

REVIEW ARTICLE

Endothelial Dysfunction and Pregnancy-Induced Hypertension: A Bibliometric Analysis (2000–2024).

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Abstract

Background: This bibliometric analysis examines the evolving landscape of research on endothelial dysfunction and pregnancy-induced hypertension (PIH), focusing on trends, influential contributors, and key themes. Endothelial dysfunction in PIH significantly impacts maternal and foetal health, yet gaps remain in understanding its mechanisms and management.

Objective: The study aims to provide a comprehensive overview of over two decades of publications on endothelial dysfunction and PIH to guide future research and clinical practice.

Study design: Data were retrieved from Scopus, covering 397 publications over 25 years. Bibliometric measures, including citation metrics, co-authorship networks, and term co-occurrence maps, were analysed using the Scopus analytics tool and VOSviewer software. Key metrics included total citations, h-index, and term clustering, offering insights into publication trends, influential contributors, and thematic areas.

Results: The analysis revealed an increasing trend in publications, being the United States and China as the most productive countries. Highly cited studies emphasised translational research linking clinical outcomes with mechanistic insights. Author keyword analysis highlighted research priorities including preeclampsia, hypertension, and oxidative stress. Co-occurrence maps revealed strategic and granular perspectives, highlighting angiogenesis, placental ischaemia, and long-term maternal health as critical themes. Limitations include reliance on Scopus data, which may exclude relevant studies indexed elsewhere.

Conclusion: This study uniquely synthesises bibliometric insights to map the progression of endothelial dysfunction and PIH research. It highlights influential contributors, emerging trends, and key gaps, offering valuable guidance for researchers and policymakers. The findings highlight the importance of integrating mechanistic research with clinical applications to improve outcomes for hypertensive disorders in pregnancy.

Keywords: *Bibliometrics, Data Visualisation, Endothelial Dysfunction, Hypertension, Pregnancy-Induced, Preeclampsia.*

Introduction

Endothelial dysfunction is central to the pathophysiology of pregnancy-induced hypertension (PIH), including gestational hypertension, preeclampsia, and eclampsia, which are linked to severe maternal and neonatal complications and long-term cardiovascular risks [1,2]. It disrupts the balance of vasodilatory and vasoconstrictive factors, leading to placental perfusion impairment, systemic inflammation, and vascular remodelling [3]. Recent research highlights the nitrate-nitrite-nitric oxide pathway's potential in mitigating oxidative stress and identifies microvascular dysfunction as a contributor to adverse outcomes and maternal vascular risks [1,2]. The role of inflammatory and metabolic biomarkers in PIH further emphasises the interplay between systemic inflammation and vascular health [4]. Longitudinal studies, such as the EPOCH study, reinforce the association of hypertensive pregnancies with persistent vascular risks [5].

Although recent studies have explored elements of endothelial dysfunction and its role in pregnancy-induced hypertension, there is a lack of comprehensive, systematic bibliometric studies that map the evolving trends, collaborative networks, and thematic shifts across this multidisciplinary field. Furthermore, patterns of research output, collaboration networks, and emerging themes remain underexplored, highlighting a need for a comprehensive bibliometric review that integrates these dimensions over the period from 2000 to 2024.

Historical background and recent developments

The understanding of endothelial dysfunction in pregnancy-induced hypertension (PIH) has evolved significantly over the past two decades. Early studies laid the groundwork by identifying endothelial dysfunction as a central mechanism in preeclampsia, linking it to inflammation, metabolic changes, and long-term cardiovascular risks [6,7]. Recent advancements have expanded this foundation, identifying novel biomarkers, mechanisms, and therapeutic approaches [8]. Sun et al. explored inflammatory and metabolic

biomarkers, proposing gene therapy as a novel intervention for PIH [9]. Tyrmi et al. added insights into genetic predispositions for preeclampsia, further refining disease risk prediction [10].

Previous studies on bibliometric analysis of endothelial dysfunction and PIH

There is a scarcity of bibliometric analyses specifically related to endothelial dysfunction and PIH (Table 1). Wei et al. conducted a bibliometric study on endothelial dysfunction in sepsis, highlighting knowledge structures in critical care settings but lacking relevance to hypertensive pregnancy disorders [11]. Alam and Islam performed a bibliometric analysis on the role of the placenta in PIH emphasising placental function but offering limited insights into endothelial biomarkers, oxidative stress, and therapeutic targets [12]. Similarly, Kahraman and Yıldırım identified global research trends in PIH but focused primarily on publication patterns rather than mechanistic or translational insights [13]. Shen et al. focused on thematic trends in the management of pre-eclampsia but did not extensively cover endothelial dysfunction as a unifying mechanism [14]. Collectively, these studies demonstrate a fragmented approach, focusing on isolated aspects such as sepsis, placental dysfunction, or clinical management, and limited integration of endothelial dysfunction and hypertensive disorders of pregnancy.

The objective of this bibliometric analysis is to provide a comprehensive perspective by mapping the interconnected research domains of clinical, molecular, and experimental studies, illustrating how endothelial dysfunction serves as a central mechanism linking PIH pathophysiology, long-term maternal health risks, and potential therapeutic targets by systematically examining trends, key themes, and research contributions in the study of endothelial dysfunction and pregnancy-induced hypertension over the past 25 years. This study will address the following research questions:

1. What are the publication trends regarding endothelial dysfunction and PIH?
2. Who are the most prolific authors in the field, and what are the key themes and topics in their research?
3. What are the most influential institutions in this field?
4. What are the most active countries in the field?
5. What are the most highly cited documents in the field of endothelial dysfunction and PIH?
6. What are the most common keywords and themes in the literature in this field?
7. What are the patterns of co-authorship in the field of endothelial dysfunction and PIH?
8. What are the key themes and topics that emerge from co-occurrence analyses of author keywords and title/abstract terms?

Methods

Search strategy and data collection

We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flowchart (Figure 1) to conduct our analysis. On 1st December 2024, we gathered data from the Scopus database publications from 2000 to 2024. Our study included “articles” and “reviews”, and we limited our search to “English” language publications. We conducted our search by utilising specific keywords in the article titles and abstract. This method assumed that all the retrieved articles are relevant to the topic of our study. The keyword search strings used were as follows:

(TITLE-ABS-KEY (endothelial AND function OR endothelial AND dysfunction AND hypertension) AND TITLE-ABSKEY (pregnancy AND induced AND hypertension OR gestational AND hypertension) OR TITLEABSKEY (postpartum AND hypertension)) AND PUBYEAR > 1999 AND PUBYEAR < 2025 AND (LIMITTO (PUBSTAGE , "final")) AND (LIMIT-TO (SUBJAREA , "MEDI") OR LIMIT-TO (SUBJAREA , "BIOC") OR LIMIT-TO

(SUBJAREA , "PHAR") OR LIMIT-TO (SUBJAREA , "NURS") OR LIMIT-TO (SUBJAREA , "IMMU") OR LIMIT-TO (SUBJAREA , "CHEM") OR LIMIT-TO (SUBJAREA , "NEUR")) AND (LIMIT-TO (DOCTYPE , "ar") OR LIMIT-TO (DOCTYPE , "re")) AND (LIMIT-TO (LANGUAGE , "English"))

A total of 472 articles were initially identified by the Scopus database.

Data screening

In order to ensure the reliability of our bibliometric analysis, only peer-reviewed journal articles were included in this study. This selection criterion was implemented to ensure the relevance and adherence to scholarly standards, as well as transparency for readers [15]. Papers from conference proceedings, books, book chapters, and other non-journal publications were excluded from our analysis. All irrelevant publications were also excluded. Following these criteria, a total of 397 scientific journal articles and reviews were chosen for the bibliometric analysis. These selected articles provide a comprehensive overview of the literature on endothelial dysfunction and PIH research spanning from 2000 to 2024. Publication-related data were exported in comma-separated values (.csv) format for further analysis.

Data analysis

The analysis utilised bibliometric measures to evaluate research trends, key contributors, and thematic patterns in the field of endothelial dysfunction and PIH. Key bibliometric measures included publication output trends, citation analysis to identify influential research, co-citation analysis to uncover clusters of related studies, and keyword co-occurrence analysis to determine dominant themes and research focus shifts over time. Additionally, author and institutional productivity were assessed to highlight leading contributors, while geographic patterns were mapped to evaluate regional research activity and collaborations. These

measures provided a quantitative basis for understanding research development, key contributions, and emerging trends within the field. We used the Scopus database as the primary data source, as well as leveraging its Analyse function to process metadata such as author names, affiliations, keywords, and citations. This allowed for an exploration of research trends, influential papers, and key institutional and geographic contributions. Furthermore, VOSviewer was used to visualise the findings, mapping keyword co-occurrences, and co-citation networks. VOSviewer also facilitated the identification of research themes, key collaborations, and geographic patterns, enhancing the analysis by providing intuitive visual insights into the complex relationships within the data.

Results

Publication profiles and trends

We retrieved a total of 287 original articles and 110 reviews. All were journal articles written in English. These articles were published in 159 different journals. Most of the publications covered Medicine (79.1%), Biochemistry, Genetics and Molecular Biology (35.8%), and Pharmacology, Toxicology and Pharmaceutics (12.6%) as the topics. Overall, the number of publications per year has increased over time with a slight temporary decrease in 2019. The highest number of publications was in 2018 with 39 articles published that year. The number of citations per year has also increased over time with a peak of 1683 in 2024 (Figure 2).

Citation metrics

A total of 397 papers have been published in this period, collectively garnering 14,484 citations, which translates to an average of 579.36 citations per year. This steady annual citation rate reflects the relevance of the research on endothelial dysfunction and PIH as well as its ongoing contribution to medical and scientific advancements. Furthermore, the average number

of C/P of 38.5 underscores the substantial impact of individual studies. An *h*-index of 67 indicates that at least 67 papers have received 67 or more citations each.

Highly cited documents

Table 5 lists highly cited documents highlighting landmark studies that have significantly shaped the understanding of endothelial dysfunction and pregnancy-induced hypertension. The most cited paper, Zhou et al., has garnered 393 citations, presenting ground-breaking findings on how angiotensin receptor agonistic autoantibodies induce preeclampsia in pregnant mice [16]. Notably, Redman and Staff with 270 citations, explores preeclampsia biomarkers and syncytiotrophoblast stress, has the highest annual citation rate of 27.00 among earlier studies [17]. More recent contributions include Dimitriadis et al., with 224 citations and an exceptional annual citation rate of 112.00 [18].

Publications by authors and institutions

Granger J.P. from the University of Mississippi School of Medicine is the most productive author with 11 publications, a total of 1,283 citations, and a high *h*-index of 10. Mitchell B.M. and Chiasson V.L., both from Texas A&M University School of Medicine, demonstrate substantial productivity with 9 and 7 publications, respectively, and high citation counts (430 and 355). Notably, authors like Sandrim V.C. (Brazil) and Hannan N.J. (Australia) also contribute significantly. However, their average citations per publication (C/P) are lower compared to leading authors from the United States, highlighting potential disparities in research impact (Table 2). As depicted in Table 3, institutional contributions to the field are led by the University of Mississippi School of Medicine and the University of Mississippi Medical Center, both in the United States, with each producing 24 publications and achieving the highest total citations of 1,785 and 1,694 citations, respectively. These institutions also exhibit strong citation metrics, with average C/P

exceeding 70 and an *h*-index of 19. Brazilian institutions, such as Universidade de São Paulo and Universidade Estadual Paulista Júlio de Mesquita Filho, show notable contributions with 13 publications each. Australian representation is seen with the University of Melbourne, which contributes 11 publications with a C/P of 66.55.

Publication by countries

The United States had the highest number of publications with 125 articles and an *h*-index of 51, which suggests the significant impact and quality of the research contributions. China followed with 40 publications, and the United Kingdom ranked third with 38 publications. The United States was also the most cited country with 6572 citations. It should be noted that the top 10 most productive countries spanned five continents, namely North America, Asia, Europe, South America, and Australia, as seen in Figure 3.

Publications by source titles

The analysis highlights Hypertension as the most prominent source title for research on endothelial dysfunction and pregnancy-induced hypertension, with 28 publications contributing a total of 1,901 citations. Other notable source titles include Hypertension in Pregnancy, which has produced 11 publications with 170 citations. The American Journal of Hypertension and the American Journal of Obstetrics and Gynecology each contribute 9 publications, but the latter exhibits a significantly higher citation count of 782 versus 605, and stronger impact metrics. Finally, the American Journal of Physiology: Heart and Circulatory Physiology adds nine publications with a cumulative 361 citations and maintains a solid reputation, reflected in its SJR of 1.45 and Q1 status (Table 4).

Top keywords

The analysis of author keywords reveals the dominant themes and research focuses within the field of endothelial dysfunction and PIH. The most frequently used keyword, "pre-eclampsia," appears in 37.3% of publications, highlighting its

centrality to the topic. Closely associated terms include "pregnancy-induced hypertension" (12.6%), "gestational hypertension" (10.2%), and "preeclampsia" (8.9%), demonstrating the broader spectrum of hypertensive conditions. Key physiological mechanisms such as "endothelial dysfunction" (15.7%), "oxidative stress" (12.3%), and "nitric oxide" (9.5%) highlight their significance in disease pathophysiology. Molecular biomarkers, including "sFlt-1" (6.8%), "PlGF" (5.4%), and "soluble endoglin" (4.7%), reflect increasing research interest in predictive and diagnostic approaches. Additionally, terms like "cardiovascular disease" (8.1%), "metabolic syndrome" (6.2%), and "postpartum" (5.9%) emphasise the long-term maternal implications of PIH.

Co-authorship by author

The co-authorship network visualisation (Figure 4) reveals distinct clusters of researchers collaborating on hypertensive pregnancy disorders. The red cluster features authors from University of Mississippi Medical Center, indicating strong internal collaboration on mechanistic studies. The yellow cluster highlights regional collaborations. The blue cluster centres around influential authors such as Granger, JP and Palei, AC, reflecting work on translational and vascular research. The green cluster shows international collaborations. Notably, Granger, JP acts as a bridge, connecting clusters and facilitating interdisciplinary research.

Co-authorship by countries

The network visualization map of co-authorship by countries highlights the United States as the central hub, reflecting its dominant role in global research output and international collaborations on endothelial dysfunction and PIH (Figure 5). Strong connections are observed with countries like the United Kingdom, Brazil, Australia, Canada, and China, indicating productive partnerships. Regional clusters showcase collaborative efforts across North America, Europe, Latin America, and Asia-Pacific regions.

Smaller nodes like Greece, Italy, and Sweden reflect more localised collaboration.

Co-occurrence analysis of author's keywords

We conducted a comprehensive analysis of author keywords utilising co-occurrence patterns. Employing a threshold of at least 5 occurrences, we identified 43 significant keywords out of a pool of 853. The network depiction of these keywords is visualised in Figure 6, as well as their relationships, with circle sizes corresponding to occurrence frequencies. Notably, the keyword "pre-eclampsia" stands out with the largest circle, indicative of its frequent appearance. This visualisation reveals the presence of six distinct clusters, each centered around a primary keyword that denotes high occurrence rates within the publications. Cluster themes include preeclampsia and its associated factors, role of oxidative stress and nitric oxide dysregulation in vascular smooth muscle and endothelial damage in hypertensive states. pregnancy-related hypertensive disorders with links to cardiovascular disease, severe preeclampsia subtypes as well as metabolic and postpartum factors.

Co-occurrence analysis of terms based on title and abstract

The network visualisation of terms from titles and abstracts reveals interconnected themes in hypertensive pregnancy disorder research (Figure 7). The red cluster emphasises clinical outcomes, focusing on maternal cardiovascular risks. The blue cluster highlights molecular mechanisms, particularly endothelial dysfunction and angiogenic imbalance. The green cluster centers on experimental research, exploring vascular mechanisms in animal models. The integration of clinical, molecular, and experimental dimensions underscores endothelial dysfunction as a unifying mechanism, with increasing attention on the long-term implications for maternal and foetal health.

Discussion

The bibliometric analysis highlights significant progress in understanding endothelial dysfunction and pregnancy-induced hypertension (PIH), with a strong focus on nitric oxide pathways, oxidative stress, and biomarkers like sFlt-1. Mechanistic studies and translational advancements, such as dietary interventions and cellular models, align with the field's precision medicine goals [24-26]. Zhou et al. (2008) is the most cited study due to its pivotal discovery of angiotensin receptor agonistic autoantibodies (AT1-AA) as a key driver of pre-eclampsia, providing strong experimental evidence in a pregnant mouse model. This research established a crucial link between immune dysregulation, endothelial dysfunction, and hypertensive pregnancy disorders, significantly advancing the understanding of pre-eclampsia pathophysiology. Its impact extends beyond obstetrics, influencing cardiovascular and immunological research by highlighting autoantibody-mediated vascular dysfunction. Furthermore, it has shaped biomarker discovery and therapeutic development, particularly in immunomodulation and targeted interventions for pregnancy-induced hypertension, solidifying its status as a foundational study in the field [16]. The surge in publications on endothelial dysfunction and PIH in 2018 was likely driven by increased global focus on maternal health, advancements in biomarker research, and emerging therapeutic interventions. Initiatives such as the Global Strategy for Women's, Children's and Adolescents' Health (2016–2030) prioritised maternal mortality reduction, driving research interest [27].

Research is predominantly driven by high-income countries like the United States, reflecting concentrated resources and expertise. However, as emphasised by Barbosa et al. and Björkman et al., addressing regional disparities in PIH prevalence and management requires research in diverse settings [1-2]. The co-occurrence maps provide complementary perspectives on research

into endothelial dysfunction and PIH. The map, based on author keywords, highlights broad research themes, focusing on clinical outcomes and mechanisms [28-29]. In contrast, the map derived from titles and abstracts delves deeper into specific mechanisms, animal models, and long-term outcomes.

In real-world contexts, these findings emphasise the importance of incorporating endothelial dysfunction markers into routine antenatal care and improving maternal health policies. Integrating endothelial dysfunction biomarkers into routine antenatal care could enhance early detection and risk stratification for hypertensive pregnancy disorders. The incorporation of endothelial stress markers into existing risk assessment models could improve clinical decision-making and guide the timing of delivery [17]. Biomarkers such as sFlt-1 and PlGF are already being explored for predictive screening, but emerging candidates like methylglyoxal and inflammatory markers provide additional insights into vascular dysfunction [30]. Regular monitoring of these biomarkers could facilitate personalised interventions, such as antioxidant or nitric oxide-based therapies, to mitigate vascular impairment [31].

Future research should prioritise addressing the geographic disparities in PIH studies. Research into cost-effective interventions, such as dietary modifications or biomarker-based diagnostics, is crucial for global impact [24,30]. Additionally, longitudinal studies, are essential to elucidate the long-term cardiovascular effects of PIH on women. Methodologically, the field would benefit from integrating advanced techniques such as 3D *in vitro* models and omics approaches to uncover new therapeutic targets [25]. Moreover, expanding research on epigenetic factors could offer insights into intergenerational impacts of PIH and endothelial dysfunction [32].

Strengths and limitations

This bibliometric analysis provides a comprehensive overview of research trends in endothelial dysfunction and PIH, highlighting

key clinical and mechanistic advancements while identifying critical research gaps. However, its reliance on Scopus, focus on English-language publications, exclusion of older foundational studies, and disproportionate representation of high-income countries may limit its coverage and relevance, particularly for low-resource settings.

Conclusion

This bibliometric analysis provides a comprehensive overview of research trends, key contributors, and thematic developments in the field of endothelial dysfunction and PIH over the past 25 years. The findings highlight the dominance of terms like preeclampsia, hypertension, and nitric oxide in the research landscape, reflecting both a clinical and mechanistic focus. Highly cited works have emphasised pivotal themes such as oxidative stress, angiogenesis, and vascular dysfunction, demonstrating their relevance to understanding and managing endothelial dysfunction and PIH. Moreover, leading institutions and authors from the United States, Brazil, and Australia have been instrumental in advancing this body of knowledge, highlighting international collaboration. While the analysis successfully identifies major trends and contributors, several limitations, such as reliance on the Scopus database and the exclusion of non-English publications, may have constrained the breadth of findings. Future research should address these gaps by integrating multiple databases and exploring emerging areas like long-term cardiovascular risks and precision medicine. This study contributes to the field by mapping the intellectual structure of research on endothelial dysfunction and PIH, offering insights for targeted interventions, interdisciplinary collaborations, and policy development such as standardised screening protocols.

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Disclosure statement

The authors report no conflict of interest.

Author contributions

HRI - responsible for conceptualization, methodology, validation, formal analysis, data curation, writing - original draft, writing - review & editing, visualization, and project administration. MMZ - responsible for conceptualization, writing - review & editing, and validation. KZ - responsible for writing - review & editing, and data curation

Table 1. Summary of previous studies

Author	Title	Domain/Search Strategy	Data Source & Scope	TDE	Bibliometric Attributes Examined
Wei et al. (2024) ¹¹	Evolutionary trend analysis and knowledge structure mapping of endothelial dysfunction in sepsis: a bibliometrics study	(TS = (sepsis OR (severe sepsis) OR (septic shock) OR (endotoxemia) OR SIRS OR (systematic inflammatory response syndrome))) AND TS = ((endothelium OR (endothelial cell*) OR endothelia OR (vascular endothelium) OR (vascular endothelial cell*)))	Web of Science Core Collection (WoSCC)	4,536	- citation tendencies - active institutions - active authors - frequently cited publications - references co-citation network - references with citation bursts - keywords
Alam, M. S., & Islam, M. M. (2022) ¹²	Bibliometric Study of Placenta in Pregnancy-Induced Hypertension	“Placenta,” “Pregnancy,” and “Hypertension” in the “Title.”	PubMed	298	- prolific authors, affiliations, journal sources, and country - co-authorship analysis - co-occurrence keyword analysis
Kahraman, E., & Yildirim, E. (2020) ¹³	A bibliometric study: Hypertension during pregnancy	"pregnancy" and "hypertension" as keywords	Web of Science Core Collection (WoSCC)	2120	- citation counts - active countries - productivity count
Shen et al. (2023) ¹⁴	Research hotspots and thematic trends in the management of pre-eclampsia: a bibliometric analysis from 2000 to 2022	(TS=(pregnan*) OR TS=(gestation)) AND TS=(*eclampsia) AND (TS=(management*) OR TS=(treatment*)) AND LA=(English)	Web of Science	1525	- titles, publication dates, authors, institutions, countries, and keywords of all articles

TDE=Total documents examined

Table 2. Most Productive Authors

Author's Name	Affiliation	Country	TP	NCP	TC	C/P	h
Granger J.P.	University of Mississippi School of Medicine	United States	11	11	1283	116.6	10
Mitchell B.M.	Texas A&M University School of Medicine	United States	9	9	430	47.8	8
Sandrim V.C.	Universidade Estadual Paulista "Júlio de Mesquita Filho"	Brazil	8	8	156	19.5	6
Chiasson V.L.	Texas A&M University School of Medicine	United States	7	7	355	50.7	6
Hannan N.J.	Mercy Hospital for Women	Australia	7	7	423	60.4	6

Notes: TP=total number of publications; NCP=number of cited publications; TC=total citations; C/P=average citations per publication; h=h-index

Table 3. Most productive institutions with minimum of 10 publications

Affiliation	Country	TP	NCP	TC	C/P	h
University of Mississippi Medical Center	United States	24	23	1694	70.50	19
University of Mississippi School of Medicine	United States	24	23	1785	74.38	19
Universidade de São Paulo	Brazil	13	13	701	53.92	11
Universidade Estadual Paulista Júlio de Mesquita Filho	Brazil	13	12	182	14	7
Harvard Medical School	United States	12	12	633	52.74	10
University of Melbourne	Australia	11	11	732	66.55	8

Notes: TP=total number of publications; NCP=number of cited publications; TC=total citations; C/P=average citations per publication; and h=h-index.

Table 4. Most active source titles

Source Title	TP	TC	Publisher	Cite Score	SJR 2024	SNIP 2024
Hypertension	28	1901	Lippincott Williams & Wilkins	20.1	Q1	2.73
Hypertension in Pregnancy	11	170	Taylor & Francis Inc	2.5	Q2	0.6
American Journal of Hypertension	9	605	Oxford Univ Press	5	Q2	0.86
American Journal of Obstetrics and Gynecology	9	782	Mosby-Elsevier	13.2	Q1	3.4
American Journal of Physiology Heart and Circulatory Physiology	9	361	Amer Physiological Soc	8.2	Q1	1.45

Notes: TP=total number of publications; TC=total citations; CiteScore = average citations received per document published in the source title; SJR = SCImago Journal Rank measures weighted citations received by the source title; SNIP = source normalised impact per paper measures actual citations received relative to citations expected for the source title's subject field.

Table 5. Top 10 highly cited articles

No.	Authors	Title	Cites	Cites per Year
1	Zhou et al. (2008) ¹⁶	Angiotensin receptor agonistic autoantibodies induce pre-eclampsia in pregnant mice	393	23.12
2	Khan et al. (2005) ⁷	A high-fat diet during rat pregnancy or suckling induces cardiovascular dysfunction in adult offspring	304	15.20
3	Williams (2003) ¹⁹	Pregnancy: A stress test for life	283	12.86
4	Redman & Staff (2015) ¹⁷	Preeclampsia, biomarkers, syncytiotrophoblast stress, and placental capacity	270	27.00
5	Rodie et al. (2004) ²⁰	Pre-eclampsia and cardiovascular disease: Metabolic syndrome of pregnancy?	241	11.48
6	Giorgini et al. (2016) ²¹	Air pollution exposure and blood pressure: An updated review of the literature	226	25.11
7	Dimitriadis et al. (2023) ¹⁸	Pre-eclampsia	224	112.00
8	Torrens et al. (2006) ²²	Folate supplementation during pregnancy improves offspring cardiovascular dysfunction induced by protein restriction	194	10.21
9	LaMarca et al. (2005) ⁶	Role of endothelin in mediating tumor necrosis factor-induced hypertension in pregnant rats	184	9.20
10	Brownfoot et al. (2016) ²³	Metformin as a prevention and treatment for preeclampsia: Effects on soluble fms-like tyrosine kinase 1 and soluble endoglin secretion and endothelial dysfunction	177	19.67

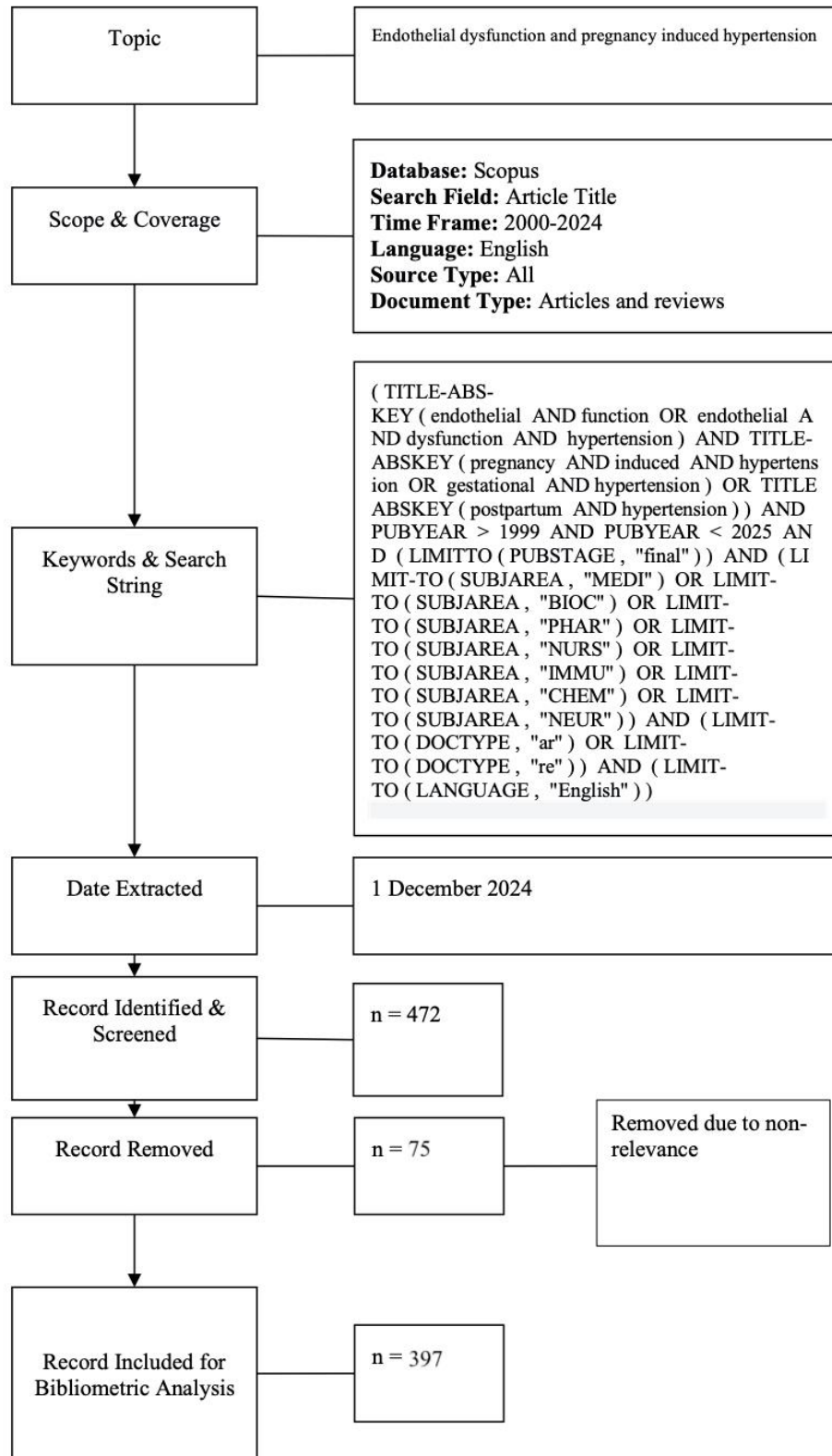


Figure 1. Flow diagram of the search strategy

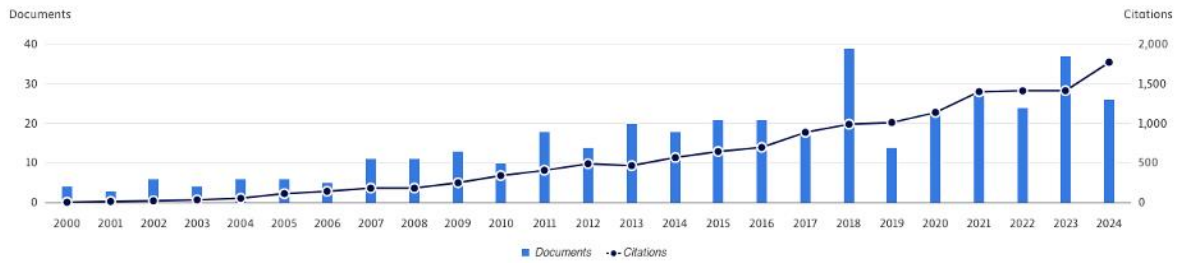


Figure 2. Total publications and citations by year of publications on endothelial dysfunction and pregnancy-induced hypertension research (2020-2024)

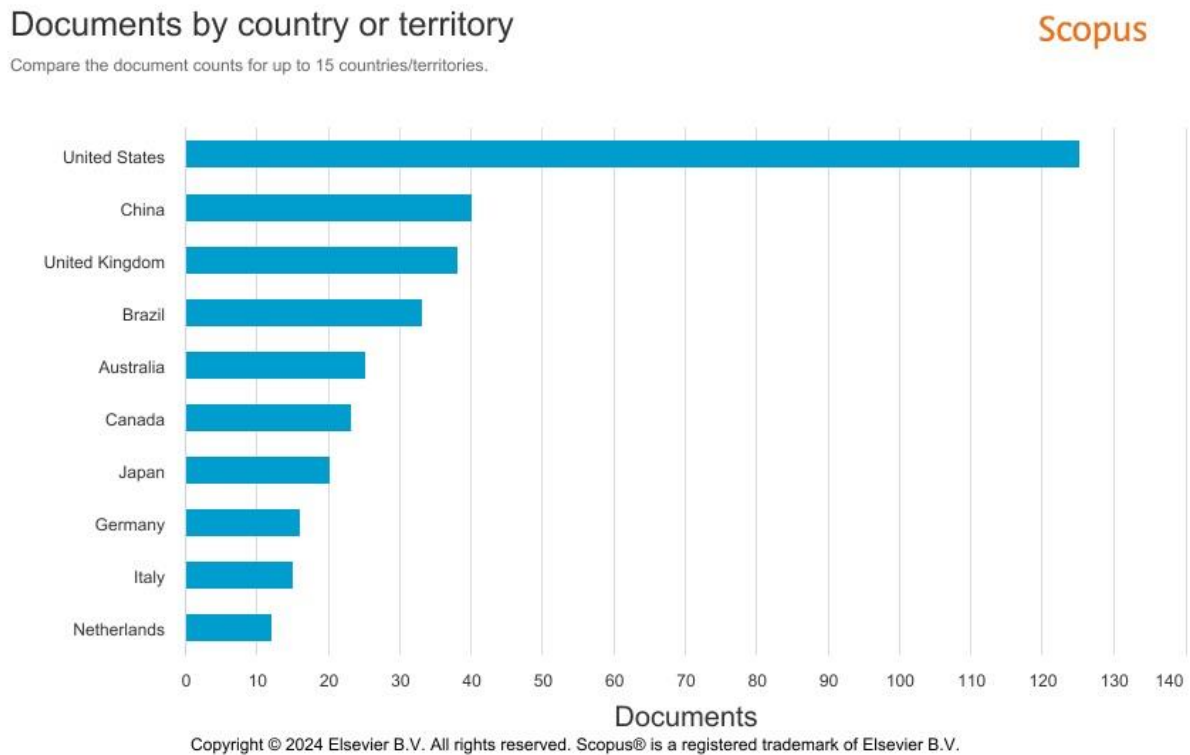


Figure 3. Top 10 countries contributing to publications on endothelial dysfunction and pregnancy-induced hypertension research over the past 25 years

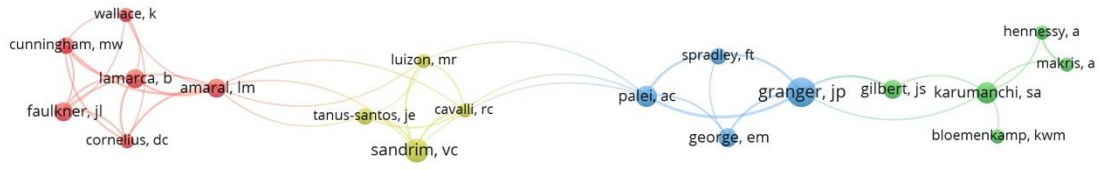


Figure 4. Network visualisation map of the co-authorship by authors of publications on endothelial dysfunction and pregnancy-induced hypertension research (2020-2024)

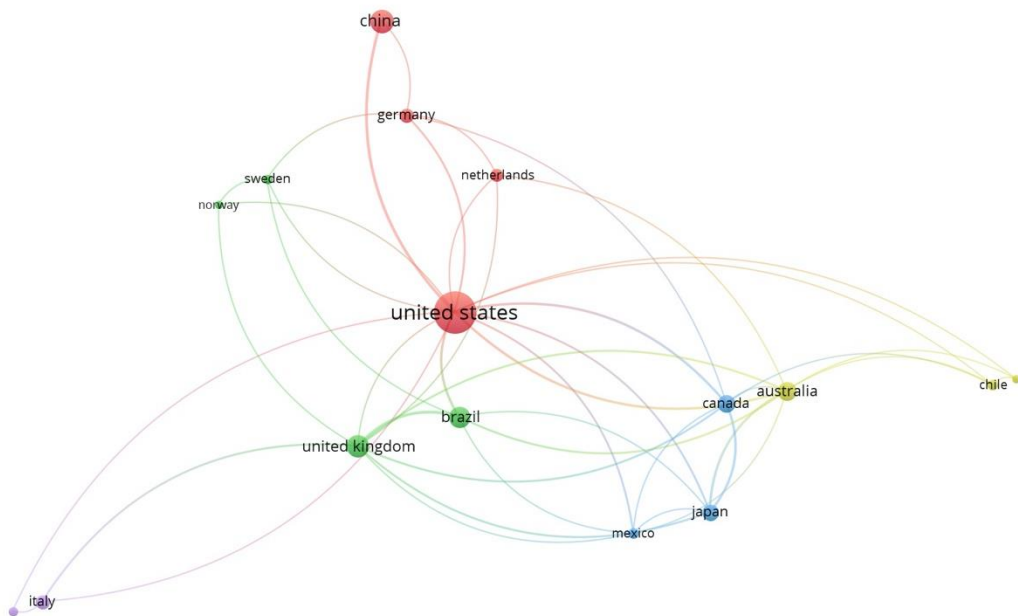


Figure 5. Network visualisation map of the co-authorship by countries of publications on endothelial dysfunction and pregnancy-induced hypertension research (2020-2024)

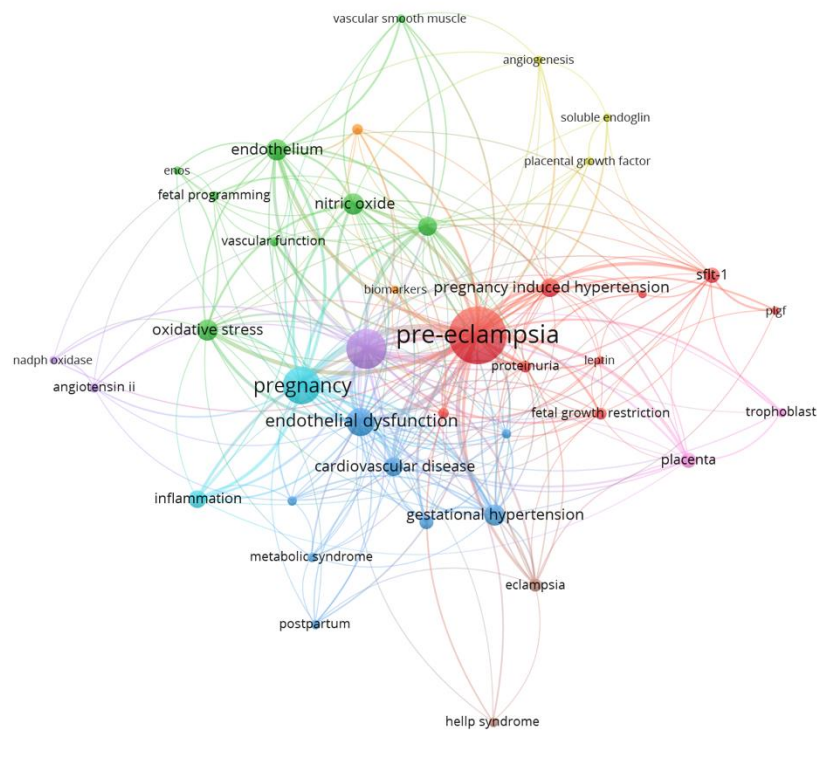


Figure 6. Network visualisation of the author’s keywords of publications on endothelial dysfunction and pregnancy-induced hypertension research (2020-2024)

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