SCIENTIFIC REVIEW | MATERNAL & REPRODUCTIVE NUTRITION

Diet, Preconception and Pregnancy

Specialty diets, nutritional supplementation and the metabolic preparation for conception

Evidence review updated by 16 September 2026

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INTABIOTECH Scientific & Regulatory Affairs

Food Science · Clinical Nutrition · Reproductive Health · Regulatory Affairs

CENTRAL THESIS

Pregnancy nutrition begins before conception. The objective is not maximal supplementation, but the earliest possible identification and correction of nutritional and metabolic constraints—while distinguishing interventions that are established from those that are merely plausible, promising or commercially over-interpreted.

Technical status

Narrative evidence review prioritising major clinical guidelines, authoritative regulatory/public-health sources, systematic reviews and meta-analyses. It is not a formal systematic review and does not replace individual medical or dietetic assessment.

Executive Summary

Nutrition relevant to pregnancy begins before a positive pregnancy test. Maternal folate status, iron stores, vitamin B12 status, iodine exposure, metabolic health and dietary behaviour are established before fertilisation and implantation. Several critical embryological processes occur before many women recognise pregnancy, making the preconception interval a genuine biological window rather than merely a planning period.[1,2,12]

Among whole-diet strategies, the Mediterranean dietary pattern currently has the most coherent evidence base. A 2026 systematic review and meta-analysis of 33 studies, including 19 randomised trials and more than 180,000 pregnancies, reported lower risks of gestational diabetes, preterm delivery, low neonatal weight and fetal-growth abnormalities with greater adherence or intervention, although evidence for pre-eclampsia and several other endpoints remained inconsistent.[4]

That evidence should not be converted into a claim that a Mediterranean diet—or any other diet—constitutes an infertility treatment. The 2026 systematic review of nutrition in assisted reproductive technology concluded that healthy patterns are reasonable and potentially advantageous, but no specific diet has consistently demonstrated improvement in live birth. The distinction between optimising reproductive physiology and treating infertility is therefore fundamental.[5]

Supplementation requires the same hierarchy. Periconceptional folic acid is firmly established for neural-tube-defect prevention. Iron, iodine, vitamin D, calcium, vitamin B12, choline and long-chain omega-3 fatty acids are important, but the need for supplemental doses above dietary adequacy varies with baseline status, geography, diet and phenotype. CoQ10, inositols, probiotics and multi-antioxidant fertility formulations remain more uncertain and should not be placed on the same evidentiary level.[1–3,7–10]

The most defensible model is therefore precision maternal nutrition: establish a high-quality diet, identify clinical and dietary risk, correct demonstrated or highly probable deficits, control metabolic disease, avoid harmful exposures and use supplements because a specific indication exists—not because a longer ingredient list appears more comprehensive.

Key Points

PRECONCEPTION	Treat it as the first phase of maternal nutrition. Folate status, nutrient reserves and metabolic phenotype predate implantation.
DIETARY PATTERN	Mediterranean-style eating is the best-supported general architecture, especially for maternal cardiometabolic outcomes; it is not a stand-alone infertility therapy.
PRIMARY ENDPOINT	In infertility and ART, live birth matters more than surrogate markers such as oocyte count, biochemical pregnancy or mechanistic biomarkers.
SUPPLEMENTATION	Folic acid has established preventive evidence. Other nutrients require context; “prenatal” is not a standardised composition.
SPECIALTY DIETS	Vegan, gluten-free and carbohydrate-restricted patterns require indication-specific assessment. Restriction itself is not a fertility intervention.
SCIENTIFIC DISCIPLINE	Separate established benefit, supported benefit, context-dependent intervention and emerging evidence. Mechanistic plausibility is not clinical proof.

Scope and Method

This technical review uses a targeted narrative approach. Priority was given to 2024–2026 evidence where available, together with current guidance from NICE, WHO, EFSA, CDC, NIH/ODS, ACOG, AESAN and Spanish PAPPS recommendations. Recent systematic reviews and meta-analyses were used for Mediterranean-diet interventions, assisted reproduction, preconception weight loss, PCOS/inositol, CoQ10, probiotics, choline, vegan pregnancy, fasting, coeliac disease and infertility supplements.[1–19]

The review deliberately distinguishes: (1) biological necessity, (2) dietary adequacy, (3) evidence that supplementation improves a clinically meaningful outcome, and (4) evidence that a higher dose is superior. These four questions are frequently conflated in commercial prenatal and fertility nutrition.

Evidence Hierarchy Used in This Review

LEVEL	MEANING	REPRESENTATIVE EXAMPLES
ESTABLISHED	Strong outcome evidence and/or major guideline consensus	Periconceptional folic acid; correction of deficiency; alcohol avoidance; pregnancy food-safety precautions
SUPPORTED	Meaningful clinical evidence with residual uncertainty about magnitude or implementation	Mediterranean dietary pattern; appropriate lower-mercury fish/DHA; calcium supplementation in low-intake populations
CONTEXT-DEPENDENT	Benefit depends materially on baseline status, geography, diet or phenotype	Iron dose; iodine supplementation; vitamin D; B12 in restrictive diets or malabsorption
EMERGING / UNCERTAIN	Mechanistically plausible or supported by selected trials, but not a universal recommendation	CoQ10 in selected DOR/ART patients; inositols in PCOS; probiotics; high-dose choline; antioxidant cocktails

Contents

1. Why Pregnancy Nutrition Begins Before Conception

The conventional model of maternal nutrition begins too late. By the time pregnancy is clinically recognised, fertilisation, cleavage, blastocyst development, implantation and the earliest stages of embryonic differentiation have already occurred. Neural-tube closure takes place in the first weeks of embryonic development, which is why folic acid prevention must be periconceptional rather than merely prenatal.[1,14]

The preconception interval also determines maternal iron reserves, vitamin B12 status, iodine exposure, body-composition trajectory, glycaemic control and habitual dietary pattern. Pregnancy then adds physiological demand to those pre-existing conditions. It follows that the most rational moment to identify and correct a nutritional limitation is before the limitation is amplified by gestation.

CLINICAL PRINCIPLE

The appropriate question is not only "What should a woman eat during pregnancy?" but "What nutritional and metabolic environment should exist before fertilisation, during implantation, throughout placentation and across fetal development?"

1.1 Developmental biology and the DOHaD framework

The Developmental Origins of Health and Disease (DOHaD) paradigm provides a useful conceptual framework: environmental exposures during critical developmental windows may influence later cardiometabolic and neurodevelopmental phenotypes. Maternal diet intersects with one-carbon metabolism, epigenetic regulation, mitochondrial function, insulin signalling, endothelial biology, thyroid physiology, erythropoiesis and placental nutrient transfer. Yet mechanistic plausibility must not be mistaken for evidence that a specific supplement changes long-term clinical outcomes. The closer a claim moves from nutrient adequacy to disease prevention or developmental enhancement, the stronger the outcome evidence must be.

2. Nutritional Optimisation versus Fertility Treatment

Specialty diets and nutritional supplements may improve physiological conditions relevant to conception, particularly where a modifiable metabolic or nutritional problem exists. That proposition is scientifically defensible. A stronger claim—that a defined diet reliably increases fertility or live birth across women—is not.

Reproductive success depends on ovarian reserve, age-related oocyte competence, tubal patency, uterine factors, semen parameters, embryo chromosomal competence and multiple endocrine variables. Major reproductive pathology cannot reasonably be expected to respond to diet alone. The 2026 systematic review of nutrition in assisted reproductive technology therefore deserves particular weight: it found that healthier dietary patterns may be favourable, but no single diet has consistently increased live birth in ART.[5]

ENDPOINT DISCIPLINE

In reproductive nutrition, live birth should remain the decisive clinical endpoint. Oocyte number, embryo morphology, biochemical pregnancy and mechanistic biomarkers may be informative, but they are not interchangeable with live birth.

3. The Preconception Phenotype and Metabolic Preparation

A useful preconception assessment is phenotype-based rather than supplement-based. Two women of identical BMI may have very different nutritional risks. One may have excellent dietary quality and adequate nutrient stores; another may have heavy menstrual losses, low ferritin, vegan food exclusions, PCOS, insulin resistance, thyroid disease or previous bariatric surgery.

A high-level assessment should examine five domains: habitual diet, metabolic status, deficiency risk, dietary exclusions and total supplement exposure. This approach reduces two opposite errors: failure to correct a real limitation, and unnecessary poly-supplementation in an already replete individual.

- Dietary pattern: vegetables, fruit, legumes, whole grains, nuts, fish, eggs, dairy or fortified substitutes, protein sources, ultra-processed food, alcohol and caffeine.
- Metabolic phenotype: weight trajectory, insulin resistance, pre-existing diabetes, blood pressure, PCOS, thyroid disease and eating-disorder risk.
- Deficiency risk: full blood count/ferritin when indicated; vitamin B12; folate; vitamin D where clinically relevant; iodine exposure rather than indiscriminate laboratory testing.
- Dietary exclusions: vegan, gluten-free, dairy-free, very-low-carbohydrate or highly restrictive diets; gastrointestinal and bariatric history.
- Supplement reconciliation: prenatal formulas, fertility products, botanicals, sports supplements and individual vitamins/minerals to detect duplication or unsafe total exposure.

4. Mediterranean Dietary Pattern and Reproductive Outcomes

Among currently studied dietary patterns, Mediterranean-style eating provides the most coherent general framework for reproductive and pregnancy nutrition. It is rich in vegetables, fruit, legumes, whole grains, nuts, extra-virgin olive oil and fish, while limiting refined carbohydrates, processed meat and ultra-processed foods. The significance of the pattern lies in its cumulative nutrient and metabolic profile rather than any single “fertility food”.

The strongest recent pregnancy evidence comes from a 2026 systematic review and meta-analysis of 33 studies, including 19 randomised controlled trials and more than 180,000 pregnancies. Higher Mediterranean-diet adherence or intervention was associated with lower gestational-diabetes risk; favourable signals were also reported for preterm delivery, low neonatal weight and fetal-growth abnormalities. Evidence for pre-eclampsia was less consistent, and several other endpoints were not significantly altered.[4]

These findings support Mediterranean eating as a rational default dietary architecture, particularly in European populations. They do not establish a universal “fertility diet”, nor do they prove that Mediterranean adherence overcomes age-related reproductive decline or major infertility pathology.[5]

5. Body Composition, Obesity and Undernutrition

Body composition is clinically relevant because both excess adiposity and chronic energy insufficiency can alter reproductive endocrinology and pregnancy risk. Obesity is frequently accompanied by insulin resistance, altered adipokine signalling and low-grade inflammation; during pregnancy it is associated with higher risks of gestational diabetes and hypertensive complications.

However, a critical nuance emerged from the 2024 systematic review and meta-analysis of preconception weight-loss interventions. Women assigned to weight-loss interventions were more likely to become pregnant, but there was no statistically significant overall improvement in live birth. The authors explicitly rejected a one-

size-fits-all recommendation to delay conception or fertility treatment solely to obtain weight loss for the purpose of improving live birth.[6]

This matters in practice. For a young woman with major metabolic dysfunction, preconception weight management may deliver meaningful health benefits. In an older woman or a patient with diminished ovarian reserve, postponing treatment to achieve an arbitrary BMI threshold may carry opportunity cost. Metabolic optimisation is therefore more defensible than weight loss as an isolated numerical target.

At the opposite end of the spectrum, undernutrition, eating disorders and very low energy availability can impair hypothalamic-pituitary-ovarian signalling, ovulation and micronutrient reserves. Nutritional adequacy—not weight reduction per se—is the central reproductive objective.

6. PCOS and Insulin-Resistant Phenotypes

Polycystic ovary syndrome is one of the clearest clinical interfaces between metabolism and reproduction. Insulin resistance is common, though not universal, and hyperinsulinaemia can contribute to ovarian androgen production and ovulatory dysfunction. High-quality dietary intervention, physical activity and metabolic risk management therefore belong within preconception care.

No single macronutrient distribution has been established as universally superior for PCOS. Mediterranean-style and lower-glycaemic-load approaches are physiologically reasonable, particularly in insulin-resistant phenotypes, but extreme carbohydrate restriction is not required to demonstrate metabolic improvement.

6.1 Inositols

Myo-inositol and D-chiro-inositol have credible mechanistic relevance because of their roles in intracellular insulin signalling. Yet the systematic review and meta-analysis informing the international PCOS guideline concluded that efficacy remains uncertain across many outcomes. Some metabolic and reproductive signals exist, but evidence quality and consistency do not support treating inositol as a universal fertility therapy.[7]

7. Assisted Reproduction and Outcome Hierarchy

Women undergoing IVF/ICSI are exposed to a large and rapidly expanding market of supplements promoted for “egg quality”, mitochondrial rejuvenation, implantation or ovarian anti-ageing. This is precisely the setting in which evidence hierarchy is most important.

The 2026 systematic review of diet in ART found no single dietary pattern with consistent live-birth improvement.[5] A 2024 umbrella review of nutrient supplements for female infertility likewise concluded that the available evidence was insufficient to recommend nutritional supplements to improve infertility, because many apparently positive findings were supported by low or very-low certainty evidence.[11]

7.1 Coenzyme Q10

CoQ10 is an example where outright dismissal would also be inappropriate. A 2024 meta-analysis of six randomised trials including 1,529 women with diminished ovarian reserve undergoing IVF/ICSI reported improvements in retrieved oocytes, clinical pregnancy and several intermediate outcomes. The authors nevertheless emphasised limited sample sizes and weak methodological reporting.[8]

The most balanced interpretation is therefore that CoQ10 is a promising adjunct in selected DOR/ART populations, not a universal preconception requirement and not an established method for reversing reproductive ageing.

8. Specialty Diets

8.1 Vegetarian and vegan diets

A well-designed vegetarian diet can support pregnancy. A vegan pregnancy can also be nutritionally adequate, but it requires deliberate nutrient replacement. Vitamin B12 deserves absolute priority because reliable unfortified plant sources are absent. Iron, iodine, calcium, vitamin D, zinc, protein quality, choline and DHA also require assessment.

A 2024 systematic review found lower intake of several nutrients among vegan pregnant women relative to omnivorous comparators, although B12 supplementation appeared capable of maintaining maternal and cord B12 status. Only six eligible studies were identified, underscoring the limited outcome evidence.[10]

PRACTICAL IMPLICATION

"Plant-based" should not be equated with nutritionally incomplete; however, "vegan" should never be assumed to be micronutritionally self-sufficient without fortification or supplementation. Algal DHA is an appropriate non-fish source of preformed DHA.

8.2 Gluten-free diets

A gluten-free diet is medically necessary in coeliac disease. Untreated coeliac disease may contribute to iron, folate, B12 and vitamin D deficiency and has been associated with adverse reproductive and pregnancy outcomes. The therapeutic target is therefore control of coeliac disease plus restoration of nutritional adequacy.[18]

In women without coeliac disease or another defined indication, gluten avoidance has no established fertility advantage. Unnecessary restriction can reduce whole-grain, fibre and fortified-food intake.

8.3 Ketogenic and very-low-carbohydrate diets

Moderating refined carbohydrate can be useful in insulin resistance and gestational diabetes. Maintaining nutritional ketosis is a different intervention. Current evidence is insufficient to recommend ketogenic diets routinely for fertility or pregnancy, and their restrictive nature can complicate fibre and micronutrient adequacy.

8.4 Intermittent and prolonged fasting

Evidence from non-pregnant metabolic studies should not be automatically extrapolated to pregnancy. A 2025 umbrella review of Ramadan fasting found little evidence of major effects on preterm birth or low birth weight, but highlighted substantial heterogeneity, methodological limitations and lack of evidence for rare clinically important outcomes such as stillbirth, miscarriage, congenital anomalies and neonatal death.[17]

The appropriate conclusion is not that prolonged fasting is beneficial, but that available studies do not support a simple universal harm estimate. Individual clinical context remains necessary.

9. Micronutrient and Supplementation Framework

Pregnancy nutrition becomes clearer when three questions are separated: Is the nutrient biologically necessary? Is adequate intake being achieved? Is supplemental dosing required to improve an outcome or

correct a defined risk? The existence of a physiological requirement does not prove that high-dose supplementation benefits already replete women.[3]

NUTRIENT	REFERENCE*	PRINCIPAL ROLE	SUPPLEMENTATION POSITION	CAUTION
Folate / folic acid	600 µg DFE; 400 µg folic acid/day preconception	Neural-tube closure; DNA/one-carbon metabolism	Established preventive supplementation	High-dose regimens require indications
Iron	27 mg/day dietary reference	Erythropoiesis; fetal iron accretion	Treat deficiency; WHO uses 30–60 mg/day as global antenatal strategy	GI intolerance; avoid assuming more is better
Iodine	220 µg/day US reference; needs vary by policy	Thyroid hormone; fetal neurodevelopment	Diet/geography dependent; Spain does not support universal supplementation	Deficiency and excess both matter
Vitamin B12	2.6 µg/day	DNA synthesis; neurological and haematological function	Essential in vegan diets, deficiency or malabsorption	Deficiency may coexist with high folate
Vitamin D	15 µg / 600 IU/day US reference	Bone/calcium physiology; wider roles under study	Correct deficiency; routine dose varies by jurisdiction	Megadosing not evidence-based
Calcium	1,000 mg/day adult reference	Maternal skeleton; fetal mineralisation	High-dose supplementation mainly when dietary intake is low	Therapeutic dose ≠ dietary requirement
Choline	450 mg/day	Phospholipids; methylation; fetal neural development	Prioritise adequate intake; many prenatal products contain little	High-dose neuroenhancement unproven
EPA+DHA / DHA	250 mg EPA+DHA + 100–200 mg DHA (EFSA)	Neural/retinal development; preterm-birth evidence	Fish or appropriate supplement	Safety limit is not a target
Vitamin A	770 µg RAE/day (adult pregnancy)	Differentiation; vision; immunity	Usually diet-based	Excess preformed retinol is teratogenic

**Reference values vary between jurisdictions and authorities. Values shown are commonly used adult-pregnancy benchmarks from NIH/ODS, ACOG and EFSA and should not be read as universal prescribing doses.[3,16,20]*

9.1 Folic acid: the benchmark intervention

Few interventions in maternal nutrition have evidence comparable with folic acid for neural-tube-defect prevention. NICE 2025 recommends 400 µg/day for women planning pregnancy or in the first 12 weeks, ideally beginning before conception. NICE reserves 5 mg/day for defined higher-risk situations, including previous neural-tube-defect-affected pregnancy, diabetes, selected haematological conditions and medicines affecting folate metabolism.[1]

Common MTHFR variants do not invalidate folic-acid use. CDC guidance updated in July 2026 states that people with common MTHFR variants can process folic acid and that folic acid remains the only folate form demonstrated to prevent neural-tube defects. Routine genotype-driven replacement of folic acid with 5-MTHF therefore goes beyond current prevention evidence.[14]

9.2 Iron

Pregnancy increases iron requirements through expansion of maternal red-cell mass, placental development and fetal iron accretion. The US dietary reference is approximately 27 mg/day.[3,20] WHO recommends 30–60 mg elemental iron plus 400 µg folic acid daily during pregnancy as a global public-health intervention to prevent maternal anaemia and selected adverse outcomes.[2]

Global public-health strategy and individual clinical prescribing are not identical. In high-resource settings, haemoglobin, ferritin, menstrual history, diet, gastrointestinal tolerance and prior anaemia may justify more individualised dosing. The correct objective is adequate iron availability—not maximal iron exposure.

9.3 Iodine: a geographical nutrient

Iodine is indispensable for thyroid hormone synthesis and fetal neurodevelopment, but supplementation policy is population-dependent. US reference intake during pregnancy is approximately 220 µg/day.[3,20] Spanish PAPPS 2024 guidance states that universal iodine supplementation during pregnancy and lactation is not currently justified in Spain; adequate intake can often be achieved with iodised salt and dietary sources, while 200 µg/day potassium iodide may be considered when intake is insufficient.[12]

AESAN's Scientific Committee likewise emphasises the need to consider population status and both deficiency and toxicity.[13] This is a clear example of why imported prenatal formulations should not be assumed to fit every jurisdiction.

9.4 Vitamin B12

Vitamin B12 is required for DNA synthesis, erythropoiesis and neurological function. Pregnancy reference intake is approximately 2.6 µg/day.[3,20] Supplementation is functionally essential in strict vegan diets and may also be required after bariatric surgery, in malabsorption syndromes or established deficiency. High folate intake does not establish adequate B12 status.

9.5 Vitamin D

Vitamin D is central to calcium homeostasis and skeletal development, with additional immunological and placental roles under investigation. The US pregnancy reference is 15 µg (600 IU)/day, whereas NICE emphasises 10 µg (400 IU)/day in circumstances associated with inadequate synthesis or intake.[1,3]

The defensible clinical principle is to prevent or correct inadequate status rather than infer that progressively higher doses produce progressively better reproductive outcomes. Optimal universal pharmacological dosing remains unresolved across guidelines.

9.6 Calcium

The adult pregnancy reference intake is approximately 1,000 mg/day.[3,20] WHO recommends higher supplemental calcium—1.5–2.0 g/day elemental calcium—in pregnant populations with low dietary calcium intake to reduce pre-eclampsia risk. This therapeutic public-health intervention should not be confused with the physiological dietary requirement.[15]

9.7 Choline

Choline contributes to phospholipid synthesis, methyl metabolism and neural development. Pregnancy intake recommendations are approximately 450 mg/day, yet many prenatal formulations contain little or none.[3,20]

A 2025 systematic review identified four randomised trials and five observational studies and found that most measured neurodevelopmental outcomes did not demonstrate benefit from higher prenatal choline exposure. Current evidence was judged insufficient to support or refute improved child neurodevelopment from increasing maternal choline intake.[9] Adequacy is therefore a sound goal; claims of proven cognitive enhancement are premature.

9.8 DHA and fish

EFSA considers 250 mg/day EPA+DHA appropriate for adults and recommends an additional 100–200 mg/day of preformed DHA during pregnancy and lactation.[16] In 2026, EFSA retained a safe level of 1 g/day for supplemental DHA alone, including during pregnancy and lactation. Importantly, a safe level is a risk-assessment threshold, not a target dose.[21]

Pregnancy fish advice should be framed as benefit–risk management rather than avoidance. Lower-mercury fish provides DHA, iodine, selenium, B12, vitamin D and high-quality protein. Spanish AESAN guidance advises avoidance of high-mercury species such as swordfish/emperor, bluefin tuna, shark species and pike while allowing safer fish choices.[22]

9.9 Vitamin A

Vitamin A is essential to normal embryonic development, but excessive preformed retinol is teratogenic. This is a key formulation issue in prenatal products: chemical form matters. Beta-carotene-rich foods should not be conflated with excessive preformed retinol exposure.[3]

10. Food Safety, Alcohol and Caffeine

Maternal nutrition cannot be evaluated solely by nutrient density. Microbiological and chemical safety are part of nutritional medicine in pregnancy.

10.1 Foodborne risk

Pregnant women have increased susceptibility to severe consequences from selected foodborne infections. CDC states that pregnant women are about ten times more likely than other people to develop Listeria infection.[23] Risk reduction includes appropriate cooking, pasteurisation, produce washing, refrigeration and avoidance of selected high-risk ready-to-eat products.

AESAN advises avoiding raw milk and unpasteurised soft cheeses, raw or undercooked meat and eggs, raw fish and shellfish, refrigerated smoked or marinated fish, inadequately washed raw produce, selected refrigerated ready-to-eat foods and high-mercury fish species during pregnancy.[24]

10.2 Alcohol

Alcohol has no nutritional role in pregnancy and no established safe fetal exposure threshold. Abstinence is the appropriate pregnancy recommendation and should also be discussed in women actively attempting conception because early embryonic exposure can precede pregnancy recognition.[12,24] The wine historically associated with Mediterranean eating is not part of the health rationale for a Mediterranean pregnancy diet.

10.3 Caffeine

Caffeine differs from alcohol because a moderate threshold has been established. EFSA concludes that caffeine intake from all sources up to 200 mg/day during pregnancy does not raise safety concerns for the fetus.[25]

Total exposure includes coffee, tea, cola, energy drinks, chocolate, guarana and caffeine-containing supplements or medicines.

11. Evidence versus Marketing in Fertility Supplementation

Commercial prenatal and fertility products frequently place established prevention, plausible mechanistic intervention and speculative enhancement within the same formulation and the same marketing hierarchy. That presentation is scientifically misleading.

INTERVENTION	RATIONALE	EVIDENCE POSITION	DEFENSIBLE INTERPRETATION
Folic acid	One-carbon metabolism; neural-tube closure	Established	Standard preventive intervention
5-MTHF replacing folic acid solely for common MTHFR variants	Active folate form	No superiority shown for NTD prevention	Marketing often exceeds evidence
CoQ10	Mitochondrial electron transport	Promising in selected DOR/ART populations	Potential adjunct; not universal fertility therapy
Myo-/D-chiro-inositol	Insulin signalling	Uncertain; some PCOS metabolic/reproductive signals	Phenotype-specific option
Probiotics	Microbiome modulation	Heterogeneous; strain-specific	No universal pregnancy probiotic recommendation
General antioxidant cocktails	Oxidative-stress biology	Low/very-low certainty	Routine fertility use not established
High-dose vitamin D for fertility	Endocrine/immunological plausibility	Correct deficiency; fertility enhancement uncertain	Treat status, not marketing
High-dose choline for fetal cognition	Neurodevelopmental biology	Insufficient human outcome evidence	Adequacy yes; enhancement unproven
Gluten-free fertility diet	Inflammation/malabsorption rationale	Indicated in coeliac disease; no general fertility benefit	Do not prescribe without indication
Ketogenic fertility diet	Insulin reduction	Insufficient reproductive-outcome evidence	Not routine fertility therapy

11.1 Probiotics

The term “probiotic” does not describe a uniform intervention. Species, strain, dose, timing and host phenotype all matter. A 2024 meta-analysis of 29 trials involving 7,735 pregnant women found low-certainty evidence that probiotic administration may make little or no difference to pre-eclampsia or preterm birth, with substantial heterogeneity across preparations.[19] Routine pregnancy probiotic prescription therefore cannot presently be justified as a class effect.

11.2 Antioxidant fertility formulations

Oxidative stress is biologically relevant to reproduction, but this does not prove that exogenous antioxidant mixtures improve live birth. The 2024 umbrella review found apparent positive effects for some supplements, but evidence was predominantly low or very low certainty and insufficient to recommend nutrient supplementation for female infertility.[11] Mechanism should not be allowed to substitute for outcome evidence.

12. Nutrition Across Gestational Stages

Pregnancy is metabolically dynamic. Nutritional priorities evolve across the continuum, and a static "prenatal diet" misses that physiology.

STAGE	PHYSIOLOGICAL PRIORITY	NUTRITIONAL FOCUS
Preconception	Nutrient reserves; metabolic control; ovulatory environment	Diet quality; folic acid; deficiency correction; alcohol avoidance; supplement review
Conception / implantation	Early embryogenesis; placentation begins	Maintain folate/B12/iodine adequacy; avoid teratogenic and unsafe exposures
First trimester	Organogenesis; nausea/food aversion common	Micronutrient density; hydration; manage vomiting; no indiscriminate caloric increase
Second trimester	Accelerating fetal growth; rising metabolic demand	Iron, protein, calcium, vitamin D, DHA; weight trajectory; glucose risk
Third trimester	Greatest fetal growth and nutrient transfer; maximal insulin resistance	Nutrient density; iron/DHA/mineral adequacy; metabolic control; food safety

12.1 Pregnancy is not "eating for two"

Energy requirements rise far less than popular culture implies. The clinically relevant objective is adequate energy to support maternal adaptation and fetal growth while maintaining appropriate gestational weight trajectory. Micronutrient requirements often increase disproportionately relative to energy intake; consequently, nutrient density becomes more—not less—important during pregnancy.

13. Gestational Diabetes and Metabolic Management

Pregnancy physiologically increases insulin resistance, particularly in later gestation. Gestational diabetes develops when pancreatic compensation is insufficient relative to this demand. Nutritional management should emphasise carbohydrate quality and distribution rather than indiscriminate carbohydrate elimination, together with adequate protein, fibre and unsaturated fats.

The contemporary Mediterranean-diet evidence is especially relevant here. The 2026 meta-analysis reported reduced gestational-diabetes risk in randomised Mediterranean-diet interventions.[4] This supports early dietary pattern intervention but does not justify assuming that a ketogenic pregnancy diet is superior simply because hyperglycaemia is involved.

14. Precision Maternal Nutrition and Clinical Algorithm

A rational preconception strategy should begin with assessment, not a supplement catalogue. The sequence below is intentionally conservative: correct what is known to matter before adding products whose value is uncertain.

STEP	QUESTION	ACTION
1	What is the reproductive context?	Natural conception, PCOS, infertility, ART, previous complications: define phenotype-specific priorities.
2	What does the habitual diet look like?	Correct pattern quality before adding multiple isolated supplements.
3	What is obligatory?	Periconceptional folic acid; avoidance of alcohol; food-safety education; medication/supplement review.
4	Is deficiency likely or demonstrated?	Use history and targeted laboratory assessment where clinically appropriate; correct deficits.
5	Is there metabolic disease?	Manage diabetes, insulin resistance, thyroid disease, blood pressure and major weight-related risk.
6	What has the diet excluded?	Vegan, gluten-free, dairy-free or restrictive patterns require replacement of nutrients lost with the excluded foods.
7	What supplements are already being used?	Reconcile all products to detect duplication, unsafe doses, botanicals and weakly supported fertility claims.

14.1 When generic advice is insufficient

Specialist nutritional management is particularly important after bariatric surgery, in clinically relevant malabsorption, inflammatory bowel disease, active coeliac disease, severe hyperemesis, eating disorders, pre-existing diabetes, chronic renal or hepatic disease, multiple pregnancy and severe food restriction. NICE specifically directs people with previous bariatric surgery who are planning pregnancy or are pregnant to obtain individualised specialist advice on folic acid and other micronutrients.[1]

15. Research Gaps and Future Directions

The next phase of reproductive nutrition will probably become more personalised, but the field must avoid confusing data richness with clinical validation. Multi-omics, metabolomics, continuous glucose data, microbiome sequencing and machine-learning models can generate highly specific associations. They do not prove that intervening on the associated variable improves conception, live birth or offspring health.

Priority research questions include: defining nutritional phenotypes most likely to benefit from specific interventions; using live birth rather than surrogate endpoints in infertility trials; establishing strain-specific microbiome interventions; identifying clinically meaningful thresholds for choline, vitamin D and omega-3 status; and improving evidence for nutritionally vulnerable groups such as vegan pregnancies, post-bariatric pregnancies and women with complex gastrointestinal disease.

RESEARCH STANDARD

Precision nutrition should remain evidence-constrained precision. The correct sequence is phenotype → intervention → clinically meaningful endpoint → replication, not biomarker → algorithm → marketing claim.

16. Conclusions

Diet can materially influence the physiological environment in which conception and pregnancy occur, but its role should neither be minimised nor inflated. Preconception is a genuine biological window: nutrient reserves, metabolic status and dietary behaviour exist before fertilisation, and early embryogenesis begins before pregnancy recognition.

The Mediterranean dietary pattern currently provides the strongest general dietary framework, particularly for cardiometabolic pregnancy outcomes. Periconceptional folic acid remains the clearest established supplement intervention. Iron, iodine, B12, vitamin D, calcium, choline and DHA should be approached through adequacy, risk and phenotype rather than indiscriminate maximal dosing.

CoQ10, inositols, probiotics and other specialised supplements remain scientifically interesting. Some may prove useful in selected populations. Their current evidence, however, does not support placing them on the same level as folic acid prevention, correction of deficiency or high-quality dietary pattern.

The future of reproductive nutrition is therefore unlikely to be defined by a larger prenatal tablet. It will be defined by earlier assessment, better phenotyping, superior dietary quality, targeted supplementation and a disciplined distinction between nutritional plausibility and demonstrated clinical benefit.

The central question is not "How many ingredients can be added before pregnancy?" but "Which nutritional constraint exists in this woman, at this reproductive stage, and does correcting it improve a clinically meaningful outcome?"

Appendix A. Nutrient Decision Matrix

NUTRIENT	PRECONCEPTION	PREGNANCY	HIGHER-RISK GROUPS	PRACTICAL DECISION	EVIDENCE
Folic acid	Start before conception	Continue ≥12 weeks	Previous NTD, diabetes, interacting drugs	Standard dose unless recognised high-risk indication	Established
Iron	Assess risk/stores	Demand rises	Heavy menses, prior anaemia, vegan diet, malabsorption	Target deficiency; align with local antenatal policy	Established/context
Iodine	Assess dietary exposure	Requirement rises	Low iodised-salt/dairy/fish intake; deficient regions	Country- and diet-specific supplementation	Context-dependent
B12	Critical in vegan/malabsorption	Continue adequate exposure	Vegan diet, bariatric surgery, GI disease	Supplement when dietary supply is unreliable or deficiency exists	Established for deficiency
Vitamin D	Assess risk	Maintain adequacy	Low sun exposure, darker skin, obesity, malabsorption	Correct inadequate status; avoid arbitrary megadose	Context-dependent
Calcium	Dietary adequacy	Maintain adequate intake	Low-calcium diet	Supplementation has strongest pre-eclampsia evidence where intake is low	Supported/context
Choline	Improve dietary intake	450 mg/day benchmark	Low egg/animal/soy intake	Ensure adequacy; do not promise cognitive enhancement	Emerging beyond adequacy
DHA	Fish/algal source	Additional preformed DHA relevant	No fish intake, vegan diet	Use lower-mercury fish or algal/fish DHA as appropriate	Supported
Vitamin A	Avoid high-dose retinol	Adequate, not excessive	Multiple supplements/cod-liver oil	Check chemical form and total exposure	Established safety principle

Appendix B. Preconception Assessment Checklist

REPRODUCTIVE CONTEXT	Age, cycle characteristics, previous pregnancies, PCOS, infertility diagnosis, ART plan, obstetric history.
DIETARY PATTERN	Plant-food diversity, whole grains/legumes, protein sources, fish, dairy or fortified alternatives, ultra-processed foods.
FOLATE	Is 400 µg/day folic acid being taken before conception? Is a recognised high-dose indication present?
IRON	History of heavy menses, anaemia, low ferritin, vegan/vegetarian diet, GI disease or bariatric surgery.
B12	Vegan diet, malabsorption, metformin/PPI exposure where relevant, bariatric history, previous deficiency.
IODINE	Use of iodised salt; dairy/fish intake; geographic context; avoid automatic high-dose iodine.
VITAMIN D	Sun exposure, skin pigmentation, obesity, malabsorption and previous laboratory status.
OMEGA-3	Frequency/species of fish intake; mercury risk; need for algal DHA in vegan diets.
METABOLIC HEALTH	Glucose status, blood pressure, thyroid disease, body-weight trajectory, eating-disorder risk.

ALCOHOL/CAFFEINE	Alcohol abstinence; total caffeine estimate from all sources.
FOOD SAFETY	Pasteurisation, raw/undercooked foods, ready-to-eat chilled foods, high-mercury fish, produce hygiene.
SUPPLEMENT RECONCILIATION	Prenatal multivitamin, fertility products, botanicals, sports supplements, duplicate vitamins/minerals and retinol exposure.

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