Quantitative Mapping of Global Research on Mobile Health Interventions for Hypertension: A Bibliometric Study

Kamariana[1,2,*], Syamsiar S. Russeng[3], Andi Arsunan Arsin[4], Amil Ahmad Ilham[5], Veni Hadju[6], Muhammad Syafar[7], Hasyim Kasim[8], Esse Puji Pawenrusi[2] and Dewi Purnama Windasari[2]

[1]*Doctoral Program in Public Health, Faculty of Public Health, Hasanuddin University, Makassar, Indonesia*

[2]*Public Health Study Program, Sekolah Tinggi Ilmu Kesehatan Makassar, Makassar, Indonesia*

[3]*Department of Occupational Safety and Health, Faculty of Public Health, Hasanuddin University, Makassar, Indonesia*

[4]*Department of Epidemiology, Faculty of Public Health, Hasanuddin University, Makassar, Indonesia*

[5]*Department of Informatics, Faculty of Engineering, Hasanuddin University, Makassar, Indonesia*

[6]*Department of Nutrition, Faculty of Public Health, Hasanuddin University, Makassar, Indonesia*

[7]*Department of Health Promotion and Behavioral Science, Faculty of Public Health, Hasanuddin University, Makassar, Indonesia*

[8]*Department of Internal Medicine, Faculty of Medincine, Hasanuddin University, Makassar, Indonesia*

Abstract: *Background*: Mobile health (mHealth) technologies are increasingly reshaping the management of hypertension, which remains a leading contributor to global cardiovascular burden. Although a rapidly expanding body of research has explored digitally supported interventions, the structural evolution, intellectual foundations, and emerging trajectories of this field have not been comprehensively synthesized.

Objective: This study aimed to map the global research landscape of mHealth interventions for hypertension and to identify the collaborative, intellectual, and conceptual structures guiding its development.

Methods: A bibliometric analysis was conducted on 474 documents indexed in Scopus using VOSviewer and R Bibliometrix. Trends in scientific production were examined alongside contributions by countries, journals, authors, and highly cited documents. Co-authorship, co-citation, and keyword co-occurrence networks were analyzed to uncover the field's knowledge architecture and thematic evolution.

Results: Scientific output in mHealth intervention for hypertension has increased steadily, led by high-income countries with strong international collaboration. Highly cited studies are mainly randomized controlled trials, indicating a solid evidence base. Thematic trends show a shift from telemonitoring to scalable, patient-centred interventions, with growing focus on engagement, implementation, and equity.

Conclusion: The research landscape on mHealth interventions for hypertension is rapidly advancing, with increasing methodological rigor and a shift toward scalable, patient-centred solutions. Nonetheless, disparities in global research contributions persist, underscoring the need for more inclusive and context-specific studies to support equitable implementation.

Keywords: Mobile health, intervention, hypertension, bibliometric analysis.

INTRODUCTION

Hypertension remains one of the most significant modifiable risk factors for cardiovascular morbidity and mortality worldwide, demanding sustained strategies for long-term monitoring and management [1, 2]. However, traditional clinic-centered models of care have proven insufficient for achieving consistent blood pressure control at the population level, particularly given the chronic and often asymptomatic nature of the condition [3, 4]. In response, healthcare systems are increasingly turning to digitally enabled solutions that extend care beyond institutional boundaries and support continuous patient engagement. Among these innovations, mobile health (mHealth) has emerged as a particularly promising approach [5]. By leveraging smartphones, wearable devices, and remote monitoring platforms, mHealth interventions offer scalable mechanisms to improve medication adherence, facilitate self-management, and enable real-time clinical feedback [6, 7]. Early investigations primarily explored feasibility and patient acceptance, but accumulating evidence now suggests that digitally supported interventions can produce clinically meaningful improvements in blood pressure outcomes [8, 9]. This evolution reflects a broader transformation in healthcare delivery, wherein connectivity and data-driven decision-making are reshaping the management of chronic disease.

The rapid expansion of mHealth research has been further accelerated by structural shifts in healthcare

*Address correspondence to this author at the Doctoral Program in Public Health, Faculty of Public Health, Hasanuddin University, Makassar, Jl. Perintis Kemerdekaan KM 10, Tamalanrea, Makassar 90245, Indonesia;
Tel: +6285397568113; E-mail: kamariana.stik@gmail.com

systems, most notably the global digitalization of medicine and the normalization of remote care during the COVID-19 pandemic [10]. As telehealth infrastructures matured, mobile technologies increasingly transitioned from experimental tools to demonstrable components of routine care. Consequently, scholarly activity surrounding mHealth interventions for hypertension has grown substantially, spanning diverse domains including clinical trials [4], behavioral science [11], implementation research [12], and health systems innovation [13]. Despite this proliferation of research, the field's intellectual architecture remains insufficiently synthesized. Existing reviews have largely focused on evaluating intervention effectiveness [6], often within narrowly defined clinical contexts. While such studies provide critical evidence, they offer limited insight into how the field has evolved, which actors and institutions are shaping its trajectory, and what conceptual directions are likely to define its future. Without this broader perspective, the cumulative dynamics of knowledge production, including collaboration patterns, thematic development, and evidentiary consolidation, remain difficult to discern.

Bibliometric analysis provides a powerful methodological lens for systematically examining the structural and developmental contours of a research domain [14]. By mapping publication trends, influential contributors, collaborative networks, and conceptual clusters, bibliometric approaches enable a panoramic understanding of scientific progress that extends beyond conventional reviews [15]. Such analysis is particularly valuable in rapidly advancing fields, where the pace of innovation can obscure the emergence of intellectual cores and research frontiers. Accordingly, the present study aims to comprehensively map the global research landscape of mHealth interventions for hypertension using a bibliometric framework.

Specifically, this study seeks to (1) examine the growth trajectory of scholarly output, (2) identify leading countries, journals, documents, and authors shaping the field, (3) uncover the intellectual structure underpinning influential research, and (4) analyze thematic evolution to illuminate emerging directions. By integrating performance analysis with science mapping techniques, this study moves beyond effectiveness-focused inquiry to provide a field-level perspective on how mHealth hypertension research is consolidating and where it is heading. In doing so, this work contributes not only a descriptive overview but also a strategic interpretation of the field's developmental stage. As digital health continues to redefine the architecture of chronic disease management, understanding the evolution of mHealth research is essential for guiding future scholarship, informing policy, and supporting the design of scalable interventions to address the persistent global burden of hypertension.

METHODS

Study Design

This study employed a bibliometric approach to systematically map the scientific landscape of mobile health (mHealth) interventions for hypertension. Bibliometric methods enable the quantitative evaluation of publication patterns, intellectual structures, and thematic evolution within a research domain, thereby providing insights that extend beyond the scope of traditional narrative reviews [15, 16]. The Scopus database was selected as the primary data source due to its extensive coverage of peer-reviewed literature and its suitability for large-scale bibliometric analyses. Nevertheless, reliance on a single database may introduce coverage bias and potentially exclude relevant studies indexed exclusively in other databases such as Web of Science or PubMed.

Search Strategy and Screening Process

A comprehensive literature search was conducted on 29 January 2026 using the following Boolean query: TITLE-ABS-KEY (("mobile health" OR mhealth OR "health app*" OR "digital health" OR telemedicine OR ehealth) AND (hypertension OR "high blood pressure") AND (intervention*))

The search strategy was applied to the title, abstract, and keyword fields to maximize retrieval of relevant studies. As detailed in Figure **1**, the initial search identified 2,774 records. To improve dataset relevance and consistency, the following inclusion criteria were applied: (1) document type restricted to articles, (2) source type restricted to journals, and (3) language restricted to English. After filtering, 1,879 records remained.

The study selection process followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) framework. First, title and abstract screening was conducted to exclude studies not directly related to hypertension management or not involving a mobile health intervention. Studies were considered unrelated when hypertension was not a primary outcome or when digital interventions did not involve mobile-health-based approaches, such as purely web-based systems without mobile integration. This screening stage excluded 529 records.

Subsequently, full-text screening was performed to assess conceptual relevance and methodological eligibility. Articles were included if they explicitly examined mHealth interventions targeting hypertension

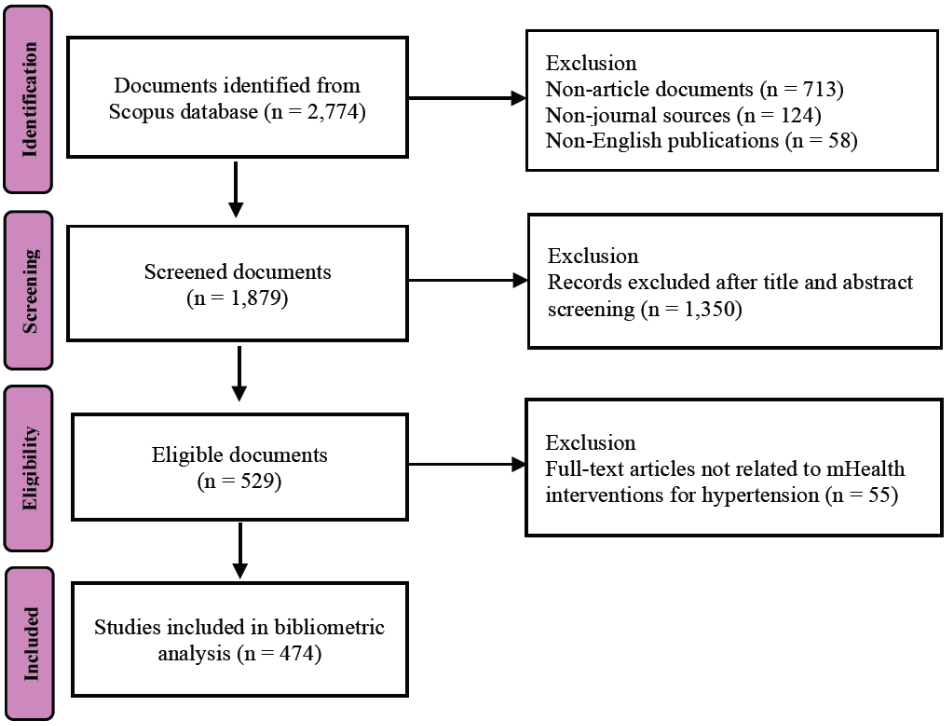


Figure 1: PRISMA Flowchart.

management, blood pressure monitoring, medication adherence, lifestyle modification, or related cardiovascular self-management outcomes. Following the eligibility assessment, a final dataset of 474 articles was included for bibliometric analysis. The complete study selection process is illustrated in Figure **1**.

Data Processing and Vizualisation

Bibliographic data were exported from Scopus in CSV format and analyzed using VOSviewer and the Bibliometrix package in R. VOSviewer was used to construct and visualize co-authorship, co-citation, and keyword co-occurrence networks because of its robust capability for handling large bibliometric datasets. Association strength normalization was applied as the similarity measure in network construction. The minimum thresholds were established according to the specific analysis type: authors with at least five publications, keywords with at least ten occurrences, and references with at least twenty citations were included in the network visualizations. Clustering resolution was maintained at the default parameter setting (1.00), and isolated nodes were excluded from visualization.

Bibliometrix was used to perform thematic mapping, science mapping, and temporal trend analyses. The thematic map was generated using Callon centrality and Callon density measures derived from the co-word matrix. Median centrality and density values were used as cut-off points to define the four thematic quadrants. Annual publication trends were further evaluated using log-linear regression analysis and Mann–Kendall trend testing to assess the statistical significance of publication growth over time.

RESULTS

Trends in Publications on Mobile Health Interventions for Hypertension

The annual scientific production on mHealth interventions for hypertension (Figure **2**) demonstrates a clear upward trajectory over the past two decades. The earliest publications appeared in 2005 and 2006, with only one article each year, reflecting the nascent stage of digital health research at the time. Between 2007 and 2011, scholarly output remained relatively modest, fluctuating between 2 and 6 publications annually. A notable acceleration began in 2012, when the number of publications increased to 14, followed by continued growth despite minor fluctuations through 2016. This phase likely corresponds to the rapid global adoption of smartphones and wireless health technologies, which expanded the feasibility of remote patient monitoring and behavioral interventions.

From 2017 onward, the field entered a phase of substantial expansion. Publications rose steadily from 18 in 2017 to 46 in 2020, indicating growing academic and clinical interest in leveraging digital tools for hypertension management. Although a slight decline was observed in 2021 and 2022, the overall trend remained positive. The most striking growth occurred between 2023 and 2025, culminating in a peak of 75 publications in 2025, the highest output recorded in the dataset. This surge suggests that mHealth for

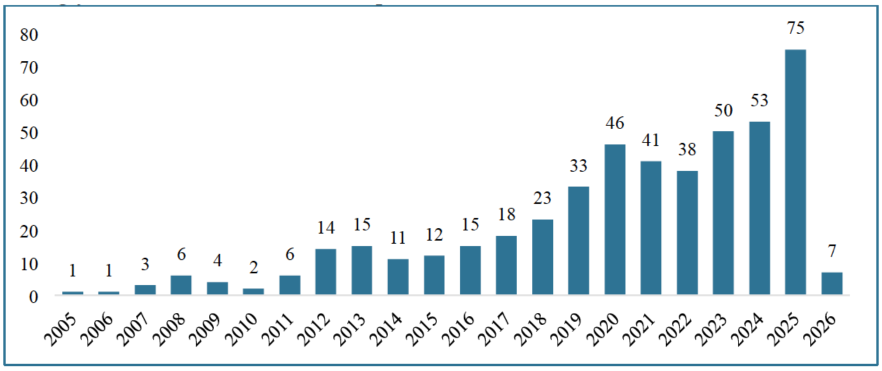


Figure 2: Annual scientific production about Mobile Health Interventions for Hypertension research.

hypertension has transitioned from an emerging research topic to a mainstream area within digital health scholarship. The lower publication count in 2026 should be interpreted cautiously, as the dataset likely reflects partial indexing for the ongoing year rather than an actual decline in research activity. Overall, the findings indicate a sustained and statistically significant increase in publication output over time, reflecting growing global recognition of mHealth interventions as scalable strategies for hypertension prevention and control.

Log-linear regression analysis demonstrated a significant upward trend in annual scientific production over the study period ($p < 0.05$). The Mann–Kendall trend test further confirmed a positive monotonic trend in publication growth. Early publications between 2005 and 2010 received moderate attention, with citation averages generally below 3.5. A significant rise occurred in 2011, followed by a peak in 2013 with an average of 6.70 citations, the highest value observed across the study period. Articles published during this stage likely benefited from novelty effects, as mobile technologies were increasingly recognized promising tools in healthcare delivery. However, citation averages declined sharply in 2014 before stabilizing at approximately 4.5 to 4.9 from 2016 to 2019. This stabilization suggests the maturation of the field, in which research output increased but scholarly attention became more distributed across a broader body of literature. From 2020 onward, average citations showed a gradual downward trend, reaching below 2.0 by 2024 and approaching zero in 2026. This pattern should not be interpreted as diminishing research quality; rather, it reflects the well-documented citation lag effect, in which recently published articles have not yet had sufficient time to accumulate citations. Taken together, these findings suggest a transition from foundational high-impact studies toward a broader and increasingly diversified research landscape.

Contributions by Country

The global distribution of research on mHealth interventions for hypertension reveals a markedly uneven yet highly interconnected landscape. Table **1** shows that the United States is the dominant contributor, with 1,570 publications and 4,715 citations since its first recorded output in 2006. This leadership reflects both sustained scholarly productivity and substantial scientific influence. The United Kingdom ranks second with 420 publications but demonstrates the highest average citation per article (46.70), indicating strong research visibility and impact despite a lower volume of output. More recent entrants into the field show contrasting patterns. China, whose first

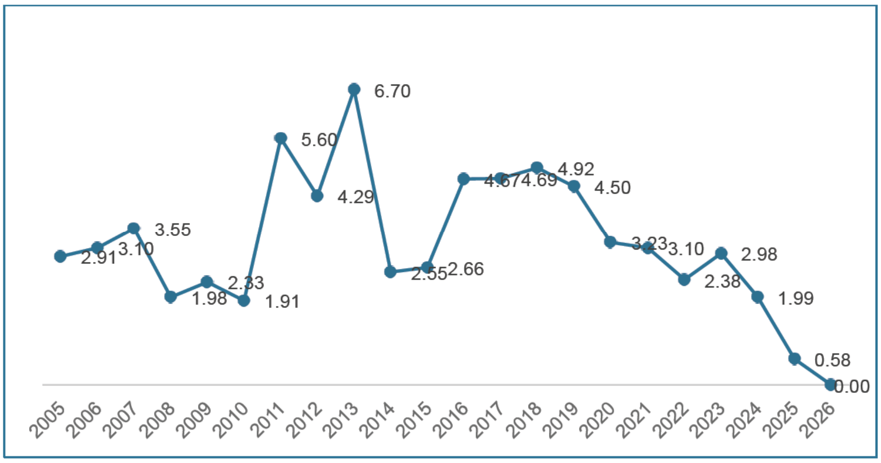


Figure 3: Average citations per year about Mobile Health Interventions for Hypertension research.

Table 1: Top 10 Most Productive Countries

Rank	Country	NP	TC	AAC	FP
1	USA	1570	4715	27.90	2006
2	UK	420	1728	46.70	2008
3	CHINA	379	672	14.90	2016
4	CANADA	145	517	32.30	2012
5	GERMANY	108	122	8.70	2012
6	BRAZIL	100	256	2.30	2013
7	JAPAN	97	74	8.20	2008
8	AUSTRALIA	65	214	21.40	2012
9	SOUTH KOREA	65	266	20.50	2009
10	SWEDEN	50	93	11.60	2009

NP = number of publications; TC = total citations; AAC = average citations per article; FP = first publication year.

publication appeared in 2016, has rapidly ascended to third place with 379 documents, highlighting accelerated research investment in digital health technologies. Meanwhile, countries such as Canada and Australia exhibit high citation averages relative to their publication counts, suggesting consistent production of influential studies. In contrast, Germany and Japan show comparatively lower citation metrics, which may indicate either newer engagement with the topic or differing research dissemination patterns. Country-level publication productivity was not normalized according to population size or national research expenditure and should therefore be interpreted cautiously. Variability in citation performance among countries may also reflect differences in publication age, collaboration networks, and journal visibility.

The collaboration network (Figure **4**) underscores the structural centrality of the United States within the global knowledge architecture. Strong co-authorship linkages connect the country with the United Kingdom, China, and several European partners, forming a dense transnational cluster that likely facilitates rapid knowledge diffusion. The United Kingdom appears to occupy an important intermediary position, bridging North American and European research communities. In contrast, several productive countries shown in the publication ranking are either weakly connected or absent from the core network, suggesting that high publication output does not necessarily translate into strong international collaboration. Overall, the visualization indicates that scientific production in this field is anchored in a limited number of highly interconnected countries that serve as intellectual hubs.

Contributions by Journal

The analysis of influential journals reveals that knowledge production on mHealth interventions for hypertension is concentrated within a relatively small

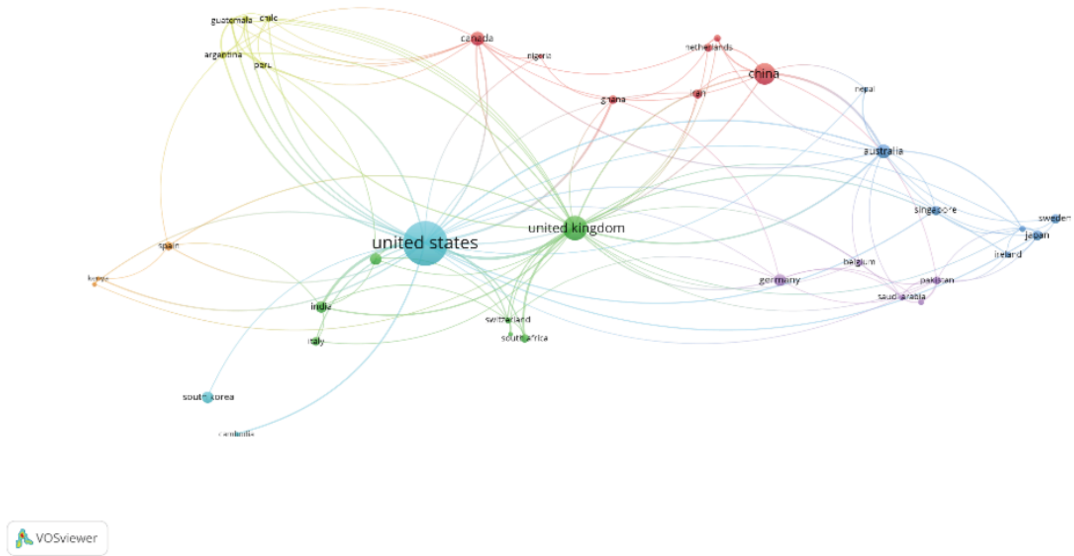


Figure 4: Co-authorship networks of countries.

Table 2: Top 10 Most Influential Journals

Rank	Sources	TC	NP	Q	Publisher
1	JMIR mHealth and uHealth	610	24	Q1	JMIR Publications Inc.
2	Telemedicine and e-HEALTH	604	16	Q1	Mary Ann Liebert Inc.
3	Journal of Medical Internet Research	555	21	Q1	JMIR Publications Inc.
4	Hypertension	380	7	Q1	Lippincott Williams and Wilkins
5	International Journal of Medical Informatics	277	6	Q1	Elsevier Ireland Ltd
6	JMIR Research Protocols	269	18	Q3	JMIR Publications Inc.
7	Journal of Clinical Hypertension	244	11	Q2	Wiley-Blackwell Publishing Ltd
8	Blood Pressure	215	6	Q2	Informa Healthcare
9	Trials	209	18	Q2	BioMed Central Ltd
10	Contemporary Clinical Trials	202	13	Q1	Elsevier Inc.

TC=total citations, NP=total number of publications, Q=Quartile.

group of high-impact sources (Table **2**). JMIR mHealth and uHealth ranks first with 610 total citations despite a modest publication count (NP=24), indicating strong scholarly visibility. Similarly, Telemedicine and e-Health and Journal of Medical Internet Research demonstrate substantial citation performance, reinforcing their roles as primary dissemination platforms for digital health research. Specialty clinical journals also appear prominently. Hypertension achieves high citation impact with comparatively few publications, suggesting that articles published in clinically oriented venues may be more translationally relevant. Meanwhile, International Journal of Medical Informatics contributes to the technological and systems-oriented dimension of the field, highlighting its interdisciplinary character.

The co-citation network (Figure **5**) reveals a well-defined intellectual landscape organized into several major clusters. The network consisted of multiple interconnected citation clusters, reflecting substantial interdisciplinary exchange between cardiovascular medicine, medical informatics, and digital health research. A prominent clinical cluster appears to centre on high-impact cardiovascular journals such as Circulation, Hypertension, and JAMA, suggesting that foundational evidence in this field is firmly rooted in established medical research. In parallel, another dense grouping centers on technologically oriented outlets, particularly Journal of Medical Internet Research, reflecting the methodological influence of digital health scholarship. The presence of highly authoritative general medical

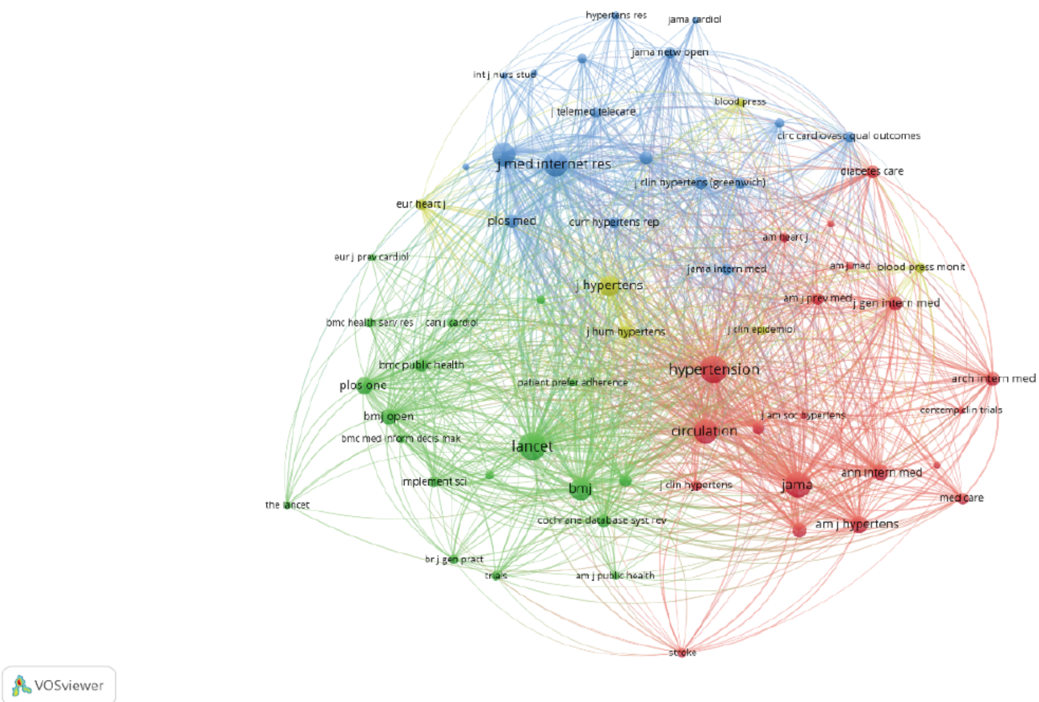


Figure 5: Co-citation networks of journals.

journals, most notably The Lancet, occupying strategic positions between clusters indicates substantial knowledge exchange across disciplinary boundaries.

Rather than forming isolated citation communities, the network demonstrates significant cross-cluster connectivity, implying that research on mHealth interventions for hypertension is informed simultaneously by clinical cardiology, medical informatics, and broader public health perspectives. The predominance of first-quartile journals within the core structure further suggests that the field's knowledge base is being shaped within high-visibility scientific arenas. Collectively, this configuration reflects an increasingly consolidated publication ecosystem in which technological innovation and clinical science converge to define the intellectual foundation of the discipline.

Contributions by Document

The analysis of highly cited documents indicates that the intellectual foundation of mHealth interventions for hypertension is strongly anchored in rigorous clinical trials and telemonitoring research (Table **3**). The most influential publication is the randomized controlled trial by [17], published in JAMA, which has accumulated 489 citations. The study demonstrated that combining home blood pressure telemonitoring with pharmacist-led case management significantly improved blood pressure control, establishing an early empirical benchmark for technology-supported hypertension care.

Another pivotal contribution is the TASMINH4 trial led by [9] in The Lancet, which confirmed that self-monitoring, with or without telemonitoring, can produce clinically meaningful reductions in systolic blood pressure. Complementing these findings, the systematic review by [18] synthesized evidence fromrandomized controlled trials and concluded that home telemonitoring improves hypertension control while maintaining a comparable safety profile. Together, these works signal that the field's most-cited evidence is rooted in experimentally robust designs rather than in exploratory digital health studies.

The co-citation network (Figure **6**) reveals a clearly organized intellectual structure shaped by several highly influential author clusters. One prominent cluster is anchored by Stephen J. Margolis, whose work on pharmacist-supported telemonitoring forms a central reference point within the network. Another major cluster revolves around Richard J. McManus, highlighting the scholarly impact of large pragmatic trials that advanced self-monitoring and telemonitoring as clinically actionable strategies in hypertension management. A further cluster centres on Hayden B. Bosworth and closely connected collaborators, reflecting the importance of behavioural and care-management approaches in early intervention research. The relative proximity among these clusters suggests that influential studies are not siloed but rather participate in an integrated citation structure, in which clinical trials, remote monitoring, and patient-centred management strategies collectively inform the field's evidentiary foundation. Rather than indicating intellectual fragmentation, the network points toward cumulative knowledge development driven by successive high-impact trials. Such a configuration suggests increasing methodological consolidation within the field, in which later investigations build upon an established corpus of experimentally validated research.

Contributions by Author

The author-level analysis highlights a concentrated intellectual leadership structure within the mHealth

Table 3: Top 10 Most Cited Documents

Rank	DOI	Author	Journal	TC	TCY
1	10.1001/jama.2013.6549	Margolis *et al.* (2013)	JAMA	489	34.93
2	10.1016/S0140-6736(18)30309-X	McManus *et al.* (2018)	The Lancet	335	37.22
3	10.1097/HJH.0b013e32835ca8dd	Omboni *et al.* (2013)	Journal of Hypertension	273	19.50
4	10.1161/CIRCULATIONAHA.115.017530	Bobrow *et al.* (2016)	Circulation	252	22.91
5	10.1001/archinternmed.2011.276	Bosworth *et al.* (2011)	Archives of Internal Medicine	208	13.00
6	10.1136/bmj.m4858	McManus *et al.* (2021)	BMJ	194	32.33
7	10.1161/HYPERTENSIONAHA.111.188409	Logan *et al.* (2012)	Hypertension	181	12.07
8	10.2196/jmir.7833	Frias *et al.* (2017)	Journal of Medical Internet Research	172	17.20
9	10.1136/bmj.f3030	McKinstry *et al.* (2013)	BMJ	164	11.71
10	10.2196/resprot.2633	McGillicuddy *et al.* (2013)	JMIR Research Protocols	159	11.36

TC=total citations, TCY=total citations per year.

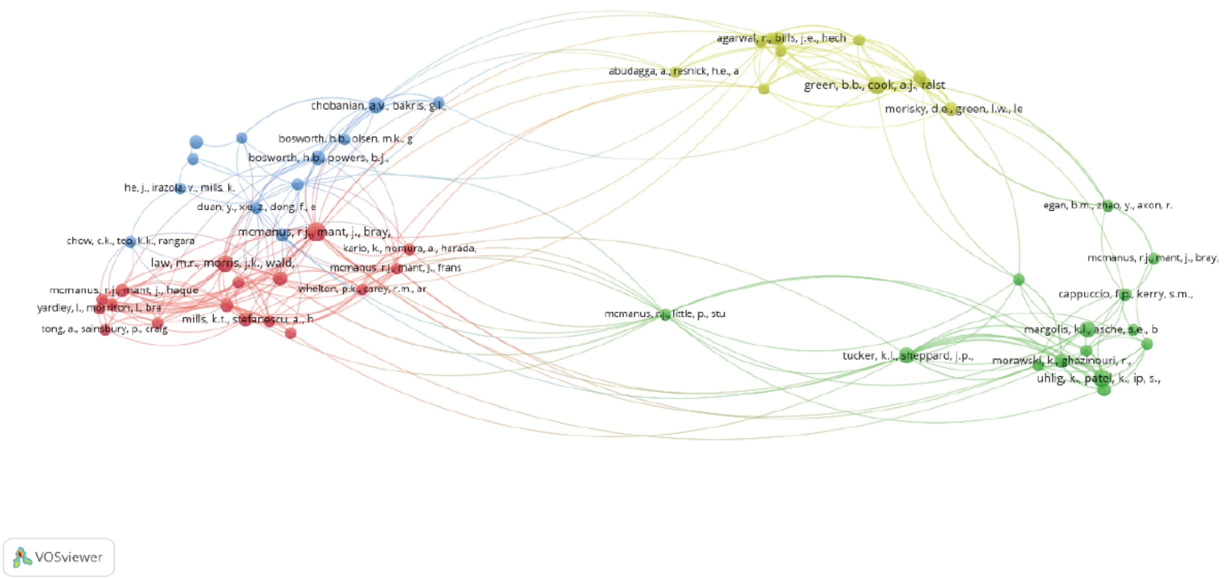


Figure 6: Co-citation networks of references.

hypertension literature (Table **4**). Richard J. McManus emerges as the most influential scholar, leading both in total citations (TC=1,094) and publication output (NP=24). His affiliation with the University of Oxford further underscores the role of established research institutions in shaping the field's scientific trajectory. Close behind, Karen L. Margolis demonstrates substantial citation impact despite a smaller publication count, suggesting that her contributions are highly authoritative. A notable pattern is the strong representation of researchers affiliated with the HealthPartners Institute for Education and Research, including Alison R. Bergdall, Patrick J. O'Connor, Michael V. Maciosek, and Nicholas K. Trower. Their collective presence suggests a coordinated research program rather than isolated scholarly efforts. Meanwhile, contributors such as Hayden B. Bosworth and Paul Little maintain strong productivity profiles, reflecting sustained engagement in behavioral and primary care-oriented intervention research.

The co-citation network reinforces these findings by revealing several densely connected author clusters. One major cluster is organized around McManus, indicating broad scholarly reliance on his work. Another cluster appears linked to Margolis and collaborators, while a separate grouping includes Bosworth and related researchers. The extensive cross-linkages among clusters suggest that the field is not fragmented but instead characterized by continuous intellectual exchange, with influential authors collectively shaping an integrated evidence base.

Author Keyword Co-Occurrence Network Analysis

The keyword co-occurrence analysis reveals a highly integrated conceptual structure centered on hypertension, which serves as the dominant organizing theme across the network. Closely related terms such as blood pressure, telemedicine, mobile health, and medication adherence indicate a strong scholarly

Table 4: Top 10 Most Influential Authors Based on Total Citations

Rank	Author	TC	NP	Institution	FP
1	MCMANUS RJ	1094	24	University of Oxford	2012
2	MARGOLIS KL	815	10	HealthPartners Institute for Education and Research	2012
3	BERGDALL AR	713	8	HealthPartners Institute for Education and Research	2012
4	ASCHE SE	710	7	HealthPartners Institute for Education and Research	2012
5	O'CONNOR PJ	709	8	HealthPartners Institute for Education and Research	2012
6	TARASSENKO L	708	7	University of Oxford	2014
7	BRADBURN P	706	3	Institute of Applied Health Research	2018
8	MACIOSEK MV	687	6	HealthPartners Institute for Education and Research	2012
9	TROWER NK	683	7	HealthPartners Institute for Education and Research	2013
10	LITTLE P	673	11	University of Southampton	2012

TC = total citations; TCY = total citations per year. Total citations per year (TCY) were calculated to account for differences in publication age.

Table 5: Top 10 Most Influential Authors Based on Total Publications

Rank	Author	NP	TC	Institution	FP
1	MCMANUS RJ	24	1094	University of Oxford	2012
2	BOSWORTH HB	15	654	Duke University	2007
3	YARDLEY L	12	539	University of Southampton	2016
4	LITTLE P	11	673	University of Southampton	2012
5	MARGOLIS KL	10	815	HealthPartners Institute for Education and Research	2012
6	GREEN BB	10	347	Kaiser Permanente	2008
7	MORTON K	10	519	University of York	2016
8	ZHANG Y	7	54	University of Mississippi Medical Center	2021
9	ODDONE EZ	9	552	Durham VA Medical Center	2007
10	BERGDALL AR	8	713	HealthPartners Institute for Education and Research	2012

TC= Total Citations, NP=total number of publications, FP=year of first publication.

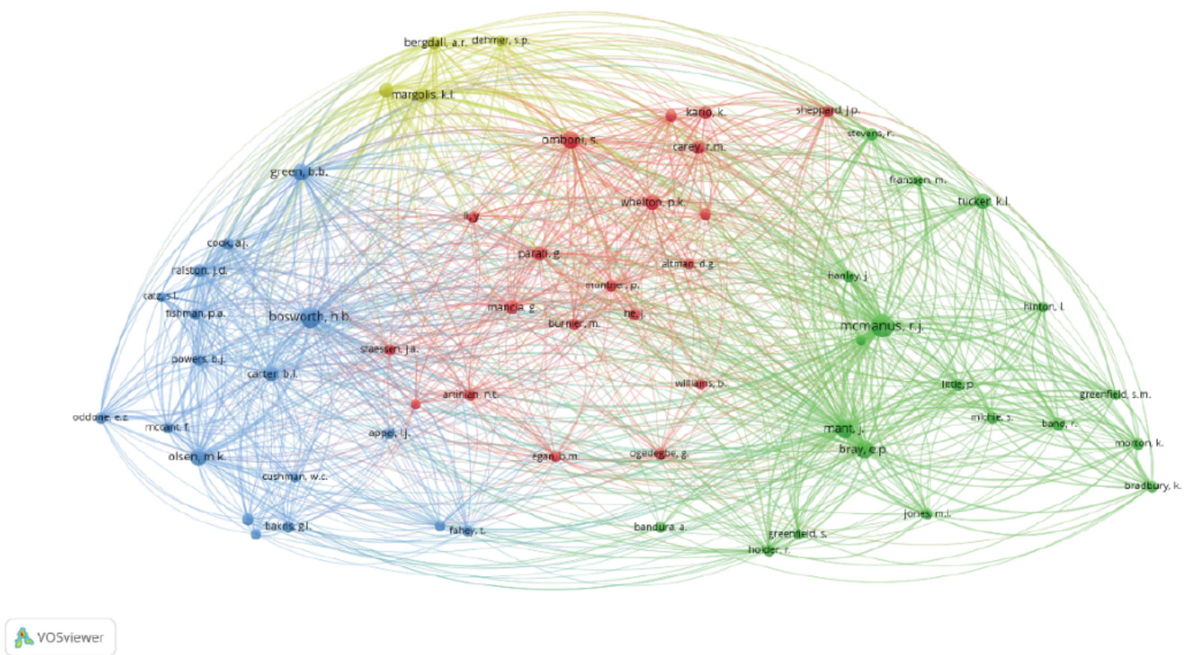
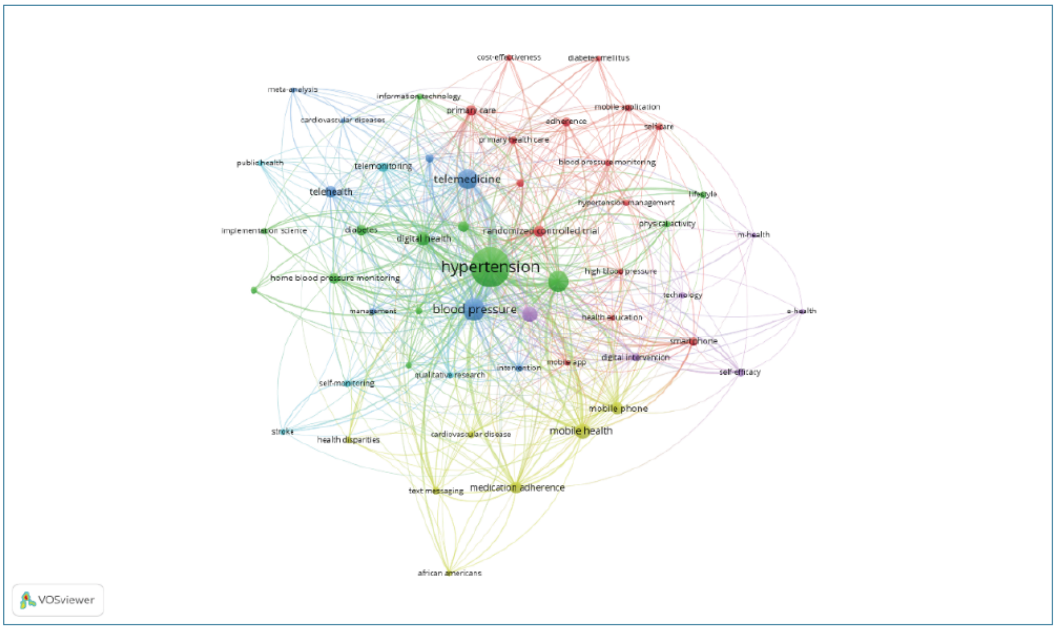


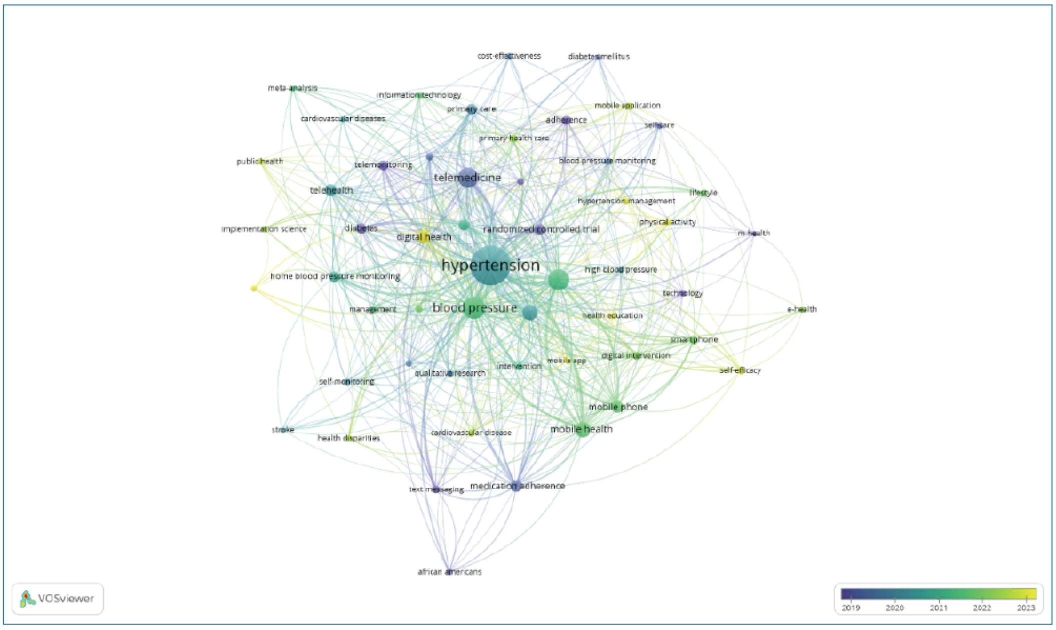
Figure 7: Co-citation networks of authors.

convergence toward technology-enabled strategies to improve clinical outcomes. The clustering analysis identifies six thematic groupings that collectively define the intellectual landscape of mHealth interventions for hypertension (Figure **8a**), illustrating how technological innovation, clinical management, behavioral science, and population health perspectives intersect within the literature.

Cluster 1 (red cluster) represents the clinical-intervention core, integrating adherence, blood pressure control, mobile applications, self-care, primary care, and randomized trials. The proximity of cost-effectiveness and diabetes mellitus suggests an increasing emphasis on evaluating both the clinical and economic value of digital interventions within routine healthcare delivery. Cluster 2 (green cluster) reflects the digital infrastructure underpinning contemporary hypertension management. Keywords such as digital health, eHealth, remote monitoring, implementation science, and information technology indicate a growing priority on scalable systems capable of supporting long-term care. The inclusion of lifestyle and physical activity further signals the integration of preventive strategies into technology-enabled platforms. Cluster 3 (dark blue cluster) captures the telemedicine-driven evidence base linking telehealth, chronic disease management, cardiovascular conditions, and intervention research. The presence of meta-analysis within this cluster suggests that the domain has accumulated sufficient empirical depth to support higher-order evidence synthesis, marking an important step toward methodological maturity.



(a) clustering network



(b) time-overlapping network

Figure 8: Author keyword co-occurrence analysis: (**a**) clustering network, (**b**) time-overlapping network.

Cluster 4 (yellow cluster) introduces an equity-oriented dimension. Terms including health disparities, African Americans, and text messaging point to targeted intervention strategies designed to improve access among historically underserved populations. The prominence of medication adherence within this grouping highlights the role of low-cost communication technologies in addressing persistent treatment gaps. Cluster 5 (purple cluster) centers on behavioral mechanisms of digital care, emphasizing self-efficacy, self-management, and technology-supported interventions. This configuration suggests that the effectiveness of mHealth is increasingly understood as contingent not only on technological capability but also on its capacity to influence patient behavior. Cluster 6 (blue cluster) reflects a broader population health orientation, incorporating public health, stroke, qualitative research, self-monitoring, and telemonitoring. The presence of qualitative approaches indicates a growing recognition of contextual and experiential factors shaping digital health adoption.

The time-overlapping visualization suggests a thematic progression over time. Earlier research focused primarily on telemonitoring and blood pressure measurement, whereas more recent keywords emphasize mobile applications, digital interventions, and constructs of patient engagement, such as self-efficacy. This pattern indicates a gradual shift from

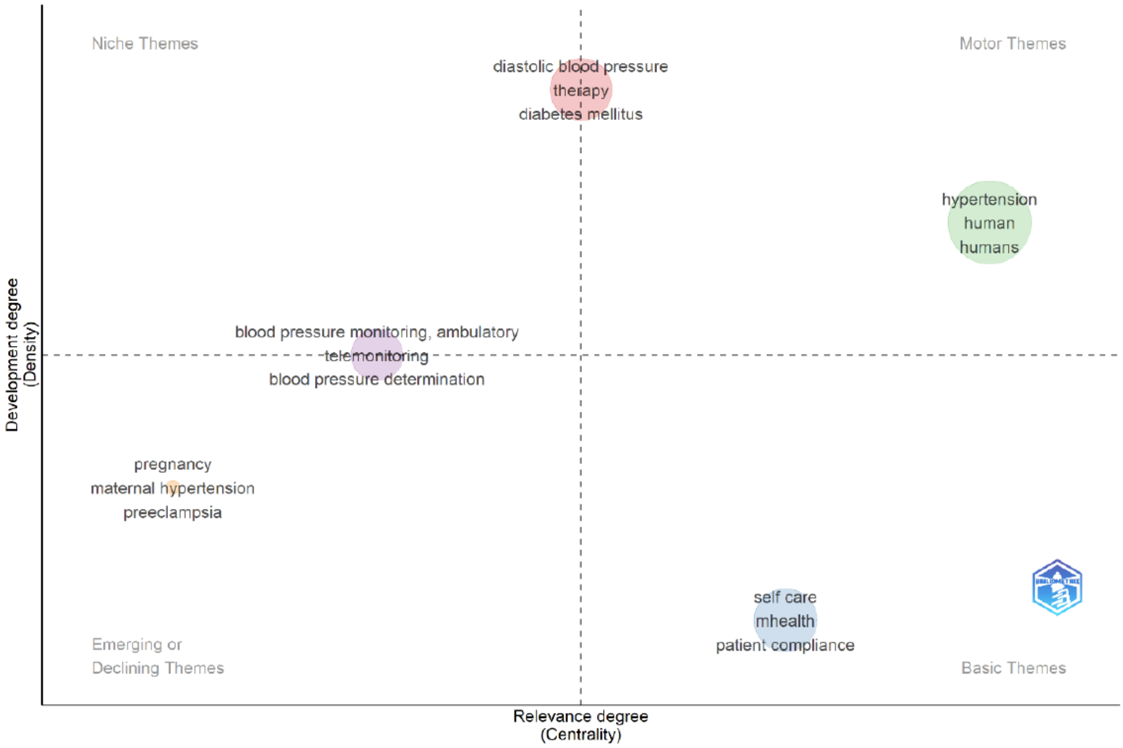


Figure 9: Thematic map.

device-oriented monitoring toward interactive, software-driven ecosystems designed to support sustained disease management.

The thematic map was generated using Callon centrality and density measures derived from the co-word matrix, with median values used as quadrant cut-offs. Formal sensitivity or bootstrap analyses were not conducted; therefore, thematic quadrant assignments should be interpreted descriptively. The thematic map (Figure **9**) illustrates the structural composition of the research field by positioning keywords according to their centrality (relevance to the field) and density (degree of internal development). The motor-theme quadrant is dominated by hypertension alongside human-related descriptors, indicating that the literature remains strongly anchored in clinically oriented investigation with direct population relevance. High centrality and density suggest that this theme functions simultaneously as the conceptual core and the primary driver of scholarly activity. Meanwhile, the basic-theme quadrant, which includes terms such as self-care, mHealth, and patient compliance, reflects topics broadly connected to the research landscape but remain comparatively underdeveloped. Their strategic position underscores their foundational importance while also signaling opportunities for deeper theoretical refinement, particularly in relation to patient-centered digital care models.

In contrast, the niche-theme quadrant includes diastolic blood pressure, therapy, and diabetes mellitus, which exhibit strong internal cohesion but limited connectivity to the broader conceptual network. This configuration suggests specialized lines of inquiry that contribute depth without substantially shaping the overall research agenda. The emerging or declining quadrant, characterized by pregnancy-related hypertension and preeclampsia, indicates themes that have yet to achieve structural integration within mainstream mHealth research. Rather than implying diminishing relevance, this positioning may reflect early-stage exploration with significant expansion potential, especially given the growing interest in remote monitoring for high-risk maternal populations. Collectively, the thematic distribution portrays a field marked by conceptual stability at its core while simultaneously revealing intellectual spaces where future innovation is likely to occur.

DISCUSSION

The present bibliometric analysis reveals a research domain undergoing substantial expansion and increasing integration into chronic disease management research, in which mHealth interventions for hypertension are shifting from technological novelty toward an embedded component of contemporary chronic disease management. The sustained growth of scholarly output reflects more than expanding academic interest; it signals broader changes in healthcare delivery practices, in which mobile technologies are increasingly positioned as integral mechanisms for continuous, patient-centered care. Early work highlighted the potential of mobile tools to extend healthcare beyond traditional clinical boundaries [26, 27], but current evidence suggests this promise is now being operationalized through methodologically robust research.

Interpreted through the innovation lifecycle, the field appears to be progressing from exploratory experimentation toward increasing research consolidation. Digital medicine typically evolves through sequential phases of validation and integration [3, 28], and the growing density of trials and evidence syntheses indicates that mHealth for hypertension has entered a more established stage of development. Consequently, the central scholarly concern is no longer whether digital interventions are feasible, but how they can be optimized, scaled, and sustainably embedded within healthcare systems.

Systemic shifts in healthcare delivery have further accelerated this trajectory. The COVID-19 pandemic catalyzed institutional acceptance of remote care, compressing what might otherwise have been a decade of digital adoption into a markedly shorter period [12, 29, 30]. For conditions requiring sustained monitoring, such as hypertension, this transition reinforced the strategic importance of telehealth and mobile-supported care models [8, 31, 32]. The expansion of research activity should therefore be understood not as a transient response to technological enthusiasm, but as evidence of accelerated integration of digital approaches into hypertension management.

At the global level, the geography of scientific production reveals enduring asymmetries in research capacity. The leadership of the United States and the United Kingdom reflects the well-established tendency for countries with mature innovation ecosystems to contribute substantially to developments in digital health research [33, 34]. Their central positions within collaboration networks suggest agenda-setting influence, as highly connected actors often define methodological norms and research priorities. China’s rapid ascent illustrates how strategic investment in digital infrastructure can reposition nations within the global knowledge economy [35, 36], although disparities between productivity and citation impact underscore that citation influence appears to develop is accrued through sustained engagement rather than rapid expansion alone.

The field’s collaborative structure further indicates that contemporary health research is increasingly organized through transnational partnerships. International collaboration has been consistently linked to enhanced knowledge diffusion and greater scholarly visibility [37, 38]. Yet the relative marginalization of several middle-income countries highlights a persistent structural gap, particularly consequential given that the burden of hypertension disproportionately affects these regions. Expanding inclusive research networks will therefore be essential to ensure that future digital health innovations are responsive to diverse healthcare contexts rather than predominantly shaped by high-resource environments.

Intellectual consolidation is equally visible within the journal ecosystem. The concentration of influential studies within a limited set of high-impact outlets suggests the emergence of a structured publication hierarchy in which recognized journals function as major dissemination platforms [39]. Importantly, the coexistence of digitally oriented journals alongside traditional cardiovascular publications signals an increasing integration between digital health and clinical cardiovascular research: mHealth is no longer confined to informatics but is increasingly normalized within clinical science. This integration supports the broader argument that the future of medicine will be defined by the seamless incorporation of digital innovation into routine care pathways [40, 41].

The evidentiary foundation of the field is further clarified by the prominence of randomized controlled trials among highly cited documents. Landmark studies shifted scholarly attention from feasibility toward demonstrable improvements in blood pressure outcomes, effectively highlighting the growing importance of clinically validated interventions. Such developments reflect an emerging expectation within digital medicine that technological innovation must yield measurable clinical benefit to achieve scientific legitimacy. The co-citation structure reinforces this interpretation by pointing to the formation of a recognizable shared foundational evidence base, a hallmark of disciplines transitioning from conceptual fragmentation toward greater conceptual consistency [42].

Authorship patterns provide additional evidence of maturation. The concentration of influence among a relatively small group of scholars suggests the presence of group of influential researchers, a characteristic commonly observed in fields approaching greater research continuity [43]. Institutional clustering among leading research teams further indicates that durable collaborative infrastructures play a pivotal role in generating high-impact scholarship rather than reflecting isolated intellectual contributions. The authorship landscape underscores the importance of organized research ecosystems in advancing digital health science.

Conceptual insights derived from keyword and thematic analyses portray a field that is simultaneously consolidating and expanding. The central positioning of telemedicine and mobile health reflects a decisive shift from episodic clinic-based care toward continuous, technology-mediated management. Cluster-level patterns indicate that the evidentiary center is firmly grounded in clinically validated interventions, while the growing prominence of digital infrastructure suggests that connectivity has become a foundational assumption rather than a novel innovation. At the same time, the emergence of behavioral and equity-oriented themes signals an important reframing of research priorities. Increasing attention to self-efficacy, patient engagement, and health disparities suggests that the field is moving beyond the question of whether digital tools are effective toward a deeper inquiry into for whom and under what conditions they produce optimal outcomes, a defining feature of mature intervention science.

Temporal keyword evolution further supports this interpretation. Early emphasis on telemonitoring established the infrastructural base for contemporary mobile applications and digitally supported self-management models. This progression reflects a broader shift from technological capability to behavioral effectiveness, an essential prerequisite for durable clinical impact. The thematic structure reinforces the conclusion that mHealth hypertension research is approaching increasing maturity of the research field. Strong motor themes anchored in hypertension coexist with expanding foundational topics, indicating both conceptual stability and continued intellectual growth.

Meanwhile, the marginal positioning of specialized clinical subdomains suggests fertile ground for future expansion through the integration of underexplored populations and conditions. Taken together, these patterns depict a research domain transitioning from technological promise toward strategic consolidation. As digital health continues to redefine the architecture of chronic disease management, mHealth for hypertension is poised not merely to support care delivery but to play an increasingly important role in future hypertension management strategies.

CONCLUSION

This study maps a rapidly maturing field in which mHealth for hypertension has evolved from early experimentation to a structured and increasingly integrated component of chronic disease care. Research trends show a shift toward scalable, patient-centred interventions supported by strong clinical evidence and implementation focus. Despite this progress, gaps remain, particularly in low- and middle-income settings and in translating innovations into sustained, real-world impact. Future work should emphasize long-term effectiveness, cost-efficiency, and equitable large-scale implementation. Overall, the findings suggest that mHealth interventions may play an increasingly important role in hypertension management when strategically integrated into healthcare systems.

REPRODUCIBILITY STATEMENT

The complete Scopus search query, final DOI dataset, and bibliometric analysis files are available in the Supplementary Materials.

REFERENCES

[1] Fisher MC, *et al.* Improving Blood Pressure in High-Risk Patients With CKD Using an Interdisciplinary Remote Hypertension Program. Kidney Intl Rep 2025; 10(4): 1101-1110. https://doi.org/10.1016/j.ekir.2025.01.028

[2] Ordunez P, Tajer C, Gaziano T, Rodriguez YA, Rosende A, Jaffe MG. The HEARTS app: a clinical tool for cardiovascular risk and hypertension management in primary health care. Rev Panam Salud Publica Pan Am J Public Health 2022; 46. https://doi.org/10.26633/RPSP.2022.12

[3] Gomis-Pastor M, *et al.* Clinical Validation of Digital Healthcare Solutions: State of the Art, Challenges and Opportunities. Healthcare 2024; 12(11): 1057. https://doi.org/10.3390/healthcare12111057

[4] Rifkin DE, *et al.* Linking clinic and home: A randomized, controlled clinical effectiveness trial of real-time, wireless blood pressure monitoring for older patients with kidney disease and hypertension. Blood Press Monit 2013; 18(1): 8-15. https://doi.org/10.1097/MBP.0b013e32835d126c

[5] Rubinstein A, *et al.* Effectiveness of an mHealth intervention to improve the cardiometabolic profile of people with prehypertension in low-resource urban settings in Latin America: A randomised controlled trial. Lancet Diabetes Endocrinol 2016; 4(1): 52-63. https://doi.org/10.1016/S2213-8587(15)00381-2

[6] Aovare P, *et al.* Assessing the Effectiveness of mHealth Interventions for Diabetes and Hypertension Management in Africa: Systematic Review and Meta-Analysis. JMIR mHealth uHealth 2023; 11. https://doi.org/10.2196/43742

[7] Brewer LC, *et al.* mHealth Intervention for Promoting Hypertension Self-management Among African American Patients Receiving Care at a Community Health Center: Formative Evaluation of the FAITH! Hypertension App JMIR Form Res 2023; 7. https://doi.org/10.2196/45061

[8] Gao W, *et al.* Telemedicine interventions to reduce blood pressure in a chronic disease population: A meta-analysis. J. Telemed. Telecare 2022; 28(9): 621-631. https://doi.org/10.1177/1357633X20959581

[9] McManus RJ, *et al.* Efficacy of self-monitored blood pressure, with or without telemonitoring, for titration of antihypertensive medication (TASMINH4): an unmasked randomised controlled trial. Lancet 2018; 391(10124): 949-959. https://doi.org/10.1016/S0140-6736(18)30309-X

[10] Abbas A, Hannan J, Stolp H, Coronado F, Sperling LS. Commitment to Hypertension Control During the COVID-19 Pandemic: Million Hearts Initiative Exemplars. Prev Chronic Dis 2022; 19. https://doi.org/10.5888/pcd19.210439

[11] Datta SK, *et al.* Economic analysis of a tailored behavioral intervention to improve blood pressure control for primary care patients. Am Heart J 2010; 160(2): 257-263. https://doi.org/10.1016/j.ahj.2010.05.024

[12] Esandi ME, *et al.* Evaluating the implementation of a hypertension program based on mHealth and community pharmacies integration to primary care centers at a municipality level in Argentina during the COVID-19 pandemic. Front Health Serv 2024; 4. https://doi.org/10.3389/frhs.2024.1263331

[13] Paluyo J, Stake A, Bryson R. “Padayon”: A new digital health model for diabetes and hypertension in rural Philippines. BMJ Innov 2022; 9(1): 43-48. https://doi.org/10.1136/bmjinnov-2021-000900

[14] Chusniyah A, Makruf I, Supriyanto. Two decades of sustainable development studies in higher education management: a bibliometric analysis. IJSHE 2024. https://doi.org/10.1108/IJSHE-11-2023-0546

[15] Özdemir Ö. The evolution, intellectual structure, and developmental trends of global mental health nursing research: A bibliometric analysis (2015-2025). Archives of Psychiatric Nursing 2026; 60: 1520-1535. https://doi.org/10.1016/j.apnu.2026.152055

[16] Mukherjee D, Lim WM, Kumar S, Donthu N. Guidelines for advancing theory and practice through bibliometric research. Journal of Business Research 2022; 148: 101-115. https://doi.org/10.1016/j.jbusres.2022.04.042

[17] Margolis KL, *et al.* Effect of home blood pressure telemonitoring and pharmacist management on blood pressure control a cluster randomized clinical trial. JAMA 2013; 310(1): 46-56. https://doi.org/10.1001/jama.2013.6549

[18] Omboni S, Gazzola T, Carabelli G, Parati G. Clinical usefulness and cost effectiveness of home blood pressure telemonitoring:Meta-analysis of randomized controlled studies. J Hypertens 2013; 31(3): 455-468. https://doi.org/10.1097/HJH.0b013e32835ca8dd

[19] Bobrow K, *et al.* Mobile Phone Text Messages to Support Treatment Adherence in Adults with High Blood Pressure (SMS-Text Adherence Support [StAR]): A Single-Blind, Randomized Trial. Circulation 2016; 133(6): 592-600 https://doi.org/10.1161/CIRCULATIONAHA.115.017530

[20] Bosworth HB, *et al.* Home blood pressure management and improved blood pressure control: Results from a randomized controlled trial. Arch. InternMed 2011; 171(13): 1173-1180 https://doi.org/10.1001/archinternmed.2011.276

[21] McManus RJ, *et al.* Home and Online Management and Evaluation of Blood Pressure (HOME BP) using a digital intervention in poorly controlled hypertension: Randomised controlled trial. BMJ 2021; 372. https://doi.org/10.1136/bmj.m4858

[22] Logan AG, *et al.* Effect of home blood pressure telemonitoring with self-care support on uncontrolled systolic hypertension in diabetics. Hypertension 2012; 60(1): 51-57. https://doi.org/10.1161/HYPERTENSIONAHA.111.188409

[23] Frias J, Virdi N, Raja P, Kim Y, Savage G, Osterberg L. Effectiveness of digital medicines to improve clinical outcomes in patients with uncontrolled hypertension and type 2 diabetes: Prospective, open-label, cluster-randomized pilot clinical trial. J Med Internet Res 2017; 19(7). https://doi.org/10.2196/jmir.7833

[24] McKinstry B, *et al.* Telemonitoring based service redesign for the management of uncontrolled hypertension: Multicentre randomised controlled trial. BMJ (Online) 2013; 346(7913). https://doi.org/10.1136/bmj.f3030

[25] McGillicuddy JW, *et al.* Mobile health medication adherence and blood pressure control in renal transplant recipients: A proof-of-concept randomized controlled trial. JMIR Res Prot 2013; 2(2). https://doi.org/10.2196/resprot.2633

[26] Giansanti D. The Future of Healthcare Is Digital: Unlocking the Potential of Mobile Health and E-Health Solutions. Healthcare 2025; 13(7): 802. https://doi.org/10.3390/healthcare13070802

[27] Sharp CA, Bresnen M, Austin L, McCarthy J, Dixon WG, Sanders C. Implementing disruptive technological change in UK healthcare: exploring development of a smart phone app for remote patient monitoring as a boundary object using qualitative methods. JHOM 2021; 35(2): 141-159. https://doi.org/10.1108/JHOM-07-2020-0295

[28] Mathews SC, McShea MJ, Hanley CL, Ravitz A, Labrique AB, Cohen AB. Digital health: a path to validation. NPJ Digit Med 2019; 2(1): 38. https://doi.org/10.1038/s41746-019-0111-3

[29] Bress AP, *et al.* Inequities in hypertension control in the united states exposed and exacerbated by covid-19 and the role of home blood pressure and virtual health care during and after the covid-19 pandemic. J Am Heart Assoc 2021; 10(11). https://doi.org/10.1161/JAHA.121.020997

[30] Nguyen H, Tran T, Nham P. AI Chatbot for Tourist Recommendations: A Case Study in Vietnam. Applied Computer (Query date: 2025-02-07) 2023; 14(14) 07. https://doi.org/10.2478/acss-2023-0023

[31] Mabeza RMS, Maynard K, Tarn DM. Influence of synchronous primary care telemedicine versus in-person visits on diabetes, hypertension, and hyperlipidemia outcomes: a systematic review. BMC Prim Care 23(1). https://doi.org/10.1186/s12875-022-01662-6

[32] Omboni S, Mancinelli A, Rizzi F, Parati G, TEMPLAR (TEleMonitoring of blood Pressure in Local phARmacies) Project Group. Telemonitoring of 24-Hour Blood Pressure in Local Pharmacies and Blood Pressure Control in the Community: The Templar Project. Am J Hypertens 2019; 32(7): 629-639. https://doi.org/10.1093/ajh/hpz049

[33] Acharya S, *et al.* Self-Measured Blood Pressure-Guided Pharmacotherapy: A Systematic Review and Meta-Analysis of United States-Based Telemedicine Trials. Hypertension 2024; 81(3): 648-657. https://doi.org/10.1161/HYPERTENSIONAHA.123.22109

[34] Phillips M, Harrington T, Srai J. Convergent Innovation in Emerging Healthcare Technology Ecosystems: Addressing Complexity and Integration. TIM Review 2017; 7(9): 44-54. https://doi.org/10.22215/timreview/1105

[35] Xiao M, *et al.* Home blood pressure monitoring by a mobile-based model in chongqing, China: A feasibility study. Int J Environ Res Public Health 2019; 16(18). https://doi.org/10.3390/ijerph16183325

[36] Xu L, Fang W-Y, Zhu F, Zhang H-G, Liu K. A coordinated PCP-Cardiologist Telemedicine Model (PCTM) in China’s community hypertension care: Study protocol for a randomized controlled trial. Trials 2017; 18(1). https://doi.org/10.1186/s13063-017-1970-z

[37] Goel RK. Knowledge diffusion worldwide: Role of university-industry collaborations and beyond. Manage Decis Econ 2022; 43(5): 1330-1339. https://doi.org/10.1002/mde.3457

[38] Smith E, Haustein S, Mongeon P, Shu F, Ridde V, Larivière V. Knowledge sharing in global health research - the impact, uptake and cost of open access to scholarly literature. Health Res Policy Sys 2017; 15(1): 73. https://doi.org/10.1186/s12961-017-0235-3

[39] Demeter M. Gatekeepers of Knowledge Dissemination: Inequality in Journal Editorial Boards. in Academic Knowledge Production and the Global South, Cham: Springer International Publishing, 2020; pp. 137-151. https://doi.org/10.1007/978-3-030-52701-3_6

[40] Bhavnani SP, *et al.* Roadmap for Innovation—ACC Health Policy Statement on Healthcare Transformation in the Era of Digital Health, Big Data, and Precision Health. Journal of the American College of Cardiology 2017; 70(21): 2696-2718. https://doi.org/10.1016/j.jacc.2017.10.018

[41] Spreafico AMC, Ascione R. Digitally Enhancing Care: Innovating Health Journeys for a Sustainable and Human-Centred Future. in Healthcare in the Digital Age, M. Bertolaso, M. L. Ilardo, and J. Ribera, Eds, Singapore: Springer Nature Singapore 2025; pp. 89-107. https://doi.org/10.1007/978-981-96-1437-0_5

[42] Makkizadeh F. Intellectual structure of knowledge in Nanomedicine field (2009 to 2018): A Co-Word Analysis. Nanomed Res J 2019; 4(2). https://doi.org/10.22034/nmrj.2019.02.007

[43] Ponomariov B, Boardman C. What is co-authorship?. Scientometrics 2016; 109(3): 1939-1963. https://doi.org/10.1007/s11192-016-2127-7

Received on 04-04-2026 Accepted on 06-05-2026 Published on 01-06-2026

https://doi.org/10.6000/1929-6029.2026.15.20