Original Article

Mapping the Landscape: a Bibliometric Review of Mobile Health Applications and Pharmacist-Integrated Interventions in Hypertension Care

Mapeo del panorama: revisión bibliométrica de las aplicaciones de salud móvil y de las intervenciones integradas del farmacéutico en el cuidado de la hipertensión

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ABSTRACT

Introduction: While mobile health applications significantly benefit hypertension management, especially when integrated with pharmacist consultations, the global research landscape in this specific area remains underexplored.

Objectives: This bibliometric study aims to map scientific output, identify key trends, and highlight influential research clusters related to the use of mobile health applications for patients with hypertension who receive pharmacist counseling.

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Methods: This study systematically analyzed literature from the Scopus database. We used keywords such as "counseling, medication, hypertension, and adherence" to investigate the use of mobile health applications for hypertension patients with pharmacist counseling, filtered by publication year, article type, source title, and language.

Results: We analyzed 133 relevant publications from 2021, with the majority from 2023 (39 documents) and published in the *Journal of the American Pharmacists Association*, PLoS One, and Trials (6 documents each). Most affiliations were from the United States (40 documents). Keyword analysis revealed strong linkages between "mobile health" and "hypertension," as well as with "adherence." However, "counseling" rarely co-occurred with "mobile health", while "lifestyle" was linked with "hypertension" and "mobile health" but not with "counseling" or "adherence."

Conclusions: This bibliometric study highlights a promising research gap in linking mobile health applications for hypertension with pharmacist counseling and lifestyle interventions to improve adherence.

Keywords: counseling; hypertension; mobile applications; pharmacists;, telemedicine.

RESUMEN

Introducción: Si bien las aplicaciones de salud móvil benefician significativamente el manejo de la hipertensión, especialmente cuando se integran con consultas farmacéuticas, el panorama de investigación global en esta área específica sigue estando poco explorado.

Objetivos: Este estudio bibliométrico tuvo como objetivos mapear la producción científica, identificar tendencias clave y resaltar clústeres de investigación influyentes, relacionados con el uso de aplicaciones de salud móvil para pacientes con hipertensión, que reciben asesoramiento farmacéutico.

Métodos: Se analizó sistemáticamente la literatura de la base de datos Scopus. Se emplearon palabras clave como "counseling, medication, hypertension, and adherence" para investigar el uso de aplicaciones de salud móvil en pacientes hipertensos con asesoramiento farmacéutico, filtrando por año de publicación, tipo de artículo, título de la fuente e idioma.

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Resultados: Se examinaron 133 publicaciones relevantes desde 2021, la mayoría de 2023 (39 documentos) y publicadas en *Journal of the American Pharmacists Association*, PLoS One y Trials (seis documentos cada una). La mayoría de las afiliaciones procedían de Estados Unidos (40 documentos). El análisis de palabras clave reveló sólidos vínculos entre "salud móvil" e "hipertensión", así como con "adherencia". Sin embargo, "asesoramiento" raras veces coincidió con "salud móvil", mientras que "estilo de vida" se vinculó con "hipertensión" y "salud móvil", pero no con "asesoramiento" o "adherencia".

Conclusiones: Este estudio bibliométrico destaca una brecha de investigación prometedora al vincular las aplicaciones de salud móvil para la hipertensión con el asesoramiento farmacéutico y las intervenciones en el estilo de vida para mejorar la adherencia.

Palabras clave: asesoramiento; hipertensión; aplicaciones móviles; farmacéuticos; telemedicina.

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Introduction

Hypertension remains a leading global health concern, contributing significantly to cardiovascular morbidity and mortality. Affecting over 1.3 billion adults worldwide, with a disproportionate burden in low- and middle-income countries, it is a primary risk factor for stroke, heart attack, and kidney disease.[1] Effective hypertension management often necessitates a multifaceted approach, integrating pharmacological treatments with lifestyle modifications, consistent patient counseling, and continuous medication adherence.[2] The challenge of achieving and maintaining blood pressure control for many patients underscores the need for innovative and accessible interventions.

The current state-of-the-art in hypertension care has witnessed the emergence of mobile health applications and the expanding role of pharmacists in direct patient

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care.[3] Mobile health applications leverage smartphone functionalities to facilitate patient self-management through features like remote monitoring, medication reminders, and educational content.[4] Concurrently, pharmacists, as highly accessible healthcare professionals, have demonstrated considerable promise in optimizing therapeutic outcomes through medication management, counseling on adherence, and blood pressure monitoring.[5,6,7] These advancements have positively impacted blood pressure control and adherence, highlighting their potential to transform chronic disease management.

Despite the individual progress in mobile health applications and pharmacist-integrated interventions for hypertension,[8] a comprehensive understanding of their combined impact, particularly concerning patient counseling, medication, and adherence, remains underexplored. While studies have examined the effectiveness of mobile health applications in promoting adherence and the benefits of pharmacist counseling,[9] a synthesized bibliometric analysis that identifies the specific themes, influential research, and collaboration patterns at the intersection of these critical areas is lacking. This gap limits the ability to identify synergistic approaches, understand the evolution of research, and pinpoint specific opportunities for future research that fully harness the potential of mobile health technology and pharmacist expertise in enhancing patient outcomes related to hypertension.[10]

This bibliometric review seeks to address these gaps by systematically mapping the landscape of scientific publications concerning mobile health applications and pharmacist-integrated interventions in hypertension care, with a specific focus on the keywords "counseling," "medication," "hypertension," and "adherence." Our objectives are to identify the key authors, institutions, and countries contributing to this field, analyze the most frequently cited articles and their thematic content related to counseling, medication, and adherence, trace the evolution of research topics and emerging trends over time within these areas, and map trend research regionally and geographically.[11] We conduct a comprehensive search of the scientific database Scopus using a predefined search strategy incorporating the specified keywords to achieve these objectives. The retrieved data will then be analyzed using bibliometric software VOSviewer to generate network

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visualizations, co-citation analyses, and statistical summaries of publication trends.

Methods

For the visualization and analysis of our data, we utilized VOSviewer version 1.6.20, a specialized software tool developed by the Center for Science and Technology Studies at Leiden University (https://www.vosviewer.com/). The data underpinning this study were comprehensively collected from the Scopus database on July 9th, 2025. We gratefully acknowledge Universitas Airlangga, Surabaya, Indonesia, for providing facilitated access to the Scopus database, which proved invaluable for this research.

Preparation for Data Collection

This study employed a bibliometric analysis approach utilizing the Scopus database to systematically map and analyze research trends within the defined scope. A comprehensive single-query search was executed, incorporating multiple relevant keywords to ensure the identification of a broad range of pertinent articles. Beyond conventional keyword, article, and journal analyses, the study also meticulously examined contributing authors, their affiliations, and countries of origin. This detailed bibliometric approach not only offers a robust overview of research developments in the field but also provides valuable insights into potential collaboration opportunities and identifies suitable scientific journals for future publications. The methodology for data collection and analysis was adapted from our previously published research.[12,13]

Determination of Search Keywords

A comprehensive search strategy was developed to identify relevant articles exploring the integration of mobile health applications and pharmacist-integrated interventions in hypertension care. The primary search string, "TITLE-ABS-KEY (Counseling AND medication AND hypertension AND adherence)," was

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meticulously applied to database searches. This string specifically targeted articles where these keywords appeared within the title, abstract, or assigned keyword list, ensuring a high degree of relevance to the research question. To further refine the results and focus on the most pertinent literature, searches were systematically filtered by publication year, article type, source title, and language.[14]

Initial Search Results

A comprehensive literature search was conducted within the Scopus database using the specified keywords, with no limitations imposed on the search results. This broad approach aimed to capture all relevant publications. Subsequently, the complete content of these identified documents, excluding only metadata, was accessed for thorough review.[15] This systematic process ultimately yielded an initial total of 483 unrefined documents where the predefined search terms were present in their titles, abstracts, or keywords, pending further refinement.

Refinement of Search Results

The initial comprehensive search within the Scopus database yielded a broad array of literature. This extensive dataset was subsequently refined through the meticulous application of specific inclusion and exclusion criteria. While Scopus offers a wide range of search parameters, including access type, year of publication, author, subject area, document type, publication stage, source title, keywords, affiliation, funding sponsor, country, source type, and language, this study rigorously focused solely on peer-reviewed journal articles. This deliberate restriction was implemented to ensure the highest level of evidence quality and to prevent potential redundancy that might arise from including book chapters or other tertiary sources.[16] The limited criteria include articles published in the last five years (2021-2025), journals as the source type, and English as the language of the document. Consequently, this stringent methodological approach resulted in a refined collection of 133 relevant research articles, which were then subjected to further in-depth analysis.

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Compile Preliminary Data Statistics

Bibliometric analysis of downloaded data was performed and visualized using VOSviewer 1.6.18 (https://www.vosviewer.com/). The advantages of VOSviewer were its work efficiency with large and small data sets, supported by various types of exciting and informative visualizations. Additionally, the final results were grouped into publication clusters based on precisely defined categories.[17]

Three types of visualization could be analyzed with VOSviewer, consisting of network, overlays, and density visualization.[18] The visualization network emphasizes the research team's cluster division that publishes articles together marked by interconnected nodes. The color difference in the visualization network reflects the different clusters of the research team. However, there were times when multiple authorship clusters would link to each other due to the existence of a specific author linking multiple clusters.[19] The author, who acts as a liaison, had a research that collaborates with more than one research team and tends to have a history of publication with more than one institution. Slightly different from network visualization, overlay visualization focuses more on the timeline of the document published. Here we could see the difference when a research team published the article, so it could be seen which research team was currently researching the topic. The interesting point was that the author, who acts as the liaison of several research teams, would have a marker color that was not always the same as one of the linked research teams. In contrast, density visualization did not show networks but rather the intensity of a research team. The increase in the yellow color intensity shows the increase in number, while the area's width shows the number of authors in a cluster. This visualization style provides an advantage for quantitative comparisons of several research team clusters, such as comparing the number of documents and citations.[20]

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Results and Discussion

Publications and citation structures

The literature search, meticulously conducted within the Scopus database, yielded a total of 133 relevant documents. A notable surge in scholarly output was observed in 2023, which recorded the highest publication frequency with 39 articles. It is important to note that while two of the identified articles originated from journals subsequently delisted from the Scopus index, their inclusion in this analysis was warranted as their publication dates preceded the official delisting. A summary of the search outcomes, including the top 10 publications ranked by citation count, is presented in Table 1.

Table 1 - The top 10 articles on Scopus have the highest citations with keywords "counseling AND medication AND hypertension AND adherence"

Publication year	Authors	Title	Journal	Publisher	Number of citations
2022	Torres-Robles *et al.*	Effectiveness of a medication adherence management intervention in a community pharmacy setting: a cluster randomised controlled trial	BMJ Quality and Safety	BMJ Publishing Group	39
2023	Silver *et al.*	Society for Maternal-Fetal Medicine Consult Series #64: Systemic lupus erythematosus in pregnancy	American Journal of Obstetrics and Gynecology	Elsevier	35
2021	Nigussie *et al.*	Rate of glycemic control and associated factors among type two diabetes mellitus patients in Ethiopia: A cross sectional study	PLoS ONE	Public Library of Science	26
2021	Polat-Ekinci *et al.*	Surveillance of psoriatic patients on biologic treatment during the	Dermatologic Therapy	John Wiley & Sons	23

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		COVID-19 pandemic: A single-center experience			
2022	Senoo *et al.*	A Smartphone App to Improve Oral Anticoagulation Adherence in Patients with Atrial Fibrillation: Prospective Observational Study	JMIR mHealth and uHealth	JMIR Publications Inc.	22
2023	Carroll *et al.*	Adherence to the 2017 Clinical Practice Guidelines for Pediatric Hypertension in Safety-Net Clinics	JAMA Network Open	American Medical Association	20
2023	Mufarreh *et al.*	Trends in Provision of Medications and Lifestyle Counseling in Ambulatory Settings by Gender and Race for Patients with Atherosclerotic Cardiovascular Disease, 2006-2016	JAMA Network Open	American Medical Association	19
2021	Parmar *et al.*	Integrating community health volunteers into non-communicable disease management among Syrian refugees in Jordan: A causal loop analysis	BMJ Open	BMJ Publishing Group	17
2022	Olson *et al.*	Assessment of adherence to aspirin for preeclampsia prophylaxis and reasons for nonadherence	American Journal of Obstetrics and Gynecology MFM	Elsevier	16
2021	Edward *et al.*	Patient and healthcare provider perspectives on adherence with antihypertensive medications: an exploratory qualitative study in Tanzania	BMC Health Services Research	Springer Nature	15

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Further analysis was systematically performed at both the journal and publisher levels. A comprehensive keyword search identified 90 distinct journals and 43 publishers actively contributing to the research. The journals demonstrating the highest publication volume were the *Journal of the American Pharmacists Association* (Elsevier), PLoS One (*Public Library of Science*), and Trials (*Springer Nature*), each contributing six documents. Elsevier emerged as the most prolific among publishers, accounting for 19 articles disseminated across 10 different journals. While BMJ Quality and Safety (BMJ Publishing Group) notably achieved the highest individual journal citation count (39 citations) for an article, journals published under the Elsevier umbrella collectively garnered the highest total citations (112 citations), underscoring their significant impact in the field. Cumulatively, all articles related to the specified keywords amassed 595 citations, indicating a substantial scholarly interest and potential for high-impact publications within this domain. A complete overview of the data is comprehensively detailed in Table 2.

Table 2 - Comparison of each journal and publisher with keywords "counseling AND medication AND hypertension AND adherence". Journals in red indicate discontinued status in the Scopus database

No.	Journal	Publisher	Total articles
1	*Journal of the American Pharmacists Association*	Elsevier	6
2	*PLoS ONE*	Public Library of Science	6
3	*Trials*	BioMed Central Ltd	6
4	*Journal of Clinical Hypertension*	John Wiley and Sons Inc	5
5	*BMC Health Services Research*	BioMed Central Ltd	3
6	*BMJ Open*	BMJ Publishing Group	3
7	*Frontiers in Pharmacology*	Frontiers Media SA	3
8	*International Journal of Environmental Research and Public Health*	Multidisciplinary Digital Publishing Institute (MDPI)	3
9	*Patient Preference and Adherence*	Dove Medical Press Ltd	3
10	*Scientific Reports*	Nature Research	3
11	*Contemporary Clinical Trials*	Elsevier	2

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12	*Exploratory Research in Clinical and Social Pharmacy*	Elsevier	2
13	*Heliyon*	Elsevier	2
14	*International Journal of Clinical Pharmacy*	Springer Science and Business Media Deutschland GmbH	2
15	*International Journal of Pharmacy Practice*	Oxford University Press	2
16	*JACCP Journal of the American College of Clinical Pharmacy*	John Wiley and Sons Inc	2
17	*JAMA Network Open*	American Medical Association	2
18	*Journal of Multidisciplinary Healthcare*	Dove Medical Press Ltd	2
19	*Journal of Nepal Health Research Council*	Nepal Health Research Council	2
20	*Journal of Pharmaceutical Health Services Research*	Oxford University Press	2
21	*Preventing Chronic Disease*	Centers for Disease Control and Prevention (CDC)	2
22	*Research in Social and Administrative Pharmacy*	Elsevier	2
23	*Acta Clinica Belgica: International Journal of Clinical and Laboratory Medicine*	Taylor and Francis Ltd.	1
24	*Addictive Behaviors*	Elsevier Ltd	1
25	*Africa Journal of Nursing and Midwifery*	Unisa Press	1
26	*African Health Sciences*	Makerere University, Medical School	1
27	*Ageing International*	Springer	1
28	*American Journal of Hypertension*	Oxford University Press	1
29	*American Journal of Obstetrics and Gynecology*	Elsevier Inc.	1
30	*American Journal of Obstetrics and Gynecology MFM*	Elsevier Inc.	1
31	*American Journal of Perinatology*	Thieme Medical Publishers, Inc.	1
32	*Asian Journal of Pharmaceutical and Clinical Research*	Innovare Academics Sciences Pvt. Ltd	1
33	*Asian Pacific Island Nursing Journal*	JMIR Publications Inc.	1
34	*BMC Cardiovascular Disorders*	BioMed Central Ltd	1
35	*BMC Endocrine Disorders*	BioMed Central Ltd	1
36	*BMC Medical Education*	BioMed Central Ltd	1
37	*BMC Public Health*	BioMed Central Ltd	1
38	*BMJ Quality and Safety*	BMJ Publishing Group	1

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39	*Brazilian Journal of Medical and Biological Research*	Associacao Brasileira de Divulgacao Cientifica	1
40	*British Journal of Clinical Pharmacology*	John Wiley and Sons Inc	1
41	*Cardiology Journal*	Via Medica	1
42	*Chronic Illness*	SAGE Publications Ltd	1
43	*Clinical Ophthalmology*	Dove Medical Press Ltd	1
44	*Contemporary Clinical Trials Communications*	Elsevier Inc.	1
45	*Current HIV Research*	Bentham Science Publishers	1
46	*Current Medical Research and Opinion*	Taylor and Francis Ltd.	1
47	*Dermatologic Therapy*	Blackwell Publishing Inc.	1
48	*Electrolyte and Blood Pressure*	Korean Society of Electrolyte and Blood Pressure Research	1
49	*European Journal of Cardiovascular Nursing*	Oxford University Press	1
50	*Geriatrics and Gerontology International*	John Wiley and Sons Inc	1
51	*Global Public Health*	Routledge	1
52	*Healthcare (Switzerland)*	Multidisciplinary Digital Publishing Institute (MDPI)	1
53	*HIV Medicine*	John Wiley and Sons Inc	1
54	*HIV/AIDS-Research and Palliative Care*	Dove Medical Press Ltd	1
55	*Indian Journal of Endocrinology and Metabolism*	Wolters Kluwer Medknow Publications	1
56	*Indian Journal of Pharmaceutical Education and Research*	Association of Pharmaceutical Teachers of India	1
57	*Indian Journal of Sexually Transmitted Diseases and AIDS*	Wolters Kluwer Medknow Publications	1
58	*Integrated Blood Pressure Control*	Dove Medical Press Ltd	1
59	*International Journal of Healthcare Management*	Taylor and Francis Ltd.	1
60	*International Journal of Nephrology and Renovascular Disease*	Dove Medical Press Ltd	1
61	*International Journal of Nursing Studies Advances*	Elsevier B.V.	1
62	*Iraqi Journal of Pharmaceutical Sciences*	University of Baghdad - College of Pharmacy	1

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63	*Irish Journal of Medical Science*	Springer Science and Business Media Deutschland GmbH	1
64	*JMIR Formative Research*	JMIR Publications Inc.	1
65	*JMIR mHealth and uHealth*	JMIR Publications Inc.	1
66	*Journal of Basic and Clinical Physiology and Pharmacology*	De Gruyter Open Ltd	1
67	*Journal of Clinical Nursing*	John Wiley and Sons Inc	1
68	*Journal of Clinical Pharmacy and Therapeutics*	John Wiley and Sons Inc	1
69	*Journal of Epidemiology and Global Health*	Springer Science and Business Media B.V.	1
70	*Journal of Family and Community Medicine*	Wolters Kluwer Medknow Publications	1
71	*Journal of Human Hypertension*	Springer Nature	1
72	*Journal of Infectious Diseases*	Oxford University Press	1
73	*Journal of Managed Care and Specialty Pharmacy*	Academy of Managed Care Pharmacy (AMCP)	1
74	*Journal of Pharmacy and Bioallied Sciences*	Wolters Kluwer Medknow Publications	1
75	*Journal of Stroke and Cerebrovascular Diseases*	W.B. Saunders	1
76	*Kardiologia Polska*	Via Medica	1
77	*Latin American Journal of Pharmacy*	Colegio de Farmacéuticos de la Provincia de Buenos Aires	1
78	*Medicina (Lithuania)*	Multidisciplinary Digital Publishing Institute (MDPI)	1
79	*Medicine (United States)*	Lippincott Williams and Wilkins	1
80	*Monaldi Archives for Chest Disease*	Page Press Publications	1
81	*Pakistan Journal of Medical Sciences*	Professional Medical Publications	1
82	*Pediatric Nephrology*	Springer Science and Business Media Deutschland GmbH	1
83	*Pharmaceutics*	MDPI	1
84	*Pharmacy Practice*	Grupo de Investigación en Atención Farmacéutica	1
85	*PLOS Medicine*	Public Library of Science	1
86	*Preventive Medicine*	Academic Press Inc.	1
87	*SAGE Open Medicine*	SAGE Publications Ltd	1

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88	*South African Family Practice*	AOSIS (pty) Ltd	1
89	*Thai Journal of Pharmaceutical Sciences*	Faculty of Pharmaceutical Sciences, Chulalongkorn University	1
90	*Vasa-European Journal of Vascular Medicine*	Hogrefe Verlag GmbH & Co. KG	1

Keyword co-occurrence

In-depth keyword analysis, visually represented in Figure 1, elucidated a complex network of research connections within the dataset. Among the 383 identified keywords, 'hypertension' (n = 45, link strength=191), 'medication adherence' (n = 23, link strength = 100), and 'adherence' (n = 18, link strength = 77) emerged as the most prominent terms. Interestingly, a notable absence of direct connections between 'hypertension' and the 'medication adherence'/'adherence' keywords suggests a potential research gap in comprehensively integrating these crucial aspects within existing literature. Our results corroborate *Hamrahian* et al.,[21] comprehensive review, which characterizes medication non-adherence in hypertension as a pervasive and intricate issue with significant negative impacts on clinical outcomes.

Further cluster analysis revealed 37 distinct keyword clusters, with the largest cluster encompassing 24 terms. This dominant cluster prominently featured 'lifestyle', 'diet', 'physical activity', and 'digital health', all exhibiting strong associations with 'hypertension'. This clustering pattern strongly suggests a prevailing research focus on the role of lifestyle modifications in hypertension management, potentially facilitated by digital health interventions. These findings highlight a critical area for future research to explore the synergistic effects of various lifestyle interventions in optimizing hypertension outcomes.[22]

Another significant cluster (cluster 2) comprised 19 terms centered around the keyword "adherence." This cluster demonstrated robust associations with terms such as "antihypertensive," "structured counseling," and exhibited cross-linkages with keywords from other clusters, including "hypertension," "compliance," "blood pressure," and "patient education." Intriguingly, the keyword 'adherence' also displayed close relationships with 'physical activity' and 'diet', indicating a promising avenue for investigating the interplay between lifestyle factors and

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medication adherence. Furthermore, "knowledge" emerged as a connecting keyword, linking not only to "adherence" but also to "diet," "patient knowledge," and uniquely, to the "clinical pharmacist" cluster. This implicit connection underscores the critical and multifaceted role of clinical pharmacists in educating patients about adherence to antihypertensive medication regimens, encompassing aspects of physical activity and dietary recommendations. Ojangba *et al.*[23] highlight lifestyle modifications, particularly those focused on medication adherence and health education, as crucial complementary strategies to antihypertensive medications for effective hypertension prevention and cardiovascular risk control. In rural Northeast China, Lu *et al.*[24] observed significant disparities in adherence patterns among middle-aged and older hypertensive patients. Specifically, medication adherence was high, contrasting sharply with alarmingly low dietary and behavioral adherence. These patterns were influenced by ethnicity, household composition, economic status, and health literacy.

Analysis of keyword trends, as depicted in Figure 2, reveals a subtle yet significant evolution in research focus, particularly with the emergence of novel keywords in publications from 2025. Specifically, terms such as 'lifestyle modification' and 'pharmacist-integrated intervention' have become prominent, demonstrating strong connections to established keywords like 'blood pressure' and 'adherence'. Concurrently, 'antihypertensive' and 'structured counseling' continue to be extensively researched, maintaining strong links with 'hypertension', 'adherence', and 'cardiovascular diseases' into 2025. These observations collectively underscore the sustained relevance of lifestyle modification, especially when delivered through pharmacist-integrated counseling, as a contemporary and impactful area of research. This continued emphasis highlights its ongoing importance in addressing critical issues related to improving medication adherence and achieving effective blood pressure control in hypertensive patients.[25]

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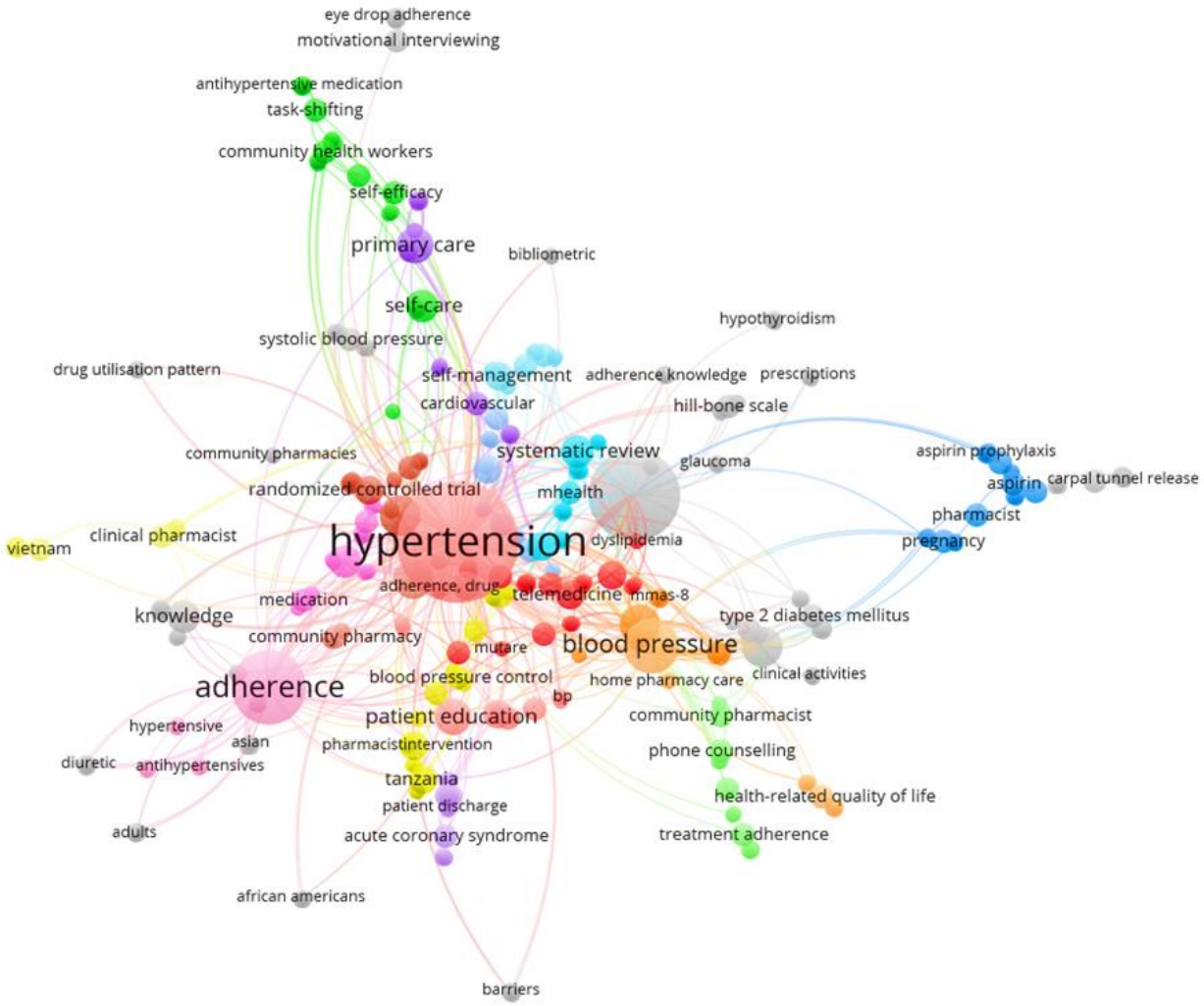

Fig. 1 – Network visualizations of the keywords "counseling AND medication AND hypertension AND adherence".

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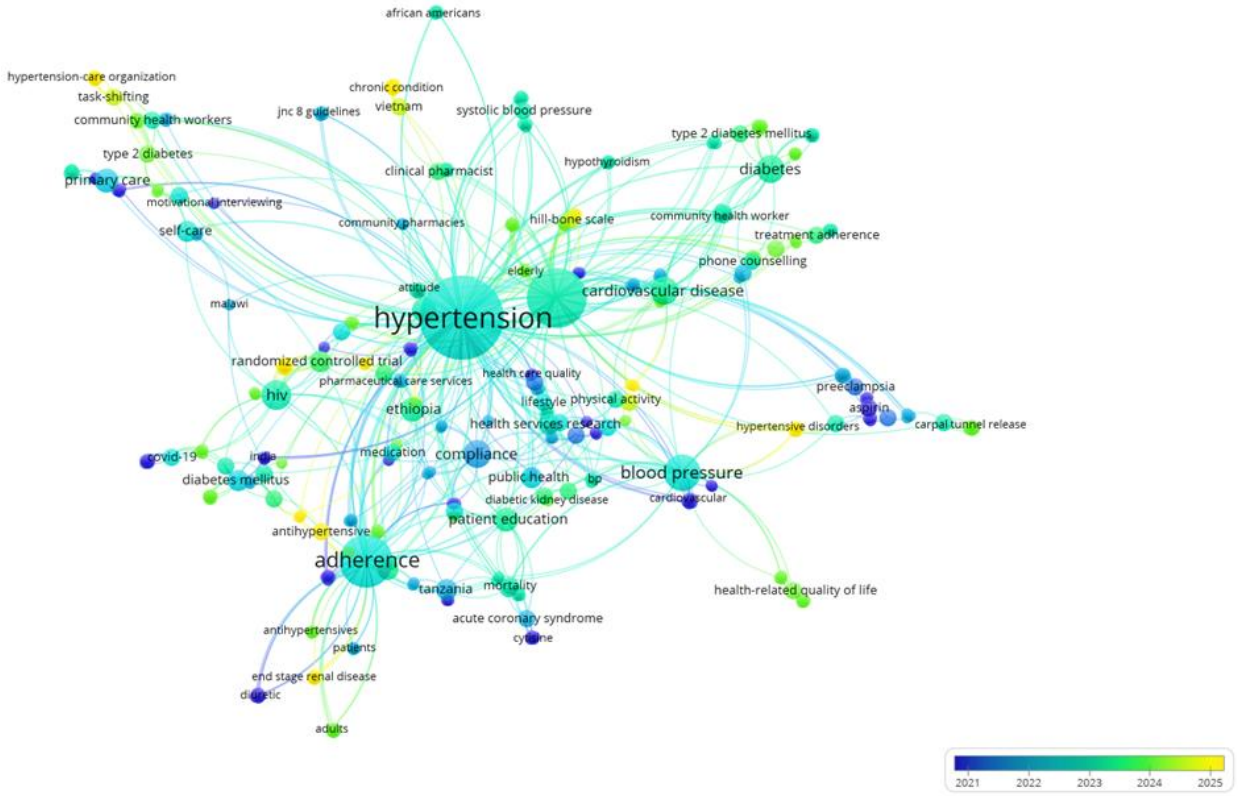

Fig. 2 – Overlay visualizations of the keywords "counseling AND medication AND hypertension AND adherence".

Author and co-authorship networks

This study analyzed author and institutional data derived from the Scopus database, focusing on publication output, citation impact, and collaborative networks within the field. Due to observed inconsistencies in institutional indexing within Scopus, our analysis was conducted at the broader university or institutional level, encompassing all associated departments, laboratories, and faculties.[26] To provide a comprehensive assessment of scholarly impact, our examination of authors considered document-level citation data rather than individual author contributions per article.

Among the 847 authors identified, Radhika Sundararajan from Cornell University emerged as the most prolific, with two publications and a total link strength of 26, indicating robust collaborative networks (Figure 3). Despite her productivity, her works garnered only a single citation, a stark contrast to the significant impact of other researchers, such as Andrea Torres-Robles *et al.*[27] from the University of Sydney, whose work received 39 citations.

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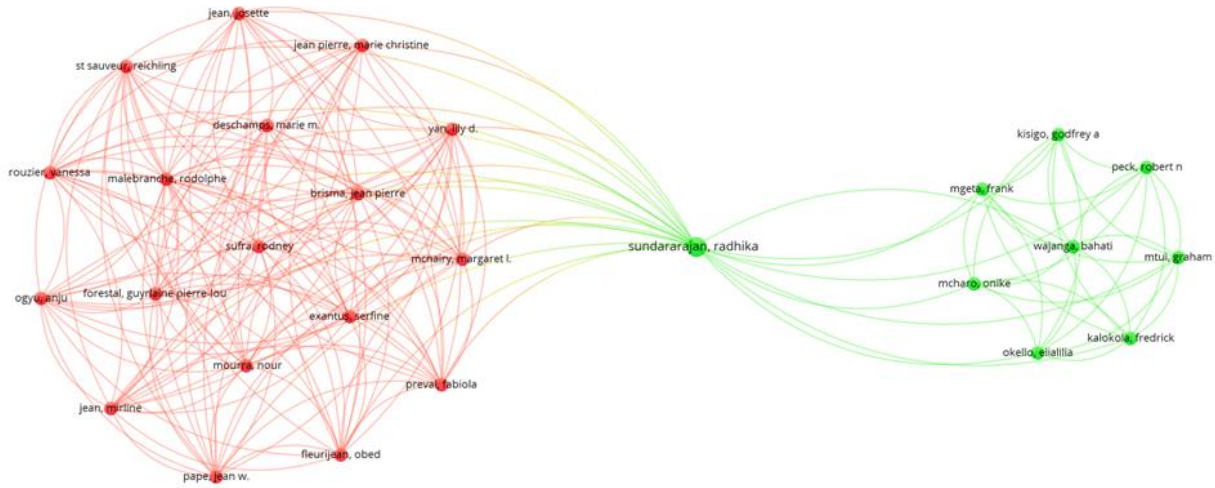

Fig. 3 – Network visualizations of authorship of the keywords "counseling AND medication AND hypertension AND adherence".

Geographic distribution of research

Our analysis extended to investigate the global distribution of research contributions, encompassing 133 documents from authors across 56 countries, frequently characterized by collaborative efforts (Figure 4). The United States emerged as the predominant contributor, responsible for 40 publications and accumulating 183 citations. Consistently, authors from the United States also exhibited the highest collaborative link strength, with 36 connections, more than double that of the second-placed nation, Pakistan (17 links). Notably, Theilmann *et al.*[28] demonstrated the most extensive cross-country collaboration, involving 30 authors across institutions from seven countries: Germany, Eswatini (formerly Swaziland), Switzerland, Norway, South Africa, the Netherlands, and the United States. However, Echeverría *et al.*[29] hold the distinction for the highest number of authors in a single publication, with 36 researchers from Chile, Italy, and the United States.

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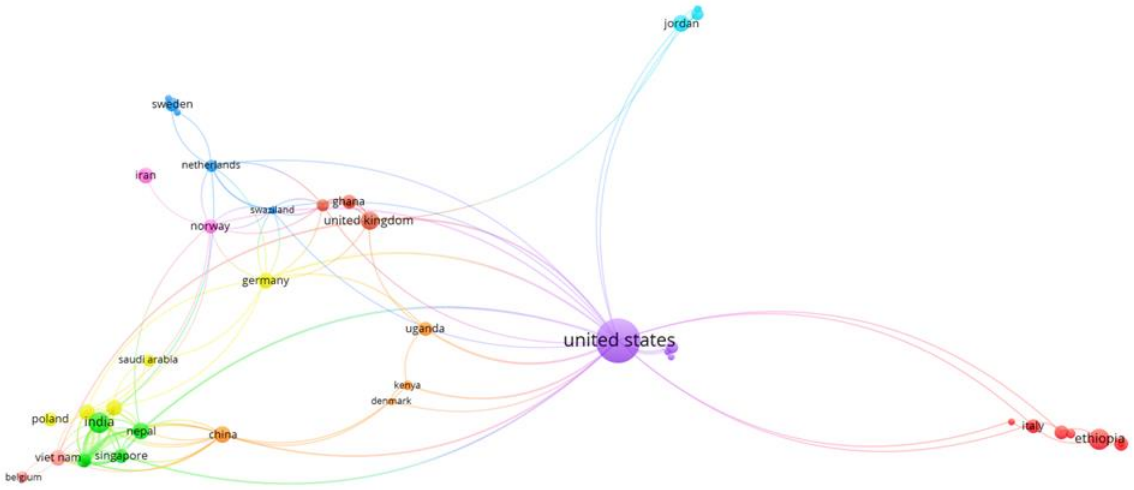

Fig. 4 – Network visualizations of countries of the keywords "counseling AND medication AND hypertension AND adherence".

An intriguing observation from the keyword analysis reveals a strong association between 'mobile health' (mHealth), 'hypertension', and 'medication adherence'. However, a notable absence of direct links was observed between the 'mobile health' cluster and the 'counseling' cluster, despite the latter also being strongly connected to 'hypertension' and 'compliance' (which can be inferred as medication adherence in this context). Conversely, the keyword 'phone counseling' demonstrates a close relationship with 'hypertension' and 'medication adherence', yet it lacks direct connections to broader terms such as 'mHealth' or 'mobile health'. This disjunction suggests a gap in the current research landscape: specifically, there appears to be limited investigation into studies that explicitly link the utilization of mobile health applications with integrated pharmacist-integrated counseling services for the purpose of monitoring and improving hypertension therapy adherence. Our findings corroborate those of Gandapur *et al.*,[30] who similarly observed that mobile health applications, such as text messages and electronic pill boxes, generally enhance medication adherence in cardiovascular disease patients.

Network analysis revealed two interconnected author clusters. The larger cluster comprised 18 authors, spearheaded by Anbrasi Edward from Johns Hopkins University, who contributed two publications and actively collaborated with researchers from diverse institutions.[31,32] This cluster demonstrates sustained

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research activity extending into 2025. In contrast, the research cluster led by Godfrey Alfred Kisigo from the London School of Hygiene and Tropical Medicine showed activity concluding in 2023.[33] Notably, Radhika Sundararajan served as a crucial connector, linking all researchers within both identified clusters.

Further analysis of author affiliations highlighted Johns Hopkins University, specifically its School of Medicine, as the most prolific institution, contributing five documents. While these publications generated a modest 21 citations, Johns Hopkins University demonstrated the highest level of collaboration, partnering with 28 institutions, including prominent entities such as the University of Iowa, Washington University, Universitätsmedizin Berlin, the University of New South Wales, and the University of Miami. This extensive collaborative footprint contrasts with the singular high-impact publication by Torres-Robles *et al.*[27] from the University of Sydney, which, despite originating from a single document, amassed 39 citations.

While the United States maintained its lead in overall publication volume, a notable trend in research recency has emerged. Although research output from the United States peaked in 2023, a more recent surge in scholarly activity was observed in several African countries, including Ghana, Kenya, and Rwanda, with their research contributions peaking in 2025. Similarly, South and Central American countries, such as Peru and Haiti, have demonstrated increasing innovation in recent years. This dynamic shift underscores an evolving research landscape where significant contributions are increasingly originating from developing nations, particularly outside of traditional research hubs in Europe and North America.[34]

A critical finding of this analysis is the conspicuous paucity of original research contributions on the focal topic (counseling, medication, hypertension, and adherence) from Southeast Asian countries. While countries such as Indonesia (2), Malaysia (5), the Philippines (1), Singapore (4), Thailand (2), and Vietnam (5) have reported related studies within the past five years, their collective output remains significantly lower than other regions. For context, the combined number of publications from these six Southeast Asian nations still surpasses that of Ethiopia (9), Jordan (6), and Nepal (6). This identified research gap presents a substantial opportunity for future investigations, particularly concerning the application of

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mobile health applications to influence lifestyle through pharmacist-integrated interventions. Consistent with Legido-Quigley *et al.*,[35] our findings suggest that sociopolitical inclusion for forcibly displaced populations in Southeast Asian nations, including Indonesia, Malaysia, Myanmar, and Thailand, continues to be problematic. While these populations contribute economically, their comprehensive health needs are largely unmet, primarily due to significant financial constraints that hinder effective intervention. Establishing strategic collaborations with researchers from other countries where these topics are more prevalent could significantly accelerate research progress and address this regional disparity.[36] This bibliometric analysis thus provides valuable insights into the current state and emerging directions of global research on counseling, medication, hypertension, and adherence.

A methodological consideration in this bibliometric mapping is potential selection bias arising from the primary search string (Counseling AND medication AND hypertension AND adherence). Because technology-specific terms such as mHealth, mobile applications, or telemedicine were not included as mandatory search operators, the apparent disconnect between 'mHealth' and 'counseling' clusters is partly an artifact of the search parameters. Nevertheless, this finding also underscores a genuine domain nuance: mainstream clinical literature on hypertension adherence traditionally conceptualizes counseling as a face-to-face or other direct clinical service, whereas digital health research frequently focuses on standalone, automated tracking tools. Acknowledging this distinction clarifies that, while mobile health platforms and pharmacist counseling independently target medication adherence, their structured integration in the empirical literature remains an emerging area of study.

Nevertheless, several limitations of this study should be acknowledged. First, the literature search was restricted to a single database, Scopus. Although Scopus is one of the largest curated multidisciplinary databases, offering broad coverage of high-impact peer-reviewed literature and comprehensive indexing of major MEDLINE/PubMed content relevant to pharmacy and digital health, some relevant studies indexed exclusively in other databases (e.g., Web of Science or Embase) or gray literature might have been omitted. Second, the search strategy was confined

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to English-language publications, which may introduce a language bias.[26] Future research should consider incorporating multiple database sources and non-English literature to further validate and broaden the generalizability of these findings.

While substantial literature exists examining the intricate relationship between counseling, medication management, hypertension, and patient adherence, a critical lacuna remains concerning the integrated investigation of these factors with emerging interventions such as mobile health technologies, comprehensive lifestyle modification programs, and pharmacist-integrated care models. This identified gap is particularly salient given the potential of these combined approaches to significantly enhance hypertension management outcomes in diverse populations. Consequently, this presents a promising and crucial avenue for future research, especially for investigators in Southeast Asia, where empirical data on these integrated approaches remain comparatively limited.

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Conflict of interest

The authors declare that they have no conflict of interest with this research, whether financial, personal, authorship, or otherwise, that could affect the research and its results presented in this article.

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