JHWCR JOURNAL OF HEALTH, WELLNESS AND COMMUNITY RESEARCH 3007-0570

DOI: https://doi.org/10.61919/h5qsxs69

*Review Article*

# Maternal Nutrition Knowledge and Pregnancy Outcomes: A Narrative Review

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**"Cite this Article" Received**: 18 October 2025; **Accepted**: 02 December 2025; **Published**: 30 December 2025

**Author Contributions:** Concept: HM, HP; Design: HM, JS, HP; Data Collection: HM, JS, AK, ZH, SG; Analysis: HM, ZH, HP; Drafting: HM, JS, SG, HP. **Ethical Approval**: Health Services Academy, Islamabad. **Informed Consent**: NA; **Conflict of Interest**: The authors declare no conflict of interest. **Funding**: No external funding; **Data Availability**: Available from the corresponding author on reasonable request; **Acknowledgments**: NA

## ABSTRACT

Background: Maternal nutrition knowledge may influence dietary decision-making during pregnancy, yet knowledge, dietary practice, nutritional status, and clinical pregnancy outcomes are frequently treated as interchangeable constructs. The direct evidence linking nutrition knowledge with adverse maternal and neonatal outcomes remains uncertain. Objective: To narratively synthesize global and regional evidence on maternal nutrition knowledge and literacy, their determinants, relationships with dietary practice and pregnancy-related outcomes, and the effects of antenatal nutrition-education interventions. Methods: Targeted searches of PubMed/MEDLINE, ScienceDirect, and literature available through PubMed Central identified cross-sectional studies, prospective observational research, randomized controlled trials, and relevant evidence syntheses. Evidence was organized thematically around knowledge levels, socioeconomic and cultural determinants, knowledge–practice relationships, nutritional and pregnancy outcomes, and antenatal education interventions. Results: Nutrition knowledge was frequently incomplete and did not consistently translate into dietary practice. In Ethiopia, adequate knowledge was reported in 73.9% of pregnant women compared with adequate practice in 63.9%. In Ireland, only 25.7% reported adherence to periconceptional folic acid recommendations. Pakistani evidence demonstrated early-pregnancy dietary inadequacy and significant effects of food myths and taboos on dietary choices. Randomized trials showed that structured nutrition interventions could improve literacy, dietary behavior, and gestational weight management; one trial reported gestational weight gain of 13.21±3.61 kg versus 16.18±4.70 kg (p=0.002), while another reduced excessive gestational weight gain from 46.0% to 27.9% (p=0.01). Effects on neonatal anthropometry and other hard clinical outcomes were less consistent. Conclusion: Maternal nutrition knowledge is a modifiable contributor to dietary behavior but should not be regarded as an independent causal determinant of pregnancy outcome. Effective antenatal programs should combine early education with individualized, culturally responsive, and practically feasible dietary support. Keywords: Maternal Nutrition; Pregnancy; Health Literacy; Nutrition Knowledge; Dietary Diversity; Antenatal Care; Gestational Weight Gain; Nutrition Education

## INTRODUCTION

Pregnancy is characterized by substantial physiological and metabolic adaptations that increase nutritional requirements to support maternal tissue expansion, placental development, fetal growth, and preparation for lactation. Maternal nutritional status and dietary quality during this period are consequently important components of maternal and fetal health, with inadequate or imbalanced nutrition potentially affecting fetal growth and several pregnancy-related outcomes (1). Nutritional requirements cannot, however, be considered solely in terms of nutrient availability or biological need. Pregnant women must also be able to recognize appropriate dietary choices, understand nutritional

recommendations, and translate this information into everyday dietary practices. These behavioral and cognitive dimensions have therefore become increasingly important components of maternal nutrition research.

Nutrition knowledge and nutrition literacy represent related but distinct constructs within this pathway. Nutrition knowledge refers principally to factual understanding of nutrients, dietary recommendations, food sources, and nutritional requirements, whereas nutrition literacy encompasses the broader competencies required to obtain, understand, evaluate, and apply nutrition information when making dietary decisions. A recent scoping review of nutrition knowledge and nutrition literacy among pregnant women found that knowledge was generally suboptimal across the available literature and that evidence directly connecting these constructs with pregnancy complications or adverse birth outcomes remained limited (2). This distinction is important because nutritional knowledge should not be equated with nutritional status or dietary intake, nor should knowledge alone be assumed to produce clinical outcomes. Rather, knowledge may influence dietary behavior within a wider pathway shaped by socioeconomic resources, food availability, cultural practices, health-service contact, and individual circumstances.

The transition from knowledge to practice is particularly important during pregnancy. Even in settings where women demonstrate moderate levels of nutritional awareness, adherence to dietary recommendations may remain inadequate. Among pregnant women attending health centers in Addis Ababa, for example, 73.9% demonstrated adequate dietary knowledge whereas only 63.9% demonstrated adequate dietary practice, indicating that increased knowledge does not necessarily translate directly into appropriate dietary behavior (3). Evidence from a comparatively highly educated Irish population similarly identified deficiencies in the translation of nutritional recommendations into practice; although nutritional supplementation was common, adherence to recommended periconceptional folic acid use remained limited, and access to pregnancy-specific nutritional advice was also inadequate (4). These findings suggest that the knowledge–practice gap is not restricted to low-resource populations and that information provision alone may be insufficient to achieve optimal maternal dietary behavior.

The determinants of maternal nutrition knowledge are similarly multidimensional. Available evidence indicates that educational attainment and household income are among the most consistently identified influences on nutrition knowledge and literacy, while occupation, family context, and access to health information may also contribute (2,3). Antenatal care provides an especially important opportunity for nutrition communication because repeated contact with healthcare professionals can provide pregnant women with timely information during a period when dietary requirements and behaviors may be changing. Nevertheless, the effectiveness of such communication is influenced by the accessibility, consistency, cultural appropriateness, and practical applicability of the advice provided. Socioeconomic constraints can further limit the extent to which knowledge can be translated into dietary action, because awareness of recommended foods does not ensure that those foods are financially or physically accessible.

These issues are particularly relevant in low- and middle-income settings, where inadequate dietary diversity may coexist with socioeconomic disadvantage, food insecurity, cultural dietary restrictions, and uneven access to professional nutrition counselling. In Pakistan, evidence from first-trimester pregnant women attending antenatal clinics in Karachi identified inadequate intake across several major food groups, demonstrating that dietary inadequacy can already be present during early pregnancy (5). Studies from Pakistani communities have additionally documented pregnancy-related food beliefs, myths, and taboos that can influence dietary choices. Such observations emphasize that maternal nutrition behavior is embedded within a social and cultural context and cannot be explained solely by individual knowledge.

At the same time, improving maternal nutrition knowledge remains a potentially modifiable component of antenatal care. Nutrition-education and counselling interventions have increasingly been evaluated

as strategies for modifying dietary behavior and gestational weight gain. Recent evidence indicates that antenatal nutrition education can improve nutritional knowledge and practice, while broader intervention literature suggests more consistent effects on behavioral and weight-related outcomes than on relatively uncommon clinical endpoints. Importantly, evidence that an intervention improves nutritional knowledge or gestational weight management should not automatically be interpreted as evidence that nutrition knowledge itself prevents low birth weight, preterm birth, hypertensive disorders, or other adverse pregnancy outcomes. The available evidence instead supports a multistep conceptual pathway in which knowledge and literacy may influence dietary decisions, which in turn interact with maternal nutritional status, socioeconomic circumstances, healthcare access, and other biological and contextual determinants of pregnancy outcomes (2).

A further limitation of the existing literature is its methodological distribution. Much of the research specifically examining nutrition knowledge during pregnancy consists of cross-sectional surveys that evaluate knowledge and practice at a single point in time. Such designs can identify patterns and associated factors but are inherently limited in establishing temporality or causality. The recent scoping review identified only one study among its 11 included studies that directly assessed nutrition knowledge in relation to adverse birth or neonatal outcomes, and the outcomes investigated were limited to hypertensive disorders of pregnancy and preterm labor (2). Consequently, the evidence supporting associations between maternal nutritional status or dietary intake and pregnancy outcomes is substantially more developed than the evidence demonstrating a direct pathway from nutrition knowledge to clinical endpoints.

Against this background, an integrated narrative synthesis is warranted to distinguish what is currently established from what remains uncertain. Existing evidence spans knowledge-attitude-practice surveys, observational investigations of dietary behavior and nutritional status, intervention studies evaluating antenatal nutrition education, and broader reviews of maternal nutrition. These bodies of evidence address different stages of the pathway between knowledge, behavior, nutritional status, and maternal or neonatal outcomes and should therefore not be interpreted interchangeably. A narrative approach allows these heterogeneous forms of evidence to be considered together while retaining distinctions in study design, exposure definition, and strength of inference.

Accordingly, this narrative review aims to synthesize global and regional evidence concerning maternal nutrition knowledge during pregnancy; identify sociodemographic, cultural, and health-system factors associated with variations in that knowledge; examine the available evidence linking nutrition knowledge and dietary practice with maternal and neonatal outcomes; and evaluate evidence concerning structured nutrition-education interventions delivered during antenatal care. The review specifically addresses the question of how maternal nutrition knowledge relates to dietary behavior and pregnancy outcomes, while distinguishing direct evidence concerning knowledge from the broader evidence concerning maternal diet and nutritional status.

## MATERIAL AND METHODS

This study was conducted as a narrative literature review designed to integrate heterogeneous evidence concerning maternal nutrition knowledge, nutrition literacy, dietary practice, antenatal nutrition education, and pregnancy-related outcomes. A narrative approach was considered appropriate because the review question encompasses multiple related constructs and incorporates evidence from different methodological traditions, including cross-sectional knowledge-attitude-practice studies, prospective observational research, randomized controlled trials of nutrition-education interventions, and evidence syntheses. The purpose was therefore interpretive and integrative rather than statistical pooling of a narrowly defined intervention or exposure.

Relevant peer-reviewed literature was identified through targeted searches of biomedical and public-health information sources, including PubMed/MEDLINE, ScienceDirect, and journal literature

available through PubMed Central. Searches used combinations and conceptual variants of the terms maternal nutrition knowledge, nutrition literacy, pregnancy nutrition, dietary practice, dietary diversity, pregnancy outcomes, gestational weight gain, antenatal nutrition education, and birth outcomes. The search strategy was intentionally broad enough to capture literature addressing both the cognitive dimensions of maternal nutrition and the behavioral or clinical outcomes potentially associated with them.

Priority was given to literature published during approximately the preceding decade in order to emphasize contemporary evidence, while older studies were retained when they provided relevant foundational or context-specific evidence not adequately represented in more recent literature. The evidence base included studies conducted in both high-income countries and low- and middle-income countries. Particular attention was given to evidence from Ethiopia, South Africa, and Pakistan because these settings contributed empirical data concerning maternal nutritional knowledge, dietary diversity, socioeconomic determinants, cultural dietary practices, and antenatal nutrition behaviors relevant to the objectives of the review.

Literature was organized according to four predefined domains derived from the review objectives: the reported level of maternal nutrition knowledge or nutrition literacy during pregnancy; sociodemographic, cultural, and health-system determinants of knowledge; evidence concerning relationships among nutrition knowledge, dietary practice, maternal nutritional status, and maternal or neonatal outcomes; and the effects of structured antenatal nutrition-education or counselling interventions. Evidence was interpreted according to study design so that findings from cross-sectional studies were treated primarily as associative, whereas randomized intervention studies were considered separately when assessing the effects of structured nutrition education. Evidence concerning maternal nutritional status or dietary intake was likewise distinguished from evidence specifically evaluating nutrition knowledge or nutrition literacy to avoid attributing clinical effects of nutrition directly to knowledge when that pathway had not been empirically demonstrated.

The synthesis followed a thematic and conceptual approach rather than a quantitative meta-analytic framework. Findings were compared across geographical and socioeconomic contexts, with attention to recurring determinants, the consistency of knowledge–practice relationships, and differences between behavioral outcomes and clinical maternal or neonatal endpoints. Numerical findings reported by individual studies were retained where they helped characterize the magnitude of knowledge deficits, dietary-practice gaps, or intervention effects, but results were not statistically pooled because of differences in study populations, definitions of nutrition knowledge and literacy, outcome measures, and study designs.

Given the narrative design, the literature-search and selection process was targeted rather than exhaustive. The purposive emphasis on recent studies, geographically informative evidence, and studies directly addressing the conceptual domains of the review may therefore introduce selection bias, and the resulting evidence base should not be interpreted as a complete census of all published maternal-nutrition research. In addition, heterogeneity in definitions and instruments used to measure nutrition knowledge, nutrition literacy, dietary practice, and pregnancy outcomes limits direct comparison across studies. These methodological characteristics were considered when interpreting the consistency and strength of the synthesized evidence.

## RESULTS

The literature identified for this narrative review encompassed several distinct but complementary evidence domains: studies measuring maternal nutrition knowledge or nutrition literacy, studies examining dietary behavior and nutritional status during pregnancy, observational studies relating nutritional characteristics to maternal or neonatal outcomes, and intervention studies evaluating antenatal nutrition education or individualized dietary counselling. Because these domains differ

substantially in their exposure definitions, study designs, measurement instruments, and outcomes, their findings were synthesized thematically rather than pooled quantitatively. Particular emphasis was placed on distinguishing direct evidence concerning nutrition knowledge from indirect evidence concerning dietary intake or maternal nutritional status.

*Table 1. Summary of Key Evidence Concerning Maternal Nutrition Knowledge, Dietary Practice, and Pregnancy-Related Outcomes*

| Study | Country/Setting | Design and Sample | Exposure/Intervention | Principal Findings |
|---|---|---|---|---|
| **Oladebo et al. (2)** | International | Scoping review; 11 included studies | Nutrition knowledge/nutrition literacy | Nutrition knowledge was generally low; education and income were dominant determinants. Only one included study directly examined knowledge in relation to adverse birth/neonatal outcomes. |
| **Tesfa et al. (3)** | Ethiopia | Cross-sectional; n=363 pregnant women | Maternal nutritional knowledge and practice | 73.9% had adequate dietary knowledge, whereas 63.9% demonstrated adequate dietary practice. Knowledge was associated with socioeconomic, obstetric, and ANC-related factors. |
| **McCarthy et al. (4)** | Ireland | Cross-sectional; n=334 pregnant women | Access to nutrition advice, knowledge, attitudes, practices | Only about two-fifths received nutrition advice. Previous nutrition education was associated with higher knowledge scores (80.0% vs. 73.3%, p<0.001), whereas receiving pregnancy advice was not associated with higher knowledge scores (p=0.6). Only 25.7% reported adherence to periconceptional folic acid guidance. |
| **Vadsaria et al. (5)** | Karachi, Pakistan | Hospital-based cross-sectional; n=306 first-trimester women | Dietary quantity and quality | Dietary inadequacy affected several major food groups during the first trimester; vegetable, protein, and dairy intake were particularly problematic. |
| **Ijaz et al. (6)** | Lahore and Faisalabad, Pakistan | Cross-sectional survey; n=150 pregnant women | Nutrition information, beliefs, myths and taboos | Pregnancy-related food myths and taboos significantly influenced dietary choices (p=0.001). |
| **Masilela and Modjadji (7)** | Mbombela, South Africa | Cross-sectional; n=400 mother–child pairs | Maternal nutrition-related knowledge | 66% had average knowledge, 28% fair knowledge, 6% good knowledge and none excellent knowledge. Maternal knowledge was associated with child stunting; average knowledge was associated with stunting in adjusted analysis (AOR 1.92, 95% CI 1.12–3.29). |
| **Habib et al. (8)** | Kurram District, Pakistan | Community-based cross-sectional; n=2,195 pregnant and lactating women | Maternal nutritional status and socioeconomic determinants | MUAC-defined undernutrition prevalence was 16.3% (95% CI 14.8–17.9) and was related to younger age, education, household economic circumstances, and sanitation-related factors. |
| **Lubrano et al. (9)** | Italy | Prospective observational; n=143 low-risk pregnancies | Healthy-diet/lifestyle adherence and nutritional status | Nutritional score was associated with maternal hemodynamic characteristics; maternal hemodynamics were additionally associated with birth and placental weight. |
| **Li and Wang (10)** | China | Randomized controlled trial; 88 enrolled, 83 analyzed | 12-week nutrition-literacy intervention | Nutrition literacy improved significantly; gestational weight gain was 13.21±3.61 kg versus 16.18±4.70 kg in controls (p=0.002), with improvements in several dietary-quality indicators. |
| **Goodarzi-Khoigani et al. (11)** | Iran | Randomized controlled trial; n=192 | Individualized nutrition education | Excessive gestational weight gain occurred in 27.9% of the intervention group versus 46.0% of controls (p=0.01); total GWG was 13.11±3.95 versus 15.37±5.16 kg (p=0.001). Birth anthropometric indices did not differ significantly. |
| **Dodd et al. (12)** | Australia | Randomized controlled trial | Dietitian-led dietary, lifestyle and exercise advice | Birth weight >4 kg occurred in 7.59% versus 8.31% of infants (aRR 0.91, 95% CI 0.54–1.55; p=0.732); no significant differences were detected in total GWG or major pregnancy/birth outcomes despite improved diet quality. |
| **Fujimoto et al. (13)** | Japan | Randomized controlled trial; n=130 | Individualized nutrition education | Post-intervention protein intake did not differ significantly between groups (p=0.051), although the increase in protein intake was 7.4 g/day greater in the intervention group (p=0.040; effect size 0.36). |

### *Maternal Nutrition Knowledge and Nutrition Literacy*

Across geographically diverse settings, the available evidence indicates that maternal nutrition knowledge and nutrition literacy are frequently incomplete, although the magnitude and nature of the deficiencies vary substantially. The most direct synthesis is provided by the scoping review of Oladebo et al., which included 11 studies and concluded that nutrition knowledge among pregnant women was generally low, while research specifically addressing nutrition literacy was considerably less developed (2). Education, income, occupation, and family influences emerged as recurrent determinants, with maternal education and household income showing particularly consistent relationships with knowledge.

Individual studies demonstrate that nutritional awareness should not be considered a binary adequate/inadequate construct. Among 363 pregnant women attending health centers in Addis Ababa,

73.9% demonstrated adequate dietary knowledge, yet adequate dietary practice was reported in only 63.9%, leaving a substantial discrepancy between understanding and behavior (3). Knowledge was associated with multiple contextual factors, including socioeconomic characteristics, family circumstances, health status, pregnancy interval, and antenatal-care attendance. This pattern is important because it indicates that apparently acceptable knowledge prevalence can coexist with weaker practical implementation.

Evidence from Ireland demonstrates that the knowledge–practice problem is not confined to low- and middle-income settings. Among 334 pregnant women, previous nutrition education was associated with higher knowledge scores, but receipt of nutrition advice during the current pregnancy itself was not associated with better knowledge scores (4). Although supplement use was common, only 25.7% of participants reported adherence to periconceptional folic acid recommendations. These findings demonstrate that high educational attainment, access to healthcare, or awareness of the importance of supplementation does not guarantee adherence to specific nutritional recommendations.

Maternal nutrition-related knowledge has also been associated with child nutritional outcomes, although such studies require cautious interpretation in relation to pregnancy outcomes. In Mbombela, South Africa, 66% of mothers had average nutrition-related knowledge, 28% had fair knowledge, 6% had good knowledge, and none had excellent knowledge (7). Maternal knowledge was significantly associated with childhood stunting, including an adjusted association for average knowledge compared with the reference category. Because this study evaluated mother–child pairs after pregnancy and involved feeding-related knowledge in addition to maternal nutrition concepts, it provides evidence of an intergenerational association rather than direct proof that prenatal nutrition knowledge determines fetal growth.

### *Knowledge, Dietary Practice, and Contextual Determinants*

The relationship between knowledge and dietary behavior was consistently modified by socioeconomic and cultural circumstances. The Ethiopian evidence showing a higher prevalence of adequate knowledge than adequate dietary practice illustrates this directly (3). In Pakistan, dietary behavior appears additionally influenced by pregnancy-specific cultural beliefs. A survey of 150 pregnant women from Lahore and Faisalabad identified highly significant effects of food myths and taboos on dietary choices ($p=0.001$), indicating that dietary decision-making can conflict with biomedical recommendations even when women have access to nutritional information (6).

Evidence concerning actual dietary intake reinforces the distinction between knowledge and practice. Among 306 first-trimester pregnant women attending an urban tertiary-care setting in Karachi, adequate quantity and quality of intake varied markedly between food groups (5). Particularly low adequacy was observed for several vegetables, protein sources, and milk or dairy products. The presence of dietary inadequacy during the first trimester is clinically relevant to the timing of nutrition education because fetal and placental development are already underway when many women first establish regular antenatal contact.

Structural determinants further constrain the practical value of nutrition knowledge. In a large community-based investigation of 2,195 pregnant and lactating women in Kurram District, MUAC-defined undernutrition was present in 16.3% (95% CI 14.8–17.9), with socioeconomic, educational, age-related, household, and sanitation factors contributing to nutritional vulnerability (8). This study did not measure nutrition knowledge as its primary exposure, but it provides important contextual evidence that the ability to follow nutritional recommendations is partly determined by material and environmental conditions. Accordingly, knowledge interventions delivered without consideration of affordability, household food availability, and family decision-making may have limited effects on actual nutrient intake.

### *Maternal Nutrition and Pregnancy Outcomes*

Direct evidence linking nutrition knowledge itself to clinical pregnancy outcomes remains substantially weaker than evidence linking maternal nutritional status or dietary characteristics to such outcomes. The scoping review found that only one of its 11 included studies directly examined nutrition knowledge in relation to adverse birth or neonatal outcomes, with the outcomes restricted to hypertensive disorders of pregnancy and preterm labor (2). Consequently, low birth weight, preterm birth, gestational diabetes, hypertensive disorders, or other obstetric outcomes cannot currently be attributed directly to deficient knowledge on the basis of the available evidence.

More developed evidence exists further downstream in the conceptual pathway. Maternal dietary quality and nutritional status have established relationships with fetal growth and pregnancy physiology (1,14). In the prospective study by Lubrano et al., 143 women with low-risk singleton pregnancies underwent nutritional and hemodynamic assessment near term (9). A higher nutritional adherence score was positively associated with maternal inotropy, while maternal hemodynamic variables were related to birth and placental weights. These findings provide biological plausibility for relationships between maternal diet and pregnancy outcome but should not be interpreted as evidence that knowledge independently produces these effects.

The distinction between nutritional knowledge, dietary behavior, and nutritional status is therefore fundamental. Knowledge can plausibly influence food selection; dietary behavior can influence energy and nutrient exposure; nutritional status interacts with maternal metabolic and physiological conditions; and these factors may subsequently influence pregnancy outcomes. However, socioeconomic resources, food access, cultural practices, pre-pregnancy nutritional status, comorbidities, obstetric factors, and healthcare access can affect multiple stages of this pathway. Cross-sectional associations between knowledge and practice cannot by themselves establish that changing knowledge will alter clinical endpoints.

### *Effects of Nutrition-Education Interventions*

Randomized intervention studies provide the strongest evidence that actively improving nutrition literacy or delivering individualized dietary education can alter selected maternal behaviors and weight-related outcomes. Li and Wang evaluated a 12-week nutrition-literacy intervention initiated early in pregnancy. Among 83 women included in the analysis, overall nutrition literacy, knowledge literacy, several measures of dietary quality, and eating-related behaviors improved relative to routine care (10). Total gestational weight gain was also significantly lower in the intervention group, at 13.21±3.61 kg compared with 16.18±4.70 kg in controls ($p=0.002$). These findings provide experimental support for a pathway from structured educational intervention to measurable behavioral and maternal weight outcomes.

Similarly, an Iranian randomized trial involving 192 pregnant women demonstrated that individualized nutrition education reduced the proportion experiencing excessive gestational weight gain from 46.0% in controls to 27.9% in the intervention group ($p=0.01$) (11). Mean total gestational weight gain was also lower following intervention (13.11±3.95 versus 15.37±5.16 kg; $p=0.001$). However, birth weight, length, and head circumference did not differ significantly between groups. The contrast between the clear maternal weight effect and the absence of a detectable neonatal anthropometric effect illustrates why successful modification of an intermediate outcome cannot automatically be interpreted as improvement in all downstream clinical outcomes.

The OPTIMISE randomized trial further illustrates this distinction. Dietitian-led dietary and lifestyle advice improved aspects of maternal diet but did not significantly reduce the proportion of infants weighing more than 4 kg at birth: 7.59% in the lifestyle-advice group versus 8.31% under standard care (aRR 0.91, 95% CI 0.54–1.55; $p=0.732$) (12). Significant differences in total gestational weight gain and other major pregnancy or birth outcomes were likewise not demonstrated. Thus, intervention efficacy

appears dependent on the population, baseline nutritional risk, intervention content, behavioral target, and selected outcome.

Evidence from Japan provides an additional example of heterogeneous response. In a randomized trial of 130 pregnant women, individualized nutrition education did not significantly change the primary post-intervention comparison of protein intake (p=0.051), although the intervention group demonstrated a 7.4 g/day greater increase in protein intake from baseline than controls (p=0.040; effect size 0.36) (13). Taken together, these trials suggest that structured and individualized nutrition education can modify knowledge, selected dietary behaviors, and gestational weight trajectories, but effects are less consistent for specific nutrient targets and hard maternal or neonatal outcomes.

## DISCUSSION

This narrative review indicates that maternal nutrition knowledge and nutrition literacy are important components of pregnancy-related dietary behavior, but the evidence does not support a simple or direct causal model in which inadequate knowledge independently produces adverse pregnancy outcomes. Three findings are particularly consistent. First, measurable knowledge deficiencies remain present across diverse socioeconomic settings, although their form and severity differ. Second, knowledge does not reliably translate into appropriate dietary practice because socioeconomic resources, cultural beliefs, food access, household dynamics, and healthcare exposure modify behavior. Third, randomized education and counselling interventions more consistently influence nutrition literacy, dietary behavior, and gestational weight gain than hard clinical outcomes such as fetal overgrowth, birth anthropometry, preterm birth, or hypertensive complications.

The distinction between knowledge and nutrition itself is central to interpretation of the literature. Maternal nutritional status and dietary intake have long been associated with fetal development and birth outcomes, with the magnitude and direction of these relationships influenced by baseline maternal status, timing of nutritional exposure, and socioeconomic circumstances (1,14). Nutrition knowledge lies further upstream. It may influence dietary choices, but its effect is mediated by whether women possess the financial, social, cultural, and practical resources necessary to act on that information. Consequently, an association between dietary inadequacy and poor pregnancy outcomes should not be cited as equivalent evidence for an association between deficient nutrition knowledge and those same outcomes.

The Ethiopian findings offer a particularly clear demonstration of this knowledge–practice discontinuity. Although almost three-quarters of women demonstrated adequate nutritional knowledge, the corresponding prevalence of adequate dietary practice was approximately 10 percentage points lower (3). Similar conceptual discrepancies are apparent in the Irish study, where knowledge and positive attitudes toward supplementation coexisted with limited adherence to periconceptional folic acid guidance (4). Together, these data suggest that interventions relying exclusively on transfer of factual information may reach a ceiling unless they also address behavioral skills, access barriers, and practical implementation.

Cultural influences further complicate this pathway. Pregnancy-related food restrictions have been documented in Pakistan for decades, and contemporary evidence indicates that myths and taboos continue to influence maternal dietary choices (6,15,16). Such beliefs may involve avoidance of foods perceived as harmful to the fetus, concerns regarding fetal size or delivery difficulty, culturally defined concepts of “hot” and “cold” foods, or restrictions reinforced within the household. These factors can persist despite biomedical advice. Culturally responsive nutrition counselling should therefore assess not only what pregnant women know but also which beliefs, family expectations, and practical constraints influence what they actually eat.

Socioeconomic circumstances are equally important. The association of maternal education and income with nutrition knowledge identified in the scoping review and Ethiopian evidence is unlikely to reflect

knowledge acquisition alone (2,3). Education may increase the ability to obtain and interpret health information, while income determines the range and affordability of foods available to the household. The Kurram District findings reinforce this structural dimension by demonstrating substantial maternal undernutrition associated with socioeconomic and environmental vulnerability (8). Therefore, nutrition education should not be treated as a substitute for interventions addressing food insecurity, poverty, sanitation, and access to nutritionally adequate foods.

Antenatal care nevertheless provides a practical platform for intervention because it permits repeated engagement during pregnancy and can integrate knowledge with individualized assessment. The available randomized trials indicate that structured interventions can improve selected intermediate outcomes. The nutrition-literacy intervention evaluated by Li and Wang produced substantial improvements in literacy and dietary-quality measures together with significantly lower gestational weight gain (10). Likewise, individualized nutrition education in Iran reduced both mean gestational weight gain and the proportion of women exceeding recommended weight-gain ranges (11). These effects are clinically relevant because excessive or inadequate gestational weight gain can identify nutritional imbalance and may contribute to later maternal or fetal risk.

However, the intervention literature also warns against assuming that behavioral improvement automatically yields detectable neonatal benefit. In the Iranian trial, improvements in gestational weight gain were not accompanied by significant differences in neonatal anthropometric measures (11). The OPTIMISE trial similarly demonstrated no significant reduction in infant birth weight above 4 kg or other major pregnancy outcomes despite dietary improvement (12). In Japan, individualized education yielded a statistically significant increase in change in protein intake but did not meet significance for the primary between-group post-intervention protein comparison (13). These discordant findings likely reflect differences in baseline risk, intervention intensity, timing, adherence, outcome frequency, statistical power, and the multifactorial determinants of obstetric endpoints.

The available evidence therefore favors a pathway model rather than a direct-effect model. Nutrition knowledge and literacy may improve recognition of appropriate food choices and recommendations; effective counselling may then facilitate dietary modification; improved dietary behavior may influence gestational weight gain and maternal nutritional status; and these intermediate changes may contribute to maternal or neonatal outcomes alongside numerous biological and social determinants. This conceptual model is consistent with the observed stronger intervention effects on proximal behavioral and weight outcomes than on distal clinical outcomes. It also explains why cross-sectional knowledge scores alone are insufficient to predict birth outcomes reliably.

Several limitations of the evidence base must be considered. Much of the literature specifically examining nutrition knowledge is cross-sectional, preventing firm temporal or causal inference. Definitions and instruments for nutrition knowledge, nutrition literacy, dietary diversity, and dietary practice vary across studies, reducing comparability. The available evidence is geographically heterogeneous but remains unevenly distributed, and the scoping review identified relatively little direct evidence from high-income settings examining nutrition literacy against clinical pregnancy outcomes (2). Studies also differ considerably in socioeconomic context and healthcare access, limiting the transferability of a knowledge threshold or intervention effect from one population to another.

This narrative review itself has methodological limitations. The literature was identified through targeted rather than exhaustive searching, and no formal systematic screening process or study-level risk-of-bias assessment was undertaken. Study selection may therefore be affected by selection and publication bias. The synthesis intentionally incorporates heterogeneous evidence—including cross-sectional surveys, prospective observational studies, randomized trials, and secondary evidence syntheses—which broadens conceptual coverage but precludes quantitative pooling and limits direct comparison of effect magnitude. In addition, several studies concern dietary status or postnatal child

outcomes rather than direct prenatal knowledge-to-birth-outcome relationships. These sources provide contextual or mechanistic support but should not be interpreted as direct evidence of causation.

For clinical practice, the findings support integration of nutrition education into routine antenatal care beginning early in pregnancy, but the educational content should move beyond generic lists of recommended foods. Counselling should assess baseline knowledge, dietary practices, cultural restrictions, household resources, and the woman's ability to implement recommendations. Individualized goal setting, repeated reinforcement, and practical dietary planning appear more consistent with the intervention evidence than one-time information provision (10–13). In settings where household members influence food purchasing or dietary restrictions, family engagement may improve the feasibility of dietary change.

At the public-health level, educational interventions should be aligned with broader measures addressing food affordability, dietary diversity, and access to maternal health services. Frontline nurses, midwives, dietitians, community health workers, and other antenatal providers require consistent evidence-based messages so that women are not exposed to contradictory recommendations. Particular attention is warranted during the first trimester because dietary inadequacy is already demonstrable at early antenatal presentation in Pakistan (5).

Future research should move beyond cross-sectional knowledge-attitude-practice surveys. Prospective cohort studies should measure nutrition knowledge or literacy early in pregnancy, repeatedly assess actual dietary behavior, account for socioeconomic and clinical confounding, and follow women through delivery. Randomized trials should clearly distinguish knowledge acquisition, dietary behavior, nutritional status, gestational weight gain, biochemical endpoints, and clinical maternal or neonatal outcomes as separate stages of the causal pathway. Standardized and validated instruments for pregnancy-specific nutrition literacy would improve comparability, while adequately powered trials are needed for relatively uncommon endpoints such as preterm birth and hypertensive disorders. Studies should also examine whether intervention effectiveness differs according to baseline education, food security, parity, body-mass index, cultural dietary practices, and timing of antenatal initiation.

Overall, maternal nutrition knowledge appears to be a modifiable contributor to dietary decision-making rather than an isolated determinant of pregnancy outcome. The most clinically useful strategy is therefore unlikely to be knowledge transfer alone. Antenatal nutrition programs should combine accurate information with individualized counselling and practical support that enables women to translate knowledge into sustainable dietary behavior within their socioeconomic and cultural circumstances.

## CONCLUSION

Maternal nutrition knowledge and nutrition literacy are associated with dietary decision-making during pregnancy, but current evidence does not establish a direct causal relationship between knowledge alone and major maternal or neonatal clinical outcomes. Observational studies consistently demonstrate gaps between nutritional knowledge and dietary practice, while socioeconomic conditions, food access, antenatal-care exposure, and cultural beliefs substantially influence whether nutritional recommendations can be implemented. Randomized trials provide stronger evidence that structured and individualized nutrition education can improve nutrition literacy, selected dietary behaviors, and gestational weight management, although effects on birth anthropometry and other hard clinical endpoints remain inconsistent. Antenatal nutrition strategies should therefore combine early, evidence-based education with culturally responsive counselling and practical support addressing barriers to dietary change. Future prospective studies and adequately powered intervention trials should evaluate the complete pathway from knowledge and literacy through dietary behavior and nutritional status to maternal and neonatal outcomes.

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