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Maternal Anthropometric and Dietary Factors in Preeclampsia: A Systematic Literature Review

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Abstract: Preeclampsia remains a major maternal and perinatal health concern and is associated with substantial morbidity and mortality. Maternal nutritional status has been increasingly recognized as a potentially modifiable factor, although previous studies have used heterogeneous nutritional indicators and reported inconsistent findings. **Objective:** This study aimed to systematically analyze and synthesize evidence on the relationship between maternal nutritional status and the occurrence of preeclampsia among pregnant women, with particular attention to anthropometric status, dietary patterns, and nutrient adequacy. **Method:** A Systematic Literature Review was conducted using a PRISMA-guided study selection process. Relevant publications were identified from PubMed, ScienceDirect, SpringerLink, Wiley Online Library, and Google Scholar. Of 26 initially identified publications, 15 studies met the eligibility criteria and were included in the final synthesis. Data were analyzed using descriptive-comparative analysis and thematic synthesis. **Results:** Most included studies reported an association between maternal nutritional factors and preeclampsia. Frequently identified factors included overweight and obesity, body mass index, dietary patterns, maternal weight gain, chronic energy deficiency, and inadequate protein intake. However, at least one study reported no significant association between pre-pregnancy BMI and preeclampsia, indicating heterogeneity across populations and measurement approaches. **Implications:** The findings support the integration of nutritional assessment, weight monitoring, and dietary counseling into comprehensive antenatal risk evaluation. **Originality:** This review integrates both overnutrition and undernutrition dimensions, demonstrating that maternal nutritional status should be understood as a multidimensional component of preeclampsia risk rather than as a single causal factor.

Keywords: maternal nutritional status; preeclampsia; pregnancy; obesity; dietary patterns; systematic literature review

INTRODUCTION

Preeclampsia is one of the hypertensive disorders of pregnancy and remains an important maternal and perinatal health problem because it is associated with increased maternal and fetal morbidity and mortality (Bisson et al., 2023). This condition may progress into a multisystem disorder and lead to various complications during pregnancy and the postpartum period (Tabacco et al., 2023). The pathogenesis of preeclampsia involves complex interactions among abnormal placentation, immune responses, inflammation, endothelial dysfunction, and maternal vascular alterations (Deer et al.,

2023). In addition to obstetric and clinical factors, nutritional factors have also received considerable attention because maternal dietary patterns and nutritional status may be associated with the risk of preeclampsia (Perry et al., 2022). These conditions indicate that monitoring maternal nutritional status during pregnancy has clinical relevance for identifying modifiable risk factors.

Previous studies on the relationship between nutritional status and preeclampsia can be categorized into three main groups. First, studies focusing on maternal anthropometric status, overweight, and obesity. A meta-analysis showed that increased maternal body mass index is associated with a higher risk of pregnancy complications, including preeclampsia (Zhang et al., 2024). Obesity has also been associated with metabolic alterations and biomarkers that may contribute to the development of preeclampsia (Abraham & Romani, 2022). Systemic inflammation associated with adipose tissue has been proposed as one of the mechanisms underlying this relationship (Alston et al., 2022). Maternal adipose tissue alterations have also been linked to placental abnormalities in pregnancies complicated by obesity and preeclampsia (Rogers et al., 2022). Furthermore, changes in adiponectin and leptin profiles have been reported among obese pregnant women with preeclampsia (Nugrahani et al., 2024).

Second, studies examining dietary patterns and nutrient adequacy. Certain maternal dietary patterns have been associated with differences in preeclampsia risk (Traore et al., 2021). Nutritional interventions during pregnancy have also been evaluated as preventive approaches for gestational hypertension and preeclampsia, although findings vary across interventions (Imanpour et al., 2023). Micronutrient supplementation among women at increased risk of preeclampsia has shown different outcomes depending on the type of micronutrient and population characteristics (Gunabalasingam et al., 2023). Vitamin D is among the micronutrients most frequently investigated in relation to preeclampsia (AlSubai et al., 2023), while calcium supplementation has also been assessed in clinical trials as a preventive strategy (Jaiswal et al., 2024).

Third, studies integrating multiple nutritional factors into the pathophysiological framework of preeclampsia. Such approaches suggest that the relationship between nutrition and preeclampsia cannot be explained by a single nutrient or anthropometric indicator alone (Kinshella et al., 2023). Despite the growing body of evidence, variations in nutritional indicators, population characteristics, study designs, and interventions have resulted in heterogeneous findings. This inconsistency indicates the need for a systematic

synthesis of the available evidence to better clarify the relationship between maternal nutritional status and preeclampsia.

Based on this gap, this study aims to systematically analyze and synthesize scientific evidence regarding the relationship between maternal nutritional status and the incidence of preeclampsia among pregnant women. Specifically, this review seeks to identify the nutritional status indicators used in previous studies, compare findings across studies, and evaluate the patterns of association between anthropometric status, dietary patterns, nutrient adequacy, and preeclampsia. A Systematic Literature Review approach is used to integrate evidence across different study designs and populations in order to provide a more comprehensive understanding of the relationship between nutritional factors and the risk of preeclampsia.

Based on the available evidence, this study proposes that maternal nutritional status is associated with the occurrence of preeclampsia, although the strength of this association may vary according to the nutritional indicator used, maternal characteristics, timing of measurement, and accompanying clinical factors. Overweight and obesity may be associated with inflammation, metabolic dysfunction, and alterations in vascular and placental function, whereas dietary patterns and micronutrient adequacy may influence physiological mechanisms related to maternal health. Therefore, nutritional status should not be regarded as a single causal factor of preeclampsia, but rather as one maternal factor that should be considered together with other obstetric and clinical determinants.

RESEARCH METHOD

The unit of analysis in this study consisted of scientific articles examining the relationship between maternal nutritional status and the occurrence of preeclampsia among pregnant women. The review focused on studies assessing nutritional indicators such as body mass index, overweight or obesity, dietary patterns, nutritional intake, and other indicators of maternal nutritional status in relation to preeclampsia. The unit of analysis was therefore not individual pregnant women directly, but empirical studies reporting findings on nutritional status and preeclampsia. Studies included in the review were selected based on their relevance to the research objective and the availability of empirical findings that could be synthesized.

This study employed a Systematic Literature Review (SLR) with a descriptive-analytical approach. The SLR design was selected because the study aimed to identify,

compare, and synthesize findings from previous empirical studies rather than collect primary data directly from participants. The review process was structured according to the principles of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) to improve transparency in article identification, screening, eligibility assessment, and final study inclusion. This approach was considered appropriate because previous studies used different nutritional indicators, populations, and research designs, resulting in heterogeneous findings that required systematic synthesis.

The data sources consisted of secondary data obtained from peer-reviewed scientific publications. Articles were identified through searches of PubMed, ScienceDirect, SpringerLink, Wiley Online Library, and Google Scholar. The review included studies published from 2020 to 2026, consistent with the publication years of the studies included in the final review. Eligible studies were empirical studies involving pregnant women and examining the relationship between nutritional status or nutritional factors and preeclampsia. Observational, cross-sectional, cohort, and case-control studies relevant to the research question were considered for inclusion. Case reports, editorials, narrative reviews without primary empirical data, duplicate publications, and studies that did not specifically examine maternal nutritional factors in relation to preeclampsia were excluded.

The data collection process was conducted through systematic identification and screening of relevant publications. Searches were performed using combinations of keywords related to "nutritional status," "maternal nutrition," "body mass index," "obesity," "dietary pattern," "pregnancy," and "preeclampsia." The initial search identified 26 publications, which were subsequently screened based on title and abstract relevance, followed by full-text eligibility assessment. A total of 15 studies met the criteria and were included in the final synthesis, comprising 10 national and 5 international publications. Relevant information was extracted using a structured data-extraction framework covering author and year, study setting, research design, sample characteristics, nutritional indicators, preeclampsia outcomes, and main findings.

The data were analyzed using descriptive-comparative analysis and thematic synthesis. The included studies were first summarized according to their methodological characteristics and major findings. The findings were then categorized into major nutritional themes, including maternal anthropometric status and obesity, dietary patterns and nutrient intake, and other nutritional factors associated with preeclampsia. Similarities and differences across studies were compared to determine the consistency of the reported

associations. Particular attention was given to studies reporting findings that differed from the dominant pattern to avoid drawing conclusions solely from statistically significant results. The final synthesis was interpreted in relation to the study objective, while considering variations in study design, nutritional indicators, population characteristics, and reported outcomes.

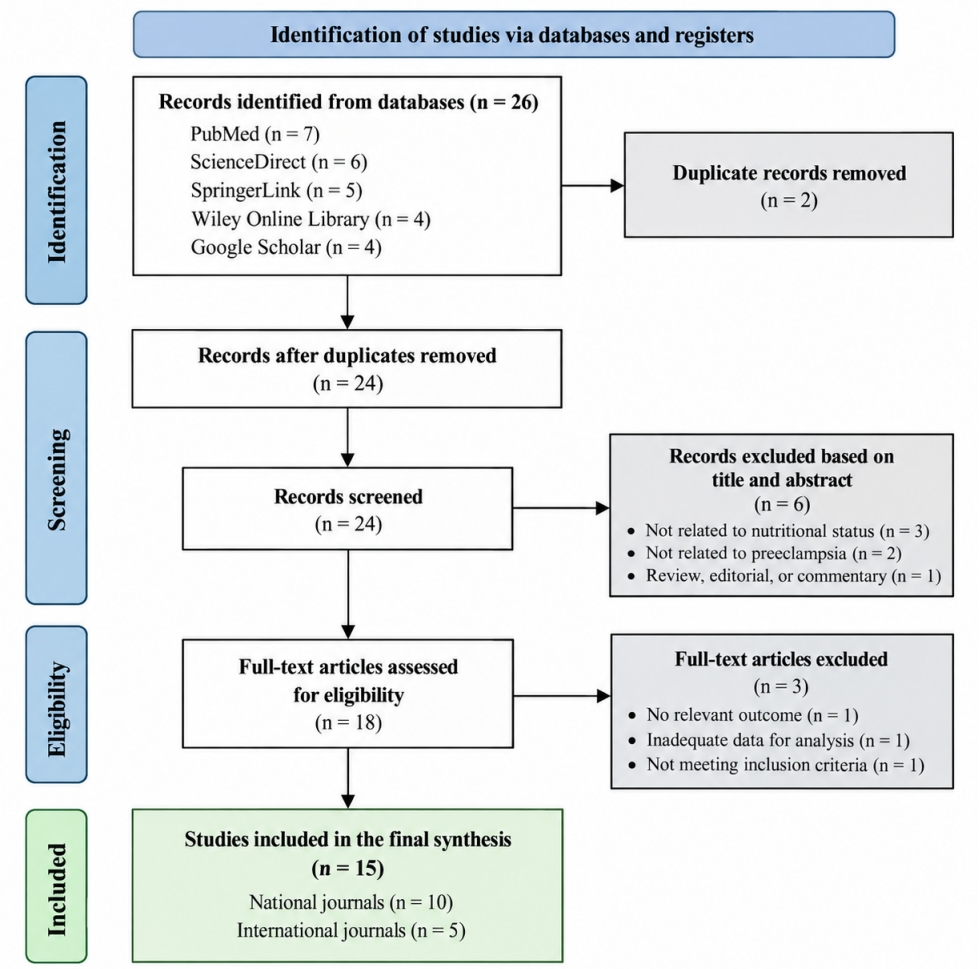

Figure 1. PRISMA Flow Diaghram of the Study Selection Process

RESULT

Nutritional Status Indicators Related to Preeclampsia

A total of 15 studies were included in the final review. The studies examined various indicators of maternal nutritional status associated with preeclampsia, including body mass index (BMI), obesity, mid-upper arm circumference (MUAC), dietary patterns, maternal weight gain, chronic energy deficiency (CED), and protein intake. Several studies also assessed nutritional status together with maternal characteristics such as age, parity, pregnancy interval, diabetes, and previous history of preeclampsia.

Table 1. Summary of Studies Included in the Systematic Review

No.	Research Title	Author/Year	Main Research Findings
1	Relationship Between Nutritional Status and Maternal Age with the Incidence of Preeclampsia at PONEK RSUD Waluyojati, Probolinggo Regency	Marfuatun (2026)	Pregnant women with nutritional risk accounted for 20 respondents (33.9%), those with age-related risk accounted for 19 respondents (32.2%), and 22 respondents (37.3%) experienced preeclampsia. Maternal nutritional status and age were significantly associated with preeclampsia.
2	Relationship Between Obesity and Severe Preeclampsia Among Third-Trimester Pregnant Women at Fatimah Hospital, Lamongan Regency	Fakhriantono et al. (2025)	Obesity among third-trimester pregnant women was associated with an increased risk of severe preeclampsia.
3	Overview of Nutritional Status and Pregnancy Risk Factors in the Working Area of Banyudono II Public Health Center	Mamnukha et al. (2025)	Anthropometric indicators and pregnancy risk factors such as BMI, MUAC, age, and blood pressure were useful for describing maternal nutritional status and pregnancy risk.
4	Relationship Between Dietary Patterns and Severe Preeclampsia Among Third-Trimester Pregnant Women at Aulia Regional General Hospital, Pandeglang	Dini Nuzlia Izati (2025)	Maternal dietary patterns were associated with severe preeclampsia among third-trimester pregnant women.
5	Relationship Between Maternal Nutritional Status and the Incidence of Preeclampsia	Habibullah (2023)	A relatively strong relationship was found between maternal nutritional status and the incidence of preeclampsia.
6	Relationship Between Body Mass Index and the Incidence of Preeclampsia at Pekapuran Raya Public Health Center, Banjarmasin City, 2024	Nadia et al. (2025)	Among women with preeclampsia, 23 respondents (13.5%) had normal BMI and 42 respondents (24.6%) were overweight, while no cases were reported among underweight women.
7	Effect of Nutritional Status Empowerment on the Incidence of Preeclampsia Among Third-Trimester Pregnant Women	Harahap & Jumhati (2023)	Nutritional status empowerment was reported to contribute to reducing preeclampsia risk by improving nutritional knowledge and practices.
8	Relationship Between Age, Parity, Comorbidities, and Maternal Nutritional Status with Preeclampsia and Low Birth Weight in an Urban Population at Fatmawati General Hospital, Jakarta, 2023	Nabillah (2023)	No significant relationship was found between age, parity, comorbidities, pre-pregnancy BMI, hemoglobin level, and preeclampsia.
9	Relationship Between Pregnancy Interval and Nutritional Status with the Incidence of Preeclampsia Among Pregnant	Wulandari (2025)	Pregnancy interval and maternal nutritional status were associated with the incidence of preeclampsia.

No.	Research Title	Author/Year	Main Research Findings
	Women at Aura Syifa Hospital, Kediri Regency, 2025		
10	Relationship Between Maternal Nutritional Status and the Incidence of Preeclampsia at Sungai Durian Public Health Center, Sintang	Della et al. (2025)	A significant relationship was found between maternal nutritional status and the incidence of preeclampsia.
11	Factors Related to the Incidence of Preeclampsia in Pregnant Women in the Working Area of Batujaya Public Health Center, Karawang Regency	Siauta et al. (2024)	Nutritional status, history of preeclampsia, diabetes, and knowledge were significantly associated with preeclampsia, while multiple pregnancy was not associated with its occurrence.
12	The Relationship Between Obesity and the Incidence of Pre-Eclampsia	Yanuaringsih et al. (2022)	Obesity was associated with the incidence of preeclampsia among pregnant women.
13	Association Between Maternal Dietary Patterns and Preeclampsia Incidence: A Cross-Sectional Study at Rehatta Hospital, Indonesia	Dary et al. (2025)	High carbohydrate intake, inadequate intake of animal-source foods, vegetables and fruits, irregular eating patterns, and fast-food consumption were significantly associated with preeclampsia ($p < 0.05$).
14	Risk Factors for Preeclampsia: A Case-Control Study in Makassar City and Gowa Regency, Indonesia	Rahma et al. (2026)	Maternal weight gain during pregnancy and fish intake were associated with the incidence of preeclampsia.
15	The Effect of Chronic Energy Deficiency and Protein Intake on the Incidence of Preeclampsia at Dr. H. Abdul Moeloek Hospital, Lampung Province	Angraini et al. (2020)	Among 66 respondents, 37.9% had CED, 81.8% had inadequate protein intake, and 51.5% had preeclampsia. CED and inadequate maternal protein intake were significantly associated with preeclampsia ($p = 0.001$).

The table reflects the 15 studies listed in the original manuscript.

The reviewed studies showed four main patterns. First, anthropometric indicators, particularly BMI and obesity, were the most frequently examined measures. Second, several studies focused on dietary patterns and nutrient intake rather than anthropometric status alone. Third, maternal nutritional status was often evaluated together with other maternal characteristics, including age, pregnancy interval, diabetes, and previous preeclampsia. Fourth, both overnutrition and undernutrition were represented in the included studies. These findings indicate that maternal nutritional status is a multidimensional construct and should not be represented solely by BMI.

Consistency of Findings Across Studies

Most of the included studies reported an association between maternal nutritional status or nutritional factors and preeclampsia. Positive associations were observed in studies examining general nutritional status, obesity, BMI, dietary patterns, maternal weight gain, chronic energy deficiency, and protein intake. For example, (Fakhriantono et al., 2025) reported that obesity was associated with an increased risk of severe preeclampsia, while (Yanuaringsih et al., 2022) also identified a relationship between obesity and preeclampsia. Diet-related studies showed a similar tendency. (Dary et al., 2025) identified significant relationships between several dietary characteristics and preeclampsia, whereas (Angraini et al., 2020) reported significant associations between chronic energy deficiency, inadequate protein intake, and preeclampsia.

However, the findings were not entirely consistent. (Nugrahani et al., 2024) reported no significant relationship between pre-pregnancy BMI and preeclampsia. This contrasting result indicates that the association between maternal nutritional status and preeclampsia was not uniformly observed across all study populations.

Overall, three main tendencies were identified: most studies reported a positive association, the association appeared across different nutritional indicators, and a smaller proportion of studies reported non-significant findings. Therefore, the reviewed evidence generally supports an association between maternal nutritional factors and preeclampsia, although variability among studies remains evident.

Patterns of Association Between Nutritional Factors and Preeclampsia

Three major patterns emerged from the reviewed evidence. The first pattern involved anthropometric status and obesity**.** Studies assessing BMI and obesity generally indicated that excessive maternal body weight was associated with preeclampsia. (Nadia et al., 2025) for example, reported a higher number of preeclampsia cases among overweight women than among women with normal BMI.

The second pattern involved dietary intake and nutritional adequacy. Maternal dietary patterns were associated with severe preeclampsia, while dietary characteristics such as high carbohydrate intake, inadequate consumption of vegetables and fruits, irregular eating patterns, and fast-food consumption were significantly associated with preeclampsia. (Rahma et al., 2026) also identified maternal weight gain and fish intake as factors associated with preeclampsia.

The third pattern concerned inadequate maternal nutritional status. Angraini et al. (2020) reported significant associations between chronic energy deficiency, inadequate protein intake, and preeclampsia. This finding indicates that nutritional conditions associated with preeclampsia are not limited to overweight and obesity but may also include insufficient energy and nutrient intake.

Overall, the findings demonstrate that maternal nutritional status is associated with preeclampsia through several dimensions, including anthropometric status, dietary patterns, and nutrient adequacy. Nevertheless, because not all included studies reported statistically significant associations, maternal nutritional status should be interpreted as one component of a broader maternal risk profile rather than as a single independent determinant of preeclampsia.

DISCUSSION

The present systematic review synthesized findings from 15 studies examining the relationship between maternal nutritional status and preeclampsia. Overall, most of the included studies reported an association between nutritional factors and preeclampsia, although the strength and direction of the relationship were not entirely consistent across studies. The reviewed evidence covered a broad range of nutritional indicators, including body mass index (BMI), obesity, mid-upper arm circumference (MUAC), dietary patterns, maternal weight gain, chronic energy deficiency (CED), and protein intake. In addition, several studies assessed nutritional status together with maternal characteristics such as age, pregnancy interval, diabetes, and previous preeclampsia. These findings indicate that maternal nutritional status should be understood as a multidimensional factor rather than as a single anthropometric measure.

One possible explanation for the observed relationship is that nutritional status influences several physiological pathways involved in the development of preeclampsia. Excessive maternal adiposity may contribute to systemic inflammation, metabolic dysfunction, oxidative stress, and endothelial abnormalities, which are also central mechanisms in the pathophysiology of preeclampsia (Abraham & Romani, 2022). Obesity-related inflammatory responses may additionally affect placental development and vascular adaptation during pregnancy (Alston et al., 2022). This mechanism is consistent with the findings of (Fakhriantono et al., 2025; Yanuaringsih et al., 2022) both of whom reported an association between obesity and preeclampsia. However, the findings of this

review also show that nutritional risk is not limited to overnutrition. Chronic energy deficiency and inadequate protein intake were significantly associated with preeclampsia in the study by (Angraini et al., 2020) suggesting that inadequate nutritional status may also contribute to maternal vulnerability.

The findings are generally consistent with previous evidence indicating that maternal BMI, obesity, and dietary factors are relevant to the risk of preeclampsia. (Zhang et al., 2024) reported that higher maternal BMI was associated with an increased risk of pregnancy complications, including preeclampsia. Dietary evidence also supports the role of maternal nutrition, as certain dietary patterns have been associated with differences in preeclampsia risk (Traore et al., 2021). In the present review, (Dary et al., 2025) reported significant relationships between preeclampsia and several dietary characteristics, including high carbohydrate intake, inadequate consumption of animal-source foods, low fruit and vegetable intake, irregular eating patterns, and fast-food consumption. (Rahma et al., 2026) further identified maternal weight gain and fish intake as factors associated with preeclampsia. The novelty of this review lies in integrating evidence from both anthropometric and dietary dimensions, including overnutrition, undernutrition, and nutrient inadequacy, rather than interpreting maternal nutritional status only through BMI or obesity.

Nevertheless, the evidence was not completely homogeneous. Reported no significant relationship between pre-pregnancy BMI and preeclampsia. This contrasting result suggests that the relationship between nutritional status and preeclampsia may be influenced by differences in study populations, nutritional indicators, timing of measurement, sample characteristics, study design, and accompanying maternal risk factors. Therefore, the absence of a significant association in one study should not be interpreted as evidence that nutritional status is irrelevant, but rather as an indication that its effect may vary across clinical and population contexts. This interpretation is consistent with the broader understanding that preeclampsia is a multifactorial condition involving placental dysfunction, inflammation, immune dysregulation, and maternal vascular abnormalities (Bisson et al., 2023; Deer et al., 2023).

The findings have important clinical and public health implications. The positive aspect of identifying nutritional status as a relevant maternal factor is that several nutritional indicators are potentially modifiable before and during pregnancy. Assessment of BMI, weight gain, dietary patterns, and nutritional adequacy may therefore complement

routine antenatal risk assessment. However, there is also a potential limitation if nutritional status is interpreted too narrowly or used as an isolated predictor. Preeclampsia cannot be explained solely by maternal nutrition because several included studies also identified age, diabetes, pregnancy interval, previous preeclampsia, and other maternal characteristics as relevant factors. Consequently, nutritional assessment should be integrated with comprehensive obstetric and clinical evaluation rather than used as a stand-alone screening criterion.

From a practical perspective, antenatal care programs should strengthen early nutritional assessment, appropriate maternal weight monitoring, dietary counseling, and identification of both overnutrition and undernutrition. Pregnant women with overweight or obesity may benefit from individualized nutritional counseling and appropriate gestational weight management, while women with CED or inadequate nutrient intake require timely nutritional support. Nutritional interventions should also emphasize balanced dietary patterns rather than focusing only on individual nutrients, as preeclampsia prevention is likely to require a broader nutritional approach (Kinshella et al., 2023)At the policy level, maternal health services should integrate routine nutritional screening with established obstetric risk assessment to support earlier identification of women at increased risk of preeclampsia. Future studies should employ more standardized definitions of nutritional status and preeclampsia and report comparable effect estimates to strengthen the evidence base and facilitate future meta-analyses.

CONCLUSION

This systematic literature review shows that maternal nutritional status is generally associated with the occurrence of preeclampsia, although the strength and consistency of this relationship vary across nutritional indicators and study populations. The reviewed evidence indicates that both excessive nutritional status, particularly overweight and obesity, and inadequate nutritional conditions, including chronic energy deficiency and insufficient protein intake, may be associated with preeclampsia. Dietary patterns and maternal weight gain were also identified as relevant factors, while at least one included study reported no significant association between pre-pregnancy BMI and preeclampsia.

The main scientific contribution of this review lies in integrating several nutritional dimensions anthropometric status, dietary patterns, and nutrient adequacy within a single analytical framework. This synthesis reinforces the view that maternal nutritional status

should not be treated as a single causal determinant, but rather as one component of a broader maternal risk profile for preeclampsia. The findings therefore support the incorporation of nutritional assessment, weight monitoring, and dietary evaluation into comprehensive antenatal risk assessment.

This review has several limitations. The included studies differed in design, nutritional indicators, population characteristics, and reported outcomes, which limited direct comparison across studies. In addition, the available evidence did not allow a quantitative pooled estimate of the association between nutritional factors and preeclampsia. Future studies should use more standardized definitions and measurements of maternal nutritional status and preeclampsia, apply rigorous quality assessment, and consider meta-analysis when sufficient homogeneous data are available.

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