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Global Trends on the Use of Artificial Intelligence in Nursing: A Descriptive and Evaluative Bibliometric Analysis Study

Hemşirelikte Yapay Zekanın Kullanımına İlişkin Küresel Eğilimler: Tanımlayıcı ve Değerlendirici Bir Bibliyometrik Analiz Çalışması

Fatma AZİZOĞLU¹ , Banu TERZİ² 

Yazarların ORCID numaraları / ORCID IDs of the authors:
F.A. 0000-0002-7102-9797; B.T. 0000-0002-9500-6872

¹Haliç University, Faculty of Health Sciences, Department of Nursing, İstanbul, Türkiye

²Akdeniz University, Faculty of Nursing, Fundamentals of Nursing Department, Antalya, Türkiye

Sorumlu yazar / Corresponding author: Banu TERZİ
E-posta: banuterzi@akdeniz.edu.tr

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ABSTRACT

Introduction: There is a need to examine the use of artificial intelligence in the branch of nursing and to investigate the characteristics of the research conducted in this field.

Aim: The aimed was to examine the characteristics of the current knowledge structure and development process in the field of the use of artificial intelligence in nursing.

Method: In the descriptive and evaluative bibliometric analysis study, data were obtained from Web of Science database. All relevant studies conducted between 2004 and 2023 were included in the study. Data analysis was performed using R Biblioshiny software. Two hundred seventy-three studies were included in the study.

Results: The most publications (n = 86, 31.50%) were made in this field in 2022. The most productive author in the field of nursing and artificial intelligence was Topaz, Maxim. The prominent topics in the studies were "virtual reality, artificial intelligence, nursing, machine learning, simulation, nursing education, education, pain, nursing students, natural language processing, nurses, robotics, deep learning and mental health".

Conclusion: There has been a significant increase in the number of studies on the use of artificial intelligence in nursing and this area offers an active field of study for nursing researchers.

Keywords: Artificial intelligence; bibliometric analysis; deep learning; nursing; virtual reality.

ÖZ

Giriş: Yapay zekânın hemşirelik alanında kullanımı hakkında fikir sahibi olabilmek ve bu alandaki uygulama ve araştırmalardaki gelişmeleri tespit edebilmek için ilgili yayınların özelliklerinin araştırılması gerekmektedir.

Amaç: Hemşirelikte yapay zekâ kullanımını alanında mevcut bilgi yapısı ve gelişim sürecinin özelliklerinin incelenmesi amaçlandı.

Yöntem: Tanımlayıcı ve değerlendirici bibliyometrik analiz çalışmasında veriler "Web of Science" veri tabanından elde edilmiştir. Çalışmaya 2004-2023 yılları arasında yapılmış ilgili tüm çalışmalar dahil edilmiştir. Veri analizi R Biblioshiny yazılımı kullanılarak gerçekleştirilmiştir. Çalışmaya iki yüz yetmiş üç çalışma dahil edilmiştir.

Bulgular: Bu alanda en fazla yayın (n = 86, %31,50) 2022 yılında yapılmıştır. Hemşirelik ve yapay zekâ alanında en üretken yazar Topaz, Maxim'dir. Çalışmalarda "sanal gerçeklik, yapay zekâ, hemşirelik, makine öğrenmesi, simülasyon, hemşirelik eğitimi, eğitim, ağrı, hemşirelik öğrencileri, doğal dil işleme, hemşireler, robotik, derin öğrenme ve ruh sağlığı" konuları öne çıkmıştır.

Sonuç: Hemşirelikte yapay zekâ kullanımına ilişkin çalışmaların sayısında önemli bir artış olmuştur ve bu alan hemşirelik araştırmacıları için aktif bir çalışma alanı sunmaktadır.

Anahtar Kelimeler: Bibliyometrik analiz; derin öğrenme; hemşirelik; sanal gerçeklik; yapay zeka.



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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). According to this definition, AI is defined as the mental activities called “intelligence” performed by human beings and performed by machines (Clancy, 2020). In computer science, AI is defined as “devices that contain intelligent agents that perceive their environment and act to maximize their chances of success at a goal”. Today, many professionals have started to use artificial intelligence in their work areas. Nursing professionals are one of them (Akgerman, Özdemir Yavuz, Kavasar & Güngör, 2022).

Nurses are the discipline members who produce the most data in health care and spend more time with healthy/patient individuals and observe them closely (Harmon, Pitt, Summons & Inder, 2021; Ronquillo et al., 2021). The use of AI in nursing has tended to increase in recent years. Although some studies show that AI has limited use in the field of nursing, its use in areas such as risk identification, chronic disease management, critical decision making, nursing diagnosis, etc. is still a matter of debate (Guo, Hao, Zhao, Gong & Yang, 2020; Abbasgholizadeh et al., 2021; von Gerich et al., 2022).

Through data mining, information processing, statistical analysis and mapping, the bibliometric method can analyze existing research and intuitively show the internal knowledge structure and evolution of the discipline. This enables researchers to understand their own academic achievements and determine future research direction (Shi et al., 2021; Xu et al., 2022).

Although there are some bibliometric studies that investigate the effects of AI on the branch of nursing, there is no comprehensive bibliometrics that analyzes the collaboration between countries, institutions and authors in the branch. In addition, there is still a lack of bibliometrics that deeply analyze the development process and boundaries of research topics in this field (Carter-Templeton, Frazier & Wu, 2018; Shi et al., 2023). It is thought that the findings of this study will be useful for researchers to understand the quality of research in these field and global trends. In this study, answers to the following questions were sought for this purpose:

Aim

The aimed was to examine the characteristics of the current knowledge structure and development process in the field of the use of artificial intelligence in nursing.

Research Questions

1. What is the publication characteristics?
2. What are the most influential publications?
3. What is the trend topics?
4. What is the thematic evolution?

Method

Study Design

In this study, a descriptive and evaluative bibliometric analysis

of articles on the use of artificial intelligence in nursing was performed. The bibliometric analysis method provides researchers with a broader profile of the literature through performance analysis, visualization and relationship analysis (Esen, Bellibas & Gumus 2020). Therefore, bibliometric analysis was used in this study for a deeper exploration and tracking of trends and for a deeper understanding of the relationship of social networks.

Study Setting

In the research, it was aimed to show the current situation at the international level by bibliometrically analyzing the researches published in the “Web of Science (WoS) Core Collection” database in the field of the use of AI in nursing. The most important feature of bibliometric analysis is that the databases from which the data set can be obtained are known.

Data Collection

Today, there are more than one database for bibliometric analysis. Among the most frequently used databases are PubMed, Embase, Scopus, Springerlink, Google Scholar, ScienceDirect. These databases contain different features from each other (Moral-Munoz, Herrera-Viedma, Santisteban-Espejo & Cobo, 2020). Compared to Scopus and Google Scholar, the WoS database is a more reliable database because it has a larger archive of journals and citations and is based on older years, contains journals with higher impact values, provides effective access to bibliographic data and has more publications. For this reason, as in many bibliometric studies, it was the preferred database for obtaining data in this study (Zavadskas, Skibniewski & Antucheviciene, 2014; Karagöz & Şeref, 2019; Ramos-Rincón, Pinargote-Celorio, Belinchón-Romero & González-Alcaide, 2019; Zhu, Song, Zhu & Johnson, 2019; Guleria & Kaur, 2021). The data of the study were obtained on October 9, 2023 from publications open to access in the WoS Core Collection database between the years 2004-2023. For bibliometric data, an advanced search was performed on all files in the WoS database with the keywords: [(((((((ALL = (“nursing”)) OR ALL = (“nursing care”)) AND ALL = (“artificial intelligence”) OR ALL = (“virtual reality”)) OR ALL = (“audio pass-through technology”)) OR ALL = (“machine learning”)) OR ALL = (“deep learning”)) OR ALL = (“image recognition and robotics”)]. The research population was found to be 633, 245. The sample was found to be 273 when the publication language, year, countries, institutions, authors, publication type, indexes indexed were Science Citation Index Expanded, Social Sciences Citation Index, Emerging Sources Citation Index and publication year was limited between 2004 - 2023. The analysis of the study was conducted on 273 publications. The studies constituting the data set of the study were taken from the WoS database in accordance with the publication acceptance criteria and are given in the publication flow diagram (Figure 1).

Data Analysis

All information about the publications was filtered according to the research acceptance criteria. At the end of the filtering, the record contents of 273 publications obtained from the WoS database were selected as “full records and references”. Publications between 1 - 123 in this dataset were exported in BibTEX format. The files

containing the exported data were organized in the R software program interface as a single file in BibTEX format for analysis. As an analysis tool, the Biblioshiny program, which is preferred for bibliometric analysis in the R software program interface, was installed. Biblioshiny allows visualization of relationships between documents. Relationships show how documents are grouped between topics (Waltman & Jan van Eck, 2013). The Biblioshiny interface makes the complex process of thematic assessment simple, straightforward and effective. Understanding themes and trends in the scientific literature can help researchers and decision makers to identify current and future research directions (Aria & Cuccurullo, 2017). General structure analysis includes general information about the data, journals, authors, descriptive bibliometric analysis and intellectual structure analysis includes evaluative bibliometric analysis of conceptual, social and intellectual structure. Nodes represent the key elements on which the analysis focuses, such as keywords, authors or specific topics (Mingers & Leydesdorff, 2015). For example, the use of keywords can be used to understand the popularity trends of a particular research area. Links indicate relationships between nodes, nodes that are related to each other. A link between two nodes indicate that these nodes are related (Jan van Eck & Waltman, 2010). Clustering shows clusters of similar or related nodes. These clusters can represent nodes grouped around a particular theme or topic (Chen, 2006). The size or color of the nodes can represent a particular metric or attribute, for example, how common a keyword is in the literature can also be decided by looking at the size (Börner, Chen & Boyack, 2003). The overall structure (topology) of the map shows how themes are related to each other. Clusters that are densely connected may indicate a strong relationship. Prominent gaps or anomalies in the map may indicate areas that have not been adequately explored in the literature or unexpected relationships (Börner et al., 2003). In this study, four thematic analyses (1. Motor themes, 2. Niche themes, 3. Core themes and 4. Emerging or diminishing themes) were used (Sott et al., 2020; López-Robles et al., 2021).

Results

General Information and Annual Publication Output

This section presents the findings obtained from the analysis of 273 articles in the field of nursing, nursing care and AI between 2004 and 2023 from the WoS database. Within the scope of the dataset, the first publication was made in 2004 ($n = 1$) and this publication had a contribution of 0.366 in the existing publications, and a soaring topic was observed in the number of articles since 2018. In the following years 2021, 2022 and 2023, it was found that there was a great improvement in the number of publications. It was found that the highest number of publications was made in 2022 ($n = 86$), and these publications accounted for 31.502% of all publications. In the bibliometric analysis, it was seen that there were ($n = 273$) publications in the article type, the annual growth rate was 25.6%, a mean of 2.1 articles were published per year, an average of 9,022 citations per article, a total of 9802 sources were used for all publications, 838 keywords were used by the authors, 1131 authors were involved in these publications, there were only 24 articles with a single author, there were 4.69 co-authorships per article, and the international co-authorship rate was 26.01%.

The Top Most Productive Authors, Countries and Journals

Topaz, Maxim (16 publications), O'Connor, Siobhan (6 publications) and Zeng, Yingchun (5 publications) were among the three most prolific authors. Most research were produced in the USA (84 articles), China (37 articles) and the UK (29 articles). Most of the studies were published in Journal of Nursing Management (24 publications), Nurse Education Today (17 publications), Asia Pacific Journal of Oncology Nursing (13 publications), respectively.

Top 10 most cited publications

When the number of publications, authors, years, journals, average citations and total citations were analyzed; it was found that the publication titled "Virtual reality as a distraction intervention for women receiving chemotherapy" ranked first, this publication was written by Schneider et al. and published in the journal "Oncology Nursing Forum" in 2004, with an annual average of 5.45 citations and 109 citations in total. In the second place, it was found that the publication titled "Using Game-Based Virtual Reality with Haptics for Skill Acquisition" was published by Butt et al. in the journal "Clinical Simulation in Nursing" in 2018 and received an annual average of 17.67 citations and 106 citations in total. In the third place, the publication titled "Open artificial intelligence platforms in nursing education: Tools for academic progress or abuse?" was published by O'Connor in the journal "Nurse Education in Practice" in 2023 and received an annual average of 51.5 citations and 103 citations in total.

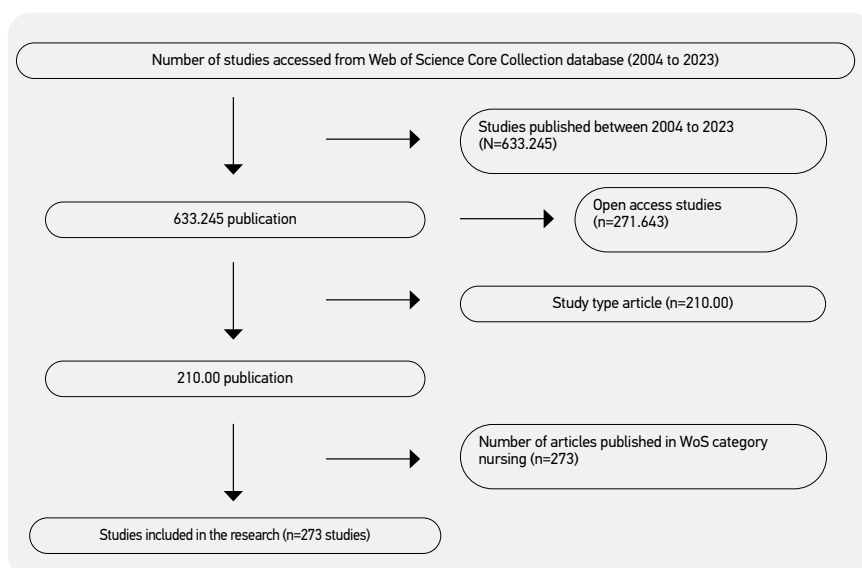


Figure 1: Publication selection flow diagram

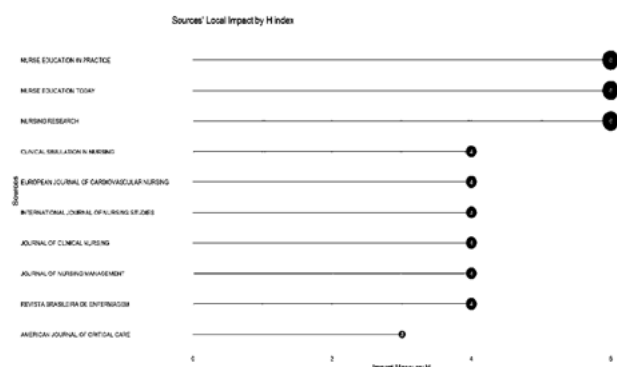


Figure 4B: Impact of journals according to h index

The h index of the journals were examined; Nurse Education in Practice (6 h index), Nurse Education Today (6 h index), Nursing Research (6 h index), Clinical Simulation in Nursing (4 h index), European Journal of Cardiovascular Nursing (4 h index), International Journal of Nursing Studies (4 h index), Journal of Clinical Nursing (4 h index), Journal of Nursing Management (4 h index), Revista Brasileira de Enfermagem (4 h index), American Journal of Critical Care (3 h index) (Figure 4B).

Discussion

In this study, a bibliometric analysis covering the years 2004 - 2023 was conducted to determine the general outlook of the publications of studies on the use of AI in the field of nursing and the global trend in this field. Visual mapping and bibliometric analyses were performed to determine the publication performance of key concepts, countries, universities and researchers in the field of the use of AI in nursing. As a result of the analysis, it was found that the number of articles published in the field of the use of AI in nursing started to increase rapidly since 2018 and reached its peak with 86 articles in 2022. The count of articles shows researchers the productivity in the relevant field, gives the opportunity to evaluate the historical development process of the field and is a descriptive indicator (Ertekin, 2014). AI is a set of techniques developed to teach computers to mimic some cognitive functions such as learning, reasoning, communicating and making decisions (Robert, 2019). Nurses are in a key position to shape and drive the development of modern AI in nursing, both as potential users of AI-based technologies and as professional care experts (McGrow, 2019). Therefore, it is inevitable that the use of AI in the field of nursing will increase day by day. The most productive author was found to be Topaz, Maxim. Accordingly, Topaz, Maxim can be recommended to researchers to understand the structure of this research field and to follow the developments in AI research in the field of nursing. The most productive country is the USA and the most productive journal is Journal of Nursing Management. Journal of Nursing Management is one of the leading journals on management and leadership in nursing. It is thought that journals with a high impact factor in the literature are more qualified and important (Garfield, 2006). Therefore, publishing publications on the use of AI in nursing in journals with high impact factor may increase the motivation of researchers and positively affect the quality of future studies. In addition, it can be said that studies in which AI is used especially in the management of nursing care

and nursing leadership may be more likely to be published in the Journal of Nursing Management. It is suggested that keywords should be examined to monitor scientific progress (Yanbing et al., 2020).

Keywords can guide authors in conceptualizing their work. The keyword analysis showed that the authors' keywords were concentrated in seven clusters. These clusters show that the use of AI in nursing is related to nursing education, virtual reality applications, management of nursing care and outcomes. The results of the keyword analysis are important in that they reflect that AI can be used in many areas of nursing. Hot topics may change over time, but they reflect key issues in the field and provide an understanding of trend topics in the field (Liu, Zhang & Kishimoto, 2021). Consideration of these issues for future AI-based nursing studies will contribute to the generation of specific research.

Study Limitations

The study data is limited to the time period between 2004 and 2023 when the literature review was conducted. Conducting another similar study by selecting a different time period may reveal different results. Another limitation is that the data was obtained only from the WoS database. The findings and recommendations of this study are limited to the general outlook and direction of the global trend in this field. In addition, although there was no language restriction during the publication search, the searches were conducted in English. Therefore, it is thought that using keywords in different languages may produce on a large scale finding.

Conclusion

The results of this bibliometric analysis study revealed that more AI - based studies should be conducted in nursing, especially in the management of care and monitoring and evaluation of outcomes. In this respect, this study can guide researchers who want to work in this field. It is seen that AI studies in the field of nursing are mostly used in nursing education. There is a need for AI research that supports the visibility of direct care and proves improvement in nursing care practices. Establishing collaborations with authors and institutions that have studies on this subject can contribute to the increase of research in the field. In addition, it may be recommended that nurses carry out joint studies with engineers on AI.

Ethical Considerations: Ethics committee approval was not required.

Author Contribution: Study Idea (Concept) and Design – FA, BT; Data Collection / Literature Review – FA, BT; Analysis and Interpretation of Data – FA, BT; Preparation of the Article – FA, BT; Approval of the Final Version to be Published – FA, BT.

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