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Research Trends in Vitamin D Deficiency Among Pregnant Women in Tropical Countries: A Bibliometric Analysis

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Abstract

Background: Vitamin D deficiency has become a critical micronutrient issue due to its high prevalence and potential to cause both non communicable and communicable disease. Pregnant women are particularly vulnerable to vitamin D deficiency, which can lead to adverse pregnancy outcomes. **Objective:** This bibliometric analysis aims to provide a better understanding of research trends and contributions of researchers on this topic, as well as to identify areas of research that need further exploration. **Method:** This study on vitamin D deficiency among pregnant women in tropical countries used the Scopus database as of July 28, 2024. Articles were then filtered based on inclusion criteria, which consisted of original English language and open access articles. Of 19 articles, 15 met the inclusion criteria. The publication results were analyzed using VOS viewer. **Results:** The query in the Scopus database showed a total of 15 publications from 2015 to 2024. Publications peaked in 2019. Indonesia had the most publications. All authors had affiliations with different institutions, so there was no significant difference between one institution and another. PLOS One and Nutrients were the top two journal sources. Most of the documents were research articles. Medicine was the most common subject of these documents. **Conclusion:** This bibliometric analysis highlights the importance of identifying and managing vitamin D deficiency in pregnant women in tropical countries. The high prevalence and serious impact on maternal and fetal health indicate the need for further research in the treatment and prevention of vitamin D deficiency.

Keywords: Bibliometric, Maternal Health, Tropical Country, Vitamin D Deficiency

Introduction

Vitamin D consists of two active metabolites, namely calcidiol 25-hydroxyvitamin D (25[OH]D) and calcitriol (1,25[OH]2D), which have proven benefits for bones (Bouillon *et al.*, 2019). Vitamin D deficiency has become an urgent micronutrient problem (Kiely, McCarthy & Hennessy, 2021), due to its high prevalence and its potential role as a cause of both non-communicable and infectious diseases (Huang *et al.*, 2023). Previously, vitamin D deficiency was estimated to occur more frequently in temperate regions such as North America and Europe (Cashman, 2022). However, vitamin D deficiency is also prevalent in countries near the equator or in tropical zones, such as South and Southeast Asia (Judistiani *et al.*, 2019). Pregnant women are a vulnerable population for vitamin D deficiency, which can potentially cause adverse pregnancy outcomes (Wimalawansa *et al.*, 2024; Zhang *et al.*, 2024). Maternal vitamin D deficiency may vary according to ethnicity, geographical location, and customs

related to local clothing (Chen *et al*., 2024; Maitra *et al*., 2025; Trollfors, 2022). The prevalence of vitamin D deficiency among pregnant women in Southeast Asia has been documented at 60%, indicating a significant public health crisis (Nindrea & Hendriyani, 2024; Oktaria *et al*., 2022). In Indonesia, data on vitamin D deficiency during pregnancy is still inadequate. According to research, the prevalence of pregnant women with vitamin D deficiency reaches 63% (Lima *et al*., 2022; Octavius *et al*., 2023)

Vitamin D deficiency is associated with various diseases, such as asthma, cancer, autoimmune disorders, falls, and chronic diseases in adulthood, including osteoporosis and cardiovascular diseases (Afzal *et al*., 2021; De Martinis *et al*., 2021; Dumbre *et al*., 2025; Ganmaa *et al*., 2022). Vitamin D deficiency during pregnancy poses risks to mothers, fetuses, and newborns, including preterm birth, spontaneous miscarriage, low fetal weight, low birth weight, and preeclampsia (Giourga *et al*., 2023; Mansur *et al*., 2022; Mulligan *et al*., 2009). Other studies have revealed that vitamin D deficiency leads to postpartum depression (Gould *et al*., 2022; Hollinshead *et al*., 2024; Ogiji & Rich, 2022; Rupanagunta *et al*., 2023). Children born to mothers with vitamin D deficiency are at risk of malnutrition and allergic diseases (Briceno Noriega & Savelkoul, 2021; Domenici & Vierucci, 2022; Vassilopoulou *et al*., 2024).

Although no causal relationship has been found between vitamin D deficiency and maternal and infant mortality rates in Indonesia, understanding the adverse impacts of vitamin D deficiency makes research on this topic critical to designing effective intervention strategies and appropriate public health policies to improve the health of future generations. Therefore, this bibliometric analysis aims to provide a better understanding of research trends and researcher contributions on this topic as well as to identify areas of research that still need to be explored.

Methodology

This study employs a bibliometric analysis on vitamin D deficiency in pregnant women in tropical countries. Data related to the topic was collected from the Scopus database. Scopus is one of the largest databases containing scientific journals, books, and conference proceedings (Putera & Pasciana, 2021). To avoid bias caused by daily changes in the database, all searches were conducted on July 28, 2024. Keywords used were "Vitamin D" AND "Pregnancy" AND "Tropical." The initial search yielded 19 studies. The literature to articles written in English, that had reached the final publication stage and were open-access literature. After screening, 15 studies met the inclusion criteria, which were downloaded in CSV format and analyzed using VOSviewer software. VOSviewer is a visualization software used for clustering analysis and data visualization of selected articles (Karim & Soebagyo, 2022). Also analyzed research trends using Scopus Analyze, covering article publication trends per year, documents based on sponsor sources, authors' country of origin, document type, and document subject.

Results

The query on the Scopus database showed a total of 15 publications between 2015 and 2024 on vitamin D deficiency in pregnant women in tropical countries.

Article publication trends per year
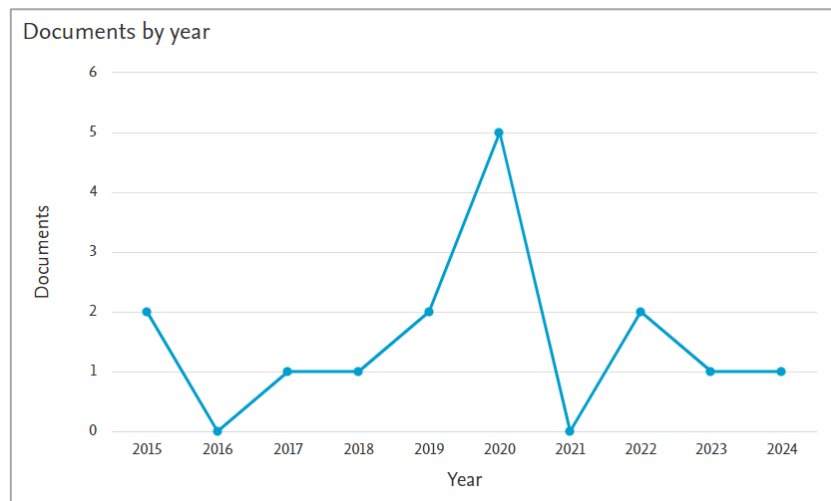
Source: Output of descriptive analysis from the Scopus web page

Figure 1: Article Publication Trends Per Year

Figure 1 shows the publication trends from 2015 to 2024, revealing a fluctuating pattern, rather than consistent increases or decreases. The year 2020 was the most productive within the observed period, with a peak of five published documents. Previous years yielded only two publications in 2015, zero in 2016, and one each in 2017 and 2018. The number rose again to two in 2019. Following the peak, there was a significant decline to zero publications in 2021, indicating interruptions or significant shifts in publication efforts or opportunities. After the decline in 2021, activity stabilized with two documents in 2022 and one document each in 2023 and 2024, showing a return to a stable but lower level of publication activity compared to the 2020 peak.

Documents based on sponsor source
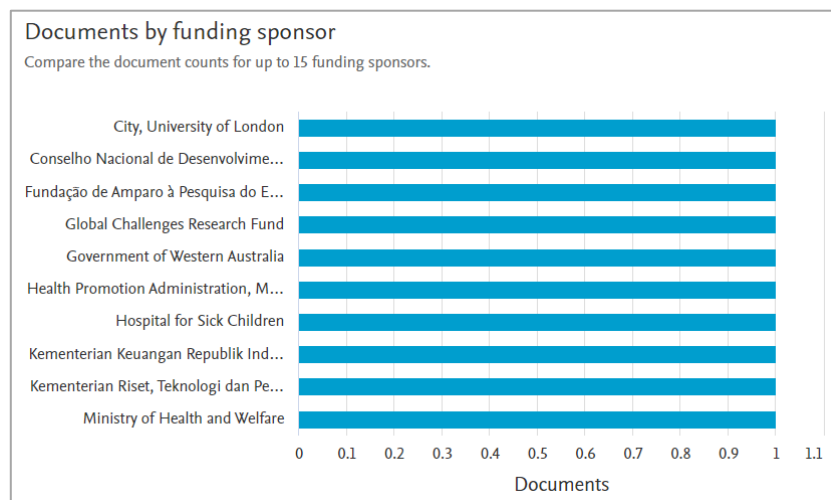
Source: Output of descriptive analysis from the Scopus web page

Figure 2. Document Based on Sponsor Source

Figure 2 shows the top 10 institutions affiliated with the document authors, which also serve as funding sponsors. All listed funding sponsors supported the same number of documents. Each sponsor funded one document, indicating an even distribution of financial support among these sponsors. No sponsor stood out significantly in terms of the number of documents funded.

Author's country of origin
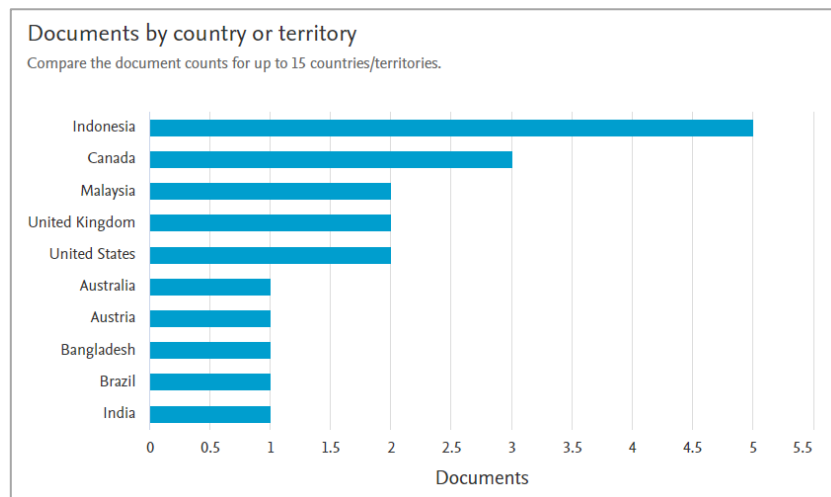
Source: Output of descriptive analysis from the Scopus web page

Figure 3. Author's Country of Origin

Figure 3 highlights the top 10 countries in document publication. The figure shows that Indonesia has a much higher number of documents compared to other countries, with five documents published, indicating a strong focus or higher activity in document production. Canada, Malaysia, the UK, and the United States form a secondary group with moderate document counts, numbering three or two documents each. Other countries have relatively lower document numbers, at one document each.

Documents based on source
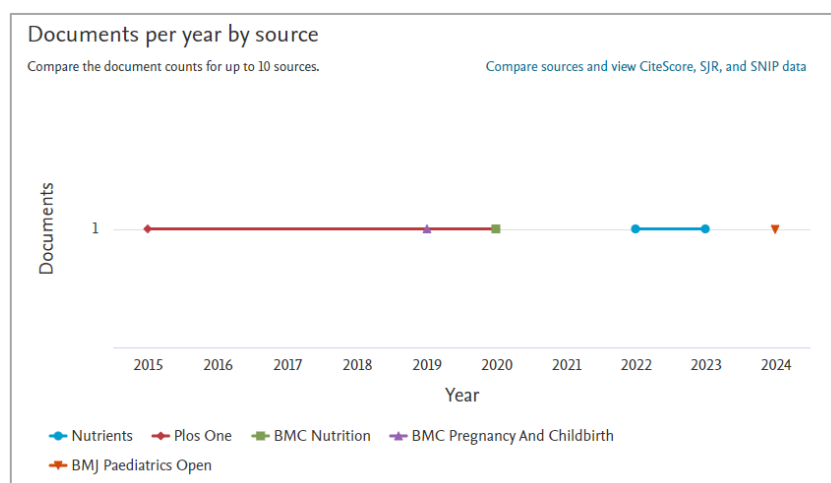
Source: Output of descriptive analysis from the Scopus web page

Figure 4. Documents Based on Source

Figure 4 shows the top five sources in publication activity. The data reveals relatively low publication activity for these sources, with each source publishing only one document during the specified years. Two sources, Plos One and Nutrients, published two documents each, in 2015 and 2020, and 2022 and 2023, respectively. Meanwhile, other sources such as BMC Nutrition, BMC Pregnancy and Childbirth, and BMJ Paediatric Open had sporadic publications over the years. This indicates that while there is research activity in these journals, the annual volume of publications is very low.
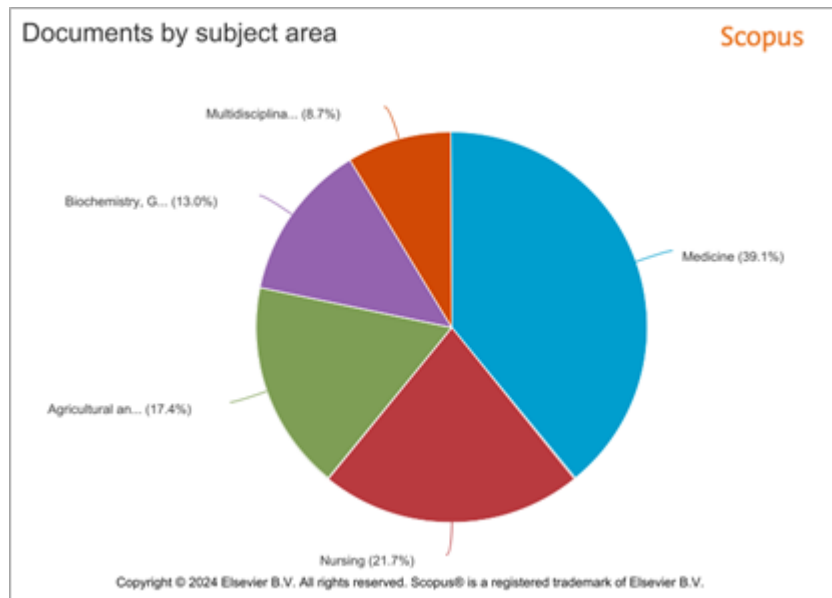
Document by type
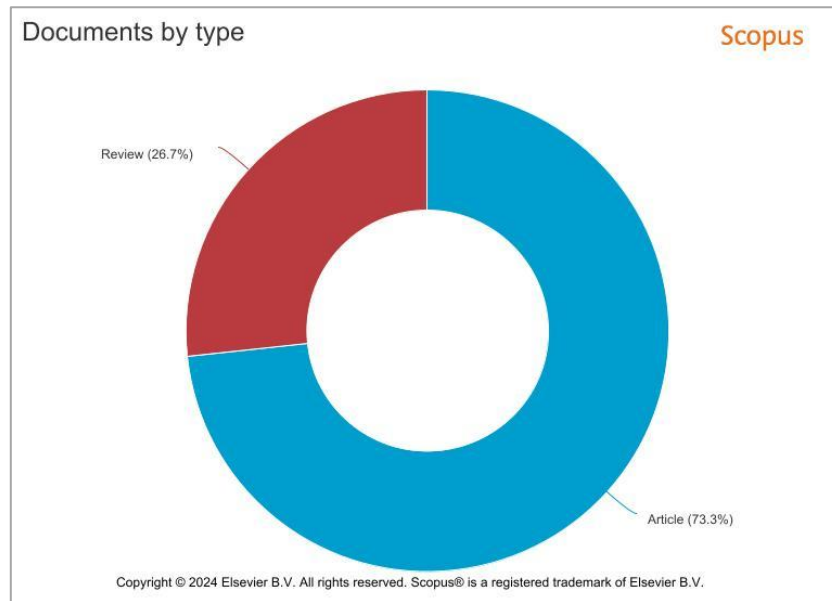
Source: Output of descriptive analysis from the Scopus web page

Figure 5. Document by Type

Documents on vitamin D deficiency in pregnant women in tropical countries consist of two types of scientific publications: articles (11 documents or 73.3%) and reviews (4 documents or 26.7%) (Figure 5).

Document by subject

Source: Output of descriptive analysis from the Scopus web page

Figure 6: Document by Subject

The Figure 6 highlights several professions involved in research on vitamin D deficiency in pregnant women in tropical countries. These include medicine (9 documents or 39.1%), nursing (5 documents or 21.7%), agriculture and biological sciences (4 documents or 17.4%), biochemistry, genetics, and molecular biology (3 documents or 13%), and multidisciplinary studies (2 documents or 8.7%).

The most cited article

Table 1: The Most Cited Article

Paper	Title	Total Citations
Pratumvinit *et al.* (2015)	Maternal vitamin D status and its related factors in pregnant women in Bangkok, Thailand	42
Oktaria *et al.* (2020)	The Prevalence and determinants of Vitamin D deficiency in Indonesian infants at birth and six months of age	30
Pontes *et al.* (2015)	Effect of injectable vitamin E on incidence of retained fetal membranes and reproductive performance of dairy cows	29
Uday & Högler (2020	Nutritional rickets & osteomalacia: A practical approach to management	24
Judistiani *et al.* (2019)	Optimizing ultraviolet B radiation exposure to prevent vitamin D deficiency among pregnant women in the tropical zone: Report from cohort study on vitamin D status and its impact during pregnancy in Indonesia	23
Hochberg & Hochberg (2019)	Evolutionary perspective in rickets and Vitamin D	21
Perumal *et al.* (2017)	Prenatal vitamin D supplementation and infant vitamin D status in Bangladesh	12
Vieth, (2019)	Weaker bones and white skin as adaptations to improve anthropological "fitness" for northern environments	8
Aji *et al.* (2020)	The associations of maternal vitamin d status during pregnancy and neonatal anthropometric measurements: A longitudinal study in minangkabau pregnant women, Indonesia	6
Ariffin *et al.* (2018)	Prevalence of vitamin d deficiency and its associated risk factors during early pregnancy in a tropical country: A pilot study	5

A collaborative network of co-words related to vitamin d deficiency among pregnant women in tropical countries
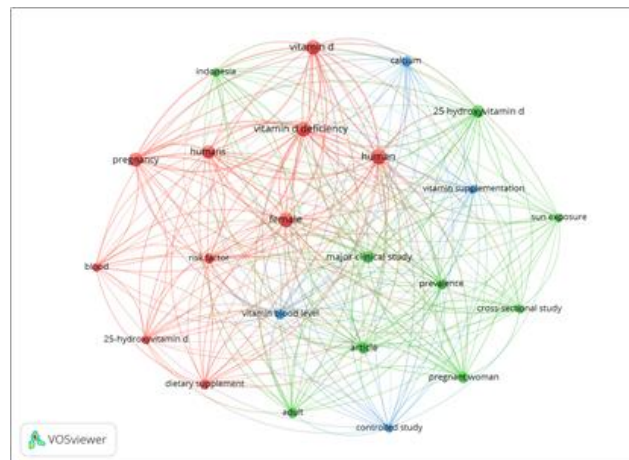
Source: Output of network analysis in VOSviewer software

Figure 7: A Collaborative Network of Co-Words Related to Vitamin D Deficiency Among Pregnant Women in Tropical Countries

Figure 7 illustrates the relationship between keywords extracted from literature on vitamin D deficiency in pregnant women in tropical countries using VOSviewer software. The articles analyzed were published in the last decade (2015–2024). Each node represents a specific keyword, while lines connecting nodes indicate co-occurrence of keywords in the same articles.

Discussion

The annual publication trends on vitamin D deficiency in pregnant women in tropical countries, as illustrated in Figure 1, reveal significant fluctuations over the years, with a notable peak in 2020. This surge in research activity is likely linked to the global COVID-19 pandemic, which spurred increased scientific interest in the role of micronutrients—particularly vitamin D—in supporting immune function. Pregnant women, being an immunologically vulnerable group, became a priority in this research focus.

Previous studies have highlighted the potential of vitamin D in reducing the risk of respiratory infections, further justifying the heightened attention during the pandemic period (Grant *et al.*, 2020).

Interestingly, the high prevalence of vitamin D deficiency in tropical regions, despite abundant sunlight, underscores the multifactorial nature of the problem. Contributing factors include limited sun exposure due to indoor lifestyles, cultural clothing practices, high melanin levels reducing dermal synthesis, and inadequate dietary intake or supplementation (Palacios & Gonzalez, 2014). These findings challenge the assumption that geographic location alone ensures adequate vitamin D status and highlight the importance of contextual public health strategies.

The observed trends may also be influenced by increased international collaboration and funding opportunities, especially those targeting maternal and child health in low- and middle-income countries (LMICs). The UNESCO Science Report (UNESCO, 2021) noted a rise in collaborative research between LMIC institutions and global health organizations, contributing to increased scientific output and visibility in these regions. However, while publication numbers have grown, substantial gaps remain in the evidence base. Many studies are observational in nature, with limited randomized trials or community-based interventions to assess the effectiveness of preventive measures.

Figure 2 illustrates the distribution of document sources based on institutional affiliations, highlighting the dispersed nature of research sponsorship in the field of vitamin D deficiency during pregnancy in tropical countries. The data show that no single institution dominates in terms of funding contributions; rather, each identified institution supported only one publication within the 2015–2024 period. This fragmentation suggests that research efforts are not centralized but instead stem from a diverse array of institutions, potentially leading to a wide range of research topics, methodologies, and contextual perspectives. While this diversity can enrich the scientific discourse and foster innovation, it may also present challenges in maintaining consistency and depth across studies. Despite their limited individual contributions, the involvement of these institutions remains crucial, particularly in under-researched areas such as micronutrient deficiencies in maternal health within tropical settings. Notably, only 15 documents were retrieved from the Scopus database in response to the targeted query, emphasizing the nascent and niche nature of this research area. Examining the role and engagement of funding bodies in such contexts is vital for understanding how financial support—or the lack thereof—shapes the scope, direction, and overall quality of scholarly output (Bozeman & Youtie, 2017). Future initiatives should consider coordinated funding strategies and cross-institutional collaboration to build a more robust and sustained research agenda in this field.

Figure 3 presents the countries with the highest number of publications on vitamin D deficiency in pregnant women, underscoring growing research attention in tropical regions. Despite their geographical advantage of year-round sunlight, countries such as Indonesia, Malaysia, Bangladesh, Brazil, and India demonstrate a disproportionately high burden of vitamin D deficiency among pregnant populations. This paradox is well-documented in previous literature and is often attributed to factors such as limited sun exposure due to cultural clothing practices, indoor lifestyles, air pollution, and darker skin pigmentation, all of which reduce cutaneous vitamin D synthesis (Palacios & Gonzalez, 2014; Pelto *et al.*, 2016). The higher average publication output from these tropical countries compared to their subtropical, temperate, and cold-climate counterparts suggests that the issue is locally recognized as a public health concern. These trends also reflect an increasing commitment by researchers and institutions in tropical countries to investigate context-specific determinants and interventions related to maternal vitamin D status. However, the concentration of studies in a limited number of countries also signals the need for broader geographic representation to better capture the full spectrum of challenges and responses across the tropical zone.

Figure 4 illustrates the distribution of publications across journals, showing that Nutrients and PLOS ONE each contributed the highest number of publications to the topic of vitamin D deficiency in pregnant women in tropical countries. In contrast, journals such as BMC Nutrition, BMC Pregnancy and Childbirth, and BMJ Paediatrics Open each published only a single article within the study period. This disparity may suggest limited research output or lower acceptance rates in these specific journals during certain

years. Such patterns reflect not only the shifting attention within the scientific community but also the influence of journal scope, editorial policies, and topical relevance on publication trends. For instance, the increasing number of publications in Nutrients likely signifies heightened scholarly interest in maternal nutrition and the broader implications of micronutrient deficiencies in recent years.

Additionally, funding availability and institutional collaboration are important factors that may affect journal selection and publication frequency. Collaborative projects often seek journals with broader readership and impact, which may partially explain the preference for multidisciplinary, open-access journals such as PLOS ONE. The predominance of original research articles across these journals indicates an ongoing effort to build empirical evidence through observational designs, which are often more feasible in resource-limited settings. Conversely, the presence of review articles underscores the scientific community's attempt to synthesize existing findings, identify knowledge gaps, and guide future research directions. Together, these patterns highlight both the growing importance of this topic and the evolving strategies used by researchers to contribute to the global understanding of maternal vitamin D deficiency.

Most of the research on vitamin D deficiency in pregnant women is concentrated within the disciplines of medicine and nursing, reflecting a strong clinical and public health orientation in addressing both the treatment and prevention of this deficiency. The dominance of these fields underscores the importance of medical and nursing roles in maternal care, including screening, supplementation, and continuous monitoring of vitamin D status throughout pregnancy. In addition to the clinical sciences, contributions from the fields of agriculture and biology emphasize the nutritional aspects of vitamin D, including the identification and promotion of food sources rich in this micronutrient. Furthermore, disciplines such as biochemistry, genetics, and molecular biology play a critical role in elucidating the physiological and molecular mechanisms underlying vitamin D metabolism and its deficiency during pregnancy. These scientific perspectives provide insights into gene-nutrient interactions, hormonal regulation, and placental function related to vitamin D. The complexity of the issue highlights the necessity of multidisciplinary approaches that integrate health, nutrition, social science, and environmental research. Collaborative efforts across these domains are essential to develop holistic strategies that address the biomedical, behavioral, and structural factors influencing vitamin D deficiency in pregnant populations, particularly in tropical regions. Such integrative frameworks can enhance the impact and applicability of research findings in policy and practice.

The bibliometric analysis revealed distinct thematic clusters within the research landscape on vitamin D deficiency in pregnant women. The red cluster centers on studies addressing risk factors, including blood biomarker measurements and dietary supplementation as key intervention strategies. The green cluster focuses on prevalence studies, highlighting the influence of sun exposure and the outcomes of major clinical research—particularly in tropical countries such as Indonesia. This cluster reflects the growing interest in understanding how sunlight availability translates (or fails to translate) into adequate vitamin D status among pregnant women. Meanwhile, the blue cluster captures research examining the interplay between vitamin D supplementation, calcium levels, and findings derived from controlled study designs, emphasizing efforts to generate high-quality evidence for clinical and nutritional guidelines.

Collectively, these clusters highlight two dominant themes in the literature: (1) the identification of risk factors for vitamin D deficiency among pregnant women, and (2) the assessment of vitamin D supplementation as a preventive measure. Notably, despite the abundance of sunlight in tropical regions, several factors hinder optimal vitamin D synthesis. These include prolonged indoor activity, cultural clothing practices that limit skin exposure, the widespread use of sunscreen, and insufficient dietary intake of vitamin D-rich foods (Augustine *et al*., 2021; Md Isa *et al*., 2022; Mendes *et al*., 2023). Such findings challenge the assumption that geographic location alone guarantees sufficient vitamin D levels.

Importantly, existing evidence suggests that vitamin D supplementation during pregnancy can significantly improve maternal and neonatal vitamin D status and reduce the risk of deficiency-related complications (Perumal *et al*., 2017). However, further research is warranted to explore context-specific

strategies tailored to tropical populations, including interventions that consider behavioral, cultural, and nutritional dimensions. Addressing these gaps through multidisciplinary approaches will be critical in formulating effective prevention programs for vitamin D deficiency among pregnant women in high-risk regions.

Conclusion

This study highlights that despite abundant sunlight in tropical countries, vitamin D deficiency remains a significant issue, particularly in Indonesia, which has the highest number of publications. Publication trends show fluctuations, peaking in 2020. Research is dominated by the fields of medicine and nursing, focusing on risk factors, prevalence, and the impact of vitamin D supplementation. Key barriers to adequate vitamin D levels include indoor lifestyles, covered clothing, and low dietary intake. Further research is needed to develop effective prevention strategies.

Conflict of Interest

The authors affirm that they have no conflicting interests.

Acknowledgement

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