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A Bibliometric Analysis of Research into Hygiene and Artificial Intelligence in the Web of Science (1996–2024)

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Abstract

This study presents a bibliometric analysis of academic publications addressing the concepts of "hygiene" and "artificial intelligence" in the Web of Science database between 1996 and 2024. The study examined the distribution of publications by year, publication types, author productivity, journal and institutional contributions, publication distribution by country, collaboration networks, and keyword relationships. The findings indicate a significant increase in the number of publications, particularly after 2019, and that this increase has accelerated AI-based hygiene and public health research in relation to the COVID-19 pandemic. The analysis revealed that the studies were primarily concentrated in disciplines such as medicine, public health, computer science, and engineering, and were also published in high-impact journals including Frontiers in Public Health, IEEE Access, and the Journal of Medical Internet Research. The most productive authors were Song T.J., Park J.H., and Huang Z., with the most contributions by country coming from the United States, the United Kingdom, China, and South Korea, respectively. According to the keyword analysis, the concepts of "artificial intelligence," "machine learning," "deep learning," and "oral hygiene" emerged prominently. Overall, the findings reveal that scientific production in the fields of hygiene and artificial intelligence is becoming increasingly interdisciplinary, application-oriented, and globally widespread.

Keywords: Bibliometric analysis, Web of Science, hygiene, artificial intelligence, machine learning, public health, interdisciplinary research

Web of Science'da Hijyen ve Yapay Zeka Üzerine Yapılan Araştırmaların Bibliyometrik Analizi (1996–2024)

Bu çalışma, 1996 ile 2024 yılları arasında Web of Science veritabanında "hijyen" ve "yapay zeka" kavramlarını ele alan akademik yayınların bibliyometrik bir analizini sunmaktadır. Çalışma, yayınların yıllara, yayın türlerine, yazar verimliliğine, dergi ve kurum katkılarına, ülkelere göre dağılımına, işbirliği ağlarına ve anahtar kelime ilişkilerine göre dağılımını incelemiştir. Bulgular, özellikle 2019'dan sonra yayın sayısında önemli bir artış olduğunu ve bu artışın COVID-19 pandemisiyle ilgili olarak yapay zeka tabanlı hijyen ve halk sağlığı araştırmalarını hızlandırdığını göstermektedir. Analiz, çalışmaların öncelikle tıp, halk sağlığı, bilgisayar bilimi ve mühendislik gibi disiplinlerde yoğunlaştığını ve ayrıca Frontiers in Public Health, IEEE Access ve Journal of Medical Internet Research gibi yüksek etki faktörlü dergilerde yayınlandığını ortaya koymuştur. En üretken yazarlar Song T.J., Park J.H. ve Huang Z. olup, ülkelere göre en fazla katkı sırasıyla Amerika Birleşik Devletleri, Birleşik Krallık, Çin ve Güney Kore'den gelmiştir. Anahtar kelime analizine göre, "yapay zeka", "makine öğrenimi", "derin öğrenme" ve "ağız hijyeni" kavramları öne çıkmıştır. Genel olarak, bulgular hijyen ve yapay zeka alanlarındaki bilimsel üretimin giderek daha disiplinlerarası, uygulama odaklı ve küresel olarak yaygınlaştığını ortaya koymaktadır.

Anahtar Kelimeler: Bibliyometrik analiz, Web of Science, hijyen, yapay zeka, makine öğrenimi, halk sağlığı, disiplinlerarası araştırma

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1. Introduction

Bibliometrics refers to the quantitative examination of scientific communication through the analysis of bibliographic data (Bellis, 2009). The concept was originally introduced by Alan Pritchard in 1969, who described it as “the application of mathematical and statistical methods to books and other media of communication” (Pritchard, 1969). Hygiene has long been recognized as a cornerstone of public health, serving as a fundamental determinant of human well-being and disease prevention. From the development of early sanitation systems to modern infection control protocols, hygiene-related practices and policies have significantly contributed to reductions in morbidity and mortality worldwide. In recent decades, heightened global awareness of communicable diseases, antimicrobial resistance, and pandemic preparedness has underscored the critical role of hygiene in both healthcare and community settings. The emergence of global health crises, such as the COVID-19 pandemic, Ebola outbreaks, and cholera epidemics, has further intensified scientific inquiry and policy-driven research into hygiene-related practices, innovative technologies, and behavioral interventions.

Given this growing relevance, research on hygiene has evolved into a multidisciplinary domain encompassing public health, environmental science, microbiology, behavioral sciences, tourism and engineering. The increasing volume and diversity of publications reflect this interdisciplinary expansion, resulting in a complex and rapidly developing body of knowledge. However, although research in this field has grown rapidly, there is a still limited understanding of its overall structure, key themes, and patterns of collaboration. Traditional narrative reviews offer useful insights but are often insufficient to reveal the quantitative relationships and connections within the broader scientific literature.

Bibliometric analysis provides a robust methodological framework for addressing this gap. By applying quantitative techniques to bibliographic data, researchers are able to evaluate the growth, impact, and thematic trends of scientific publications (Pritchard, 1969; Bellis, 2009). Such analyses facilitate the identification of influential authors, institutions, and journals, as well as the mapping of thematic clusters and emerging research fronts. In the context of hygiene research, bibliometric methods can reveal how scholarly attention has shifted over time from early sanitation-focused studies to contemporary investigations of hygiene behavior, health education, and digital or artificial intelligence-based monitoring systems.

The Web of Science (WoS) database, widely regarded for its comprehensive and curated indexing of high-impact academic publications, provides a reliable foundation for such analyses. Conducting a bibliometric study based on WoS-indexed literature allows for the systematic evaluation of global research patterns and citation dynamics, thereby illuminating the intellectual landscape of hygiene-related scholarship. A search of the Web of Science database revealed no research on the bibliometric analysis of publications on "hygiene" and "AI." Only a study by Çobanoğlu (2025) analyzed the bibliometric characteristics and research trends of scientific publications on oral health and oral care in the field of nursing using visual mapping. Therefore, the present study aims to conduct a comprehensive bibliometric analysis of hygiene-related publications indexed in the Web of Science database. Specifically, the study seeks to examine the temporal distribution and growth trends of hygiene publications, identify the most productive authors, institutions, countries, and journals, analyze the citation and co-citation structures to uncover the intellectual foundations of the field, and explore thematic clusters and emerging research trends through keyword co-occurrence and trend analyses. The findings are expected to contribute to a better understanding of the global research landscape on hygiene, providing valuable insights for scholars, practitioners, and policymakers aiming to strengthen hygiene-related research and interventions.

2. Materials And Methods

In this study, the characteristics of research on hygiene and artificial intelligence in the were examined Web of Science database using bibliometric methods. The data were collected from WoS databases e.g., Science Citation Index Expanded (SCI Expanded), Conference Proceedings Citation Index (CPCI-S), Emerging Sources Citation Index (ESCI), Social Sciences Citation Index (SSCI), Art & Humanities Citation Index (A&HCI) and Conference Proceedings Citation Index - Social Science & Humanities (CPCI & SSH) for the period between 2016-2024. An advanced search was adopted and used the following keywords for searching and retrieving data: “hygiene” and “artificial intelligence”. The query path is: TS ("hygiene" and "artificial intelligence"). The bibliographic data related to hygiene and artificial intelligence included publication trends, publication types, top WoS categories, most productive authors, top journals, top affiliations, most cited publications, highly collaborative authors, highly cited articles and total link strength and most used keywords. A total of 347 bibliographic records were retrieved, and these were analysed and mapped using the VoSviewer version 1.6.20 (https://www.vosviewer.com/) and Microsoft Excel 2016.

3. Results

3.1. Publication Trends

The temporal analysis of publications indexed in the Web of Science database demonstrates a progressive and sustained increase in scholarly output addressing the intersection of hygiene and artificial intelligence. The first publication on hygiene and AI "Comparative evaluation of the use of artificial neural networks for modelling the epidemiology of schistosomiasis mansoni" was written by Hammad et al. 1996. Between 1996 and 2013, the number of publications remained very limited, fluctuating between one and two per year. After 2017, the number of publications began to increase, with a rapid increase observed from 2019 onwards. Publication output rose to 12 in 2019, 26 in 2020, and 34 in 2021. This reflects the increasing integration of AI technologies into hygiene-related research, particularly in response to global health concerns. This upward trend continued in subsequent years, reaching 53 publications in 2023 and peaking at 67 in 2024 (Figure 1). These findings demonstrate a marked acceleration in academic production and growing global interest in the role of AI in improving hygiene, public health monitoring, and disease prevention.

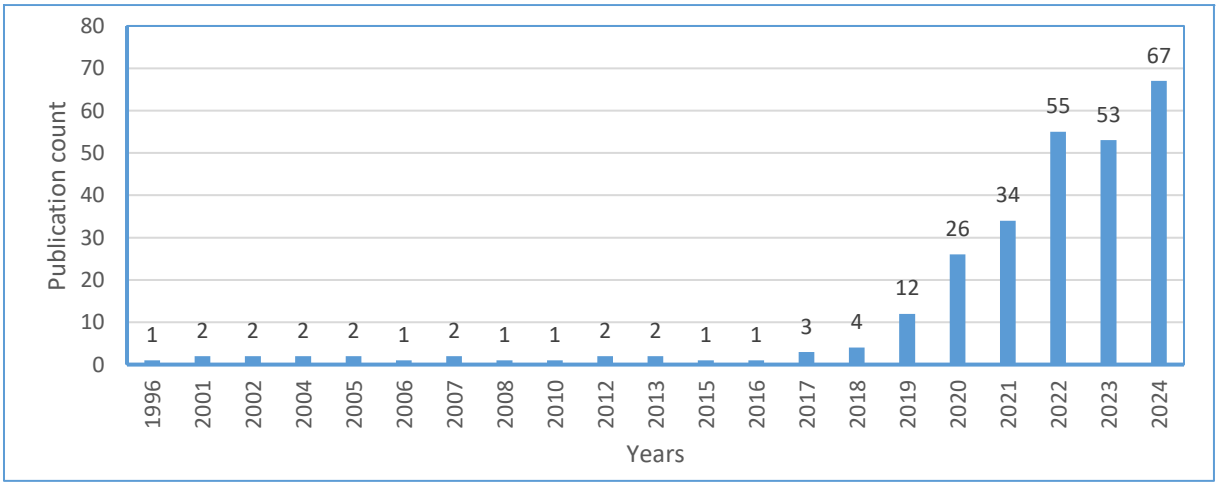


Figure 1. Number of publications on hygiene and AI between 1996 and 2024 in WoS database

3.2. Distribution of Publication types

Figure 2. presents the distribution of document types related to hygiene and AI indexed in the Web of Science database. The analysis reveals that articles constitute the predominant

publication type (n = 156), indicating that original research forms the core of scholarly output in this field. Proceedings papers (n = 54) and review articles (n = 48) also represent a substantial proportion of the literature, reflecting both the ongoing dissemination of emerging research findings and the increasing effort to consolidate existing knowledge. In contrast, other document types, including editorial materials (n = 8), meeting abstracts (n = 7), and a small number of data papers, letters, early access items, and retracted publications (n = 1 each), account for only a minor share of the total output (Figure 2).

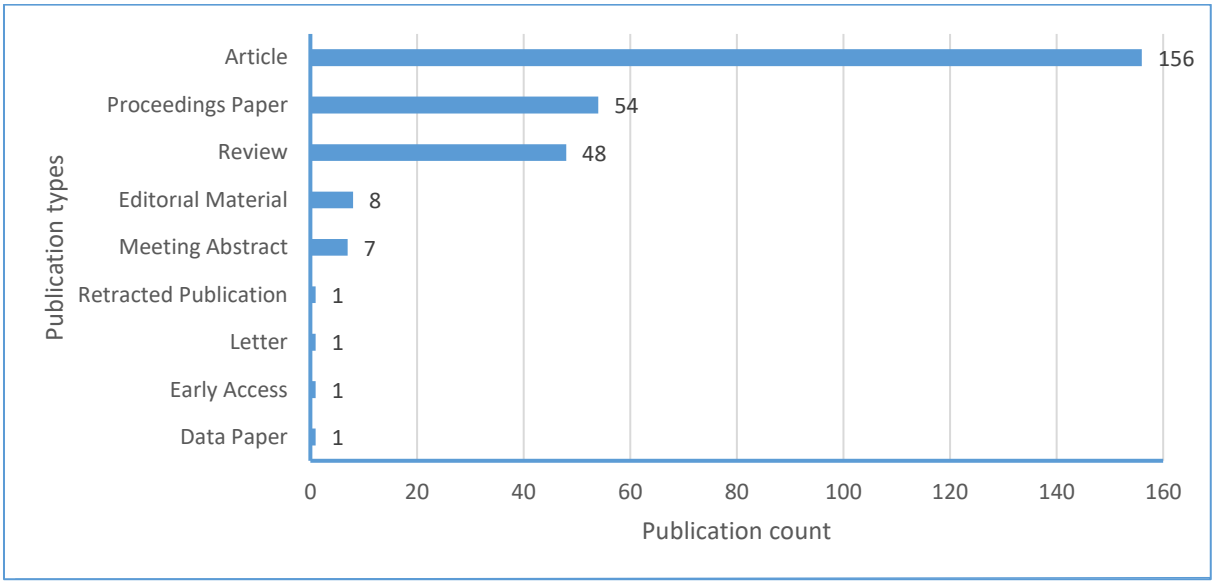


Figure 2. Number of publication types on hygiene and AI between 2016 and 2024 in WoS database

3.3. Leading Journals and Publication Sources

The analysis of Web of Science data indicates that research on hygiene and AI is concentrated in a limited number of journals and conference proceedings. The American Journal of Tropical Medicine and Hygiene ranks first with 12 publications (IF = 1.6, Q3), followed by Frontiers in Public Health with eight papers (IF = 3.4, Q1). Other key publication outlets include Lecture Notes in Artificial Intelligence (n = 7, IF = 0.302, Q4), American Journal of Infection Control (n = 5, IF = 2.4, Q3), Brain Broad Research in Artificial Intelligence and Neuroscience (n = 5, IF = 0.5, Q4), and Lecture Notes in Computer Science (n = 5, IF = 0.302, Q4). Additional journals such as Diagnostics (n = 4, IF = 3.3, Q1), IEEE Access (n = 4, IF = 3.6, Q2), and Journal of Personalized Medicine (n = 4, IF = 3.0, Q2) also made notable contributions. Journals with three publications, including BMC Oral Health, Cureus Journal of Medical Science, Journal of Clinical Periodontology, Journal of Medical Internet Research, and Sensors, represent significant venues that bridge medical and technological perspectives (Table 1).
Publications also appeared in high-impact multidisciplinary journals such as Applied Sciences, Artificial Intelligence in Medicine, and Scientific Reports. Overall, the diversity of publication venues across the Q1 to Q4 categories demonstrates the interdisciplinary nature of hygiene and AI research, bridging the health sciences and technological domains.

Table 1. Journals and conferences indexed in the web of science with three or more publications on hygiene and AI, including impact factor (IF) and category quartile (CQ)

Journal or Conference Titles	Count	IF*	CQ⁺
American Journal of Tropical Medicine and Hygiene	12	1,6	Q3
Frontiers in Public Health	8	3,4	Q1
Lecture Notes in Artificial Intelligence	7	0,302	Q4
American Journal of Infection Control	5	2,4	Q3
Brain Broad Research in Artificial Intelligence and Neuroscience	5	0,5	Q4

Lecture Notes in Computer Science	5	0,302	Q4
Transactions of The Royal Society of Tropical Medicine and Hygiene	5	1,5	Q3
Diagnostics	4	3,3	Q1
IEEE Access	4	3,6	Q2
Journal of Personalized Medicine	4	3	Q2
BMC Oral Health	3	3,1	Q1
Cureus Journal of Medical Science	3	1,3	Q2
IFIP Advances in Information and Communication Technology	3	0,87	Q3-Q4
Journal of Clinical Periodontology	3	6,8	Q1
Journal of Medical Internet Research	3	6	Q1
Sensors	3	3,5	Q2

IF* = Impact Factor. **CQ**$^{+}$ = Category Quartile

3.4. Author Productivity and Collaboration Networks

Based on data retrieved from the Web of Science database, a total of 203 individual authors have contributed to publications that addres the intersection of hygiene and AI. This wide distribution of contributors indicates a highly diverse authorship network, reflecting the interdisciplinary nature of the research area. Among these contributors, the most productive authors are Song T.J. (6), Park J.H. (5), and Huang Z. (4), who stand out as leading figures in the field. They are followed by Kim J.W., Chang Y., Nathavitharana, R.R., Li, G and Lee, H., each with three publications. Additionally, researchers such as William Makupa, Arnold Milstein, Robles-Bykbaev, Vladimir, Shilio, Bernadetha R., Bascaran, Covadonga, Chen, Chih-Chang, Kusnoto, Budi, Robles-Bykbaev, Yaroslava, Allareddy, Veerasathpurush, Burlea, Stefan Lucian, Cleland, C, and Kabasawa, Yuji, each contributed two studies to the field (Figure 3).

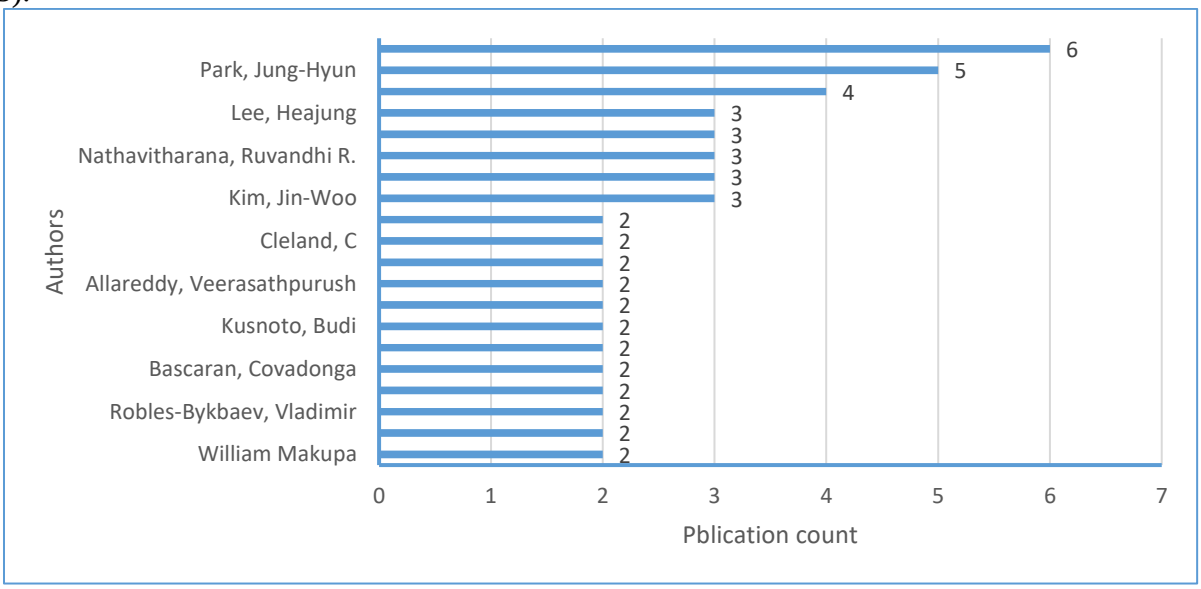


Figure 3. Top 20 authors and publication count on hygiene and AI between 2016 and 2024 in WoS database

A co-authorship network map generated using VOSviewer software demonstrates the existence of a limited number of strong collaboration groups on hygiene and AI. Nodes (dots) represent authors, and lines represent co-publication relationships between authors. Visual analysis reveals that authors such as Babu Harysh Winster Suresh, Chettri Dewan, Elangovan Ajay, Vellingiri Balachandar, Maurya Brij Mohan, Yadav Nidhi, Velusamy Parthasarathy, Pulwani Chirag, Iyer Mahalaxmi, and Kanda Savleen Singh are at the center of the network and have a high density of connections between them. These authors are the focal point of research collaborations in the field and drive much of the interaction in the literature (Figure 4). The

overall network structure suggests that a specific research group collaborates intensively, but integration among authors across the field remains limited. This suggests that research at the

intersection of hygiene and AI is still evolving, and collaboration networks have not yet fully expanded globally.

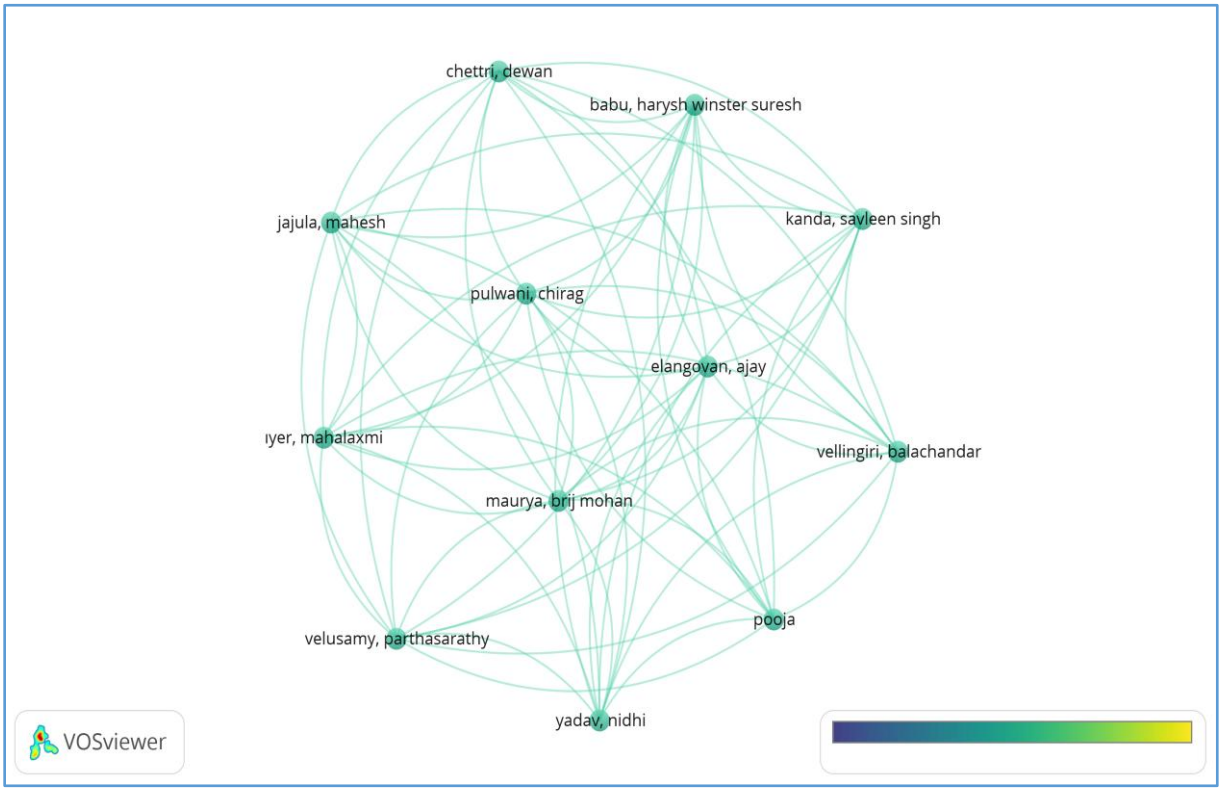


Figure 4. Co-authorship network visualization of researchers working on hygiene and AI (based on VOSviewer analysis).

3.5. Most cited publications and total link strength

In the analysis of the most cited publications and total link strength, leading studies in the field stand out. The most cited study is Jiang and Wen (2020), with 503 citations, making it one of the key reference points in the field. This study is followed by Haque et al. (2020) (178 citations), Pillai et al. (2021) (167 citations), and Shuja et al. (2021) (154 citations), representing early contributions of artificial intelligence to hygiene applications (Table 2).

In terms of total link strength, Thurzo et al. (2021) rank highest with a link strength value of 18, highlighting its central position in the literature. Studies by Haque et al. (2020) (11), Pillai et al. (2021) (10), Shuja et al. (2021) (10), and Jiang and Wen (2020) (10) also stand out with their high link strength values. In contrast, some highly cited studies, such as those by Navas et al. (2021) and Wang et al. (2021), exhibit low link strength, indicating limited connections within the research network despite being frequently cited in the literature. Recent studies by Vassilopoulou et al. (2024), Kaswan et al. (2024), and Vinothkanna et al. (2024), however, exhibit low link strength, indicating that they have not yet been fully integrated into the literature.

Table 2. Ranking of the 15 most cited publications and total link strength on hygiene and AI in WoS.

Rank	First Author*	References	Citations	TLS
1	Jiang (2020)	Jiang and Wen (2020)	503	10
2	Haque (2020)	Haque et al. (2020)	178	11
3	Pillai (2021)	Pillai et al. (2021)	167	10
4	Shuja (2021)	Shuja et al. (2021)	154	10
5	Navas (2021)	Navas et al. (2021)	141	0
6	Wang (2021)	Wang et al. (2021)	135	0
7	Manigandan (2020)	Manigandan et al. (2020)	83	5
8	Li (2022a)	Li et al. (2022)	80	7
9	Cabitza (2020)	Cabitza et al. (2020)	71	3
10	Huang (2022)	Huang et al. (2022)	70	9
11	Abd-Alrazaq (2020)	Abd-Alrazaq et al. (2020)	70	8
12	Fitzpatrick (2020)	Fitzpatrick et al. (2020)	57	5
13	Valk (2022)	Valk et al. (2022)	56	0
14	Olawade (2024)	Olawade et al. (2024)	55	3
15	Nathavitharana (2022)	Nathavitharana et al. (2022)	50	0

*The top 15 most cited articles in the table were automatically obtained from the VoSviewer application, and only the first author's name has been retrieved. The correct sources are displayed in the reference's column.

In the network analysis (Figure 5), studies by Haque et al. (2020), Shuja et al. (2021) and Thurzo et al. (2021) stand out as central nodes due to their strong connections. A particularly close thematic relationship (AI-based hygiene management) is observed between Haque et al. (2020) and Shuja et al. (2021), while early studies such as Manigandan et al. (2020) and Cabitza et al., (2020), form the initial clusters of the network. Despite its relatively isolated location, Thurzo et al. (2021) exhibit the highest link strength, reflecting the central influence of a different thematic perspective. An examination of the color scale (2020–2023) reveals that publications from the 2020–2021 period form dense clusters, while studies from 2023 onward are scattered with sparse links. These findings confirm that the field experienced rapid development in 2020–2021 and has recently undergone thematic diversification.

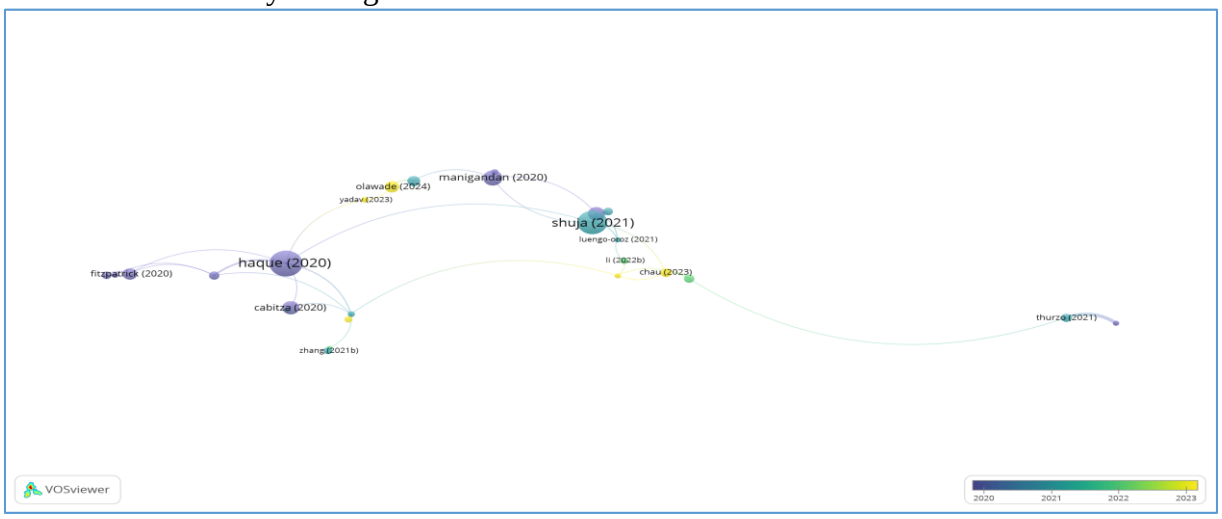


Figure 5. Citation network of authors' total link strength of publications in hygiene and AI.

3.6. Distribution of Publications by Countries and Affiliations

According to the results of the bibliometric analysis, the distribution of institutions producing publications in the fields of hygiene and AI by country shows a quite wide geographical diversity. The country with the most publications is the United States (53 publications), followed by the United Kingdom (26), China (25), South Korea (20), and Germany (12). These countries are followed by Egypt (11), the Netherlands (8), Ireland (7), Australia (6), Taiwan (6), and Qatar (6). Countries such as Italy (5), Spain (4), France (2), Switzerland (2), and Romania (2) in the European continent have also made notable contributions. In addition, Canada (4), Malaysia (4), Hong Kong (4), and Japan (2) are among the important research centers in the Asia-Pacific region. In addition, countries such as Brazil, Singapore, South Africa, Tanzania, Ukraine, Ecuador, and Peru also contribute to scientific production in this field. In general, research outputs show a global distribution centered in North America, Europe, and East Asia. It has been determined that the USA, the United Kingdom and China are in a leading position in international publication production in this field (Figure 5).

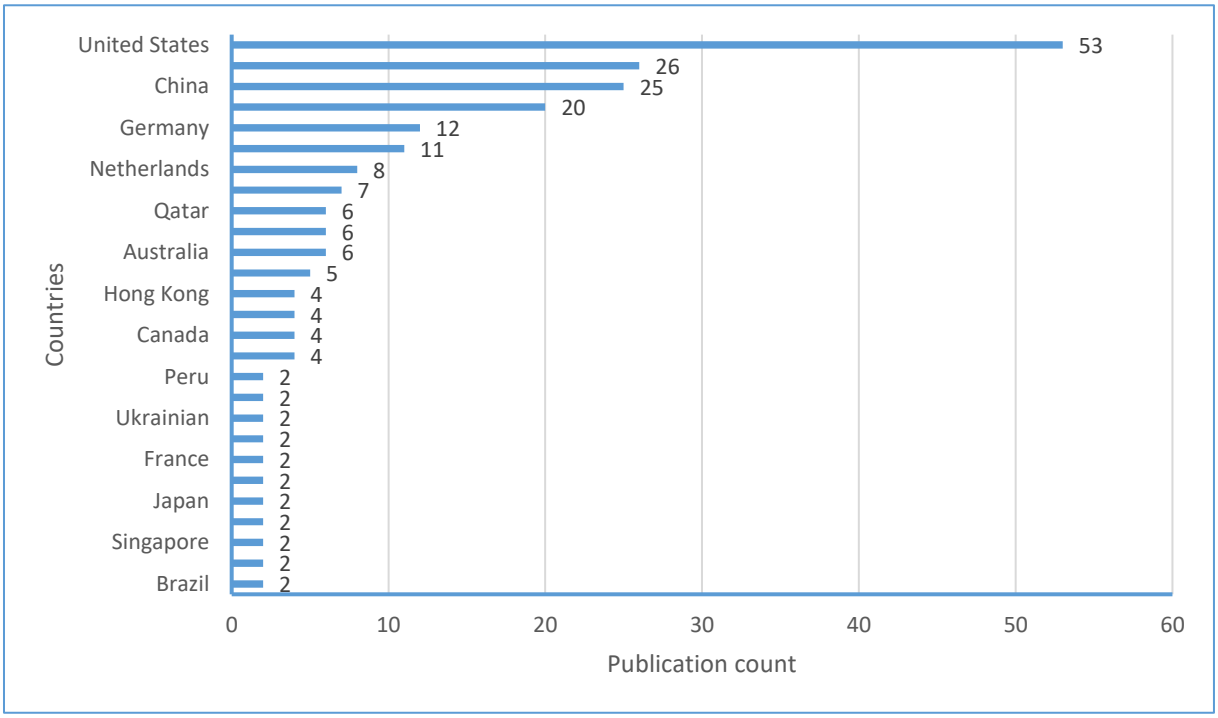


Figure 6. Country-wise distribution of publications on hygiene and AI in the web of science database

According to the results of the bibliometric analysis, the University of London (8 publications), Egyptian Knowledge Bank (7 publications), and Ewha Woman's University (6 publications) stand out among the institutions that contributed most to the research field during the period under study. These institutions are followed by Harvard University and its affiliates (Harvard Medical School and Harvard University Medical Affiliates), demonstrating the strong institutional presence of the United States in the field. China is represented by numerous institutions, with universities such as Beijing Technology Business University, Peking University, Zhengzhou University, and Shanghai Jiao Tong University being particularly prominent. Similarly, in the United Kingdom, institutions such as University College London, London School of Hygiene & Tropical Medicine, Imperial College London, and King's College London make significant contributions based on interdisciplinary collaborations. In Europe, leading institutions such as the Helmholtz Association (Germany), Trinity College Dublin (Ireland), University of Cambridge (UK), University of Barcelona (Spain), and Leiden

University (Netherlands) stand out. In Asia, Yonsei University, Seoul National University (SNU), Korea University, and the National University of Singapore are notable. In the Middle East and Africa region, institutions such as Cairo University (Egypt), Qatar Foundation (Qatar), Hamad Bin Khalifa University (Qatar), and Addis Ababa University (Ethiopia) represent regional contributions to the field. Furthermore, in Latin America, institutions such as the Pontificia Universidad Católica del Perú and the Universidade de São Paulo (Brazil) are also participating in the global research network.

Table 3. Affiliations with 3 or more publications on hygiene and AI in the Web of Science database

Affiliations	Country	Count
University of Landon	United Kingdom	8
Egyptian Knowledge Bank EKB	Egypt	7
Ewha Woman's University	South Korea	6
Harvard University	United States of America	6
Harvard University Medical Affiliates	United States of America	6
Beijing Technology Business University	China	5
Harvard Medical School	United States of America	5
Cairo University	Egypt	4
Helmholtz Association	Germany	4
London School Of Hygiene Tropical Medicine	United Kingdom	4
Peking University	China	4
University Kebangsaan Malaysia	Malaysia	4
University College London	United Kingdom	4
Zhengzhou University	China	4
Beth Israel Deaconess Medical Center	United States of America	3
Carol Davıla University of Medicine Pharmacy	Romania	3
Chinese Academy of Sciences	China	3
Hamad Bin Khalıfa University Qatar	Qatar	3
Kaohsiung Medical University	China	3
Kaohsiung Medical University Hospital	China	3
New York University	United States of America	3
Qatar Foundation QF	Qatar	3
Shanghai Jiao Tong University	China	3
Stanford University	United States of America	3
State University System of Florida	United States of America	3
Trinity College Dublin	Ireland	3
University of Illinois Chicago	United States of America	3
University of Illinois Chicago Hospital	United States of America	3
University of Illinois System	United States of America	3
University of L'Aquila	Italy	3
Yonsei University	South Korea	3
Yonsei University Health System	South Korea	3

3.7. Keyword Co-occurrence and Thematic Analysis

According to data obtained from the Web of Science database, approximately 200 different keywords were used in publications related to hygiene and AI. The term with the highest frequency of occurrence was "artificial intelligence" (34 occurrences, total link strength: 174), occupying a central position in the co-occurrence network and forming the primary focus term of the field. Other concepts directly representing AI were "machine learning" (11 occurrences, 65 link strength), "deep learning" (4 occurrences, 25 link strength), and "artificial intelligence

(AI)" (2 occurrences), which exhibited particularly strong associations with health and hygiene themes. Links to keywords such as "oral hygiene," "hand hygiene," "periodontal diseases," "infection prevention," and "hospitals" indicate that AI technologies are extensively used in applied fields such as dentistry, hospital hygiene, and infection control. In the network structure, the green cluster corresponds to health and clinical applications, the blue cluster to pandemic and public health themes, and the yellow and purple clusters to technological and engineering-focused studies. According to the temporal distribution, pandemic and infection control topics were prominent in the 2020–2021 period, while studies on dentistry, image analysis, and AI applications in healthcare increased after 2022 (Figure 5). These findings reveal that the concepts of AI and hygiene constitute an interdisciplinary research area, creating a dynamic knowledge network where technological innovation and healthcare themes integrate.

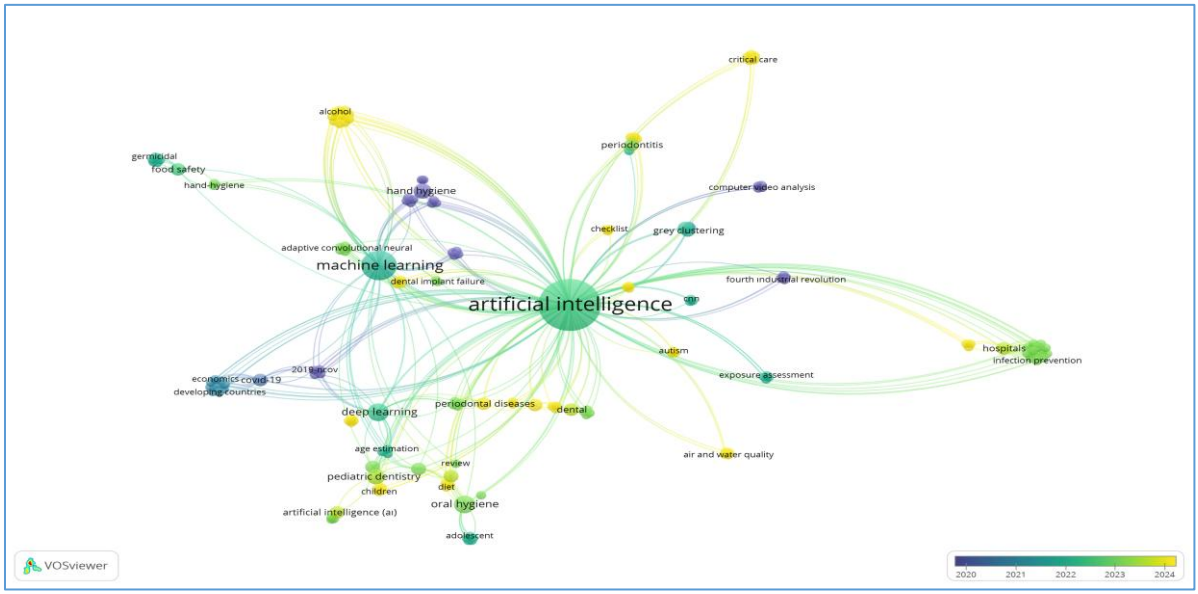


Figure 7. Co-occurrence network and thematic structure of keywords in hygiene and AI publications based on web of science database

4. DISCUSSIONS

In this study, academic publications addressing the concepts of "hygiene" and "artificial intelligence" in the Web of Science database from 1996 to 2024 were analyzed using bibliometric method The analysis results cover the evolution of publications over the years, publication types, leading journals, author productivity, collaboration networks, distribution across countries and institutions, and keyword analyses.

Publication trends over the years show that studies, which remained quite limited between 1996 and 2013, increased rapidly, especially after 2017. This increase, which became more pronounced starting in 2019, stemmed from the widespread adoption of AI in hygiene and public health research driven by the COVID-19 pandemic. The 67 publications reached in 2024 indicate that academic interest in this field has peaked. This trend demonstrates the increasing integration of AI technologies into hygiene management, disease prevention, and public health monitoring processes, as well as the strengthening of interdisciplinary research.

An examination of publication types revealed that research and review articles accounted for the largest share, with conference proceedings also making a significant contribution. This demonstrates that the topic is addressed from both theoretical and applied perspectives.

Additionally, various types of studies, including editorials, meeting abstracts, letters, and data articles, are also included in the literature.

Journal analysis revealed that studies in the field of hygiene and AI are published in journals with varying scientific levels and impact factors. The American Journal of Tropical Medicine and Hygiene (n=12, IF=1.6, Q3), Frontiers in Public Health (n=8, IF=3.4, Q1), and Lecture Notes in Artificial Intelligence (n=7, IF=0.302, Q4) are the journals with the highest number of publications. There are also significant publications in high-impact journals such as IEEE Access, Diagnostics, Journal of Clinical Periodontology, and Journal of Medical Internet Research. This shows that hygiene and AI research attract attention in different scientific fields with both theoretical and applied aspects, and scientific quality increases with the concentration in Q1–Q2 journals.

An examination of the distribution of publications on hygiene and AI by type reveals that the largest share belongs to research articles and review articles. Furthermore, full-text papers constitute a significant portion, demonstrating that academic activity in this field is also developing through conferences. In addition, editorials, meeting abstracts, and a limited number of data articles, letters, and early access studies were also included in the literature. This finding demonstrates that the topic is increasingly being addressed through both original research and review articles.

According to data obtained from the Web of Science database, academic publications on hygiene and AI are interdisciplinary. These publications span a wide spectrum, encompassing both health sciences and engineering and information technology. Studies published in high-impact journals such as Frontiers in Public Health, American Journal of Tropical Medicine and Hygiene, Journal of Medical Internet Research, Artificial Intelligence Review, and IEEE Access demonstrate the growing scientific interest in this field. Furthermore, papers published in conference series such as Lecture Notes in Computer Science, Advances in Intelligent Systems and Computing, and Proceedings of IEEE International Conferences emphasize the applied and technological aspects of the topic. Bibliometric analysis of journals revealed that publications are distributed across different impact factors and quartiles. The American Journal of Tropical Medicine and Hygiene (n=12, IF=1.6, Q3) had the highest number of publications, followed by Frontiers in Public Health (n=8, IF=3.4, Q1) and Lecture Notes in Artificial Intelligence (n=7, IF=0.302, Q4). A significant number of studies were also published in high-impact journals including the American Journal of Infection Control, Diagnostics, IEEE Access, Journal of Clinical Periodontology, and Journal of Medical Internet Research. This distribution demonstrates that the interaction between hygiene and AI is gaining importance in both theoretical and applied research areas. The concentration of publications in Q1 and Q2 journals indicates that the scientific quality of studies in this field is improving and that researchers are adopting innovative approaches based on interdisciplinary collaboration.

According to the author's analysis, 203 different researchers have been published in this field. Among the most productive authors, Song Tae-Jin (6), Park Jung-Hyun (5), and Huang Zhigang (4) stand out. This suggests that while certain researchers are leading the field, overall production is spread across a broad range of researchers. The co-authorship network map generated with VOSviewer software reveals the existence of a limited number of strong collaboration clusters in this research area. In the map, nodes represent authors and connecting lines represent co-publication relationships. The analysis shows that authors such as Babu Harysh Winster Suresh, Chettri Dewan, Elangovan Ajay, Vellingiri Balachandar, Maurya Brij Mohan, Yadav Nidhi, Velusamy Parthasarathy, Pulwani Chirag, Iyer Mahalaxmi and Kanda Savleen Singh are central to the network and exhibit a high degree of connectivity. These researchers represent the core of collaborative activities that underpin intellectual exchange in the field. However, an overall analysis of the network structure reveals that while some groups exhibit strong internal collaboration, intergroup and international connections are relatively limited. This suggests that research at the intersection of hygiene and AI is still nascent, and

collaboration networks have not achieved full global integration. This finding suggests that greater innovation and knowledge sharing in the field may be possible by encouraging broader international collaborations in the future.

According to analysis results based on Web of Science data, research on hygiene and artificial intelligence has increased rapidly, especially since 2020, and the field has been shaped around certain pioneering studies. Studies such as Jiang and Wen (2020), Haque et al. (2020), Pillai et al. (2021), and Shuja et al. (2021) stand out with their high citation counts, representing early contributions to artificial intelligence in hygiene management and practices. Thurzo et al. (2021), with the highest link strength, is at the center of the network, demonstrating a strong interaction and guiding role in the research field. Conversely, some publications, such as Navas et al. (2021) and Wang et al. (2021), are represented with low link strength despite receiving high citations, suggesting a more limited thematic interaction within the literature.

Clusters in the network structure reveal that the research topic has diversified over time and new subfields have begun to emerge. In particular, the strong connections between the studies by Haque et al. (2020) and Shuja et al. (2021) demonstrate a shared focus on the use of AI applications in hygiene management. Thurzo et al. (2021)'s study, despite its isolated location, boasts high link strength, demonstrating that it contributes to the development of the field by developing a different perspective in the literature. The strong clusters of publications concentrated in the 2020–2021 period reveal that research interest in this field increased due to the impact of the pandemic, and that studies focused on a wider range of topics after 2023.

When looking at the distribution of publications by country, the United States, the United Kingdom, and China stand out as the countries with the highest publication output. These are followed by countries such as South Korea, Germany, and Egypt. Developing countries are also increasingly contributing to this field, with Asian countries such as Malaysia, Qatar, and Taiwan demonstrating remarkable productivity. This demonstrates that AI technologies are being adopted globally in health and hygiene applications and that research activities in this field are not limited to developed countries. An institutional analysis revealed that publications are produced by a large number of higher education institutions, research centers, and healthcare organizations. Among the institutions with the highest number of publications are the University of London, Egyptian Knowledge Bank, Ewha Womans University, and Harvard University. These institutions are followed by leading academic centers such as Beijing Technology Business University, Harvard Medical School, and Cairo University. This diversity demonstrates that the field is not limited to technical sciences; This demonstrates that the field is shaped by the collaborative contributions of medicine, public health, informatics, and engineering. In general, it is understood that research on hygiene and artificial intelligence is progressing based on interdisciplinary and international collaboration, and that institutions based in North America, Europe, and Asia, are leading in research productivity.

Keyword analysis results indicate that the concepts of "artificial intelligence," "machine learning," and "deep learning" are at the center of research. The frequent use of these terms, along with "oral hygiene," "hand hygiene," "pediatric dentistry," and "COVID-19," demonstrates the increasing use of AI in healthcare and monitoring individual hygiene behaviors. Furthermore, keywords such as "food safety," "industrial hygiene," "pollution detection," and "environmental monitoring" reveal that research extends beyond the medical field to environmental and industrial dimensions. The prominence of technological concepts such as "Internet of Things," "sensors," and "smart hospital" demonstrates the integration of digitalization with hygiene management.

An overall assessment of the findings reveals that research in the field of hygiene and AI is becoming increasingly interdisciplinary, application-oriented, and globally widespread. The increasing diversity of studies demonstrates that AI technologies are beginning to be effectively used not only in healthcare but also in environmental, industrial, and social hygiene applications. Furthermore, developing scientific collaborations across countries and institutions

reveal that this field is evolving toward a multi-centric structure in knowledge production. This trend suggests that AI-supported systems will be used more robustly and integrated in areas such as public health management, infection control, and environmental monitoring in the future, thus increasing the potential for scientific and practical contributions from innovative interdisciplinary approaches.

In conclusion, despite offering a comprehensive bibliometric overview of research at the intersection of hygiene and artificial intelligence, this study has several limitations. The reliance on the Web of Science database may have excluded relevant studies from other sources, including non-English and gray literature. Moreover, bibliometric indicators primarily capture quantitative trends and do not fully reflect methodological quality or real-world effectiveness, particularly given the rapid evolution of AI technologies. Future research should integrate multiple databases, incorporate qualitative analyses, and examine the practical, ethical, and contextual dimensions of AI-based hygiene applications, with greater attention to emerging technologies and underrepresented regions.

Conflict of interest

The authors declares that they have no known competing financial or non-financial, professional, or personal conflicts that could have appeared to influence the work reported in this manuscript.

Ethical Approval

The authors declares that formal consent is not required for this type of study.

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