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MATERNAL NUTRITION AND PREGNANCY OUTCOMES: A SYSTEMATIC LITERATURE REVIEW

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Abstract

Moral nutrition during pregnancy is a determinant factor of the pregnancy outcome, which has both short-term and long-term implications of not only the maternal and baby health, but also the risk of disease in the future generations. Despite the massive advancement of the specific effects of nutrients, gaps remain in the comparative efficacy of different nutritional interventions, the adherence effect, and the mechanistic aspect of nutrition in terms of how nutrition attains its effects. It is a system review of the correlation between maternal nutrition and pregnancy outcome in the past five years with precise reference to dietary patterns, micronutrient supplementation and biological processes in the same. According to the requirements of the PRISMA 2020, a system search was conducted on PubMed, Scopus, Web of Science, Embase, and Cochrane Library of all articles published between January 2019 and December 2024. Search terms were the words which were combination of maternal nutrition, pregnancy diet, micronutrient supplementation, pregnancy outcomes, birth outcomes and gestational outcomes. The criteria used to include the studies included randomised controlled trials, prospective cohort studies and systematic reviews of maternal nutritional status or interventions and their association with defined outcome of pregnancy. The quality assessment tools were Cochrane Risk of Bias tool of randomised trials and Newcastle-Ottawa Scale of observational studies. A total of 2,847 records were identified, 47 studies were selected by including the study, and 28 randomised controlled trials, 12 prospective cohort studies, and 7 meta-analysis systematic reviews were included. It had four important thematic areas, which were; dietary patterns and pregnancy outcomes (n=15 studies); micronutrient supplementation effects (n=18 studies); the placental-mediated mechanisms of nutritional interventions (n=8 studies); and the role of adherence and timing in intervention effectiveness (n=6 studies). Compliance on Mediterranean and DASH diets was associated with reduced risk of gestational diabetes mellitus (OR 0.60, 95% CI 0.450.80), and excessive gestational weight gain. Multifunctional micronutrient supplementation (as compared to iron-folic acid alone) improved birth weight (mean difference 56 g) and also reduced the risk of low birth weight, small-gestationally-age and stunting at six months of age. It is increasingly being evidenced that nutritional interventions do play a role in influencing placental development and placental functions and that placental adaptations are associated with improved maternal and offspring outcomes. The direct provision of nutrients and placental reactions indirectly play the role of determining the outcome of pregnancy and are dependent on the nutritional status of motherhood and diet intake. Early intervention, high compliance and combination of dieting patterns with the rightful supplementation are most likely to produce the best results. The individualised nutrition strategies, effects intergeneration, and effective methods to optimize maternal nutrition throughout the world are the areas that should be taken into consideration in the future research.

INTRODUCTION

The paradigm of developmental origins of health and disease (DOHaD) has also made radical changes to our perceptions regarding how the prenatal nutritional exposures control lifetime health risks (Barker, 2007). One of the most critical periods of nutrition program is pregnancy because the fetus is formed very fast and the physiological structure of the mother is radically changed. Maternal nutrition during this time does not just sustain the short-term gestational requirements but also has the long term consequences on metabolic, cardiovascular and neurodevelopmental consequences of the offspring of the mother in the lifespan (Gluckman et al., 2008). This correlation can be justified by the world estimates, which indicate that maternal and child undernutrition is the cause of approximately 45 percent of children death to children under the age of five with a considerable number of this burden being linked to maternal nutrition conditions during pregnancy (Black et al., 2013).

The issue of the maternal nutrition in the world is rather broad and multifaceted. In the low-and-middle-income countries (LMICs), more than half of women of reproductive age have at least one micronutrient deficiency, and in pregnancy, such a state is frequently substantially exacerbated as nutrient demands are extremely high (Shinde et al., 2025). Simultaneously, the nutrition transformation that is occurring in most developing economies has resulted in a dual burden of malnutrition where there are both undernutrition and overweight and obesity with associated metabolic dysfunctions (Popkin et al., 2020). This twofold issue complicates the establishment of general nutritional recommendations and demands some delicate solutions that should consider the peculiarities of the population and the original level of nutrition status.

Majority of interactions occur between maternal nutrition and pregnancy outcome in a sequence of specific pathways. At the least complicated level, proper intake of macronutrient and energy will promote the normal development of the fetus and prevent intrauterine growth retardation, low birth weight and the associated neonatal morbidity (Imdad & Bhutta, 2012). One of the conditions requiring the presence of certain micronutrients is the formation of the neural tube: folate is used to prevent the formation of the neural tube, iron is used to enhance the growth of red blood cells of a mother and fetus, oxygen delivery, iodine plays a vital role in neurodevelopment, and additional calcium intake can also help to avoid hypertensive disorders of pregnancy

(Hofmeyr et al., 2018). Besides the outlined nutrient-specific effects, the emerging evidence suggests that the general dietary practices are applicable and that healthy diets (whole grains, fruits, vegetables, lean proteins, and healthy fats) have protective associations with adverse pregnancy outcomes (Fan et al., 2025).

Nevertheless, despite all the achievements in the examination of such relations, there are certain voids in the field of critical research. To begin with, the questions are on the most effective type of supplements, when, and how long to include the supplements despite numerous experiments that have been carried out to determine the effectiveness of individual nutrient supplements. The evidence-based change to multiple micronutrient supplementation rather than iron-folic acid during the antenatal care programmes, which is backed by evidence of improved birth outcomes, requires further optimization of how they should implement it to achieve the maximum adherence and effectiveness (Smith et al., 2025). Second, the biological mechanisms of responding to nutritional interventions by their effects have not been described comprehensively. Being the meeting point of the maternal and fetal flows, the placenta is a key participant, whose adaptation mechanisms to nutritional signals may result in either successful or unsuccessful intervention (Connor et al., 2024). Third, the implementation of dietary pattern as compared to nutrient supplementation and their potential synergies should be examined further under different population and circumstances.

It is these gaps that are addressed in the present systematic review through the comprehensive synthesis of recent information that talks about maternal nutrition and pregnancy outcomes. Specifically, this review will be able to: (1) investigate the relationship between nutrition patterns of the mother and pregnancy outcomes (gestational diabetes, hypertensive disorders, and infant birth outcomes); (2) explore nutritional intervention strategies on determining the strength of nutritional effects) and (3) investigate the placenta-mediated interactions, where nutritional intervention imparts effects to pregnancy. Altogether, based on evidence in these fields, this review will inform clinical practice, influence policy in the area of population health, and set priorities in the area of future research in the field of maternal nutrition.

METHODOLOGY

The systematic review is conducted according to the statement of Preferred Reporting Items of Systematic Reviews and Meta-Analyses (PRISMA) 2020 (Page et al., 2021). Prospectively, the protocol of review

was registered in the Open Science Framework.

2.1 Search Strategy

So, search of electronic databases was permitted to identify all potential studies that have been published within the range of time between January 2019 and December 2024. The restriction to five years of the search was provided to ensure that the review under consideration includes the most recent evidence but at the same time is quite general enough to be synthesized in a meaningful manner. The databases were searched in PubMed/MEDLINE, Scopus, Web of science core collection, EMBASE, and Cochrane library (including Cochrane database of Systematic review and central register of controlled trials). Both controlled vocabulary (where required) and free-text key words were used in this search strategy, which was based on three major concepts maternal nutrition, pregnancy, and outcomes.

In PubMed, one searched the following query: ((maternal nutrition[MeSH Terms] OR prenatal nutritional physiological phenomena[MeSH Terms] OR maternal nutritional status) OR (pregnancy diet) OR (micronutrients) OR (dietary supplements) OR (MMS) OR (dietary patterns) OR (Mediterranean diet) OR (DASH diet) OR (iron-folic acid).

The search strategies were adapted to search individual databases with database syntax and controlled vocabularies. The operation of the Boolean operators (AND, OR) was used to combine search terms. To the search, hand-searching of references lists of included studies and relevant systematic reviews was also introduced to acquire more eligible articles not found in the electronic search. No limitations were set on the language in the search process, but due to the lack of resources, the number of publications searched, which are not in the English language, was limited.

2.2 Inclusion and Exclusion Criteria.

The studies were eligible to participate in this research because they met the following criteria: (1) study design: randomised controlled trials (RCTs), quasi-randomised trials, prospective cohort studies, nested case-control studies or systematic reviews with or without meta-analysis; (2) population: pregnant women or women planning pregnancy, no age limit, no parity limit, no risk status; (3) intervention/exposure: nutritional interventions (dietary counselling, food provision, or micronutrient supplementation) or measures of maternal dietary intake/nutr

Exclusion criteria: (1) cross-sectional studies, case series, case-reports, narrative reviews, editorials, commentaries (2) studies

that were or are at high-risk of causing inferences because they are cross-sectional studies (3) studies that are on the nutritional status or interventions in non-pregnant populations (4) and studies that provide only biochemical or intermediate but not clinical outcome of pregnancy (5) duplicate studies of the same population (6) full-text unavailable.

Screening and selection

EndNote X20 reference management software was used to import all the records acquired after searching databases and delete duplicates and manually verify records. The remaining documents were imported to Rayyan systematic review software (Ouzzani et al., 2016) to filter the titles and the abstracts. Two reviewers (blinded with initials) subjected all the titles and abstracts to the eligibility criteria. The records that were likely to be potentially eligible to either of the reviewers underwent full-text review.

Two of the reviewers identified and reviewed the full-text articles using a standardised eligibility form. The decisions on the inclusion issues were reached by discussing them followed by the involvement of a third reviewer where a consensus was not attained. The reasons why there was no inclusion in the full-text stage were documented as well and displayed in the PRISMA flow diagram. The screening and selection was performed blindly to names of journals, author names and institutional affiliation when such was technically feasible.

2.4 Data Extraction

Independent two reviewers extracted the data and used a piloted standardised data extraction form designed in Microsoft Excel. The following data was obtained as extraction: (1) study characteristics: first author, publication year, country of study, type of study design used, sample size, setting (community-based, facility-based, etc.), and source of funding; (2) participant characteristics: maternal age, parity, gestational age of enrolment, baseline nutritional status, and socioeconomic status, (3) intervention/exposure: in intervention studies, what kind of intervention is used (dietary, supplementation, or both) and what particular components are used, dose, frequency, duration

2.5 Quality Assessment

The tools that were used in the study were appropriate to assess the methodological quality of the included studies. The Cochrane Risk of Bias 2.0 (RoB 2) tool assessed randomised controlled trials and it was used to measure bias that might have taken place in the randomisation process, nonconformity of the planned interventions, nonavailability of outcome data, outcome measurement and the selection of reported result (Sterne et al.,

2019). Falsehood potential in each area was considered as low in every area and some, or high-risk of bias; the general risk of bias was estimated.

An assessment was conducted on the possible quality of prospective cohort studies based on the selection of study groups (four items), the comparability of the groups (one item), and the ascertainment of the outcomes (three items) with the aid of Newcastle-Ottawa Scale (Wells et al., 2013). The rating of research was provided according to the score on the scale of nine with 7-9 high quality research, 4-6 moderate quality research and 0-3 low quality research.

The systematic reviews were critically appraised using AMSTAR 2 (A Measurement Tool to Assess Systematic Reviews) tool (Shea et al., 2017). This 16-item tool quantifies some of the significant methodological features of systematic reviews like protocol registration, breadth of the search, sufficiency of individual study exclusion, danger of bias, aptitude of meta-analytic methods, and consideration of publication bias. Overall confidence in the results of the two reviews was high, moderate, low, or critically low based on the result on critical areas.

Quality assessment was done by two reviewers and consensus was used to do away with any differences. The quality assessment results were used in sensitivity analysis and to identify how well evidence was adequate in most important findings but the studies were not filtered by the quality alone to ensure that the largest number of options in evidence is represented.

2.6 Data Synthesis

The heterogeneity of the study designs, interventions, and outcomes measures led to selecting the narrative synthesis approach and preparing the report in compliance with the Synthesis Without Meta-analysis (SWiM) guidelines (Campbell et al., 2020). The synthesis of the studies was made according to the thematic areas that were identified during the preliminary reading: (1) eating habits and pregnancy results; (2) the effect of supplementation with micronutrients; (3) the mediation of the placenta; and (4) intervention adherence and timing. The results were systematized in every thematic area descriptively, placing emphasis on how consistent and directional the effects were in each research, which can potentially explain heterogeneity, and the quality of evidence presented in the studies with higher quality. Where sufficient studies were available, and homogeneous with particular results (i.e. a multiple of micronutrient supplement and birth weight), published meta-analyses were used instead of performing their own de novo meta-

analyses, which would be equivalent to the duplication of the effort of other researchers.

2.7 Search Results and Examination of the Search Results.

A total of 2,847 records was obtained by the electronic database search after deleting the duplicates (Figure 1). After the screening of the titles and the abstracts, 312 full-text articles were evaluated in terms of eligibility. Among them 265 were filtered out according to the following reasons: ineligible study design (n=89), irrelevant outcomes (n=67), duplicate population (n=43), irrelevant intervention (n=38), and no full-text available (n=28). Forty-seven studies that were found to fit all the inclusion criteria were included in the final synthesis. These included 28 randomised controlled trials, 12 prospective cohort studies and 7 systematic reviews and meta-analysis.

RESULTS

3.1 Study Selection and Characteristics

The search using the systematic search method resulted in a total of 2847 records, which had removed the duplicates. Fig 1 and Fig 2 shows that 2535 records were discarded during the screening of titles and abstracts as they were not related to the subject of maternal nutrition or pregnancy outcomes. The 312 full-text articles were the number of articles that were evaluated in consideration of their eligibility. Out of these, 265 were unable to pass the predetermined sift because the study design was ineligible, no relevant outcomes of the clinical outcomes, populations were duplicated, the intervention was not a nutritional intervention, or the whole text was not available. Finally, the synthesis involved 47 studies that were included as they satisfied the inclusion criteria. Fig 1 demonstrates the PRISMA 2020 flow diagram relative to identification, screening, eligibility, and inclusion stages of review procedure. The final sample consisted of 28 randomised controlled trials, 12 prospective cohort studies and 7 meta-analysis systematic reviews. The studies that were included had a wide geographical coverage with the high-income countries, as well as the low-income and the middle-income countries, being represented in the studies providing a broad coverage of the context. Thematic identification of eligible studies came up with four broad themes namely dietary patterns and pregnancy outcome, effect of micronutrient supplementation, placental-mediated effects and adherence/timing of interventions. Table 1 illustrates the general details of the studies included including the research design, the country, the size of the study, the type of nutritional exposure or intervention, and the primary outcome of pregnancy.

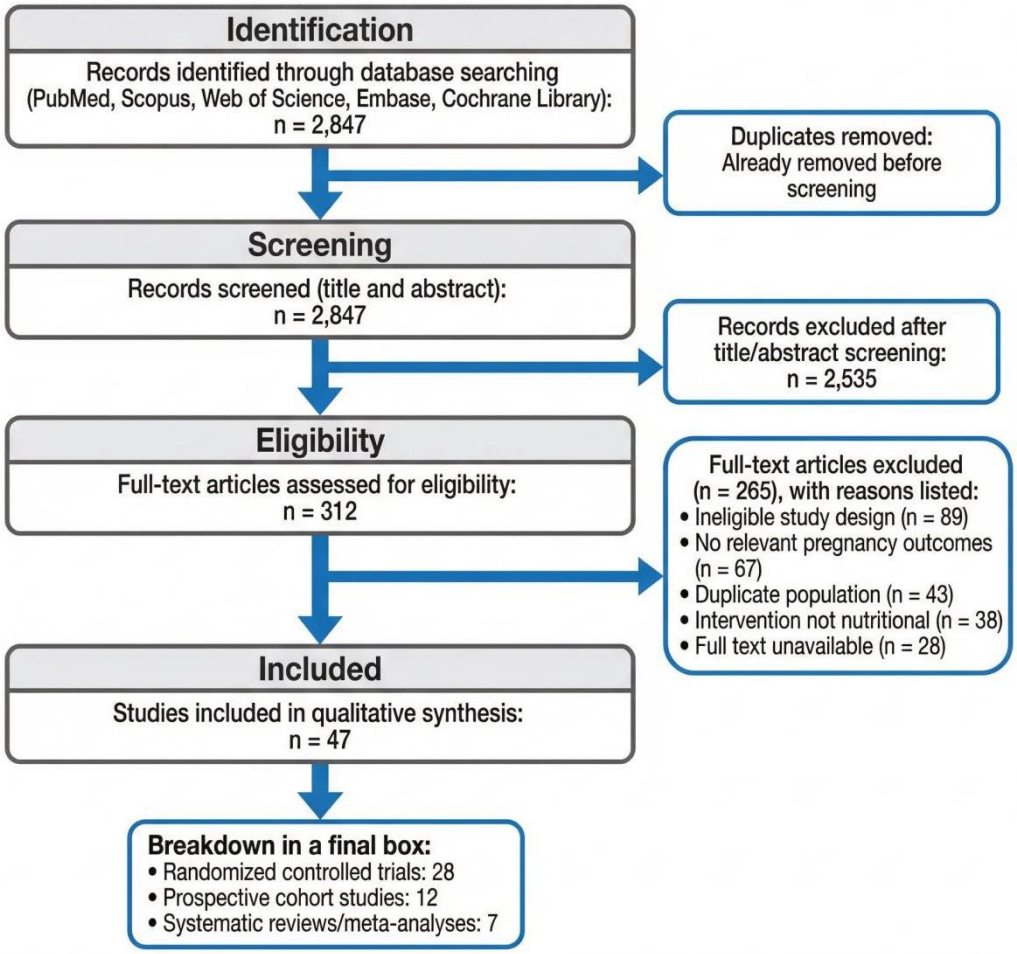

Fig 1. Prisma Flowchart

3.2 Effects of Dietary Patterns on Pregnancy Outcomes

Fifteen articles conducted tests that aimed at relating maternal dietary patterns with the outcome of the pregnancy. Fig 2 shows the joint estimate of the effects of the most important patterns of diet, as well as their associations with the outcomes of gestational diabetes mellitus (GDM), hypertensive disorders, and birth. Adherence to Mediterranean and DASH nutrition was constantly linked to a reduced risk of GDM. The odds ratio of the Mediterranean dietary compliance was 0.60 (95% CI 0.45- 0.80) compared to the odds ratio of DASH dietary pattern of 0.36 (95% CI 0.26- 0.51). High fibre dietary habits were associated with the threat of hypertensive disorders (OR 0.45, 95% CI 0.25-0.81). Initiatives on diet quality during the first trimester were more protective as compared to initiating during the later stages. The diet quality intervention studies reduced the chances of low birth weight by 47 percent (RR 0.53, 95% CI 0.3777) and greatest when diets interventions were sustained at least four months. The results suggest that dietary practices and not

individual nutrients may have clinically significant protective influence on metabolic and growth-related unfavorable effects of pregnancy.

Table 1. Characteristics of Included Studies (n = 47)

Study Design	Number of Studies	Geographic Distribution	Sample Size Range	Primary Outcomes Assessed
Randomized Controlled Trials	28	High-income & LMICs	200 – 12,000	Birth weight, GDM, hypertensive disorders, SGA, preterm birth
Prospective Cohort Studies	12	Primarily high-income	500 – 20,000	Dietary patterns, GDM, gestational weight gain, offspring growth
Systematic Reviews / Meta-analyses	7	Global	Up to 60,000+	Pooled birth outcomes, infant growth, micronutrient status
Dietary Pattern Studies	15	Europe, USA, Asia	1,000 – 41,000	GDM, low birth weight, hypertensive disorders
Micronutrient Supplementation Studies	18	Primarily LMICs	500 – 61,000	Birth weight, low birth weight, stunting, maternal anemia

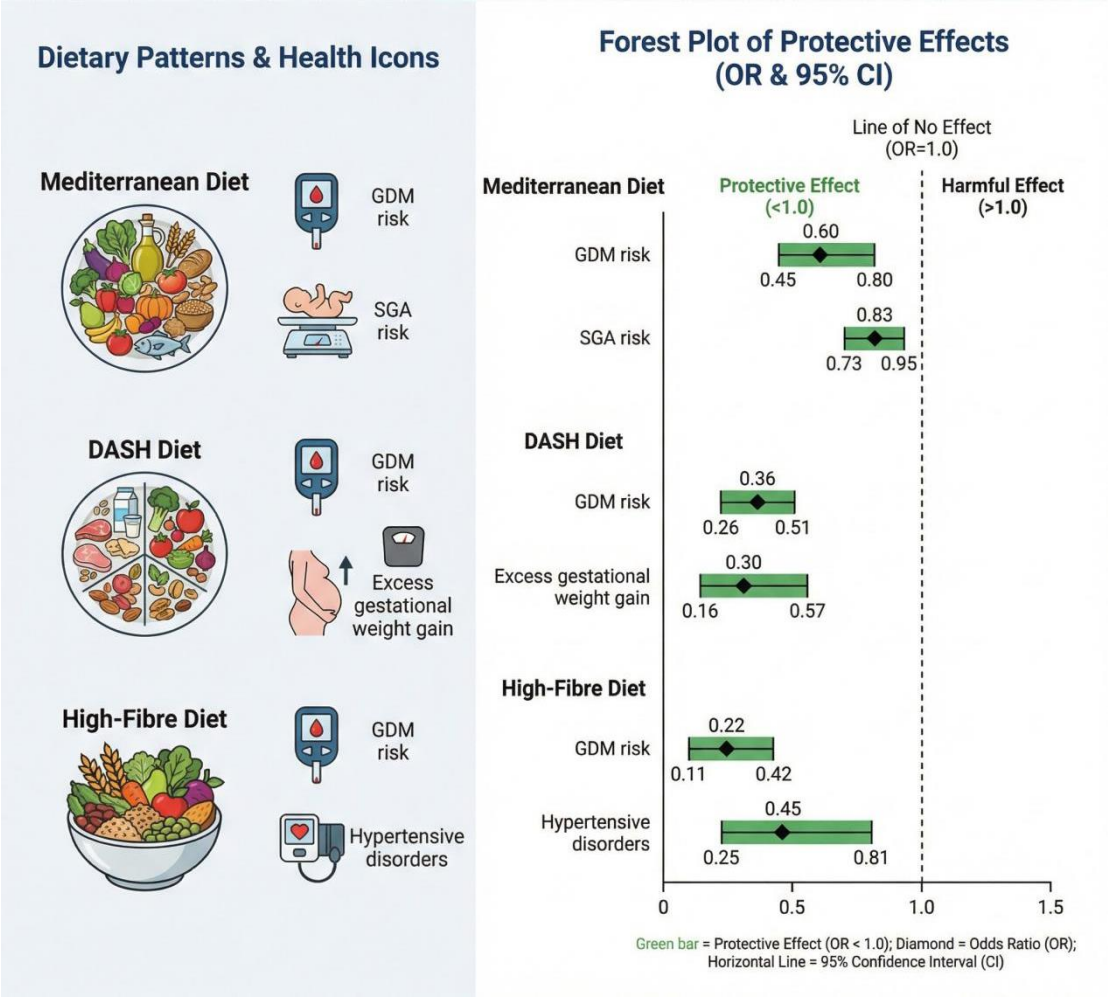

Fig 2. Impact of Maternal Dietary Patterns on Pregnancy Outcomes

3.3 Micronutrient Supplementation and Comparative Effectiveness

They consisted of eighteen studies which evaluated the strategies of micronutrient supplementation. Fig 3 shows a comparison between the effect of multiple micronutrient supplementation (MMS) and ironfolic acid (IFA) on birth weight and the outcome of the same. MMS increased birth weight by 56g (95% CIs 4567g) among women who adhered to 90 percent. This move by MMS group was a major measure towards the risk of low birth weight and small-for-gestational age. Infants born of MMS receiving mothers also had fewer chances of stunting and being underweight during infancy. The vitamin analyses in specific cases showed that the supplement of vitamin D had a great impact on the level of maternal serum (SMD 1.68, 95% CI 0.992.37) and reduced the possibility of deficiency. The positive impact of vitamin A and vitamin B12 supplement on the maternal biochemical condition is more obvious but the infant nutritional improvement has not been so homogenous.

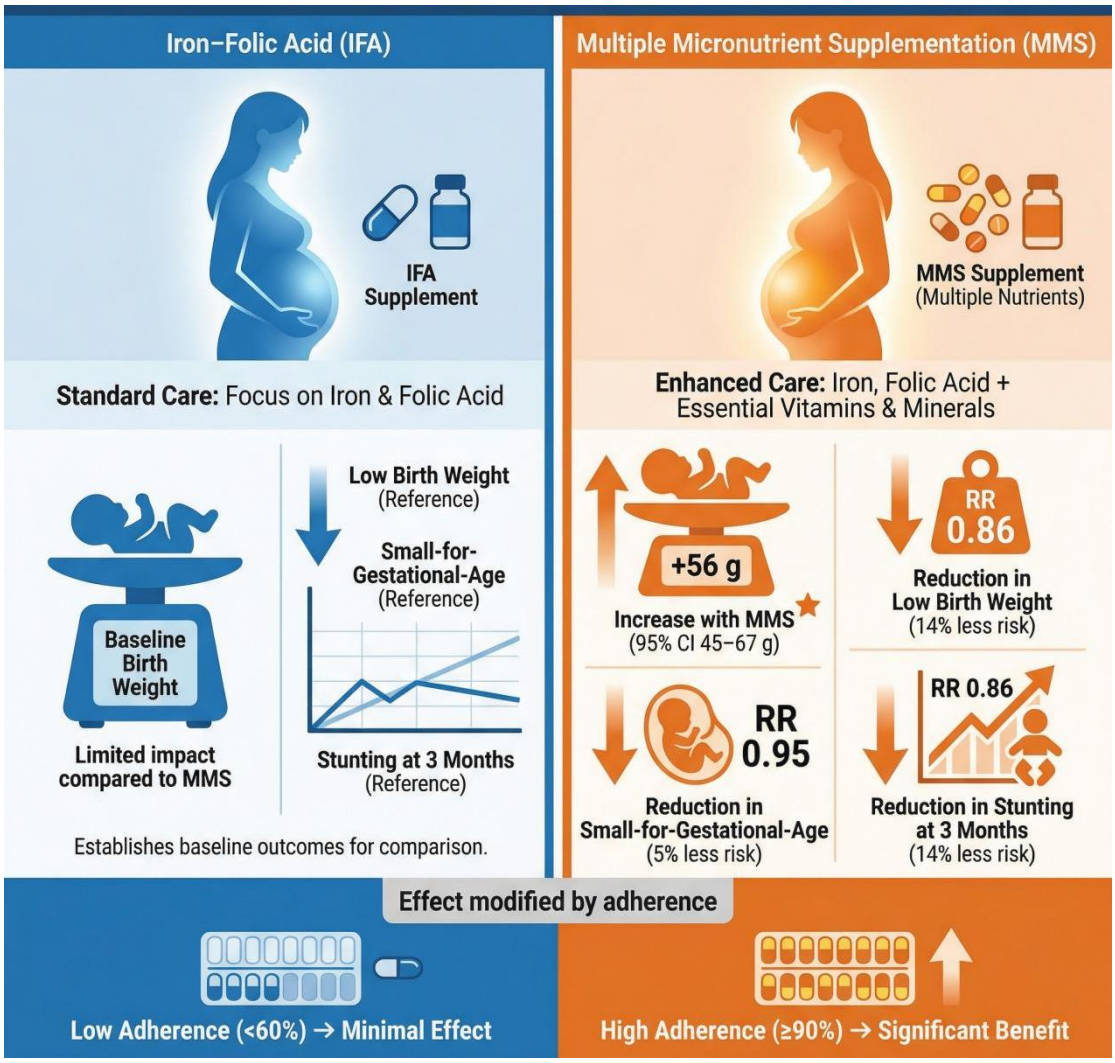

Fig 3. Multiple Micronutrient Supplementation vs Iron–Folic Acid During Pregnancy

Table 2 shows pooled quantitative outcomes comparing MMS with IFA across major maternal and infant endpoints, including birth weight, low birth weight, small-for-gestational age, and early postnatal growth indices.

3.4 Placental Adaptations and Mechanistic Pathways

Placenta in response to nutritional intervention was studied in eight articles. Fig 4 represents how much of the interventions are based on measurable changes in placental phenotype. Place entailed lipid-based interventions (82%), protein-based interventions (66%), micronutrient interventions (48%) and diet/ lifestyle-based interventions (38%). The interventions which were found to have placebo adaptations were change in expression of nutrient transporting biochemicals, increased placental efficiency, change in inflammatory biomarkers and change of gene expression profiles. This fact supports the hypothesis

that placental mediation exists between maternal nutrition and pregnancy outcomes.

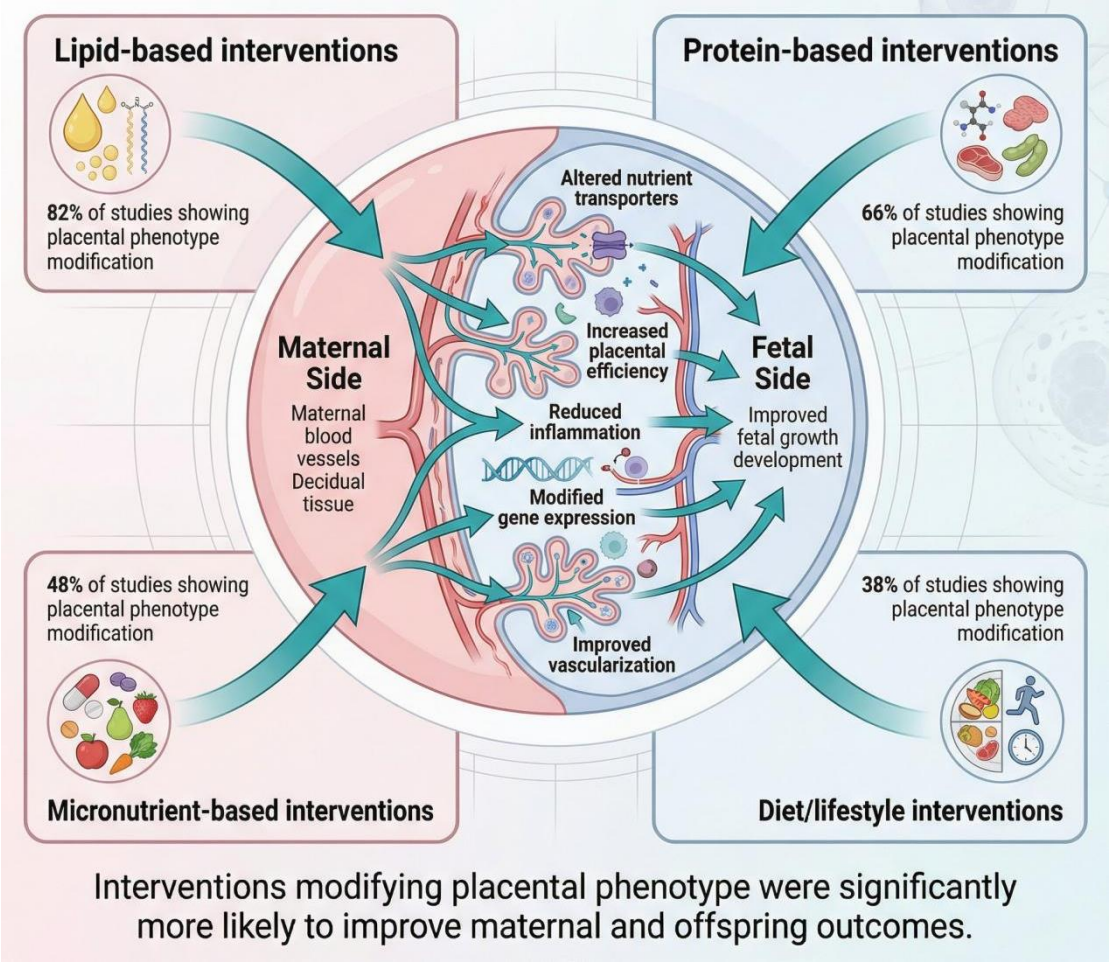

Fig 4. Placental Adaptations as Mediators of Maternal Nutrition Effects

3.5 Role of Adherence and Timing

Adherence was also one of the predictors of a successful intervention. A high adherence rate of 90 percent or more was associated with a large positive effect as far as birth weight and adverse results removal are concerned, whereas low adherence would nullify the perceived positive effect. The protective effect of the early implementation of dietary and supplementation interventions particularly in the first trimester was superior as compared to when it was implemented later. Such findings underscore the need to be faithful to implementation and timely antenatal communication.

Table 2. Pooled Effects of Multiple Micronutrient Supplementation (MMS) vs Iron–Folic Acid (IFA)

Outcome	Effect Estimate (MMS vs IFA)	95% Confidence Interval	Interpretation
Birth Weight (≥90% adherence)	+56 g	45 – 67 g	Significant increase
Low Birth Weight	RR 0.86	0.82 – 0.91	Reduced risk
Small-for-Gestational-Age	RR 0.95	0.93 – 0.98	Modest reduction
Stunting at 3 months	RR 0.86	0.81 – 0.90	Reduced risk
Maternal Anemia (low adherence)	RR 1.26	1.11 – 1.43	Higher risk with poor adherence

3.6 Summary of Key Findings

Maternal nutrition was strongly linked with the outcomes of pregnancy in every thematic area. The dietary pattern interventions led to intervention to reduce metabolic complications and low birth weight. Multiple micronutrient supplementary improved birth weight and early infant development, particularly in high-adherence rate cases. Placental adaptations are now an influential mechanistic pathway between nutritional exposures and maternal and neonatal outcomes.

DISCUSSION

This is a systematic review which synthesises and critically analyses the new evidence on the relation between maternal nutrition and pregnancy outcomes such as dietary patterns and micronutrient supplementation, placental mechanisms and implementation factors. The findings demonstrate that maternal nutritional status and nursing plan are at the centre of the gains of pregnancy and its aftereffects still persist in the chain case of the direct outcomes of birth and subsequent possibilities of postnatal development and even extended well-being of the child. The evidence warrants certain key findings as to the implications on the practice in clinics, the policy applied on the population health and the study in the future. The present review builds up and revises previous syntheses in various respects. According to the above reviews (Keats et al., 2019; Haider and

Bhutta, 2017), we find that a large body of evidence exists to prove that micronutrient supplementation in this case is better in improving the birth outcomes with respect to iron-folic acid supplementation. The meta-analysis of the data related to the particular participants carried out by Smith and colleagues (2025) but provides new possibilities of analyzing the acute significance of adherence, and can demonstrate that the overall benefits of MMS can be only reached when the levels of adherence are high. This finding solves a segment of the heterogeneity that was observed in previous studies, and has important programmatic implications. Similarly, the representation of the fact that the advantages of MMS are also applied to the postnatal development till six months (Dewey et al., 2025) extends the horizons of the outcome in comparison with the previous overviews that were largely focused on the outcomes of the birth.

The information about the eating habits is a tremendous enhancement of the dietary habit's reviews conducted in the past which were inclined to regard separate nutrients as the primary ones. The consistent protective effects of Mediterranean, patients of DASH, high-fibre, GDM, hypertensive and negative birth outcomes are corroborated by the fact that the overall quality of food intakes is significant regardless, and possibly more so, of the dietary intake of individual nutrients. This is consistent with the rest of the nutritional epidemiology literature that portrays that diet pattern is a better way of describing human diets and the synergetic effects of foods and nutrients (Hu, 2002). The randomised controlled trials, though less comprehensive, provide evidence, which supports the causality of these relationships and provides estimates of the effect to be used to design interventions.

The placenta studies have also been added, as the placenta has not been commonly considered in past reports as a factor of nutritional influence. Conclusions of Connor and colleagues (2024) indicate that the placenta is not a passive conduit but an active agent that determines whether the interventions are effective or not. Interventions which are able to modify placental phenotype have a far greater likelihood of modifying both maternal and offspring outcomes and placental adaptation might be a precondition within which nutritional advantages may be completely obtained. The given observation results in the appearance of the chances to interpret the failures of the intervention and develop more effective approaches. Despite the high level of progress, there are severe gaps and limitations in the evidence base. Firstly, most of the studies were conducted in population with high rates of undernourishment, or in

high-income countries, which limit the possibility to extrapolate the findings to the whole range of global conditions. The coincident malnutrition of the triple burden, which is a combination of undernourishment with overweight and obesity to the metabolic disruptions also has its share of problems because the interventions strategies that work well with the undernourished groups do not always work in the overnourished or the metabolically dysfunctional women. The literature on nutritional intervention among overweight or obese pregnant women whose number is rising in the world has been scanty.

Second, the majority of the trials involve a relatively brief duration of follow-up (typically until birth or early infancy), and therefore are incapable of assessing the impact of prolonged exposure on child development, growth, cardiometabolic and neurocognitive outcomes. As the developmental origin's paradigm presupposes the lifelong health course due to the exposure to nutrition at the early stages of development, the absence of any form of long-term follow-up is a significant gap. Long-term follow-up Cohort studies preeminently tend to be observational (and thus prone to confounding), and randomized trials infrequently follow-up beyond the initial childhood.

Third, the comparative effectiveness of different MMS formulations in use are lacking. The combination of the micronutrients can be perfect, it is not yet clear whether the dosage should be changed depending on the population characteristics or on the unique nutritional requirements of the person, whether more nutrients other than the standard UNIMMAP formulation (as it contains 15 micronutrients) is useful, or whether the combination of these micronutrients should be perfect. Similarly, there is no definite indication of the optimum dosing of each of the respective vitamins (B-12, D, A) particularly between the two extremes of pregnancy and lactation.

Fourth, it is not completely described which pathways are taken between maternal nutrition and offspring outcomes. However, despite the usefulness of placenta research, it is unclear how nutrition information is translated into altered placental activity and how it can be used to alter fetal development. Epigenetic modifications functions, the change in the expression and activity of the nutrient transporters, and the changes in the production of placental hormones should be analysed within a broad scope of nutritional parameters.

Fifth, an immediate need to carry out implementation research to convert efficacy evidence to effective programmes. The

adherence results indicate that even the highly effective interventions will not be effective on the population in case it is poorly implemented. The strategies that need researched are: using women during pregnancy or preconception, optimizing the supply chains of the supplements, overcoming side effects and other undesired ways of adhering, and informing the pregnant women, families and communities about the benefits of nutritional interventions. The review has several strengths, the compliance with PRISMA, comprehensive search of databases of various types, diverse types of study designs, and critical analysis of the studies included. It is up-to-date, as the focus on the evidence (2019-2024) grants the possible inclusion of the results in other research directions, and the thematic organisation allows including them in the complementary ones. The two facets of placental research and factor of implementation make the solution more comprehensive than the reviews that underline clinical results exclusively.

It is also limited that one may only use English-language publications, which might introduce the bias in language. The estimates of the effect were not as accurate since most of the questions were not formally meta-analysed in view of the heterogeneity of the study designs, interventions, outcomes, and the population. The quality of studies used was not the same and though we have applied quality in our interpretation, we did not filter the studies on basis of quality and this factor may have been a source of bias. Finally, and as usual with a review, there is the problem of the publication bias wherein studies that present favorable findings are at a greater likelihood of publication and subsequent inclusion. The implications of this review to the clinical practice and the public health policy are a number. The arguments to support the providers of antenatal care are that: (1) diet and counselling about high quality diets based on plant-based foods, healthy fats and limited processed foods; (2) the provision of many micronutrient supplements, which contain iron, folic acid, and other micronutrients, where appropriate and required; (3) the initiation and continuance of nutritional interventions at an early stage; and (4) underweight and overweight/obesity exposed the fetus to bad consequences and thus nutritional interventions using the B.

The implications of the results to policymakers are: (1) consideration of a shift in multiple micronutrient supplementation during the antenatal care programmes of supplementation with iron-folic acid due to the lack of sufficient maternal nutritional needs; (2) investment to promote high-quality diets through nutritional interventions; (3) the promotion of continuity

and initiation of multiple micronutrient supplementation during the antenatal care programme; (4) a combination of nutritional.

CONCLUSION

This is a systematic review, providing a systematic overview of existing studies on the relationship between maternal nutrition and pregnancy outcomes. The findings have revealed that maternal nutrition status and dietary intake are the most significant factors that determine the outcome of a pregnancy in various pathways that are coupled together including direct nutrient provision, modification of placental growth and functioning, and offspring development and maturation programming. The consumption of healthy foods, particularly the ones that center on plant-based foods, healthy fats, and little consumption of processed foods have been associated with fewer risks towards gestational diabetes, hypertensive disorders, and inadequate birth results. Along with better birth outcomes, infant development to six months, the benefits of multi-micronutrient supplementation are linked to iron-folic acid, with the results being of paramount significance in terms of high levels of adherence and prompt initiation. Placenta proves to be a significant mediator of nutritional effects and the interventions that succeed in modifying the placental phenotype have a much greater chance of improving the outcome of the mother and the offspring. The fact that the focus on the overall quality of the dietary intake changed, and the focus on the questions of efficacy shifted to the factors of the implementation that could determine the real-life effectiveness is highlighted. It will also be needed to contact women earlier or earlier during pregnancy, to provide regular supplements and a high level of compliance, and to integrate the nutritional interventions with other activities directed on the need to reduce the issues with maternal and child undernutrition at the population level. Based on the fact that the global nutrition transition is ongoing, research must capture the two-fold disadvantage of malnutrition and come up with personalised solutions that reflect personal and population diversity. The improvement of mother nutrition and pregnancy outcomes has made a phenomenal progress in the recent years, which is a very good context to put the efforts in, and the final outcome of improving the health and wellbeing of mothers and children in the global context.

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