Frontiers in Health Informatics
ISSN-Online: 2676-7104
www.healthinformaticsjournal.com
2024; Vol 13: Issue 7
Open Access

Bibliometric Analysis: Exploring Pregnant Women's Cadmium (Cd) Exposure And Preeclampsia Over 69 Years

Ajinah[1], Hasnawati Amqam[1], Agus Bintara Birawida[1], Anwar Daud[1], Lalu Muhammad Saleh[2], Ridwan[3]

[1]Department of Enviromental Health, Faculty of Public Health, Hasanuddin University, Makassar City, South Sulawesi, Indonesia

[2]Department of Occupational safety and health, Faculty of Public Health, Hasanuddin University, Makassar City, South Sulawesi, Indonesia

[3]Department of Epidemiology, Faculty of Public Health, Hasanuddin University, Makassar City, South Sulawesi, Indonesia

Cite this paper as: Ajinah, Hasnawati Amqam, Agus Bintara Birawida, Anwar Daud, Lalu Muhammad Saleh, Ridwan (2024). Bibliometric Analysis: Exploring Pregnant Women's Cadmium (Cd) Exposure And Preeclampsia Over 69 Years. *Frontiers in Health Informatics*, *13 (7) 214-226*

ABSTRACT

Preeclampsia is a critical pregnancy complication characterized by hypertension and proteinuria after 20 weeks of gestation, significantly impacting maternal and fetal health. Beyond age and genetic factors, environmental exposure to heavy metals, particularly cadmium (Cd), has been associated with an increased risk of preeclampsia. This study employs bibliometric analysis to investigate trends in research on cadmium exposure and preeclampsia from 1955 to 2024. Using Scopus-indexed articles analyzed with VOSviewer and Tableau, this study identifies publication trends, key contributing countries, and thematic focuses in the field. Results highlight a notable increase in research since 2015, with the United States, China, and Mexico leading contributions. Keywords such as "Pregnancy AND Cadmium" and "Preeclampsia" reveal evolving themes linking environmental exposure to adverse pregnancy outcomes. This study underscores the importance of mitigating cadmium exposure to support maternal health and aligns with global efforts to achieve SDGs 3 (Health), 6 (Clean Water),11 (Sustainable Cities), and 12 (Responsible Consumption).

Keywords: Pregnancy, Cadmium, Preeclampsia, Bibliometric Analysis

INTRODUCTION

Preeclampsia is a severe pregnancy complication characterized by hypertension and proteinuria after the 20th week of gestation [1]. In pregnancies with preeclampsia, trophoblast cell invasion only occurs in a portion of the spiral artery in the myometrial region, resulting in impaired placental function [2]. Preeclampsia is believed to occur due to changes in the blood vessels of the placenta that cause high blood pressure in pregnant women [3]. although it may also precede certain conditions, such as hydatidiform mole [4].

Severe cases of preeclampsia can progress to eclampsia, a life-threatening condition marked by seizures and one of the major causes of maternal and neonatal death [1]. Hypertension induced by pregnancy is a primary factor in maternal and infant mortality [5]. Preeclampsia also poses lifelong health risks, such as an increased chance of type 2 diabetes in offspring during adulthood[1]. For the mother, preeclampsia can lead to eclampsia [6].Thus, preeclampsia represents a critical global health challenge, particularly in developing countries where it is associated with significant maternal and

fetal morbidity and mortality [7]. The World Health Organization (WHO) estimated that, as of 2020, approximately 934 cases of preeclampsia occur daily worldwide. In Indonesia, the incidence rate of severe preeclampsia ranges from 3.4% to 8.5% [8]. Preeclampsia is a systemic vascular disorder with endothelial cell damage as its primary target [9], affecting blood vessels in the retina, choroid, and optic nerve [10]. The primary systemic response to elevated blood pressure is the narrowing and vasoconstriction of blood vessels [11].

Cadmium (Cd) is a toxic heavy metal that poses significant health risks to humans. The higher the concentration and duration of exposure, the greater the toxic effects [12]. Cadmium can be released into the environment through industrial processing and agricultural activities [13] ,and it has a substantial impact on health status Cadmium enters the human body primarily through occupational exposure, diet, drinking water, cosmetics, and smoking [14]. Pregnant women have high iron requirements, which enhances cadmium absorption during pregnancy [11] .Increased cadmium absorption during pregnancy can elevate risks through inhalation and oral routes [15]. Cadmium exposure is associated with preeclampsia, primarily due to increased systolic blood pressure and proteinuria [15].

Studies suggest that industrial regions, particularly coastal cities, have a higher risk of heavy metal exposure due to pollution from industry, air contamination,and consumption of contaminated seafood [16]. Health issues among pregnant women are often multifactorial, and the role of toxic environmental exposure [17]. Including heavy metals, has not received sufficient attention [18].Most studies have assessed the relationship between heavy metal exposure in individuals and its effects [19] , but information regarding the sources and pathways of heavy metal exposure in pregnant women remains limited. [20].

This study aims to analyse publication trends related to cadmium exposure in pregnant women and its association with preeclampsia risk using a bibliometric approach. By analysing 70 articles from the Scopus database, this study focused on identifying the development of the number of publications, scientific contributions from various authors and countries, and analysing journals that have significant implications in supporting SDGs, especially SDG 3 which targets reducing maternal mortality due to pregnancy complications such as preeclampsia. In addition, exposure to cadmium originating from industrial environments shows the importance of hazardous chemicals management in accordance with SDG 6 (Clean Water), SDG 11 (Sustainable Cities and Communities), and SDG 12 (Responsible Consumption and Production) [20]. This study highlights the need to reduce the environmental impact of heavy metals as a measure to support maternal and child health in favour of future prevention.

Research methods

Location and research design

This study utilizes a bibliometric analysis to explore the relationship between cadmium (Cd) exposure in pregnant women and the risk of preeclampsia. The approach allows for a comprehensive assessment of global research trends, publication growth, and thematic focuses in this area. Data were extracted from the Scopus database, spanning 70 articles published between 1955 and 2024. The analysis included articles with keywords such as "Pregnancy," "Cadmium," and "Preeclampsia," filtered based on relevance and adherence to inclusion criteria. Tools such as OpenRefine, Tableau, and VOSviewer were employed for data cleaning, visualization, and network mapping.

Population and sample

The bibliometric analysis aimed to:

1. Identify publication trends and key research themes.
2. Evaluate citation metrics, including citation frequency and h-index, to determine the impact of articles and authors.
3. Map collaborations between researchers and institutions.
4. Highlight gaps in the research field to guide future studies

Data Collection and Processing

Data were collected from Scopus using a systematic search strategy. Articles were screened based on their titles, abstracts, and keywords, and filtered to exclude irrelevant or non-English publications. The processing steps were as

follows:

Data Cleaning: OpenRefine was used to standardize author names, keywords, and institutional affiliations.

Visualization: Tableau was applied to generate publication trend graphs, while VOSviewer was utilized to create bibliometric maps and co-occurrence networks.

Data analysis

1. Inclusion Criteria:
   - Studies published in English between 1995 and 2024.
   - Peer-reviewed articles and reviews related to cadmium exposure and preeclampsia.
2. Exclusion Criteria:
   - Non-English publications, theses, dissertations, books, and conference papers.
   - Grey literature and articles lacking relevance to the topic.

A detailed flow diagram illustrating the article selection process is provided in Figure 1.

Research Ethics

This study relied on publicly available data from Scopus, ensuring no ethical concerns or privacy violations. All analysis tools were used according to standard bibliometric practices.

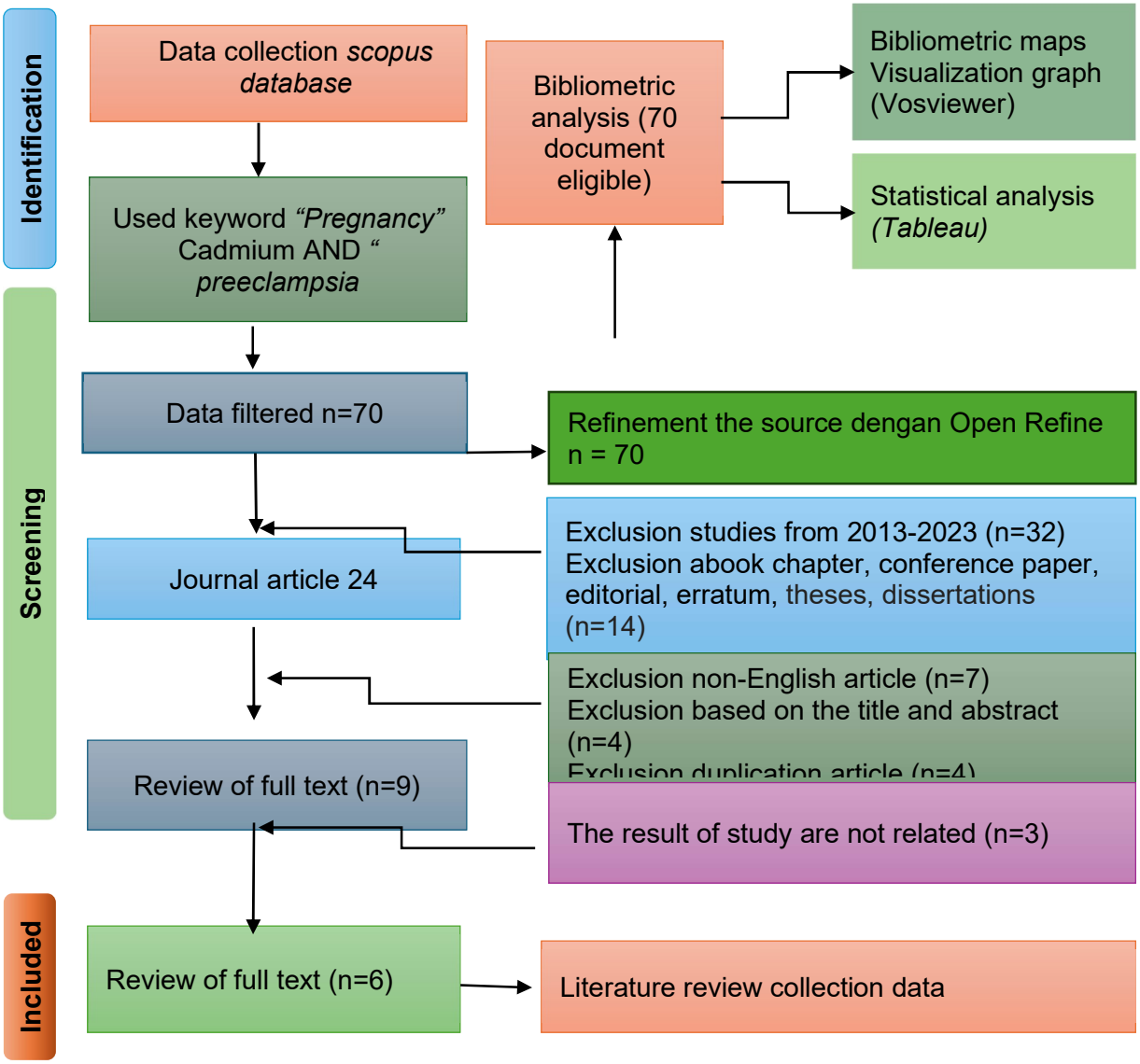

Figure 1. Table of Data Processing Mechanisms

Results

This study identifies publication trends concerning cadmium exposure in pregnant women and preeclampsia. Analysis shows an increasing focus on this topic since 2015, especially in developing countries like the United States, China, and Mexico. The following sections present annual publication trends, providing insights into the steady increase in research on cadmium exposure and preeclampsia risk.

1. Document Type Trends with the Highest Publication Volume

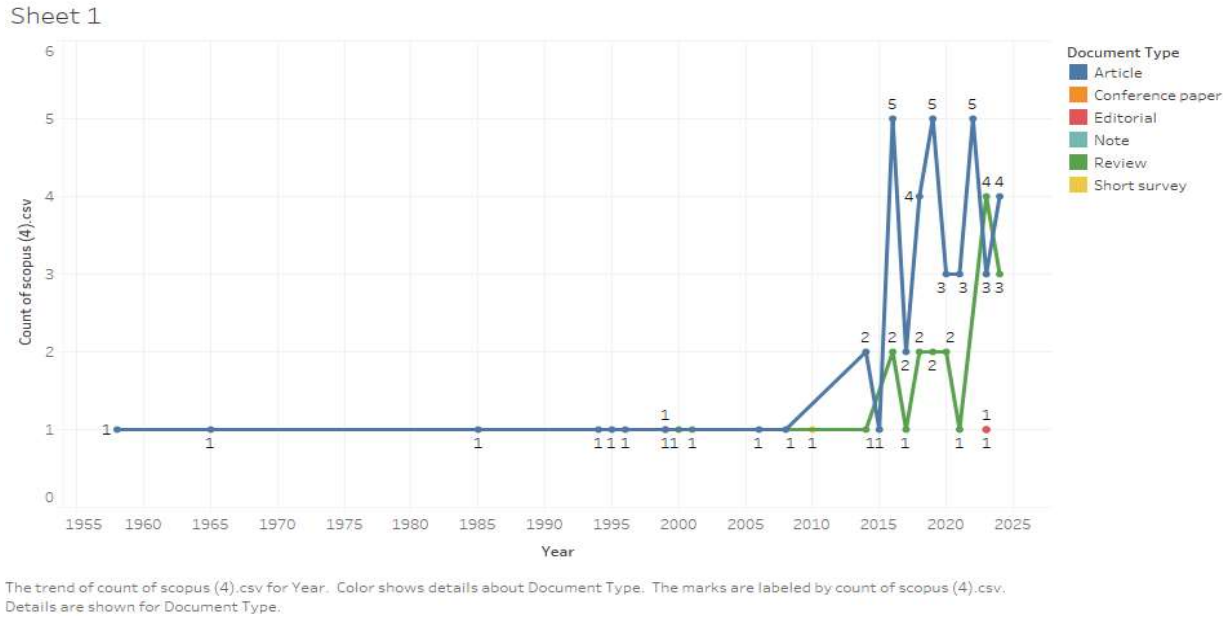

Figure 2. Trends in journal publications per year Presence of Cadmium (Cd)

Figure 2 presents the bibliometric analysis trends, displaying the number of publications by document type from the Scopus database between 1955 and 2025. In the initial period (1955-2000), publication rates were relatively low, averaging one publication per year. Documents during this period were limited to articles, with no significant increase or variation in document types. All publications were scientific articles without reviews, editorials, or other document types, indicating limited attention to the topic within the research community at that time. However, since 2015, there has been a notable rise in publication volume focused on research articles (dark blue), with peak publication numbers observed in 2015 and 2025, totaling five publications and four reviews, respectively. This increase highlights a growing and sustained interest in cadmium exposure and preeclampsia, particularly through original research that contributes new data.

2. Contributions from various countries

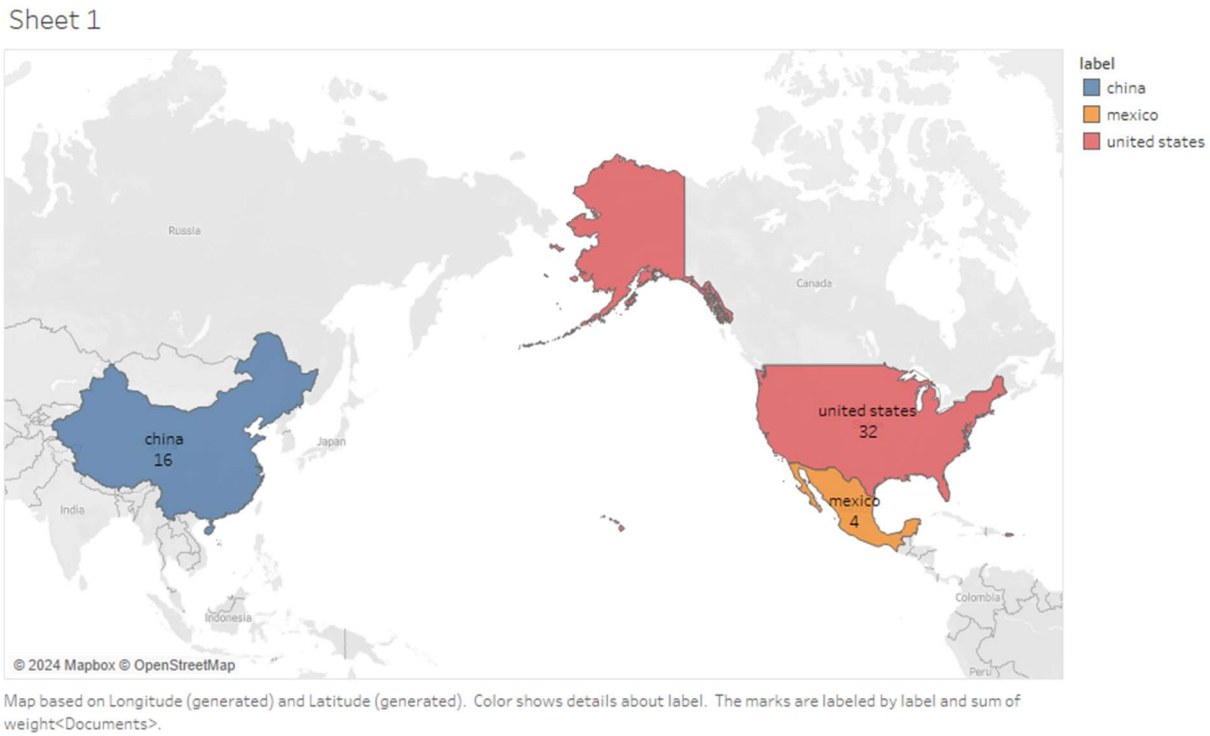

Figure 3. Number of documents published between countries

Figure 3 illustrates the number of published documents by country, demonstrating the intensity and distribution of research on heavy metal exposure, specifically maternal cadmium exposure and preeclampsia. The United States ranks highest, with 32 articles on this topic, reflecting a strong research interest in environmental health and its impact on pregnancy outcomes within this country. The United States' robust research infrastructure allows for significant investigation into this area, often aligning with health and environmental policy initiatives. China ranks second with 16 articles, indicating serious concern over the health impacts of heavy metals, especially cadmium, due to industrialization and urbanization in China. Mexico ranks third, suggesting an increasing focus on environmental health risks, particularl heavy metal exposure in pregnant women, among developing nations in Asia and Latin America.

3. Co-Occurrence Network Analysis of Author Keywords

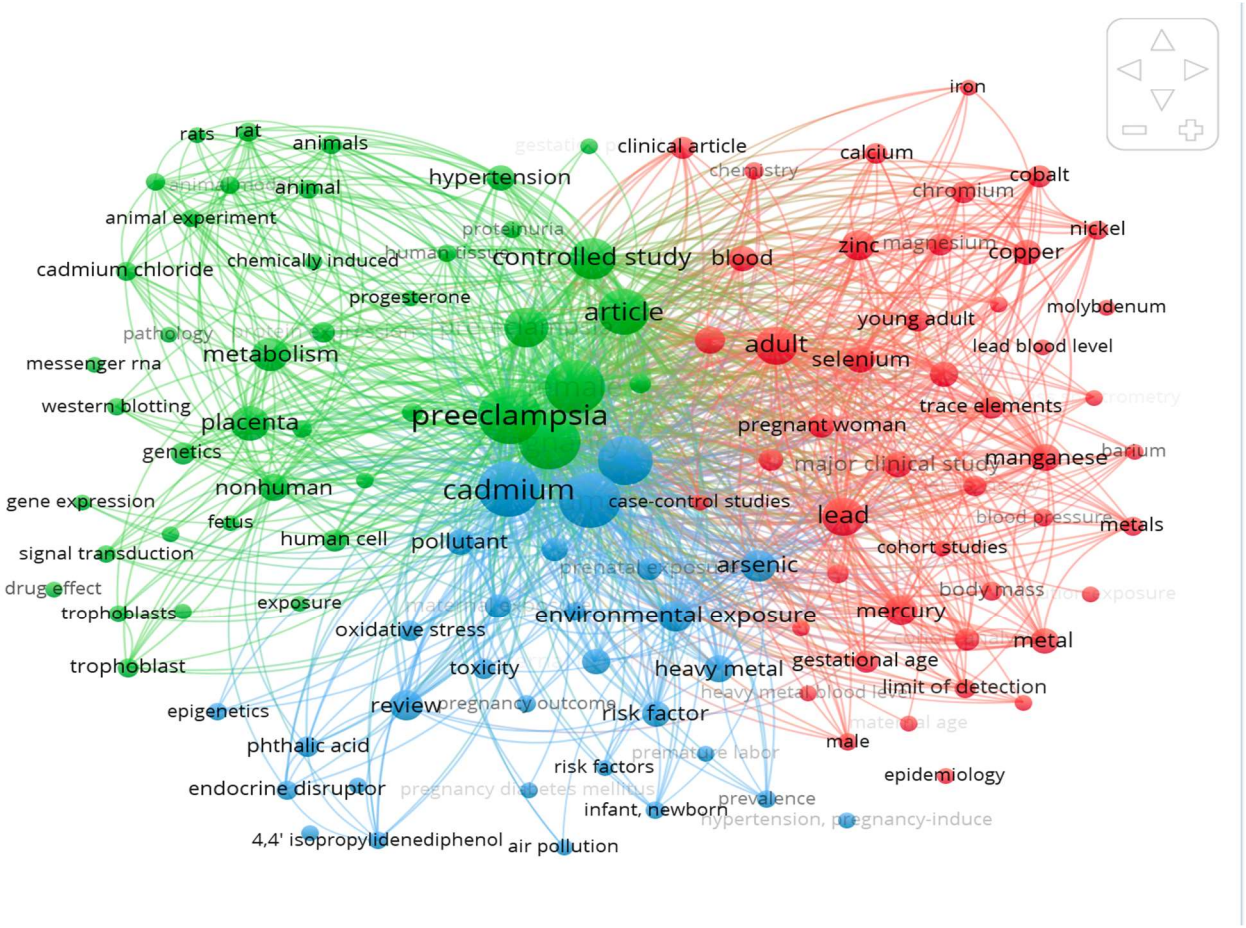

Figure 4. Co-Occurrence Network Analysis of Author Keywords

Figure 4 presents a network visualization generated by VOSviewer software, showing connections between keywords based on co-occurrence frequency in scientific literature. This visualization identifies 57 instances of keyword co-occurrence across three distinct clusters represented by green, blue, and red colors, associated with various research topics. The green cluster (Pregnancy and Preeclampsia) has 24 occurrences, indicating a central focus on pregnancy and preeclampsia. The red cluster (Heavy Metal Toxicology) includes 21 occurrences, encompassing keywords related to heavy metals and toxicology, emphasizing a close relationship between heavy metal exposure and health risks, particularly during pregnancy. Cadmium stands out as a significant environmental risk factor within this group. The blue cluster (Environmental Exposure and Risk) shows 11 occurrences, highlighting themes such as “environmental exposure” and “endocrine disruptor,” underscoring the impact of cadmium on endocrine health and risk factors from environmental exposure. Collectively, this visualization illustrates the interconnections between pregnancy, cadmium exposure, and its toxicological effects, particularly in studies on preeclampsia, heavy metal exposure, and environmental health risks.

4. Keyword Co-Occurrence Network by Year (2014-2020)

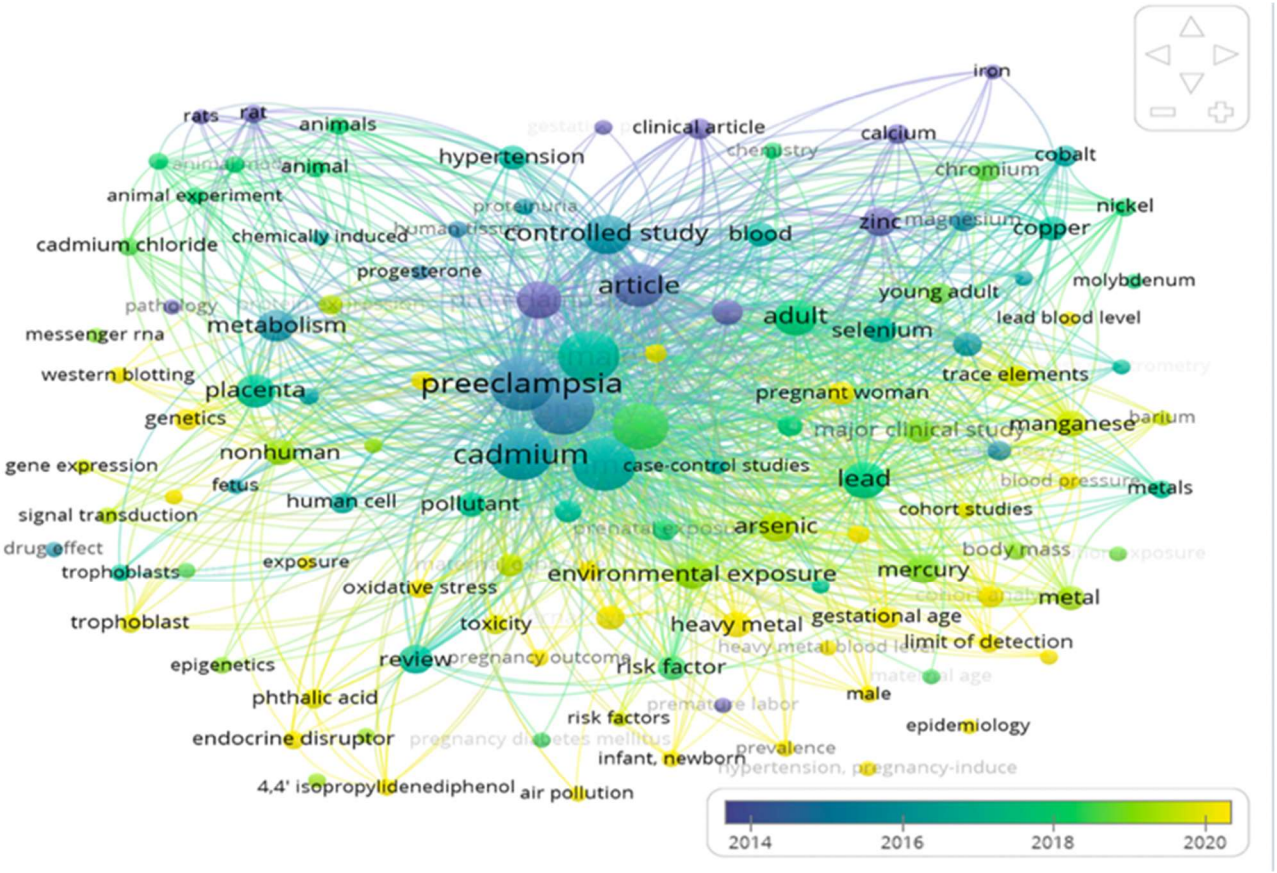

Figure 5. Co-occurrence network by author keywords 2016-2020

Additionally, the bibliometric analysis on maternal cadmium levels and preeclampsia highlights potential research directions through keyword co-occurrence trends over time. Figure 5 shows an overlay visualization of keyword relationships using VOSviewer, with an emphasis on trends by publication year. At the bottom of the figure, a color scale represents the period from 2014 to 2020, where darker colors (purple) indicate earlier studies, and lighter colors (yellow) represent recent studies. Central keywords, such as “Preeclampsia” and “Cadmium,” appear frequently, suggesting a strong connection to other topics like the placenta, environmental exposure, and heavy metals. This time trend indicates that while research on preeclampsia and cadmium exposure has existed for several years, research intensity has increased over time, with more studies emerging closer to 2020 (indicated by yellow colors). This trend demonstrates a growing interest in understanding cadmium exposure within the context of pregnancy and environmental toxicity, offering insights into the evolution of scientific focus in recent years.

Table 1. Below summarizes key studies on maternal cadmium exposure and its association with preeclampsia risk.

No	research title	Autor	Country	Year	Population/Methods	Key findings	Measurement Variable	Implications	Ref

1	Placental Cadmium Levels and Preeclampsia Risk	Laine et al.	Amerika serikat	2015	72 women, southeastern United States	Higher levels of Cd in the placenta are associated with an increased risk of preeclampsia, and the risk is reduced by adequate levels of Se and Zn.	Placental levels of Cd, Se, Zn, incidence of preeclampsia	Demonstrates the potential of nutritional strategies to reduce Cd toxicity during pregnancy.	[21]
2	Hypertension in Pregnancy and Cardiovascular Risk in Offspring in Young Adulthood	Alsnes et al.	Norwegia	2017	15,778 young adults, HUNT study (Norway)	Hypertension in pregnancy is associated with increased cardiovascular risk in offspring, such as higher systolic and diastolic blood pressure and BMI in young adulthood.	Blood pressure (systolic & diastolic), BMI, waist circumference	Emphasises the importance of cardiovascular health monitoring in the offspring of hypertensive pregnancies.	[22]
3	Cadmium Exposure and Pregnancy-Induced Hypertension (PIH)	Liu et al.	Tiongkok wuhan China	2018	5,429 women, Wuhan, China	Higher urinary Cd levels increase the risk of PIH, especially in women with low socioeconomic status.	Urinary Cd levels, socioeconomic status, PIH diagnosis	Indicates that environmental Cd exposure is a risk factor for PIH with socioeconomic status as a	[23]

								modifying factor	
4	Ocular Changes Triggered by Preeclampsia	Ghavidel et al.	Iran	2018	Literature review	Preeclampsia can cause ocular complications such as hypertensive retinopathy and retinal detachment which generally improve after delivery.	Blood pressure measurement, retinal examination, visual complaints	Recommend regular eye examinations in patients with preeclampsia to monitor the severity of the disease	[24]
5	Pathophysiology and Clinical Presentation of Preeclampsia	Ives et al.	America	2020	Literature review	Preeclampsia involves endothelial dysfunction due to angiogenic imbalance (sFlt-1, sEng), which affects multiple organs. Labour is the definitive treatment; aspirin can be used for prevention in high-risk groups	Levels of sFlt-1, sEng, proteinuria, blood pressure	Highlights the need for prevention and development of targeted therapy in preeclampsia.	[25]

6	Cadmium and Zinc Concentrations in Pregnant Women: A Prospective Cohort Study	Li et al.	China	2023	185 pregnant women, Taiyuan, China	High levels of cadmium (Cd) and zinc (Zn) in urine are associated with changes in metabolic biomarkers that increase the risk of obesity. Zinc has the potential to reduce Cd toxicity but requires careful supplementation	Urinary Cd and Zn levels, metabolic biomarkers in the arginine and proline pathways	The importance of monitoring Cd exposure and balancing Zn supplementation to prevent metabolic disorders	[26]

Discussion

This bibliometric analysis provides a global overview of research on maternal cadmium exposure and preeclampsia. Figure 1 illustrates the systematic data selection process, from identifying to evaluating relevant articles, with 70 selected articles reflecting a robust and structured methodology that ensures research validity.

Figure 2 illustrates annual publication trends Between 1955 and 2024 (69 years), research on cadmium exposure and preeclampsia showed limited growth until 2015, when a significant increase occurred. The highest number of publications occurred between 2015 and 2023, reflecting the increasing awareness of environmental impacts on maternal health.

Although there is still a lack of research on this topic, it is expected to increase in the future, in line with government programs that support global efforts in achieving SDGs 3 (Health), 6 (Clean Water), 11 (Sustainable Cities), and 12 (Responsible Consumption) bibliometric analysis, including international collaborations that emphasize the number of maternal deaths in cases of preeclampsia. Therefore, the causative factors of preeclampsia in addition to genetics and age, exposure to the heavy metal Cadmium (Cd) in the blood of pregnant women is becoming an increasingly interesting field of research that can trigger researchers in this field in the future.

this topic. Figure 3 provides a comparative view of countryin investigating cadmium exposure among pregnant women and preeclampsia. The United States emerged as the leading contributor with 32 articles, followed by China (16 articles) and Mexico (12 articles). These findings indicate that countries with advanced research infrastructure or heightened industrial activity are more engaged in this topic..

Figure 4 visualizes the keyword co-occurrence analysis revealing three main points
Cluster 1 (Green): exploring Pregnancy and Preeclampsia,Cluster 2 (Red): exploring Heavy Metal Toxicology,Cluster 3 (Blue): on Environmental Exposure and Risk.

The theory underlying this analysis is that bibliometrics can reveal the keywords and research trends that are of most

interest in the scientific community, which in this case focus on the heavy metal Cadmium and preeclampsia.

Figure 5 presents an analysis of keyword trends over time, with keywords in yellow signifying newer research topics. The bibliometric maps generated via VOSviewer showcase the interconnections between keywords such as "Pregnancy AND Cadmium" and their relationships to preeclampsia, environmental exposure, and systemic health risks. Recent keywords (highlighted in yellow) suggest an evolving focus

This study highlights the significant association between cadmium (Cd) exposure during pregnancy and the risk of preeclampsia. The surge in the number of publications since 2015 reflects the increasing global awareness of the impact of the environment on maternal health. Major contributors to the study, such as the United States, China, and Mexico, demonstrated the influence of industrialization on cadmium exposure.

In addition, keyword analysis identified major themes such as “pregnancy,” “cadmium,” and “preeclampsia,” highlighting the systemic effects of environmental toxicity on pregnancy outcomes. These findings support the hypothesis that cadmium toxicity exacerbates systemic hypertension and proteinuria, key mechanisms in preeclampsia These results are consistent with previous literature:

1. Increased Hypertension Risk: Liu et al. (2018) reported that high urinary cadmium levels increase the risk of gestational hypertension, especially in urban areas with low socio-economic status.
2. Nutrient Buffering Effect: Laine et al. (2015) demonstrated the protective role of selenium (Se) and zinc (Zn) in reducing cadmium toxicity during pregnancy. This opens up opportunities for nutrient-based interventions.
3. Global Implications: Other studies support the finding that cadmium exposure is a global health threat, especially in industrialized and coastal areas. This study expands the understanding with a cross-country analysis that identifies major contributions from the United States, China, and Mexico.

This study shows the need for preventive measures to reduce cadmium exposure to mitigate the risk of preeclampsia, which directly supports efforts to achieve the SDGs:

1. Environmental Policy: Stricter regulation of cadmium emissions from industry could reduce the risk of exposure, especially in pregnant women.
2. Nutritional Interventions: Further research is needed to evaluate selenium and zinc supplementation as mitigation strategies.
3. Awareness Raising: Public education on sources of cadmium exposure, such as food and air pollution, is important for risk reduction.

This study has some limitations, such as:

1. Only using articles indexed in Scopus, so there is a possibility that other studies are missed.
2. The bibliometric analysis was descriptive and did not explore in detail the biological mechanisms linking cadmium exposure and preeclampsia.

Recommendations for Future Research

1. Multinational Studies: Population-based studies in different countries may provide insights into variations in risk of cadmium exposure.
2. Longitudinal Approach: Long-term studies are needed to observe the impact of cadmium exposure throughout pregnancy and its long-term effects.
3. Intervention Development: Nutrition-based strategies and environmental policies should be developed to prevent the risk of preeclampsia associated with cadmium exposure.

Conclusions and Implications

Based on bibliometric analysis, the topic of the impact of heavy metals, particularly cadmium (Cd), on the incidence of preeclampsia remains relatively under-explored despite its high prevalence. This study shows that publications related to cadmium exposure and preeclampsia increased significantly after 2015, with major contributions from countries such as the United States, China and Mexico. This surge reflects a growing global awareness that as part

of efforts to support the SDGs (Sustainable Development Goals), this study emphasizes the importance of preventing health risks from cadmium exposure during pregnancy and the need for sustainable environmental policies to improve maternal health globally. These results provide important insights for the development of public health policies and preventive interventions, especially in high-risk countries.

Conflict of Interest Statement

ACKNOWLEDGEMENTS

We would like to express our deepest gratitude to all Lecturers and Staff of Hasanuddin University, Department of Environmental Health for their support, guidance, and contribution in the preparation of this article and We do not forget to express our respect and appreciation to all parties who cannot be mentioned one by one for their contribution and assistance, which is very meaningful for the smooth running of this research.

Hopefully the results of this research can be useful and become a positive contribution to the development of science in the field of Environmental Health Science.

FINANCIAL SUPPORT

This work was not supported by any funding agency.

AUTHOR CONTRIBUTION STATEMENT AND CONFLICT OF INTEREST

All authors contributed equally

No conflict of interest

REFRENCES

[1] F. Rahmawati, M. I. Aldika Akbar, dan A. Atika, "pengaruh imt ibu hamil preeklampsia dengan luaran perinatal," *IMHSJ*, vol. 3, no. 2, hlm. 148–159, Jun 2021, doi: 10.20473/imhsj.v3i2.2019.148-159.

[2] A. K. Dewi, A. M. Maulana, R. A. Nugrahaputra, dan A. Nurokhim, "hubungan preeklampsia dan paritas dengan kejadian partus prematurus di rsud banyumas periode januari sampai desember 2017," *HMJ*, vol. 1, no. 2, Des 2018, doi: 10.30595/hmj.v1i2.3144.

[3] M. Fakhri, N. A. Mappaware, M. I. Wahab, A. S. Dewi, dan A. Kadir, "Analisis Faktor Determinan pada Penderita Preeklampsia Di RSIA Sitti Khadijah 1 Makassar Tahun 202," 2023.

[4] M. Sididi, M. N. Bustan, dan F. A. Gobel, "analisis faktor risiko kejadian preeklampsia di rskd ibu dan anak siti fatimah kota makassaR," vol. 3, no. 5, 2019.

[5] I. M. Harini, T. Novara, dan S. Sutrisno, "Perbedaan Kadar Kalsium Darah pada Kehamilan Preeklamsia dengan Kehamilan Normotensi," *JKB*, vol. 30, no. 2, hlm. 109–113, Agu 2018, doi: 10.21776/ub.jkb.2018.030.02.6.

[6] K. Rosmiati, T. Lasmini, S. K. H. Adha, Y. Purba, dan R. Rahmawati, "perbandingan kadar logam kadmium (cd) pada urin perokok aktif dan perokok pasif di desa air emas".

[7] N. Jais, M. Ikhtiar, A. Gafur, dan H. H. Abbas, "bioakumulasi logam berat kadmium (cd) dan kromium (cr) yang terdapat dalam air dan ikan di sungai tallo makassar," vol. 1, no. 3, 2020.

[8] M. A. Anggraini, H. H. Putra Iqra, M. Y. Andari, dan A. Danianto, "Manifestasi Okular pada Preeklampsia," *Cermin Dunia Kedokteran*, vol. 50, no. 1, hlm. 36–39, Jan 2023, doi: 10.55175/cdk.v50i1.337.

[9] Dwi Saputri dan Precelia Fransiska, "Karakteristik Ibu Hamil Dengan Preeklampsia," *CM*, vol. 8, no. 1, hlm. 132–142, Apr 2023, doi: 10.52235/cendekiamedika.v8i1.221.

[10] M. Doi, N. Usui, dan S. Shimada, "Prenatal Environment and Neurodevelopmental Disorders," *Front. Endocrinol.*, vol. 13, hlm. 860110, Mar 2022, doi: 10.3389/fendo.2022.860110.

[11] R. M. Sari, "Profile of Cadmium (Cd) Levels in Urine in Active Smokers," *JLM*, vol. 2, no. 1, hlm. 37–41, Jul 2021, doi: 10.31983/jlm.v2i1.6982.

[12]H. Inadera *dkk.*, "Association of blood cadmium levels in pregnant women with infant birth size and small for gestational age infants: The Japan Environment and Children's study," *Environmental Research*, vol. 191, hlm. 110007, Des 2020, doi: 10.1016/j.envres.2020.110007.
[13]D. R. Amin, "Analisis faktor – faktor yang mempengaruhi nyeri punggung pada ibu hamil di desa karang raharja," 2023.
[14]N. Desriva, T. Bin Sansuwito, dan R. I. Dioso, "Preeclampsia Screening Using The Smartphone Method: Literature Review," *IJHS*, vol. 1, no. 4, hlm. 873–883, Des 2023, doi: 10.59585/ijhs.v1i4.211.
[15]P. Rani dan A. Dhok, "Effects of Pollution on Pregnancy and Infants," *Cureus*, Jan 2023, doi: 10.7759/cureus.33906.
[16]M. A. S. Pramesti, M. A. M. Wulandari, N. Yumna, dan H. Santosa, "Hubungan Paritas, Riwayat Hipertensi, dan Indeks Massa Tubuh dengan Kejadian Preeklampsia," *jsi*, vol. 6, no. 02, hlm. 431–442, Feb 2024, doi: 10.59141/jsi.v6i02.95.
[17]M. Fakhri, N. Andi Mappaware, M. I. Wahab, A. S. Dewi, dan A. Kadir, "Faktor Determinan Pada Penderita Preeklampsia di RSIA Sitti Khadijah 1 Makassar tahun 2021," *fmj*, vol. 3, no. 8, hlm. 581–592, Agu 2023, doi: 10.33096/fmj.v3i8.328.
[18]J. M. Olivares, J. Sermon, M. Hemels, dan A. Schreiner, "Definitions and drivers of relapse in patients with schizophrenia: a systematic literature review," *Ann Gen Psychiatry*, vol. 12, no. 1, hlm. 32, 2013, doi: 10.1186/1744-859X-12-32.
[19]D. P. Mayaserli dan J. S. Rahayu, "perbandingan kadar logam kadmium (cd) dalam urin perokok aktif dan pasif di terminal kota padang," *JKP*, vol. 5, no. 1, hlm. 58–64, Jun 2018, doi: 10.33653/jkp.v5i1.96.
[20]Sutiati Bardja, "Faktor Risiko Kejadian Preeklampsia Berat/Eklampsia pada Ibu Hamil," *EMB*, vol. 12, no. 1, hlm. 18–30, Mei 2020, doi: 10.36456/embrio.v12i1.2351.
[21]J. E. Laine *dkk.*, "Placental Cadmium Levels Are Associated with Increased Preeclampsia Risk," *PLoS ONE*, vol. 10, no. 9, hlm. e0139341, Sep 2015, doi: 10.1371/journal.pone.0139341.
[22]I. V. Alsnes *dkk.*, "Hypertension in Pregnancy and Offspring Cardiovascular Risk in Young Adulthood: Prospective and Sibling Studies in the HUNT Study (Nord-Trøndelag Health Study) in Norway," *Hypertension*, vol. 69, no. 4, hlm. 591–598, Apr 2017, doi: 10.1161/HYPERTENSIONAHA.116.08414.
[23]H. Liu *dkk.*, "Cadmium body burden and pregnancy-induced hypertension," *International Journal of Hygiene and Environmental Health*, vol. 221, no. 2, hlm. 246–251, Mar 2018, doi: 10.1016/j.ijheh.2017.11.001.
[24]L. Alizadeh Ghavidel, F. Mousavi, M. Bagheri, dan S. Asghari, "Preeclampsia Induced Ocular Change," *International Journal of Women's Health and Reproduction Sciences*, vol. 6, no. 2, hlm. 123–126, Mei 2017, doi: 10.15296/ijwhr.2018.20.
[25]C. W. Ives, R. Sinkey, I. Rajapreyar, A. T. N. Tita, dan S. Oparil, "Preeclampsia—Pathophysiology and Clinical Presentations," *Journal of the American College of Cardiology*, vol. 76, no. 14, hlm. 1690–1702, Okt 2020, doi: 10.1016/j.jacc.2020.08.014.
[26]H. Liu *dkk.*, "Cadmium body burden and pregnancy-induced hypertension," *International Journal of Hygiene and Environmental Health*, vol. 221, no. 2, hlm. 246–251, Mar 2018, doi: 10.1016/j.ijheh.2017.11.001.