Journal of Scientometric Research, 2026; 15(1):226-238.
https://www.jscires.org

Research Article

Global Research Trends on Hypertension among Young Adults: Bibliometric Analysis and Visualizations of Literature from 2015 to 2024

Yashashwini Anethyar[1], Madhu B[1,*], Sheeba P[2], Manjunatha MC[1], Suraj MB[1], Mounika Sree M[1], Chaithra M[1]

[1]Department of Community Medicine, JSS Medical College, JSSAHER, Mysuru, Karnataka, INDIA.
[2]Department of Research Division, JSS Academy of Higher Education and Research (JSSAHER), Mysuru, Karnataka, INDIA.

ABSTRACT

Hypertension is the most common cardiovascular disease, affecting an estimated 1.28 billion adults worldwide, with a rapidly increasing burden among young adults driven largely by modifiable behavioral risk factors. Although substantial research exists, few bibliometric studies have systematically examined the global research landscape and evolving priorities in young adult hypertension. This bibliometric analysis examined 4,609 English-language articles published between 2015 and 2024 and indexed in the Scopus database. Trends in publication output, authorship, institutional and country contributions, collaboration networks, and research themes were analyzed using bibliometric mapping methods. The findings show a steady increase in publications and citations over the study period, with the United States leading in research output and international collaboration. Harvard Medical School and the University of Birmingham emerged as key institutional contributors. Thematic analysis shows that shift in research focus from pathophysiology, complications, and treatment outcomes in earlier years toward risk-based prevention, lifestyle factors, psychosocial determinants, digital health, and machine learning approaches in more recent years. Overall, the results indicate both the maturation of research on hypertension among young adults and persistent gaps, particularly in intervention-based and longitudinal studies, highlighting the need for interdisciplinary and context-specific approaches to support early prevention and precision management.

Keywords: Bibliometric analysis, Cardiovascular diseases, Hypertension, Research trends, Young adults.

Correspondence:
Madhu B
Department of Community Medicine, JSS Medical College, JSS AHER, Mysuru, Karnataka, INDIA.
Email: madhub@jssuni.edu.in

Received: 22-12-2025;
Revised: 09-01-2026;
Accepted: 11-03-2026.

INTRODUCTION

Cardiovascular Diseases (CVDs) remain the leading cause of death worldwide, and many of these deaths are preventable through effective management of hypertension (U.S. Department of Health and Human Services, 2020). Hypertension, often termed the 'silent killer', is responsible for over 10 million deaths annually, and is the leading modifiable risk factor (Mariachiara *et al.*, 2023). Globally, the age-standardized prevalence of hypertension is estimated at 33%, affecting approximately 1.28 billion adults, nearly two-thirds of whom reside in low and middle-income countries. Despite this burden, 46% of individuals with hypertension remain undiagnosed, particularly among younger age groups; only 42% receive treatment, and merely one in five adults achieves adequate blood pressure control (World Health Organization, 2023). Although hypertension is traditionally more common among elderly individuals, recent epidemiological evidence shows that hypertension and prehypertension may begin during adolescence and persist into adulthood (Daştan *et al.*, 2017). A meta-analysis study reported a pooled prevalence of masked hypertension of 10.4% among very young adults aged from 4 to 25 years (Martin *et al.*, 2025). Furthermore, the earlier the onset of prehypertension and hypertension, the higher the risk for other CVDs and mortality (Redwine and Daniels, 2012).

The increasing burden of hypertension among adults has been strongly associated with modifiable behavioral risk factors such as less physical activity, smoking, obesity, alcohol consumption, poor sleep, unhealthy dietary patterns, and stress (Adetunji *et al.*, 2025; Vo *et al.*, 2023). Despite this, awareness and prevention of hypertension among young adults remain limited, and targeted health literacy interventions on cardiovascular diseases can significantly improve knowledge and promote positive lifestyle changes, highlighting the importance of health promotion activities in reducing the long-term risk of hypertension (Nazar *et al.*, 2019). While numerous primary studies have examined hypertension and its determinants, research has predominantly

OPEN ACCESS

Manuscript TECHNOMEDIA

DOI: 10.5530/jscires.20260350

Publishing Partner : Manuscript Technomedia. [www.mstechnomedia.com]

focused on older populations. Consequently, a comprehensive understanding of how research on hypertension among young adults has evolved, where it is concentrated, and which areas remain underexplored is still limited. Bibliometrics applies mathematical and statistical methods to quantitatively assess scientific literature and is especially useful for synthesizing rapidly expanding and fragmented research fields such as young adult hypertension (Donthu *et al*., 2021). Bibliometric approaches enable the evaluation of publication trends, collaboration networks, and thematic structures, thereby revealing the intellectual foundations and developmental trajectories of a research domain. With the rapid growth of scientific publications and advances in bibliometric software, these methods have become increasingly valuable and widely applied across multiple disciplines, including biomedical and public health research (Montazeri *et al*., 2023).

Therefore, this study aims to map the global research landscape on hypertension among young adults from 2015 to 2024 by examining trends in publication output and citation impact, identifying key authors, journals, institutions, and countries, and exploring patterns of scientific collaboration. The study also analyzes the thematic structure and evolution of research topics to highlight dominant areas, emerging trends, and critical gaps that can inform future research directions.

METHODOLOGY

Data source and search strategies

Scientific literature on hypertension among young adults was retrieved from the Scopus database using the institutional account. Scopus was selected because of its broad coverage of peer-reviewed biomedical and public health journals and its compatibility with bibliometric analysis software.

The search was conducted in the "title-abstract-keywords" options to ensure comprehensive retrieval of relevant studies. In many publications, the age group or population of interest is not explicitly stated in the title or abstract but is indexed within author provided or database assigned keywords. Including keywords, therefore, improves sensitivity and reduces the risk of missing relevant studies, which is consistent with recommended practices in bibliometric research. This following with the Boolean query and keywords, TITLE-ABS-KEY ("young adult hypertension" OR "prehypertension" OR "high blood pressure" OR "elevated blood pressure" OR "blood pressure disorder" OR "hypertension") AND ("young adult" OR "age 18–25" OR "college students" OR "university students" OR "undergraduate students" OR "postgraduate students") AND ("risk factors" OR "prevalence" OR "intervention") AND ("monitoring" OR "screening"). As shown in Figure 1, the initial search yielded 26,295 records. The inclusion criteria limited the results to journal articles published between 2015 and 2024, resulting in the exclusion of 9,539 records. Further exclusion criteria were applied to remove errata, non-English publications, and non-article document types such as conference papers, reviews, editorials, and notes, yielding 12,902 records eligible for relevance assessment. These records were then further screened for relevance using a two-stage process. Initially, Scopus filtering options and keyword-based refinement were applied to exclude studies that were clearly unrelated to the target population. This was followed by title and abstract screening to assess population relevance. During this process, articles were excluded (n=8,293) if they did not primarily focus on young adults or adolescents transitioning into adulthood, despite containing hypertension related terms. Typical exclusions included studies focused exclusively on older adult or pediatric populations, animal or laboratory-based research, genetic or molecular studies without population-level relevance, and articles addressing hypertension without explicit consideration of young adult age groups. Only studies that clearly examined hypertension or elevated blood pressure among young adults or comparable populations were retained for the final analysis.

Bibliographic metadata, including the names, affiliations, and countries of the authors, as well as keywords, were standardized to a uniform format for analysis after complete records were exported to Microsoft Excel 2021. This study was exempt from Ethics Committee approval because it was a retrospective examination of already published literature.

Analysis and visualization tools

VOSviewer version 1.6.20 (Center for Science and Technology Studies, Leiden University, The Netherlands) has been used for bibliometric mapping and visualization (VOSviewer - Visualizing Scientific Landscapes, v.1.6.20 (2023). Microsoft Excel 2021 was used to manage bibliographic data and to generate tables summarizing the top authors, institutions, and journals based on publication output.

In bibliometric research, performance indicators and science mapping techniques are widely used to evaluate the structure, influence, and evolution of a research field. In the present study, analysis of the most productive authors and journals was conducted to identify key contributors and primary dissemination channels shaping research on hypertension among young adults. Highly productive and highly cited authors often influence research priorities and methodological approaches, while leading journals serve as central platforms for disseminating influential findings within the field.

Institutional and country level analyses were performed to examine the geographical distribution of research output and to identify major research hubs contributing to knowledge production. These analyses provide insights into global research capacity, collaboration patterns, and disparities between regions. Such assessment is particularly relevant for hypertension among young adults, given the growing disease burden in low and

middle-income countries and the need to understand gaps in research representation.

Co-authorship analysis at the author, institutional, and country levels was conducted to assess patterns of scientific collaboration. Collaborative networks reflect the exchange of expertise, resources, and methodological approaches and are often associated with increased research visibility and citation impact. Mapping these networks enables the identification of core collaborative clusters, influential partnerships, and gaps in international cooperation, thereby informing opportunities for strengthening interdisciplinary and cross regional research collaboration. In the VOSviewer generated maps, authors, organizations, or countries are represented as nodes, with node size indicating publication volume. Collaborative relationships are depicted by links between nodes, where line thickness represents Link Strength (LS). The sum of all link strengths for an entity represents its Total Link Strength (TLS), indicating overall collaboration intensity, while the distance between nodes reflects the closeness of collaborative relationships.

Keyword co-occurrence analysis was employed to identify major research themes, hotspots, and the temporal evolution of topics within young adult hypertension research. This approach enables visualization of thematic structures and emerging trends, supporting the identification of research gaps and potential future directions. VOSviewer provides three types of visualizations for keyword analysis: network maps illustrating relationships among keywords, overlay maps depicting the temporal evolution of research topics, and density maps highlighting areas of high research activity.

RESULTS

Annual number of publications and citations

A total of 4,609 scholarly articles on hypertension among young adults were retrieved from Scopus covering the years 2015 to 2024. Figure 2 illustrates the annual trend of publications along with their citation counts. Publication output showed a gradual rise until 2018. In 2019, a marked increase was observed, with publications reaching 401 articles, reflecting a 33.6% growth compared to 2015. From 2020 onward, the growth pattern remained strong, with annual publications steadily rising and peaking at 664 in 2024, which was more than double the 2018 count. Nearly half of the total publications were produced during the period 2021-2024. In parallel, citation counts consistently increased each year, despite some fluctuations, further emphasizing the growing recognition of this field. Together, the progressive rise in both publications and citations highlights an expanding global interest in hypertension research among young adults, likely driven by improved awareness, early screening initiatives, and preventive strategies.

Top author and most productive journal

There were 4,609 papers on hypertension among young adults, with 25,995 authors in total. Table 1 presents the ten most productive authors in this research area. The leading contributor was Schutte Aletta with 27 publications, followed by Muntner Paul (*n*=24) and Yokonishi Tetsuhiro (*n*=24). Importantly, Muntner Paul not only ranked among the top 10 but was also the most highly cited author with 6,310 citations. In total, 160 authors had produced at least five publications, and these were included in the co-authorship analysis (Figure 3(A)), with thresholds set at a minimum of five papers and citations. Among them, Yokonishi Tetsuhiro demonstrated the strongest collaborative performance with a Total Link Strength (TLS) of 80, followed by Shimbo Daichi (TLS=67) and Lloyd Jones (TLS=63). Strong collaboration between Schwartz Joseph and Shimbo Daichi, with a Link Strength (LS) of 11, followed by Muntner Paul and Shimbo Daichi, with an LS of 10.

There have been at least five publications on hypertension among young adults in 160 journals. The top ten journals with the highest published papers are listed in Table 2. PLOS One published the highest number of papers (*n*=137), followed by International Journal of Environmental Research and Public Health (*n*=85) and Journal of Hypertension (*n*=78).

Institutions and Countries

Analyzed the work across multiple institutes in relation to studies on young adults' hypertension. Papers on young adult hypertension have been published by 6796 organizations across 174 countries. The top ten most productive institutions are listed in Table 3, with the largest number of papers were the Harvard Medical School (*n*=98) published highest number of papers on young adult hypertension, followed by The University of Alabama at Birmingham (*n*=81). Co-authorship analysis was performed for 58 institutions with at least 20 papers without any citation limitations. As shown in the Figure 3(B), Northwestern University Feinberg school of medicine, Chicago, United States had the highest collaboration performance with TLS of 98, followed by the university of Alabama at Birmingham, United States (TLS=87), Columbia university Irving Medical Center, New York, United States (TLS=83), Harvard Medical School, Boston, United States (TLS=82), Johns Hopkins University School of Medicine, Baltimore, United States (TLS=72). The strongest collaboration was between the Seoul National University, Seoul, South Korea, and Soongsil University, Seoul, South Korea (LS=20), followed by the Columbia University, New York, and the University of Alabama at Birmingham (LS=16), UCSF School of Medicine, San Francisco, and the University of California (LS=12).

Evaluated the various countries' research activities. There were at least 15 publications on young adult hypertension from 60 countries. The top 10 most productive countries in the field of

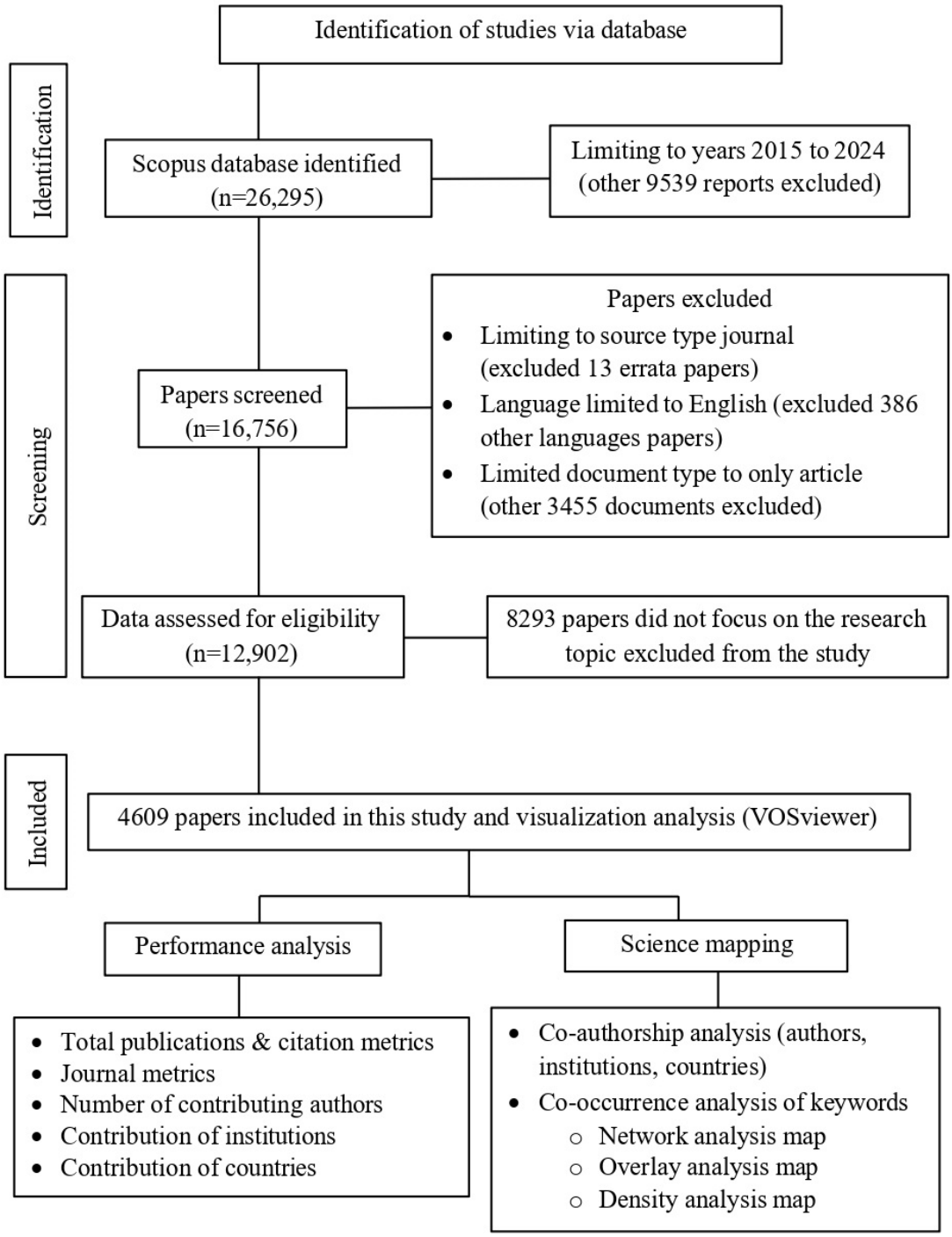

Figure 1: Paper retrieval flow chart. The criteria and methods for identifying papers on young adult hypertension in the Scopus database are shown in the flowchart.

adult hypertension, together with TLS and citations, are shown in Table 3.

The United States contributed the highest number of papers (*n*=1387), followed by China (*n*=613), the UK (*n*=363), and India (*n*=253). The highly cited country is the United States, followed by the UK (*n*=28296), and Australia (*n*=12866). Co-authorship analysis was performed for these countries with a minimum of 15 papers with a minimum of 5 citations per country. Figure 3(C) shows that the United States had the highest collaboration performance, with TLS of 1088, followed by the United Kingdom (TLS=796), Italy (TLS=469), Germany (TLS=398), and Australia (TLS=372). The strongest collaboration was between the United States and the United Kingdom (LS=112), followed by Canada and the United States (LS=75), China and the United States (LS=70), Italy and the United Kingdom (LS=55), United States and Italy (LS=46).

Thematic modeling and keyword co-occurrence analysis

From 4609 papers, a total of 25398 keywords were extracted. Among the keywords that appeared at least 100 times were hypertension (*n*=3737), major clinical study (*n*=2288), young adult (*n*=2078), risk factors (*n*=1795), body mass (*n*=1391), prevalence (*n*=1305), obesity (*n*=1182). A total of 625 keywords that had appeared at least 40 times were included for keyword co-occurrence analysis using VOSviewer. Keyword co-occurrence analysis is shown in Figure 4, where there are three visual maps: network, overlay, and density maps.

The keyword co-occurrence network map is shown in Figure 4A, which visualizes the structural relationships among frequently occurring keywords in the literature on hypertension among young adults. Based on co-occurrence patterns, keywords were grouped into five distinct clusters. For each cluster, the primary terms are shown in Table 4, representing major thematic domains within the field. Cluster 1 formed the largest and most centrally positioned group, indicating a high degree of connectivity with other thematic clusters. This cluster was dominated by keywords related to clinical outcomes and comorbidities, including complications, comorbidities, heart failure, coronary artery disease, chronic kidney failure, mortality, and treatment outcomes. The central placement and dense interconnections of this cluster suggest that outcome-oriented clinical concepts are strongly embedded across multiple areas of young adult hypertension research. Cluster 2 consisted primarily of epidemiological and lifestyle-related keywords, such as hypertension, young adult, prevalence, obesity, smoking, alcohol consumption, physical activity, and lifestyle. This cluster showed strong co-occurrence links with both the metabolic cluster (Cluster 4) and the clinical outcomes cluster (Cluster 1), indicating frequent integration of lifestyle and epidemiological variables with clinical and metabolic aspects of hypertension research. Cluster 3 represented clinical trials, pathophysiology, and biomarker-focused research, with keywords including blood pressure, systolic blood pressure, diastolic blood pressure, antihypertensive agents, blood pressure monitoring, biomarkers, arterial stiffness, and randomized controlled trial. This cluster was moderately connected to other clusters, reflecting its role as a bridge between mechanistic research and applied clinical outcomes. Cluster 4 focused on metabolic and biochemical determinants, with prominent keywords such as body mass index, waist circumference, dyslipidemia, glucose, insulin resistance, cholesterol, metabolic syndrome, and Hemoglobin A_{1C}. The close spatial positioning of this cluster to Cluster 2 indicates frequent co-occurrence between metabolic and lifestyle-related factors. Cluster 5 was the smallest and most peripherally positioned cluster and comprised keywords related to epidemiological study designs and risk prediction models, including cohort study, prospective study, incidence, risk assessment, longitudinal study, and proportional hazards model. The peripheral placement and fewer connections of this cluster indicate limited integration of longitudinal and predictive modeling approaches with other thematic areas.

Table 1: List of the ten most productive authors.

Author name	Number of Papers	Total Citations	Institutional Affiliation	Country
Schutte Aletta	27	466	North-West University, Potchefstroom	South Africa
Muntner Paul	24	6310	Vagelos College of Physicians and Surgeons, New York	United States
Yokonishi Tetsuhiro	24	623	Juntendo University School of Medicine, Tokyo	Japan
Shimbo Daichi	22	338	Columbia University Irving Medical Center, New York	United States
Han Kyungdo	19	187	Soongsil University, Seoul	South Korea
Lewis Cora	18	401	The University of Alabama, Birmingham	United States
Lloyd Jones	18	1061	Northwestern University Feinberg School of Medicine, Chicago	United States
Kruger Ruan	17	319	North-West University, Potchefstroom	South Africa
Schwartz Joseph	17	222	Renaissance School of Medicine at Stony Brook University, Stony Brook	United States
Mels Catharina	13	182	North-West University, Potchefstroom,	South Africa

The overlay visualization map (Figure 4B) shows the temporal evolution of research topics based on the Average Publication Year (APY) of keywords. Earlier keywords are represented by blue nodes, intermediate period keywords by green nodes, and more recent keywords by yellow to red nodes. Keywords associated with earlier publication years were primarily related to clinical management and mechanistic research, including drug effects (APY=2015.9), pathophysiology (APY=2018.8), treatment outcomes (APY=2018.9), and follow-up studies (APY=2018.9). These keywords were predominantly located within clusters related to clinical outcomes and pathophysiology. Keywords with intermediate APY values clustered around epidemiological and risk-based themes, including young adult (APY=2019.9), biomarkers (APY=2019.7), risk factor (APY=2020.0), and lifestyle (APY=2020.1). These terms were mainly distributed across Clusters 2, 3, and 4, reflecting a shift toward population level and risk-oriented research. More recent keywords, represented by red nodes, included physical activity (APY=2021.1), quality of life (APY=2021.5), cardiovascular risk factor (APY=2022.6), mental health (APY=2023.1), education (APY=2023.9), machine learning (APY=2024.5), and cardiovascular risk factors (APY=2024.8). These keywords were distributed across lifestyle related and methodological clusters, indicating a recent expansion of research focus toward psychosocial dimensions and advanced analytical approaches.

The density visualization map (Figure 4C) represents the spatial distribution and frequency intensity of keywords across the research field. Areas shown in red and yellow indicate high keyword density and frequent co-occurrence, whereas blue and cyan regions represent lower frequency and weaker co-occurrence. High density regions were concentrated around keywords such as hypertension, risk factors, body mass, blood pressure, prevalence, and young adult, reflecting their central role and repeated occurrence across the literature. These keywords correspond primarily to Clusters 1, 2, and 4, indicating that clinical outcomes, epidemiology, and metabolic determinants constitute the core thematic areas of young adult hypertension research. Lower density regions were observed for keywords related to longitudinal study designs, predictive modeling, and advanced analytical methods. These areas were primarily associated with Cluster 5 and appeared more diffusely distributed, reflecting comparatively lower frequency and weaker integration with other themes.

DISCUSSION

General information

A bibliometric analysis of 4609 papers on young adult hypertension was done for this study. The overall status of worldwide research on young adult hypertension was determined by evaluating the authors, source journals, organizations, and countries, as well as their collaborations. There has been a remarkable rise in the volume of research published each year, reflecting a growing global interest in understanding and addressing hypertension among young adults.

The strong collaboration between the Schwartz Joseph and Shimbo Daichi. They coauthored an article titled "Race and sex differences in asleep blood pressure: The Coronary Artery Risk Development in Young Adults (CARDIA) study", published in the Journal of Clinical Hypertension, with 31 citations. According to their research, nocturnal hypertension and non-dipping systolic blood pressure are highly prevalent in black adult men and women, and both conditions are associated with an increased

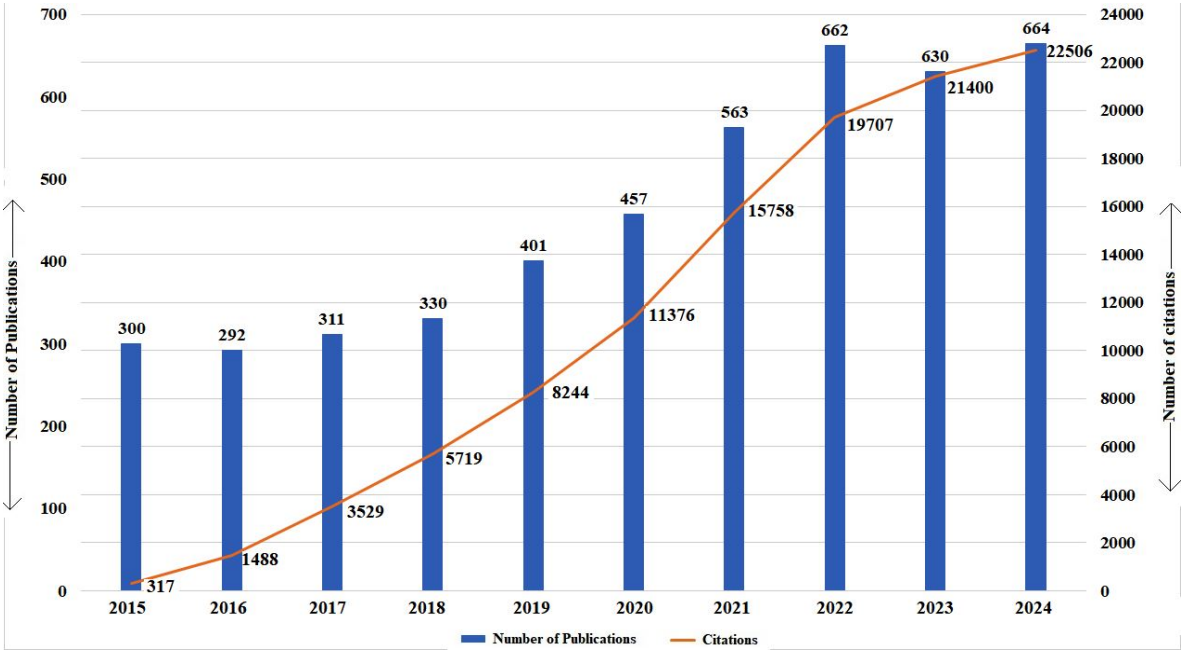

Figure 2: Variations in the annual number of papers and their corresponding citations.

Table 2: A list of the ten most productive journals.

Journals	Number of Papers	Number of Citations	Quartile (2024)
PLoS One	137	2602	Q1
International Journal of Environmental Research and Public Health	85	1132	Q1
Journal of Hypertension	78	3328	Q1
BMC Public Health	58	1194	Q1
Journal of Clinical Hypertension	57	880	Q2
Nutrients	50	1196	Q1
Scientific Reports	49	493	Q1
BMJ Open	47	610	Q1
Hypertension	47	3869	Q1
Frontiers in Endocrinology	45	339	Q1

risk of cardiovascular disease (Booth *et al.*, 2019). PLOS One is the journal that published the highest articles about hypertension in young adults (2.97% of all papers), followed by International Journal of Environmental Research and Public Health (1.84% of all papers) and Journal of Hypertension (1.69% of all papers).

Geographical distribution of research and generalizability

Most of the institutions that published research on hypertension in young adults were based in the US. The highest number of studies on young adult hypertension was conducted by the Harvard Medical School, followed by the University of Alabama at Birmingham. However, the Brigham and Women's Hospital has the highest citations in published papers than the papers published by Harvard Medical School and the University of Alabama. In terms of the number of publications and overall citations, the United States ranks top, demonstrating its dominant position in the field of study. China is second out of the ten most productive nations in the world. However, China has to enhance its cooperation in this field as it now primarily works with the United States and the United Kingdom and has limited collaborations with other countries. Third and fourth largest with the highest number of papers are the UK and India, respectively, where the UK is collaborating effectively with a larger number of countries, whereas India's collaboration is with the Southeast Asian countries. Although research output from several countries has increased in recent years, the relatively low level of international collaboration in some regions is reflected in fewer citations. Conversely, countries with fewer publications but stronger collaborative ties tend to receive higher citation counts, highlighting the influence of global partnerships on research visibility and impact. These geographical disparities underscore gaps in effective international collaboration. This imbalance raises questions regarding the generalizability of findings and emphasizes the need for more equitable distribution of research funding and stronger global partnerships to foster comprehensive and representative knowledge development in this field.

Research areas of interest and future directions

Keywords from this study were grouped into five clusters, each cluster represented a distinct aspect of hypertension. These clusters provide a comprehensive overview of existing research domains. However, they also reveal notable gaps in addressing broader issues related to hypertension among young adults.

Cluster 1 focuses on research examining clinical outcomes and comorbidities associated with hypertension. Since hypertension is often asymptomatic, it frequently remains undetected and untreated, leading to severe complications. It is a major cause of end-stage renal disease, doubles the risk of coronary artery disease, increases the likelihood of heart failure fourfold, and raises the risk of cerebrovascular disease and stroke sevenfold (Adhikari *et al.*, 2015). Diabetes commonly coexists with hypertension, compounding the risk of complications (Kundu *et al.*, 2023) and imposing significant economic burdens, particularly in low- and middle-income countries (Amon *et al.*, 2024). Chronic hypertension has also been linked with conditions such as diabetes and hypothyroidism in pregnancy (Perejón López *et al.*, 2025). In addition, secondary hypertension has a considerable prevalence among young adults (De Freminville *et al.*, 2024). While psychosocial factors, such as depression, further exacerbate the burden of high blood pressure, with studies from Ghana showing a higher prevalence among women in the working population (Ofori *et al.*, 2024). Future research should aim to explore the underlying factors contributing to these observed geographical and socioeconomic disparities. Expanding research to include larger and more diverse populations, particularly in low-resource settings, will provide a clearer understanding of contextual risk factors for comorbidities and complications. Additionally, studies examining the economic implications of hypertension, including catastrophic health expenditure and the proportion of household spending on healthcare, are warranted to better inform equitable prevention and management strategies.

Epidemiology and lifestyle-related risk factors are discussed in cluster 2. Recent studies show that hypertension prevalence is rapidly increasing in this age group, with regional variations (Zhang *et al.*, 2023). While prevalence appears to be stabilizing in developed regions, it continues to rise in Southeast Asia, where hypertension and prehypertension often begin in adolescence and track into adulthood. Among university students in ASEAN countries, 19% were found to have prehypertension and 6.7% hypertension (Peltzer *et al.*, 2017). Similarly, studies from India reported a high incidence of prehypertension (50%), particularly systolic prehypertension, among apparently healthy medical undergraduates (Senthil and Krishndasa, 2015). These findings underscore the role of modifiable risk factors such as smoking, alcohol use, poor dietary habits, physical inactivity, and elevated BMI, which are common among college students. However, awareness of the long-term health consequences remains low, highlighting the urgent need for early prevention and lifestyle interventions to reduce the future cardiovascular burden (Tran *et al.*, 2022). Notably, few studies within this cluster have focused on intervention-based research aimed at preventing prehypertension or modifying lifestyle risk factors. Implementing preventive programs targeting college and university populations could yield substantial long-term health benefits. Furthermore, longitudinal studies following young cohorts over time would provide valuable insights into how early-life behaviors influence the subsequent development of hypertension and related metabolic disorders.

Cluster 3 focuses on research in clinical trials and biomarker studies related to hypertension. Several Randomized Controlled Trials (RCTs) have explored non-pharmacological management, with evidence showing that mindfulness-based interventions significantly reduce blood pressure in patients with hypertension (Chen *et al.*, 2024). Similarly, a twelve-month smartphone-guided breathing meditation program demonstrated sustained reductions in systolic blood pressure among non-medicated stage 1 hypertensive adults, indicating promise as a first-line behavioral intervention when adherence is maintained (Chandler *et al.*, 2020). Biomarker studies further advance understanding of hypertension risk. Nuclear Magnetic Resonance-derived biomarkers such as LPIR (Lipoprotein Insulin Resistance Index), GlycA (inflammation marker), BCAA (total branched-chain amino acids), and glycine have been strongly associated with insulin resistance and glycemia in young adults, particularly

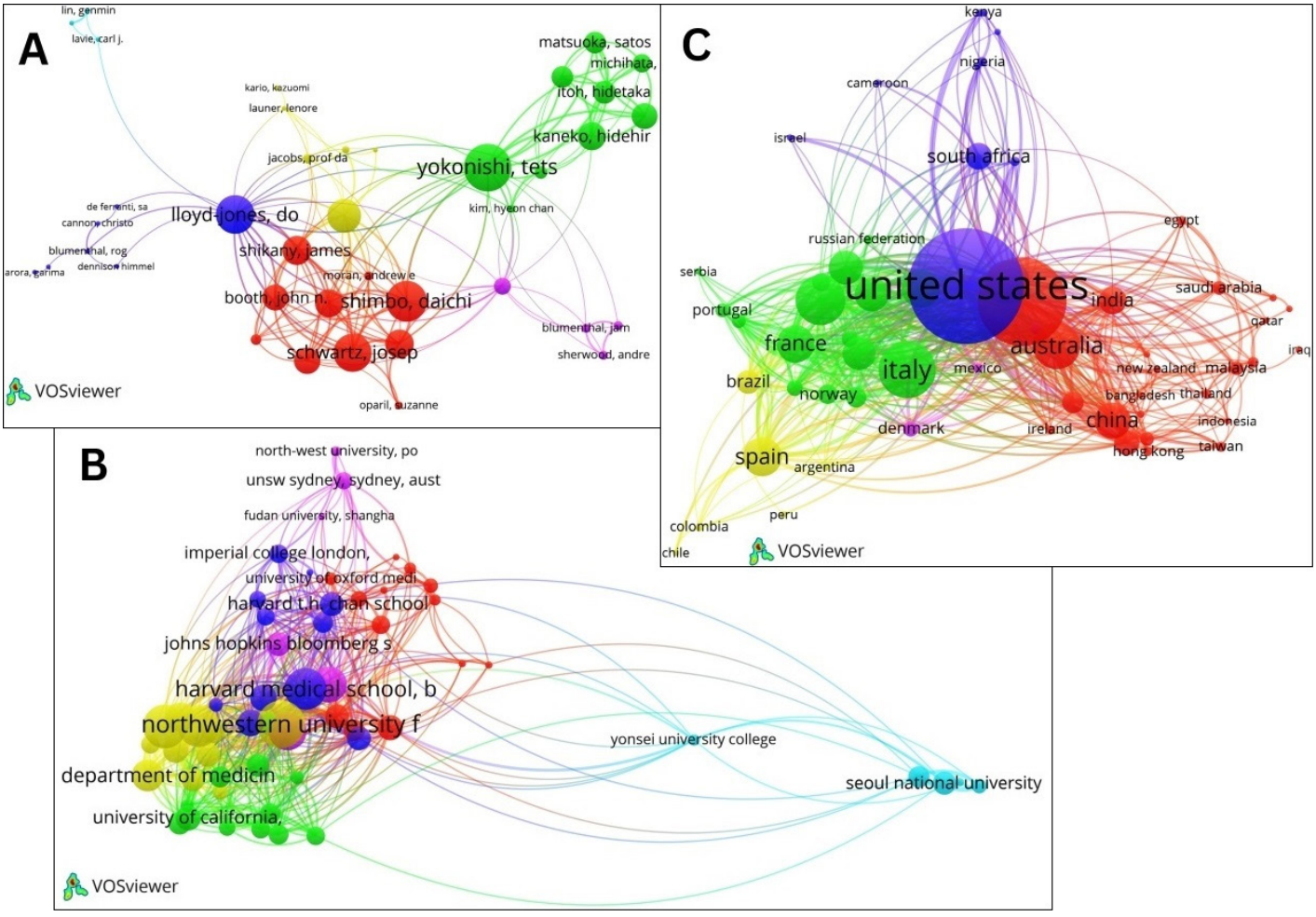

Figure 3: Mapping of Co-authorship analysis by using VOSviewer. A) authors, B) institutions and C) countries that published papers regarding hypertension among young adults.

Table 3: List of the top ten productive institutes and countries in research on young adult hypertension.

Countries/ Institutions Name	Number of Papers	Number of Citations	Total Link Strength
Institutions			
Harvard Medical School, US	98	8499	82
The University of Alabama at Birmingham, US	81	8348	87
Northwestern University Feinberg School of Medicine, US	66	2095	98
Universidade de São Paulo, Brazil	65	4077	29
Johns Hopkins University School of Medicine, US	58	1724	72
Brigham and Women's Hospital, US	57	10933	47
The University of North Carolina at Chapel Hill, US	55	2265	43
Chinese Academy of Medical Sciences and Peking Union Medical College, China	54	1412	15
Duke University School of Medicine, US	52	1146	67
University of Michigan, US	51	9916	35
Countries			
United States	1387	52637	1088
China	613	10709	275
United Kingdom	363	28296	796
India	253	3222	197
Italy	230	4072	149
South Korea	229	10652	469
Brazil	203	5565	167
Australia	197	12866	372
Canada	189	10407	349
Germany	175	10942	398

those with prediabetes and type 2 diabetes mellitus, reflecting a biochemical profile of elevated cardiovascular risk (Chung *et al.*, 2021). Additionally, albuminuria and reduced estimated glomerular filtration rate were identified as prognostic markers for left ventricular hypertrophy among South Asians with hypertension, highlighting their value in risk stratification and early detection of cardiovascular damage (Feng *et al.*, 2017). Despite these advancements, there remains a pressing need for more rigorously designed randomized controlled trials with larger sample sizes to generate higher-quality evidence and validate the effectiveness of emerging behavioral and biomarker-based interventions in diverse populations.

Cluster 4 emphasizes the metabolic determinants of hypertension, including obesity, dyslipidemia, insulin resistance, and metabolic syndrome. Studies show a high prevalence of clustering of Metabolic Syndrome (MetS) components such as abdominal obesity, elevated blood pressure, and fasting glucose, with women having twice the burden of 3-factor MetS compared to men, highlighting the need for community-based screening and lifestyle interventions (Mengesha *et al.*, 2020). Insulin Resistance (IR) is another critical determinant, affecting nearly 40% of young American adults without diabetes, with clustering of cardiometabolic risk factors observed even among non-obese individuals. This underscores the importance of screening for IR beyond BMI (Parcha *et al.*, 2022). Globally, obesity remains a major driver of cardiovascular disease, accounting for nearly 10% of CVD deaths, with over 878 million adults living with obesity in 2022. Projections suggest that two-thirds of adults may be overweight or obese by 2050 (Lopez-Jimenez *et al.*, 2025). In India, the phenotype of Normal Weight Obesity (NWO) further complicates risk, as with normal BMI individuals, but higher body fat percentage demonstrated similar cardiometabolic risks, including hypertension, dyslipidemia, and diabetes, as those classified as obese, emphasizing the limitations of BMI alone in risk assessment (Kapoor *et al.*, 2020). Future research should prioritize understanding the efficacy of lifestyle modification and therapeutic interventions among individuals with NWO and insulin resistance. Additionally, there is a need for primordial prevention studies focusing on metabolic health promotion from early adulthood to curb the progression of hypertension and associated cardiometabolic diseases.

Cluster 5 highlights the role of advanced epidemiological designs, prospective, retrospective, predictive models, and longitudinal cohort studies in predicting hypertension related risks. A 10-year follow-up demonstrated that the adipose-to-lean ratio in middle adulthood was strongly associated with incident T2DM, hypertension, and dyslipidemia (Booker *et al.*, 2024). Adolescent hypertension has also been linked to elevated stroke risk in young adulthood, as evidenced by a large nationwide retrospective cohort study in Israel (Fishman *et al.*, 2023). Among HIV-infected adults in low-income countries, prospective studies found hypertension to be highly prevalent and associated with a two-fold increased risk of mortality, emphasizing it as a critical threat to long-term survival (Batavia *et al.*, 2018). Similarly, longitudinal data from China showed that a history of hypertension increased the risk of future fractures, reinforcing its systemic impact beyond cardiovascular outcomes (Du *et al.*, 2024). Despite these advancements, there remains a paucity of longitudinal and predictive studies focusing on young adults, particularly in low- and middle-income countries. Most existing models are derived from older or high-risk populations, limiting their applicability to younger cohorts. Future research should focus on developing context specific predictive models incorporating lifestyle, behavioral, and biomarker data to enable early risk stratification. Integrating digital health tools, wearable devices, and machine learning approaches could further enhance real time risk prediction and support preventive strategies for young adults at risk of hypertension.

Keyword co-occurrence overlay mapping using VOSviewer software was employed to predict the future research directions. The overlay map shows the temporal evolution of the keywords inside each cluster, beginning with research that focuses on early studies (2015-2018) concentrated on clinical and methodological foundations, such as drug effects, ethnology, pathophysiology, and treatment outcomes, indicating a strong emphasis on disease mechanisms and outcomes. By 2019-2020, the focus transitioned to population-level and risk-based approaches, with recurring terms like young adult, biomarkers, risk factor, and lifestyle. This shift reflects increasing attention to prevention, risk stratification, and early detection of hypertension in younger populations. In recent years (2021-2024), emerging keywords highlight holistic health and advanced methodologies, including physical activity, quality of life, cardiovascular risk factors, mental health education, and machine learning. These reflect the evolving research agenda toward patient-centered outcomes, integration of psychosocial determinants, and application of advanced computational models in hypertension research. This temporal progression suggests that future research is likely to emphasize interdisciplinary approaches, where lifestyle modification, psychosocial health, digital interventions, and AI-driven prediction models converge to refine hypertension prevention and management strategies.

Implications for the field

The findings of this bibliometric analysis provide valuable insights into the evolving research landscape on hypertension among young adults. The steady growth of publications in this area reflects an increasing global recognition of hypertension in younger populations as an emerging public health concern. However, the geographical imbalance in research contributions highlights disparities in global scientific engagement. A significant proportion of studies originates from high-income countries such as the United States and the United Kingdom, where research infrastructures and funding mechanisms are more established. This concentration of research leadership may limit the representativeness of findings for low- and middle-income countries, where young adults may face different risk profiles, sociocultural determinants, and healthcare access challenges. The identification of influential institutions, including major academic

Table 4: The clusters of keywords.

Clusters	Research hotspots	Number of items	Main keywords
1	Clinical outcomes and comorbidities in hypertension	232	Complication, comorbidity, heart failure, coronary artery disease, depression, chronic kidney failure, mortality, treatment outcome.
2	Epidemiology and lifestyle-related risk factors	181	Hypertension, young adult, prevalence, obesity, smoking, alcohol consumption, physical activity, lifestyle.
3	Clinical trials, pathophysiology, and biomarkers	101	Blood pressure, systolic/diastolic BP, antihypertensive agents, blood pressure monitoring, biomarkers, arterial stiffness, randomized controlled trial.
4	Metabolic and biochemical determinants of hypertension	91	Body mass index, waist circumference, dyslipidemia, glucose, insulin resistance, cholesterol, metabolic syndrome, Hemoglobin A_{1C}.
5	Epidemiological designs and risk prediction models	20	Cohort study, prospective study, incidence, risk assessment, longitudinal study, proportional hazards model, sensitivity analysis.

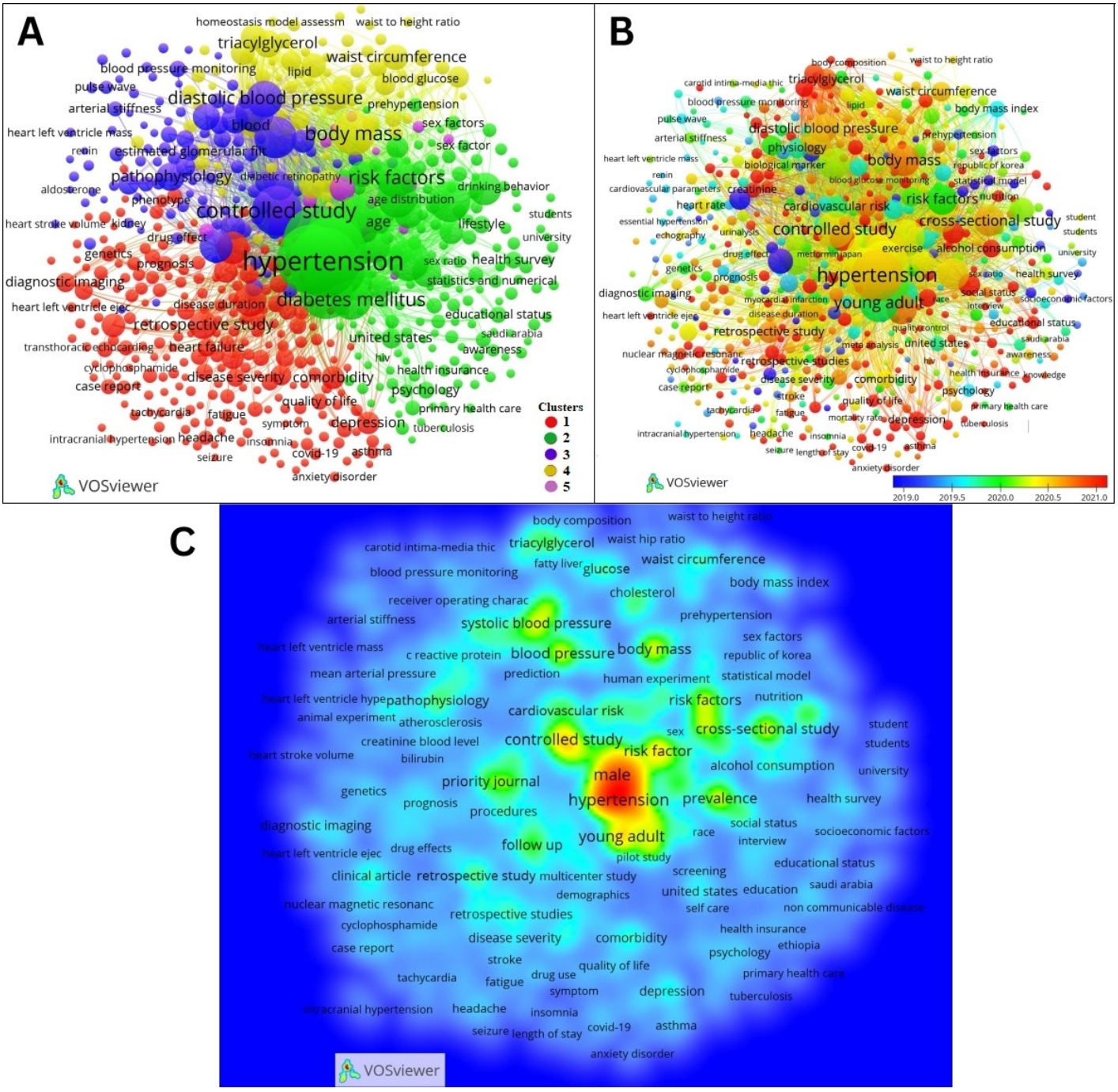

Figure 4: Keyword co-occurrence analysis by using VOSviewer. A) network map, B) overlay map, C) density map.

centers in the United States, underscores the presence of research hubs that drive innovation and shape global discourse in the field. These centers serve as key contributors to methodological advancement and capacity building, offering potential opportunities for collaborative networks with underrepresented regions. Keyword cluster and temporal analyses further illustrate how research themes have evolved over time, shedding light on emerging areas of interest and gaps that remain unexplored. Much of the existing work focuses on assessing clinical outcomes, comorbidities, metabolic and lifestyle factors among young hypertensives. However, relatively few studies employ advanced epidemiological designs or explore interventional and preventive approaches. This gap underscores the need for comprehensive, multidisciplinary strategies and longitudinal research to better understand and mitigate the burden of hypertension in young adults.

LIMITATIONS

This bibliometric study provides a comprehensive overview of research hotspots and future trends in young adult hypertension. It is important to acknowledge some limitations. The reliance on a single database may have restricted the comprehensiveness of the retrieved literature. Although Scopus is an extensive and reliable source, it may not encompass all relevant articles in the field, thereby introducing potential selection bias. Despite incorporating a broad range of search terms, some relevant keywords might have been overlooked, and consequently, certain articles may not have been included in the final analyses. Bibliometric metadata are subject to periodic updates therefore; future analyses may yield slightly different results. Restricting the search to English-language publications may have introduced language bias, possibly excluding valuable research published in other languages. Moreover, the focus on primary research articles may have limited insights from review papers and policy reports. A key limitation of bibliometric analysis lies in its quantitative nature, which does not allow for in-depth evaluation of conceptual frameworks or methodological rigor of the included studies. Future research, such as scoping or systematic reviews, could provide a more detailed understanding of the conceptual and methodological aspects of research on young adult hypertension. Despite these constraints, this bibliometric analysis offers valuable insights into the global research landscape of this field.

CONCLUSION

This comprehensive bibliometric analysis of hypertension among young adults reveals a steady increase in publications and citations, highlighting the growing recognition of hypertension as an emerging public health challenge in the younger population. The United States is the leading contributor with strong collaborative performance in young adult hypertension research, while PLOS One emerged as the most productive journal in young adult hypertension research. Co-authorship analyses indicate the presence of collaborative networks, though opportunities remain for strengthening cross-country and inter-institutional collaborations, especially among the low and middle-income countries, where the burden is projected to rise. Keyword analysis revealed evolving research priorities from clinical outcome, pathophysiological studies, to current emphases on lifestyle, psychosocial determinants, digital health, and machine learning, showing a future shift towards interdisciplinary and precision prevention strategies. The findings of the study will make it easier for readers to quickly and efficiently obtain important information in this area. Additionally, the study helps researchers find possible research partners and highlights top researchers and universities.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

REFERENCES

Adetunji, A., Uche-Orji, C., Ezebialu, C., Adebayo, P. C., Sanusi, F., Imo, U., Adiat, T., and Ajala, T. (2025). The prevalence and risk factors of pre-hypertension and hypertension among clinical students at the university of Ibadan, Nigeria. BMC Cardiovascular Disorders, 25(1), 393. https://doi.org/10.1186/s12872-025-04852-z

Adhikari, P., Pemminati, S., Pathak, R., Kotian, M. S., and Ullal, S. (2015). Prevalence of hypertension in boloor diabetes study (BDS-II) and its risk factors. Journal of Clinical and Diagnostic Research, 9(11), IC01–IC04. https://doi.org/10.7860/JCDR/2015/16509.6781

Amon, S., Aikins, M., Haghparast-Bidgoli, H., Kretchy, I. A., Arhinful, D. K., Baatiema, L., Awuah, R. B., Asah-Ayeh, V., Sanuade, O. A., Kushitor, S. B., Mensah, S. K., Kushitor, M. K., Grijalva-Eternod, C., Blandford, A., Jennings, H., Koram, K., Antwi, P., Gray, E., and Fottrell, E. (2024). Household economic burden of type-2 diabetes and hypertension comorbidity care in urban-poor Ghana: a mixed methods study. BMC Health Services Research, 24(1), 1028. https://doi.org/10.1186/s12913-024-11516-9

Batavia, A. S., Severe, P., Lee, M. H., Apollon, A., Zhu, Y. S., Dupnik, K. M., McNairy, M. L., Pape, J. W., Fitzgerald, D. W., and Peck, R. N. (2018). Blood pressure and mortality in a prospective cohort of HIV-infected adults in Port-au-Prince, Haiti. Journal of Hypertension, 36(7), 1533–1539. https://doi.org/10.1097/HJH.0000000000001723

Booker, R., Wong, M., Bancks, M. P., Carnethon, M. R., Chow, L. S., Lewis, C. E., Schreiner, P. J., and Alexandria, S. J. (2024). The longitudinal association of adipose-to-lean ratio with incident cardiometabolic morbidity: The CARDIA study. Journal of Diabetes and Its Complications, 38(5), e108725. https://doi.org/10.1016/j.jdiacomp.2024.108725

Booth, J. N., Anstey, D. E., Bello, N. A., Jaeger, B. C., Pugliese, D. N., Thomas, S. J., Deng, L., Shikany, J. M., Lloyd-Jones, D., Schwartz, J. E., Lewis, C. E., Shimbo, D., and Muntner, P. (2019). Race and sex differences in asleep blood pressure: The Coronary Artery Risk Development in Young Adults (CARDIA) study. Journal of Clinical Hypertension, 21(2), 184–192. https://doi.org/10.1111/jch.13474

Chandler, J., Sox, L., Diaz, V., Kellam, K., Neely, A., Nemeth, L., and Treiber, F. (2020). Impact of 12-month smartphone breathing meditation program upon systolic blood pressure among non-medicated stage 1 hypertensive adults. International Journal of Environmental Research and Public Health, 17(6), 1955. https://doi.org/10.3390/ijerph17061955

Chen, Q., Liu, H., and Du, S. (2024). Effect of mindfulness-based interventions on people with prehypertension or hypertension: a systematic review and meta-analysis of randomized controlled trials. BMC Cardiovascular Disorders, 24(1), 104. https://doi.org/10.1186/s12872-024-03746-w

Chung, S. T., Matta, S. T., Meyers, A. G., Cravalho, C. K., Villalobos-Perez, A., Dawson, J. M., Sharma, V. R., Sampson, M. L., Otvos, J. D., and Magge, S. N. (2021). Nuclear Magnetic Resonance Derived Biomarkers for Evaluating Cardiometabolic Risk in Youth and Young Adults Across the Spectrum of Glucose Tolerance. Frontiers in Endocrinology, 12, e665292. https://doi.org/10.3389/fendo.2021.665292

Daştan, İ., Erem, A., and Çetinkaya, V. (2017). Urban and rural differences in hypertension risk factors in turkey. Anatolian Journal of Cardiology, 18(1), 39–47. https://doi.org/10.14744/AnatolJCardiol.2017.7452

De Freminville, J. B., Gardini, M., Cremer, A., Camelli, S., Baron, S., Bobrie, G., Gosse, P., Boulestreau, R., Gebara, N., Doublet, J., Dussartre, T., Grataloup, C., Lorthioir, A., Massien, C., Madjalian, A. M., Riancho, J., Soulat, G., Postel-Vinay, N., Azizi, M., … Amar, L. (2024). Prevalence and Risk Factors for Secondary Hypertension in Young Adults. Hypertension, 81(11), 2340–2349. https://doi.org/10.1161/HYPERTENSIONAHA.124.22753

Donthu, N., Kumar, S., Mukherjee, D., Pandey, N., and Lim, W. M. (2021). How to conduct a bibliometric analysis: An overview and guidelines. Journal of Business Research, 133, 285–296. https://doi.org/10.1016/j.jbusres.2021.04.070

Du, X. P., Zheng, M. L., Yang, X. C., and Zheng, M. L. (2024). High blood pressure is associated with increased risk of future fracture, but not vice versa. Scientific Reports, 14(1), e8005. https://doi.org/10.1038/s41598-024-58691-7

Feng, L., Khan, A. H., Jehan, I., Allen, J., and Jafar, T. H. (2017). Albuminuria and kidney function as prognostic marker of left ventricular mass among South Asians with hypertension. Journal of the American Society of Hypertension, 11(12), 811–822. https://doi.org/10.1016/j.jash.2017.10.003

Fishman, B., Bardugo, A., Zloof, Y., Bendor, C. D., Libruder, C., Zucker, I., Lutski, M., Ram, A., Hershkovitz, Y., Orr, O., Omer, M., Furer, A., Goldman, A., Yaniv, G., Tanne, D., Derazne, E., Tzur, D., Afek, A., Grossman, E., and Twig, G. (2023). Adolescent Hypertension Is Associated with Stroke in Young Adulthood: A Nationwide Cohort of 1.9 Million Adolescents. Stroke, 54(6), 1531–1537. https://doi.org/10.1161/STROKEAHA.122.042100

Kapoor, N., Lotfaliany, M., Sathish, T., Thankappan, K. R., Thomas, N., Furler, J., Oldenburg, B., and Tapp, R. J. (2020). Prevalence of normal weight obesity and its associated cardio-metabolic risk factors – Results from the baseline data of the Kerala Diabetes Prevention Program (KDPP). PLoS ONE, 15(8), e0237974. https://doi.org/10.1371/journal.pone.0237974

Kundu, S., Rahman, M. A., Kabir, H., Al Banna, M. H., Hagan, J. E., Srem-Sai, M., and Wang, L. (2023). Diabetes, Hypertension, and Comorbidity among Bangladeshi Adults: Associated Factors and Socio-Economic Inequalities. Journal of Cardiovascular Development and Disease, 10(1), 7. https://doi.org/10.3390/jcdd10010007

Lopez-Jimenez, F., Cesare, M. Di, Powis, J., Shrikhande, S., Codato, E., Zhou, B., Bixby, H., Adeoye, M., Evans, N., Lara-Breitinger, K., Arellano Rodriguez, M., Hadeed, L., Barquera, S., Taylor, S., Perel, P., Piñeiro, D., Narula, J., Pinto, F., Chazal, R., … Fox, E. (2025). World

heart report 2025: Obesity and cardiovascular diseases. https://world-heart-federation.org/wp-content/uploads/World_Heart_Report_2025_Online-Version.pdf

Mariachiara, D. C., Honor, B., Thomas, G., Lisa, H., Chodziwadziwa, K., Diana, V. M., Jeremiah, M., Borjana, P., Pablo, P., Daniel, P., Sean, T., and Fausto, P. (2023). World Heart Report 2023: Confronting the World's Number One Killer. In World Heart Federation. https://world-heart-federation.org/resource/world-heart-report-2023/

Martin, S. S., Aday, A. W., Allen, N. B., Almarzooq, Z. I., Anderson, C. A. M., Arora, P., Avery, C. L., Baker-Smith, C. M., Bansal, N., Beaton, A. Z., Commodore-Mensah, Y., Currie, M. E., Elkind, M. S. V., Fan, W., Generoso, G., Gibbs, B. B., Heard, D. G., Hiremath, S., Johansen, M. C., … Palaniappan, L. P. (2025). 2025 Heart Disease and Stroke Statistics: A Report of US and Global Data from the American Heart Association. Circulation, 151(8), e41–e660. https://doi.org/10.1161/CIR.0000000000001303

Mengesha, M. M., Ayele, B. H., Beyene, A. S., and Roba, H. S. (2020). Clustering of elevated blood pressure, elevated blood glucose, and abdominal obesity among adults in dire dawa: A community-based cross-sectional study. Diabetes, Metabolic Syndrome and Obesity, 13, 2013–2024. https://doi.org/10.2147/DMSO.S250594

Montazeri, A., Mohammadi, S., M.Hesari, P., Ghaemi, M., Riazi, H., and Sheikhi-Mobarakeh, Z. (2023). Preliminary guideline for reporting bibliometric reviews of the biomedical literature (BIBLIO): a minimum requirements. Systematic Reviews, 12(1), 239. https://doi.org/10.1186/s13643-023-02410-2

Nazar, M., Khan, S. A., Kumar, R., and Hafeez, A. (2019). Effectiveness of health literacy intervention on cardiovascular diseases among university students of Pakistan. BMC Health Services Research, 19(1), 504. https://doi.org/10.1186/s12913-019-4348-y

Ofori, M. A., Mensah, D. K., Nizeyimana, I., Jha, N., Zeba, Z., and Roy, S. (2024). High Blood Pressure and Depression Among the Working Population of Ghana: A Generalized Linear Model of the Risk Factors. Depression and Anxiety, 2024, e5261760. https://doi.org/10.1155/2024/5261760

Parcha, V., Heindl, B., Kalra, R., Li, P., Gower, B., Arora, G., and Arora, P. (2022). Insulin Resistance and Cardiometabolic Risk Profile among Nondiabetic American Young Adults: Insights from NHANES. Journal of Clinical Endocrinology and Metabolism, 107(1), e25–e37. https://doi.org/10.1210/clinem/dgab645

Peltzer, K., Pengpid, S., Sychareun, V., Ferrer, A. J. G., Low, W. Y., Huu, T. N., Win, H. H., Rochmawati, E., and Turnbull, N. (2017). Prehypertension and psychosocial risk factors among university students in ASEAN countries. BMC Cardiovascular Disorders, 17(1), 230. https://doi.org/10.1186/s12872-017-0666-3

Perejón López, D., Medrano Duarte, N. M., Serna Arnáiz, M. C., Orós Ruiz, M., Siscart Viladegut, J., and Gascó Serna, I. (2025). Subtypes of hypertension and their association to comorbidities and ethnicity in pregnant women. PLOS ONE, 20(6), e0326649. https://doi.org/10.1371/journal.pone.0326649

Redwine, K. M., and Daniels, S. R. (2012). Prehypertension in Adolescents: Risk and Progression. Journal of Clinical Hypertension, 14(6), 360–364. https://doi.org/10.1111/j.1751-7176.2012.00663.x

Scopus preview - Scopus - Welcome to Scopus. Scopus preview - Scopus - Welcome to Scopus. (2025). https://www.scopus.com/home.uri?zone=headerandorigin=sbrowse

Senthil, S., and Krishndasa, S. N. (2015). Pre-hypertension in apparently healthy young adults: Incidence and influence of haemoglobin level. Journal of Clinical and Diagnostic Research, 9(11), CC10–CC12. https://doi.org/10.7860/JCDR/2015/14970.6847

Tran, D.-M. T., Silvestri-Elmore, A., and Sojobi, A. (2022). Lifestyle Choices and Risk of Developing Cardiovascular Disease in College Students. International Journal of Exercise Science, 15(2), 808–819.

U.S. Department of Health and Human Services. (2020). The Surgeon General's Call to Action to Control Hypertension. www.surgeongeneral.gov

Vo, H. K., Nguyen, D. V., Vu, T. T., Tran, H. B., and Nguyen, H. T. T. (2023). Prevalence and risk factors of prehypertension/hypertension among freshman students from the Vietnam National University: a cross-sectional study. BMC Public Health, 23(1), 1166. https://doi.org/10.1186/s12889-023-16118-4

VOSviewer - Visualizing scientific landscapes. VOSviewer - Visualizing scientific landscapes. (2023). https://www.vosviewer.com/

World Health Organization. (2023). Global report on hypertension: The race against a silent killer. https://www.who.int/teams/noncommunicable-diseases/hypertension-report

Zhang, Z., Li, M., Li, J., Yu, O., Jiang, B., Chen, Y., and Guo, L. (2023). Meta-analysis and time trend prediction of the prevalence of hypertension in Chinese college students. Medicine (United States), 102(42), e35644. https://doi.org/10.1097/MD.0000000000035644

Cite this article: Anethyar Y, Madhu B, Sheeba P, Manjunatha MC, Suraj MB, Sree MM, *et al*. Global Research Trends on Hypertension among Young Adults: Bibliometric Analysis and Visualizations of Literature from 2015 to 2024. J Scientometric Res. 2026;15(1):226-38.