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Dietary Patterns and the Risk of Hyperemesis Gravidarum: A Systemic Review

Ida Ayu Mas Sasmari Brahmani[1], Ni Ketut Sumartini[2]

[1]Faculty of Medicine, Udayana University, Bali, Indonesia
[2]Department of Clinical Nutrition, Faculty of Medicine, Udayana University / Ngoerah General Hospital Denpasar, Bali, Indonesia

Corresponding Author: Ida Ayu Mas Sasmari Brahmani

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ABSTRACT

Hyperemesis gravidarum (HG) is a severe form of nausea and vomiting in pregnancy that may result in dehydration, electrolyte imbalance, and adverse maternal–fetal outcomes. HG affects 0.3% to 10.8% of pregnancies worldwide, with an incidence of 5.42% reported in Indonesia in 2019. Dietary patterns before and during early pregnancy are suspected to influence its occurrence, yet the evidence remains inconsistent. This systematic review aimed to evaluate the association between dietary patterns and the risk of hyperemesis gravidarum. A literature search was conducted in PubMed, ScienceDirect, Google Scholar, and the Cochrane Library for observational studies published within the last ten years. Study selection and quality assessment were performed independently using the Joanna Briggs Institute Critical Appraisal Tool and the Newcastle–Ottawa Scale. Five studies met the inclusion criteria. The findings indicate that diets rich in fish, eggs, seafood, unprocessed meat, fruits, vegetables, nuts, seeds, milk, and adequate fluid intake are associated with a lower risk of hyperemesis gravidarum. In contrast, high consumption of saturated fats, carbonated beverages, and added sugars is linked to an increased risk. In conclusion, dietary patterns represent a modifiable factor that may influence the development of hyperemesis gravidarum. Further well-designed studies are required to support preventive nutritional strategies for pregnant women

Keywords: Hyperemesis gravidarum, dietary patterns, pregnancy, risk factors, nutrition.

INTRODUCTION

Hyperemesis gravidarum (HG) is a severe form of nausea and vomiting in pregnancy that may lead to dehydration, electrolyte and acid–base imbalance, significant weight loss, and other serious complications. Globally, HG affects approximately 0.3%–10.8% of pregnant women [1,2]. In Indonesia, national data show a consistent burden, with 5.31% of pregnant women affected in 2018 and 5.42% in 2019 among those seeking healthcare services [3]. The clinical impact of HG is substantial, as it increases the risk of maternal morbidity and adverse pregnancy outcomes, including preterm birth and low birth weight, often related to inadequate maternal nutritional intake [1,4,5]. These data highlight the urgency of identifying modifiable risk factors to prevent and manage HG [3,6].

Although nausea and vomiting are common symptoms during early pregnancy, HG represents a more severe clinical condition that often requires medical intervention and hospitalization [7]. Recent studies have

shown that HG can significantly affect maternal health and pregnancy outcomes if not properly managed. Several maternal factors have been identified as potential contributors to the development of HG, including nutritional status, physical activity levels, and psychosocial support. A recent study reported that maternal nutritional status and physical activity are significantly associated with the occurrence of hyperemesis gravidarum, and social support—particularly support from the husband—may also play an important role in reducing the severity of symptoms among pregnant women [8].

The etiology of HG is multifactorial and involves hormonal, genetic, psychological, and environmental components. Elevated concentrations of human chorionic gonadotropin and estrogen, family history of HG, multiple gestation, maternal age, body mass index, and exposure to certain foods or odors have been identified as potential risk factors [9]. In recent years, nutritional factors have gained increasing attention, as dietary intake represents a modifiable exposure during the preconception and early gestational periods [1,2,10]. Several observational studies suggest that dietary patterns may influence the occurrence or severity of HG; nevertheless, most investigations focus on individual nutrients or specific food items rather than comprehensive dietary patterns [11]. Clinical guidelines emphasize the importance of early diagnosis, adequate nutritional support, and appropriate pharmacological therapy to prevent complications and improve maternal well-being [12].

This limitation reflects an important research gap. Current evidence remains fragmented and occasionally contradictory, with some studies indicating protective effects of balanced diets rich in protein, fruits, and vegetables, while others report increased risk associated with high-fat or high-sugar dietary patterns. To date, a structured synthesis of recent observational findings examining overall dietary patterns in relation to HG risk is still limited. Clarifying this relationship is essential to strengthen the scientific basis for preventive strategies.

Therefore, this systematic review aims to identify and critically analyze existing evidence on the association between dietary patterns and the risk of HG. By synthesizing recent literature, this study seeks to determine dietary patterns that may increase or decrease HG risk and to contribute to the development of evidence-based nutritional recommendations for women in the preconception and early pregnancy periods.

MATERIALS & METHODS

This systematic review was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines (Page et al., 2021) to ensure transparent and standardized reporting. The methodological approach was also aligned with the recommendations of the Cochrane Handbook for Systematic Reviews of Interventions (Higgins et al., 2022). As this review focused on observational evidence regarding dietary patterns and hyperemesis gravidarum, no meta-analysis was performed due to anticipated heterogeneity in exposure definitions and outcome measurements. This modification is consistent with methodological guidance suggesting narrative synthesis when statistical pooling is not appropriate.

A systematic literature search was conducted in PubMed, ScienceDirect, Google Scholar, and the Cochrane Library. The search covered publications from January 2014 to December 2024. The search strategy used Boolean operators combining the following keywords: “hyperemesis gravidarum” AND (“diet” OR “dietary pattern” OR “nutrition” OR “eating habits”) AND (“risk” OR “association” OR “relationship”) AND (“pregnancy” OR “pregnant women” OR “gestation”). All retrieved records were exported into reference management software to remove duplicates and facilitate screening. The

search strategy was adapted for each database while maintaining the core concepts to ensure comprehensiveness.

Two independent reviewers screened titles and abstracts based on the predefined eligibility criteria. Articles deemed potentially eligible were assessed in full text. Disagreements were resolved through discussion, and if necessary, consultation with a third reviewer. The inter-reviewer process was conducted to minimize selection bias and enhance reliability.

Methodological quality was assessed according to study design. Cohort and case-control studies were evaluated using the Newcastle–Ottawa Scale (Wells et al., 2014), which assesses selection, comparability, and exposure/outcome domains. Cross-sectional studies were appraised using the Joanna Briggs Institute Critical Appraisal Checklist for Analytical Cross-Sectional Studies (JBI, 2017). Quality assessment was performed independently by two reviewers. Studies were categorized as low, moderate, or high methodological quality based on standardized scoring criteria.

Data were extracted using a standardized extraction form that included study characteristics (author, year, country), study design, sample size, population characteristics, type of dietary exposure assessed, method of dietary assessment, definition of hyperemesis gravidarum, main findings, and reported effect estimates (e.g., odds ratio, relative risk, confidence interval).

Given the heterogeneity in dietary assessment methods and outcome definitions, a qualitative narrative synthesis was conducted. Findings were grouped according to dietary patterns associated with decreased risk and increased risk of hyperemesis gravidarum. The strength and consistency of associations were interpreted based on direction of effect, statistical significance, and study quality.

The study selection process is presented using a PRISMA flow diagram. Characteristics of included studies and quality appraisal results are summarized in tabular form. The synthesis emphasizes methodological rigor, strength of evidence, and implications for clinical and public health practice

RESULT & DISCUSSION

A total of 802 records were initially identified through comprehensive searches of PubMed, ScienceDirect, Google Scholar, and the Cochrane Library. After removing duplicate records, 86 unique articles remained for screening. These articles were subsequently evaluated based on title and abstract according to the predefined eligibility criteria, resulting in 27 studies deemed potentially relevant for full-text review. Following full-text assessment, studies were excluded if they did not meet the inclusion criteria, demonstrated low methodological quality, lacked clear outcome measures, or provided incomplete data relevant to dietary patterns and hyperemesis gravidarum. After this rigorous selection process, 5 studies fulfilled all eligibility criteria and were included in the final qualitative synthesis. The overall selection procedure is illustrated in the PRISMA flow diagram (Figure 1) (Table 1).

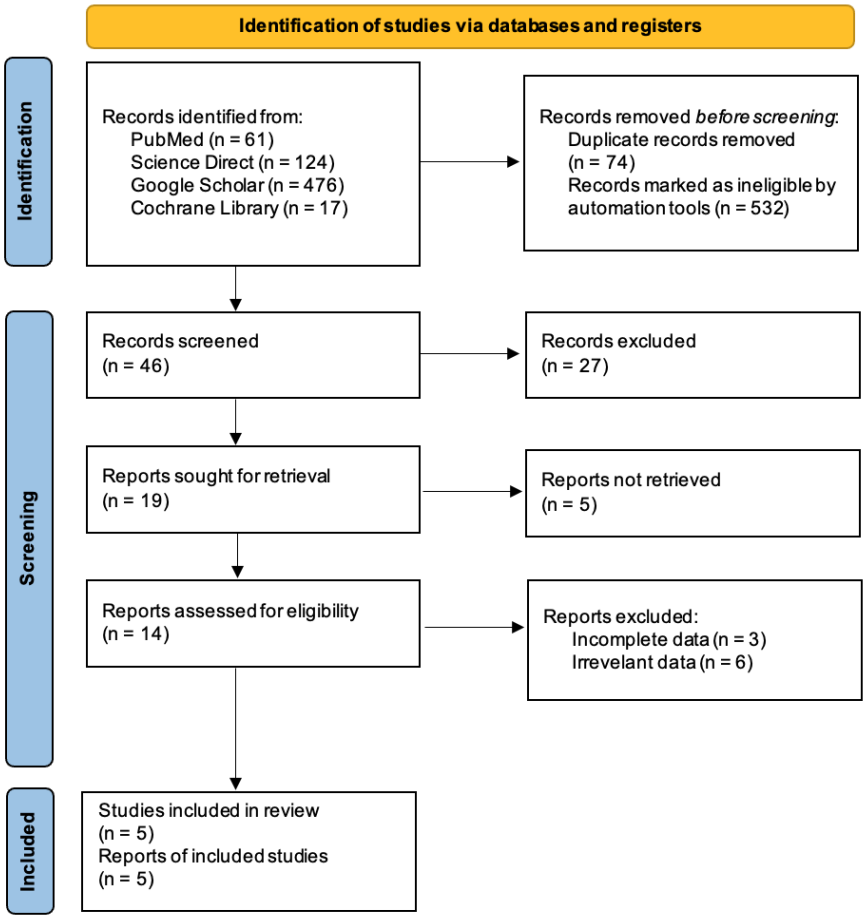

Figure 1. PRISMA (*Preferred Reporting Items for Systematic Reviews and Meta-Analyses*) Flowchart

The methodological quality of the included studies was assessed according to their respective study designs to identify potential sources of bias that could influence the validity of the findings. Case-control studies were evaluated using the Newcastle–Ottawa Scale (NOS), while cross-sectional studies were appraised using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross-Sectional Studies.

Table 1. Characteristics of Studies Included in the Systematic Review

Author	Year	Country	Study Design	Population	Main Findings
Cheng et al.	2023	China	Cross-sectional	2,515 pregnant women with and without HG	Dietary patterns rich in fish, shrimp, and meat were significantly associated with HG risk.
Montazer et al.	2024	Iran	Case-control	45 HG cases and 135 controls	Higher pre-pregnancy Mediterranean diet scores were associated with lower HG risk.
Zhi et al.	2024	China	Cross-sectional	2,033 pregnant women (167 HG; 1,866 non-HG)	High dietary inflammatory potential increased HG risk by 1.65-fold.
Ashebir et al.	2022	Ethiopia	Case-control	120 HG cases and 240 controls	Saturated fat intake was associated with a fourfold increased risk of HG.
Zhu et al.	2023	China	Cross-sectional	303 healthy first-trimester pregnant women	Women with nausea and vomiting had lower energy, protein, fat, vitamin, and mineral intake.

Cheng et al. (2023), a cross-sectional study, showed strong methodological rigor based on the JBI checklist. This cross-sectional study included 2,515 pregnant women aged 21–45 years (mean 31.2 ± 3.4 years), of whom 226 were diagnosed with HG. Dietary intake was assessed using a 110-item semi-quantitative food frequency questionnaire (FFQ) evaluating consumption over the previous year. The study reported that specific dietary patterns were significantly associated with HG risk [1]. These findings are consistent with previous literature indicating that dietary patterns and nutrient intake play an important role in the occurrence and severity of nausea and vomiting during pregnancy. Maslin et al. (2021) reported that women with hyperemesis gravidarum often demonstrate altered dietary intake patterns and reduced tolerance to certain foods, which may contribute to the development or worsening of symptoms [13,14].

Montazer et al. (2024), employing a case-control design, achieved a good quality rating on the Newcastle–Ottawa Scale. This case-control study involved 45 newly diagnosed HG cases and 126 non-HG controls recruited from hospitals in Tehran, Iran. Dietary intake during the year prior to pregnancy was assessed using a 168-item semi-quantitative FFQ to calculate the Mediterranean diet score. Higher adherence to the Mediterranean diet was significantly associated with reduced HG risk [5]. Similarly, Barroso-Ruiz et al. (2025) reported that higher adherence to the Mediterranean dietary pattern during early pregnancy was associated with lower severity of nausea and vomiting symptoms. These findings support the potential protective role of balanced dietary patterns rich in fruits, vegetables, whole grains, and unsaturated fats [15].

Zhi et al. (2024), a cross-sectional study, also met key methodological standards according to the JBI checklist. This cross-sectional study included 2,033 pregnant women from the China Birth Cohort Study. Dietary data were collected using a 108-item questionnaire assessing pre-pregnancy intake. The Dietary Inflammatory Index (DII) was calculated, and nausea severity was evaluated using the Pregnancy-Unique Quantification of Emesis (PUQE) score. A higher DII score (pro-inflammatory diet) was significantly associated with increased HG risk [16]. These results align with the growing evidence suggesting that pro-inflammatory dietary patterns may contribute to adverse pregnancy symptoms and metabolic disturbances. Rees and Brough (2025) emphasized that dietary inflammatory potential during pregnancy can influence maternal health outcomes and pregnancy-related symptoms [17].

Ashebir et al. (2022), using a case-control design, demonstrated good quality based on NOS assessment. This case-control study included 120 HG cases and 240 controls attending healthcare services. Data were obtained through structured face-to-face interviews covering demographic, reproductive, medical, psychological, and dietary factors. The findings demonstrated a significant association between dietary patterns—particularly saturated fat intake—and increased HG risk [9]. Previous research has also highlighted the importance of nutritional status and dietary composition in women with hyperemesis gravidarum. Maslin and Dean (2022) noted that inadequate or unbalanced dietary intake may worsen HG symptoms and contribute to maternal nutritional deficiencies [18].

Zhu et al. (2023), a cross-sectional study, fulfilled relevant JBI criteria, including valid exposure measurement and clearly defined outcomes. This cross-sectional study involved 303 first-trimester pregnant women recruited from ten cities in China. Dietary intake was assessed using a 24-hour dietary recall and a semi-quantitative FFQ evaluating the previous month's intake. Women experiencing nausea and vomiting in pregnancy, including HG, showed lower overall energy and micronutrient intake compared to those without symptoms [4]. Consistent with these findings, Erick (2022) emphasized that severe nausea and vomiting

during pregnancy may lead to significant nutritional deficiencies and gestational malnutrition if not appropriately managed [19].

The methodological quality assessment indicated that all included studies demonstrated a low risk of bias. Three cross-sectional studies [1,4,16] were evaluated using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Analytical Cross-Sectional Studies and met the majority of the quality criteria, indicating appropriate participant selection, valid exposure and outcome measurement, and suitable statistical analysis. The two case-control studies [5,9] were assessed using the Newcastle–Ottawa Scale and were rated as having low risk of bias, reflecting adequate case and control definition, comparability between groups, and appropriate control of confounding variables. Overall, the included evidence can be considered methodologically sound and reliable for qualitative synthesis (Table 2). This assessment is consistent with previous systematic reviews indicating that most recent observational studies investigating dietary patterns and hyperemesis gravidarum have demonstrated adequate methodological quality and provide valuable evidence for understanding the role of nutrition in pregnancy-related nausea and vomiting [11,20].

Table 2. Study Quality Assessment

Study	Design	Quality Assessment Tool	Risk of Bias
Cheng et al. (2023)	Cross-sectional	JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies	Low
Montazer et al. (2024)	Case-control	Newcastle–Ottawa Scale	Low
Zhi et al. (2024)	Cross-sectional	JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies	Low
Ashebir et al. (2022)	Case-control	Newcastle–Ottawa Scale	Low
Zhu et al. (2023)	Cross-sectional	JBI Critical Appraisal Checklist for Analytical Cross-Sectional Studies	Low

The included studies consistently demonstrate that specific dietary patterns significantly influence the risk of hyperemesis gravidarum. Diets rich in fish, eggs, shrimp, unprocessed meat, fruits, vegetables, legumes, seeds, dairy products, and adequate fluid intake are associated with a reduced risk of HGamong pregnant women. In contrast, dietary patterns characterized by high consumption of pro-inflammatory components, particularly saturated fats and carbonated or sweetened beverages, are associated with an increased risk. These findings suggest that nutritional intake represents a modifiable factor in the prevention and management of hyperemesis gravidarum. Ensuring balanced and adequate nutrient consumption during the preconception and early pregnancy periods is essential to reduce risk and support optimal maternal health outcomes. women experiencing hyperemesis gravidarum frequently exhibit inadequate dietary intake and nutritional deficiencies, highlighting the importance of early nutritional assessment and intervention [18]. Furthermore, Erick (2022) noted that prolonged nausea and vomiting during pregnancy may lead to gestational malnutrition if appropriate dietary management is not implemented [19].

The synthesized evidence indicates a consistent association between dietary patterns and the risk of HG. Cheng et al. (2023) reported that dietary patterns rich in fish, shrimp, and meat were associated with

a 37% reduction in HG risk, while consumption of eggs, milk, and adequate water intake was associated with a 58% lower risk. In contrast, frequent intake of carbonated and sweetened beverages increased the risk by 64% [1]. Similarly, Montazer et al. (2024) found that higher adherence to a Mediterranean dietary pattern—characterized by high consumption of fruits, vegetables, legumes, whole grains, fish, and olive oil, with limited red and processed meat—was associated with a 25% reduction in HG risk [5]. Conversely, Zhi et al. (2024) demonstrated that a pro-inflammatory diet high in saturated fats and added sugars increased HG risk by 65% [16]. Supporting these findings, Ashebir et al. (2022) reported that saturated fat intake increased the risk by 75%, absence of ginger consumption increased the risk by 67%, and inadequate vitamin B intake increased the risk by 54% [9].

Furthermore, Zhu et al. (2023) observed that lower intake of mushrooms, algae, legumes, seeds, meat, eggs, and dairy products was associated with a higher likelihood of nausea and vomiting in pregnancy, including HG [4]. Collectively, these findings emphasize the protective role of balanced, nutrient-dense dietary patterns and the detrimental impact of pro-inflammatory dietary components on HG risk (Table 3). Nishihara et al. (2023) reported that inadequate nutrient intake among pregnant women experiencing nausea and vomiting may negatively affect maternal nutritional status and pregnancy outcomes. Collectively, these findings emphasize the protective role of balanced, nutrient-dense dietary patterns and the detrimental impact of pro-inflammatory dietary components on HG risk [21].

Table 3. Study Analysis Results Based on Subgroup Analysis

Study	Dietary Pattern	Effect on Hyperemesis Gravidarum
Cheng et al. (2023)	Fish, shrimp, and meat	Reduced risk by 37%
	Eggs, milk, and adequate water intake	Reduced risk by 58%
	Carbonated and sweetened beverages	Increased risk by 64%
Montazer et al. (2024)	Mediterranean diet (high in fruits, vegetables, legumes, whole grains, fish, olive oil; low in	Reduced risk by 25%
Zhi et al. (2024)	Pro-inflammatory diet (high saturated fat and added sugars)	Increased risk by 65%
Ashebir et al. (2022)	Saturated fat intake	Increased risk by 75%
	No ginger consumption	Increased risk by 67%
	Inadequate vitamin B intake	Increased risk by 54%
Zhu et al. (2023)	Low intake of mushrooms, algae, legumes, seeds, meat, eggs, and dairy products	Associated with increased risk

The Effect of Diet on the Risk of Hyperemesis Gravidarum

This systematic review synthesized current evidence regarding the association between dietary patterns and the risk of HG. Overall, the findings consistently demonstrate that dietary intake represents a significant and modifiable factor influencing HG risk. Protective patterns were characterized by higher consumption of protein-rich foods, omega-3 sources, micronutrient-dense foods, and adequate hydration, whereas pro-inflammatory dietary components, particularly saturated fats and added sugars,

were associated with increased risk. These findings align with previous research highlighting that nutritional intake plays a critical role in the development and management of hyperemesis gravidarum, as women experiencing HG frequently present with inadequate energy and micronutrient intake due to persistent nausea and vomiting [18,22]

Protein-rich dietary patterns, including eggs, milk, seafood, legumes, and unprocessed meat, were consistently associated with reduced HG risk across studies [1,4,5]. This protective effect may be explained by improved metabolic stability and hormonal modulation during early pregnancy. Adequate protein intake supports glycemic stability, potentially preventing fluctuations that trigger nausea. Moreover, these foods provide essential micronutrients such as vitamin B6 and thiamine, both of which play roles in neurotransmitter regulation and have recognized antiemetic properties. The observed association between inadequate vitamin B intake and increased HG riskstrengthens the biological plausibility of this relationship [9]. Maslin et al. (2021) reported that women with hyperemesis gravidarum often experience inadequate protein and micronutrient intake, which may exacerbate symptom severity and compromise maternal nutritional status [13].

Adherence to the Mediterranean dietary pattern was also associated with reduced HG risk [5]. This pattern emphasizes fruits, vegetables, legumes, whole grains, fish, and olive oil, which collectively provide antioxidants and anti-inflammatory nutrients. The anti-inflammatory profile of such diets may be particularly relevant, as emerging evidence suggests that inflammatory pathways contribute to the severity of nausea and vomiting in pregnancy. Conversely, higher Dietary Inflammatory Index scores were associated with increased HG risk [16], reinforcing the role of systemic inflammation in HG pathophysiology. Barroso-Ruiz et al. (2025) demonstrated that greater adherence to the Mediterranean dietary pattern during early pregnancy was associated with reduced gastrointestinal symptoms, including nausea and vomiting [15].

Saturated fat intake and frequent consumption of carbonated or sweetened beverages were consistently linked to increased HG risk [1,9,16]. Diets high in saturated fats may enhance inflammatory cytokine production and alter gastrointestinal motility, potentially exacerbating nausea. Similarly, high intake of simple sugars may induce glycemic instability and autonomic responses that intensify nausea symptoms. These findings suggest that pro-inflammatory and metabolically destabilizing dietary components may contribute to HG development. Evidence from nutritional research also suggests that diets high in refined sugars and saturated fats are associated with systemic inflammation and metabolic disturbances during pregnancy, which may worsen pregnancy-related gastrointestinal symptoms [17,22].

Ginger consumption emerged as a potential protective factor [9]. Its antiemetic properties, mediated through modulation of serotonin and muscarinic receptors, support its role as a complementary dietary strategy in HG management. Previous clinical reviews have also identified ginger as a safe and effective complementary therapy for reducing nausea and vomiting during pregnancy [23].

From a clinical perspective, these findings highlight the importance of early nutritional counseling during the preconception and first-trimester periods. Dietary guidance emphasizing balanced protein intake, adequate hydration, anti-inflammatory food choices, and sufficient micronutrient consumption may serve as a preventive strategy for women at risk of HG [24]. Furthermore, early nutritional assessment is essential because women with severe nausea and vomiting are at increased risk of malnutrition and weight loss during pregnancy [25]

However, several limitations should be considered. Most included studies employed

cross-sectional or case-control designs, limiting causal inference. Dietary assessment relied largely on self-reported questionnaires, which are susceptible to recall bias. Additionally, variations in HG diagnostic criteria and dietary assessment tools may introduce heterogeneity across studies. Despite these limitations, the overall methodological quality was low risk of bias, supporting the reliability of the synthesized findings.

Future research should prioritize prospective cohort designs and standardized dietary assessment methods to clarify temporal relationships and strengthen causal interpretation. Randomized dietary intervention studies may further elucidate the preventive potential of specific dietary patterns in reducing HG risk.

In conclusion, this review provides evidence that dietary patterns are significantly associated with HG risk. Balanced, protein-rich, and anti-inflammatory dietary patterns appear protective, whereas saturated fat– and sugar-rich diets may increase susceptibility. Nutritional optimization represents a promising and modifiable approach to HG risk reduction in early pregnancy.

Research Limitations and Challenges

Several limitations should be considered when interpreting the findings of this review. First, the majority of included studies employed cross-sectional and case-control designs, which limit causal inference. The temporal relationship between dietary patterns and the onset of HG cannot be definitively established. Second, dietary intake was primarily assessed using self-reported food frequency questionnaires or dietary recalls, which are inherently susceptible to recall bias and misclassification. Pregnant women experiencing nausea and vomiting may underreport or inaccurately recall their dietary intake, potentially influencing the observed associations.

In addition, variability in dietary assessment tools, definitions of HG, and adjustment for confounding variables may contribute to heterogeneity across studies. Although most studies controlled for important covariates such as maternal age, body mass index, and parity, residual confounding cannot be excluded. Genetic susceptibility, hormonal variation, psychological factors, and environmental exposures may independently influence HG risk and were not uniformly accounted for in all studies. These factors may partially explain differences in reported effect sizes.

Recommendations for Future Research

Future research should prioritize prospective cohort studies to clarify the temporal relationship between dietary patterns and HG onset. Longitudinal designs would allow assessment of dietary changes before and during early pregnancy and their association with symptom progression. Standardization of HG diagnostic criteria and dietary assessment methods is also recommended to improve comparability across studies.

Moreover, well-designed dietary intervention trials are needed to evaluate whether modifying specific dietary components can effectively reduce HG incidence or severity. Such studies would provide stronger evidence for causal inference and enable the development of evidence-based nutritional guidelines tailored to women at risk of HG. Further exploration of biological mechanisms, including inflammatory pathways and hormonal regulation, may also enhance understanding of the pathophysiological links between diet and HG.

CONCLUSION

This systematic review demonstrates that dietary patterns significantly influence the risk of hyperemesis gravidarum. Diets rich in fish, eggs, seafood, unprocessed meat, fruits, vegetables, legumes, seeds, dairy products, and adequate hydration are associated with reduced risk, likely due to their high content of protein, unsaturated fatty acids, vitamins, and essential minerals.

In contrast, dietary patterns characterized by high saturated fat intake, carbonated beverages, and added sugars are associated with increased risk. These findings highlight the importance of balanced nutritional intake during the preconception and early pregnancy periods as a modifiable strategy to reduce HG susceptibility. Further longitudinal studies are required to clarify temporal relationships and strengthen causal evidence regarding dietary influences on hyperemesis gravidarum.

Declaration by Authors

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