant finding of this study is the evolution of keyword usage over time. In the past, concepts such as "nursing informatics" and "data mining" were prominent, but in recent years, interest in AI technologies like "ChatGPT" and "Chatbot" has significantly increased. The launch of ChatGPT has sparked widespread interest in the roles of AI-powered chatbots in education, clinical settings, and the creation of scientific documentation (Choi et al., 2023). The rise of these technologies has enriched nurse education with interactive and personalized learning experiences, significantly enhancing the effectiveness and efficiency of education in areas such as remote patient monitoring. Through ChatGPT, nurses can access various health-related topics, including patient care, clinical skills, and medical research (Liu et al., 2023; Sharma & Sharma, 2023). This technological advancement has created a notable focus in educational research, as highlighted by Zheltukhina et al. (2024), who particularly emphasized ChatGPT in medical and nursing education. The analysis of the most-cited articles in this study also reveals topics that support this development. The evolution of AI topics in nursing research underscores the growth of AI technologies and the increasing interest and awareness in this area. Subjects ranging from predicting pressure injuries in critical care patients to using chatbots in nursing education represent current AI and nursing research trends. Although research trends are dynamic and subject to change, they play a crucial role in identifying the current challenges and opportunities in the field (Liu et al., 2021).

Limitations of study

This study draws exclusively from the WoSCC database, so results may vary with PubMed or Google Scholar databases. As WoSCC focuses on English articles, relevant non-English studies might need to be noticed. The chosen keywords could omit some pertinent articles. Data was last updated on August 08, 2023, omitting newer research. Additionally, recent articles might have accumulated few citations. These factors should be considered when interpreting the study's findings.

CONCLUSION

From 2018 to 2023 (August 08), there has been a noticeable alignment between the increase in AI-related publications in nursing and the broader national AI strategies. This suggests that AI's role in nursing is gradually gaining momentum. As the application of AI in nursing is still in its early phases, it is anticipated to offer significant scientific insights in the future.

AI is and will be a technological development that significantly impacts nursing. Nurses and researchers should explore AI's potential in nursing management and education. In this respect, nurse managers should focus on AI more. For this, nurse managers should lead nurses in developing policies, strategies, or roadmaps for AI applications. They should encourage both international cooperation and collaboration among researchers for AI research. In addition, they should encourage nurses and nursing researchers to conduct further research on the use of AI applications in nursing services management and nursing education. Nurse leaders should be remarkably prepared to guide the establishment of AI-driven strategies and approaches.

This study's findings can serve as a valuable guide for professionals, helping them understand potential research directions and enhancing patient care outcomes. A similar study can be conducted in future databases such

as Google Scholar, Scopus, etc. In this way, how far AI has progressed in nursing can be estimated.

Acknowledgement
None.

Conflict of Interest
No conflict of interest has been declared by the author(s).

Author Contributions
Plan, design: ÇK; **Material, methods and data collection:** ÇK; **Data analysis and comments:** ÇK; **Writing and corrections:** ÇK.

Funding
This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.

Ethical considerations
Given the nature of this bibliometric study, no ethics committee approval was required. Since bibliometric studies use open-access data, they do not require an ethics committee event.

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