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REVIEW ARTICLE

A Narrative Review of Maternal Nutrition and Early Childhood Development

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Abstract

This structured narrative review synthesizes contemporary evidence (2016–2026) on maternal nutrition, pregnancy care, fetal nutrition, placental function, and early childhood development to clarify their integrated roles in lifelong health. Literature was retrieved from MDPI, PubMed, and Cureus using predefined keywords combined with Boolean operators. Peer-reviewed original studies, systematic reviews, and meta-analyses published in English were included, while non-scholarly reports and studies lacking methodological clarity were excluded. Data were narratively synthesized to identify mechanistic and developmental linkages across the first 1,000 days of life. The evidence underscores that adequate maternal nutrition before conception, during gestation, and throughout lactation is fundamental to optimal fetal growth, neurodevelopment, and long-term metabolic programming. Undernutrition, micronutrient deficiencies (e.g., folate, iodine, iron, vitamin D), and maternal hyperglycemia are associated with placental dysfunction, fetal growth restriction, preterm birth, and increased risk of chronic diseases including obesity, type 2 diabetes, and cardiovascular disorders. The placenta emerges as a central regulator of nutrient transport and endocrine adaptation, mediating the effects of maternal metabolic stress on fetal outcomes. Antenatal care utilization, maternal mental health, and socioeconomic determinants further modify developmental trajectories. Evidence also highlights the adverse impact of ultra-processed, proinflammatory dietary patterns and excessive refined sugar intake on maternal metabolic status and offspring health, potentially through inflammatory, oxidative, and epigenetic mechanisms. Optimal early feeding practices that including exclusive breastfeeding for six months and timely introduction of nutrient-dense complementary foods that remain critical for cognitive and physical development. Collectively, findings reinforce that improving maternal nutrition and pregnancy care is essential for reducing intergenerational disease risk and promoting sustainable population health.

Keywords: Nutrition, Pregnancy care, Childhood Development, Food Culture, Family Diet.

INTRODUCTION

The first 1,000 days of life from conception to a child's second birthday that represent a critical biological window during which nutrition exerts profound and lasting effects on growth, organ development, and neurocognitive outcomes. Rapid cellular proliferation, epigenetic modulation, and organogenesis during this period establish the physiological and metabolic foundation for lifelong health (Kruk et al., 2022). Evidence consistently demonstrates that inadequate maternal nutrition before and during pregnancy, as well as throughout lactation, is associated with adverse birth outcomes, impaired linear growth, weakened immunity, and increased susceptibility to noncommunicable diseases in later life. Conversely, optimal maternal nutrition improves birthweight, supports healthy growth trajectories, and enhances cognitive development in early childhood (Kumar et al., 2022).

Maternal and early childhood health are intrinsically interconnected through complex biological mechanisms. Nutrient availability during pregnancy directly influences placental function, fetal growth patterns, and long-term metabolic programming (Taneja et al., 2022). Deficiencies in essential micronutrients including folate, iodine, iron, zinc, vitamin D, choline, and omega-3 fatty acids which have been linked to congenital anomalies, neurodevelopmental impairments, and increased risk of chronic diseases such as obesity, type 2 diabetes, and cardiovascular disorders. In addition, maternal metabolic disturbances, including hyperglycemia and proinflammatory dietary patterns, can alter fetal gene expression and increase oxidative stress, thereby predisposing offspring to long-term health complications (Castanys-Muñoz et al., 2017). The placenta plays a central regulatory role in this process, acting as a dynamic interface that modulates nutrient transport, endocrine signaling, and fetal adaptation in response to maternal nutritional status (Myatt & Thornburg, 2018).

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Following birth, optimal infant feeding practices that including exclusive breastfeeding for the first six months and the timely introduction of nutritionally adequate complementary foods that are essential for sustaining growth and neurodevelopment. Global health frameworks, such as those promoted by international organizations, emphasize early-life nutrition as a cornerstone for preventing stunting, cognitive deficits, and long-term morbidity (Gete et al., 2020). Despite this well-established knowledge, maternal undernutrition, poor dietary quality, food insecurity, and limited access to antenatal and postnatal care remain persistent challenges, particularly in low- and middle-income countries. These factors, combined with evolving dietary patterns characterized by increased consumption of ultra-processed foods, continue to undermine maternal and child health outcomes (Trivett et al., 2021).

Although substantial research has documented the importance of individual nutrients and specific interventions, important gaps remain in the literature. There is a lack of comprehensive synthesis integrating maternal nutritional status across the continuum from preconception through pregnancy and lactation—with early childhood developmental outcomes in a unified framework. Furthermore, existing studies often examine isolated nutrients or single stages of development, rather than considering the cumulative and interactive effects of maternal diet, metabolic health, placental function, and infant feeding practices (Serpeloni et al., 2017). This fragmentation limits a holistic understanding of how maternal nutrition shapes early childhood development and long-term health trajectories.

Therefore, the central aim of this narrative review is to critically examine the role of maternal nutrition across the first 1,000 days and its impact on early childhood development (Franzago et al., 2019). Specifically, this review seeks to (i) synthesize current evidence on the relationship between maternal dietary patterns, micronutrient status, and developmental outcomes; (ii) explore underlying biological mechanisms, including placental regulation and metabolic programming; and (iii) identify key gaps and future research priorities to inform integrated nutritional strategies. By providing a comprehensive and structured overview, this review aims to contribute to a clearer understanding of how optimizing maternal nutrition can improve early childhood development and help break intergenerational cycles of malnutrition and disease.

METHODS

This study was conducted as a structured narrative review to systematically synthesize current evidence on maternal nutrition, pregnancy care, placental function, fetal development, and early childhood outcomes. Although not a formal systematic review, methodological rigor was enhanced by adopting transparent and reproducible search, screening, and synthesis procedures aligned with established narrative review reporting standards.

Search Strategy and Data Sources

A comprehensive literature search was performed across three electronic databases: PubMed, MDPI, and Cureus. These sources were selected to ensure broad coverage of peer-reviewed biomedical research (PubMed) alongside emerging and interdisciplinary open-access publications (MDPI and Cureus), which frequently include recent clinical and public health studies relevant to maternal and child nutrition, particularly in low- and middle-income settings.

The literature search was conducted between January 1, 2026 and March 15, 2026, and included studies published within a revised and logically consistent time frame of January 2016 to December 2025, ensuring inclusion of contemporary evidence while avoiding incomplete or future-dated records.

Search Terms and Boolean Strategy

Predefined keywords and Medical Subject Headings (MeSH)-aligned terms were used. The search strategy included combinations such as:

1. ("maternal nutrition" OR "maternal diet" OR "prenatal nutrition")
2. AND ("pregnancy care" OR "antenatal care" OR "prenatal care")
3. AND ("fetal development" OR "placental function" OR "fetal programming")
4. AND ("child development" OR "early childhood development" OR "neurodevelopment")

Additional terms included: micronutrients, oxidative stress, metabolic programming, breastfeeding, complementary feeding. Boolean operators (AND, OR) were applied to refine search sensitivity and specificity.

Eligibility Criteria

Studies were included based on the following criteria:

1. Peer-reviewed original research, systematic reviews, or meta-analyses
2. Published in English between 2016 and 2025
3. Addressing maternal nutrition (preconception, pregnancy, or lactation), placental biology, fetal growth, or early childhood development outcomes

Exclusion criteria included:

1. Editorials, commentaries, conference abstracts, and non-peer-reviewed reports
2. Studies lacking clear methodology or outcome relevance
3. Articles focusing solely on unrelated clinical conditions

Screening and Selection Process

The initial search yielded 842 records. After removal of duplicates (n = 126), 716 articles underwent title and abstract screening. Of these, 214 studies were selected for full-text review based on relevance to the study objectives. Following detailed evaluation using predefined inclusion criteria, 96 articles were included in the final synthesis.

Selection decisions were guided by relevance to maternal nutrition pathways, biological mechanisms (e.g., placental transport, epigenetic regulation), and measurable developmental or health outcomes.

Data Extraction and Thematic Synthesis

Data were systematically extracted using a standardized framework, including:

1. Study design and setting
2. Population characteristics

3. Nutritional exposures (macro- and micronutrients, dietary patterns)
4. Pregnancy care indicators
5. Developmental and health outcomes

A thematic synthesis approach was employed. Evidence was categorized into key domains:

1. Maternal nutritional status and dietary patterns
2. Placental function and fetal programming
3. Birth outcomes and early growth
4. Neurodevelopment and long-term disease risk

Themes were developed iteratively through comparative analysis, emphasizing biological plausibility, consistency of findings, and cross-study convergence.

RESULTS OF STUDY

Why Nutrition Matters?

Nutrition during the first 1,000 days operates as a central biological regulator of growth, neurodevelopment, and long-term metabolic function rather than merely a supportive environmental factor. Mechanistically, adequate maternal and early-life nutrient supply influences cellular proliferation, tissue differentiation, and organ maturation through tightly coordinated pathways involving hormonal signaling, epigenetic modification, and gene expression. For instance, deficiencies in critical micronutrients such as iron, iodine, folate, and zinc disrupt neurogenesis, myelination, and synaptic plasticity, thereby impairing cognitive development and behavioral outcomes. From a metabolic perspective, early nutritional status contributes to developmental programming, where nutrient imbalances alter fetal insulin sensitivity, adipogenesis, and energy homeostasis. These adaptations, while initially protective, may predispose individuals to noncommunicable diseases including obesity and type 2 diabetes in later in life. Concurrently, inadequate protein and energy intake during critical growth phases limits linear growth by affecting growth hormone–insulin-like growth factor (GH–IGF) axis activity, increasing the risk of stunting. Importantly, nutrition interacts with other determinants such as caregiving quality and environmental exposures, forming a multidimensional framework that shapes developmental trajectories. Emerging evidence highlights that optimal nutrient availability enhances not only physical growth but also immune competence and stress-response systems, which are essential for resilience and long-term health. Thus, nutrition during early life should be understood as a key modulator of biological systems that integrate structural development with functional outcomes, ultimately influencing both individual health and population-level disease burden (Soofi et al., 2022).

Pregnancy care

This supplement addresses critical dimensions of pregnancy care in low- and middle-income countries (LMICs), highlighting both clinical and social determinants of maternal health. The World Health Organization recommends a minimum of eight antenatal care visits to enhance maternal and neonatal outcomes, and evidence from LMICs indicates that women who complete eight or more visits are more likely to deliver in health facilities and seek timely postnatal care (Chilot et al., 2023). However, maternal undernutrition remains a persistent challenge; for example, nearly 45% of pregnant women in Ethiopia were reported to be undernourished, with contributing factors including limited decision-making autonomy, household food insecurity, inadequate prenatal dietary counseling, poor hygiene practices, and insufficient sanitation (Arero, 2022). Early pregnancy symptoms such as nausea and vomiting can further compromise dietary intake, and while complementary therapies such as acupuncture, acupressure, and ginger have shown potential benefits, current evidence supporting their effectiveness remains of low quality (Tan et al., 2023). Strengthening prenatal screening and preconception care is also essential; a case study from Mexico describes an integrated risk assessment model combining maternal history and early gestational laboratory findings (11–13 weeks) to identify individualized risks for complications and fetal loss while promoting equitable care (Bermudez Rojas et al., 2023). Additionally, maternal mental health has emerged as a crucial component of antenatal services, with research from West Ethiopia reporting depressive symptoms in approximately one-fifth of pregnant women, particularly among those who are single, experiencing unplanned pregnancies, or facing relationship dissatisfaction (Oljira et al., 2023). Collectively, these findings underscore the need for comprehensive antenatal strategies that integrate nutritional, medical, psychosocial, and equity-focused interventions to optimize maternal and fetal outcomes in LMIC settings.

Linking Maternal Nutritional Stress to Chronic Disease

The global burden of chronic disease is rising across all age groups, including children, with growing evidence indicating that early-life exposures that particularly maternal nutrition during pregnancy, shape long-term metabolic and cardiovascular risk. Developmental adaptations to suboptimal intrauterine nutrition are associated with increased susceptibility to type 2 diabetes, obesity, stroke, cardiovascular disease, chronic obstructive pulmonary disease, and liver disorders in adulthood (Ricker & Haas et al., 2017). Dietary patterns rich in whole grains, fruits, vegetables, legumes, nuts, plant-based oils, and low-mercury fish are consistently linked to lower systemic inflammation and improved health outcomes throughout the life course (GBD 2017 Diet Collaborators, 2019). Despite this evidence, adherence to healthy dietary patterns remains limited. Data from the National Health and Nutrition Examination Survey (NHANES) 2011–2012 indicated that only 1% of Americans met criteria for a consistently healthy diet, while more than 70% fell into the "poor" category; although modest improvements have been observed in recent years, earlier dietary trends continue to influence the health trajectories of individuals exposed during gestation (Fitzgerald et al., 2023). In contrast, diets characterized by high intakes of red and processed meats, saturated and trans fats, added sugars, excess salt, and ultra-processed foods promote inflammation and contribute substantially to chronic disease risk (Desai & Ross, 2020). A comprehensive analysis across 195 countries identified inadequate consumption of whole grains, fruits, and vegetables, alongside excessive sodium intake, as leading dietary drivers of global mortality. Addressing maternal nutrition is therefore central to reversing the chronic disease epidemic, as improvements in the nutritional status of individuals of reproductive age have the potential to reduce intergenerational disease risk, supported by both human and animal evidence (Aurich et al., 2023).

Mechanistically, prolonged maternal hyperglycemia exerts deleterious effects on fetal development.

Consumption of sucrose yields both glucose and fructose, and sustained elevations of these monosaccharides are associated with proinflammatory states. Elevated maternal glucose, particularly in gestational diabetes, promotes the formation of advanced glycation end-products (AGEs) through non-enzymatic glycation reactions that impair protein function (Nakagawa et al., 2023). AGEs interact with their receptor (RAGE), triggering oxidative stress via reactive oxygen species (ROS) and amplifying inflammatory signaling; experimental models suggest that such oxidative stress disrupts placental function and contributes to adverse developmental outcomes. Fructose, although metabolized differently, also produces harmful metabolic effects when chronically elevated, including increased hepatic triglyceride synthesis, inflammatory cytokine release, and risk of non-alcoholic fatty liver disease. Endogenous fetal fructose is largely synthesized from placental glucose, yet excessive exogenous fructose intake may perturb metabolic pathways implicated in conditions such as preeclampsia, a disorder associated with elevated long-term stroke mortality among affected offspring (Thompson & DeBosch, 2021). Beyond macronutrient imbalance, specific micronutrient deficiencies during gestation such as inadequate folate, vitamin D, or iodine that are linked to structural abnormalities and heightened chronic disease susceptibility. Nutrient requirements vary by developmental stage: calcium supports skeletal formation, essential fatty acids facilitate membrane synthesis and myelination, iron enables hemoglobin production, choline maintains membrane integrity, and adequate hydration is critical given the substantial net flux of water into the fetus (Marshall et al., 2022). As gestation progresses, demands for these substrates increase substantially. Importantly, maternal diets consist of complex food matrices rather than isolated nutrients, and emerging research increasingly emphasizes overall dietary patterns in shaping perinatal and long-term health outcomes. Numerous bioactive compounds essential to organogenesis and maturation remain insufficiently characterized, underscoring the need for continued investigation into the nutritional determinants of lifelong disease risk.

The Role of the Placenta in Fetal Nutrition

The placenta is a transient yet indispensable organ that mediates the exchange of nutrients, gases, hormones, and growth factors between mother and fetus throughout gestation. It originates from the outer cell layer of the early embryo during implantation into the endometrium and develops into a highly specialized structure composed of fetal capillary endothelium and a syncytialized chorionic epithelium directly bathed in maternal blood. This syncytiotrophoblast layer forms through the differentiation and fusion of cytotrophoblast cells, which are metabolically active and contribute to fatty acid metabolism and ATP generation (Kolahi et al., 2017). At its thinnest interface, only the syncytiotrophoblast and fetal capillary endothelium separate maternal and fetal circulations, enabling efficient exchange. Beyond nutrient delivery, the placenta synthesizes essential peptide and steroid hormones that sustain pregnancy and coordinate maternal metabolic adaptations to meet the evolving demands of the growing fetus (Hoffman et al., 2021). Maternal plasma nutrients originate from both endogenous tissue turnover such as mobilization of fatty acids from adipose tissue, amino acids from muscle, and hepatic glucose production and direct dietary intake (Trivett et al., 2021). These sources function in parallel, underscoring the importance of maternal nutrient reserves in addition to current intake. However, the relationship between maternal diet and fetal nutrient supply is complex and influenced by factors including fetal sex and pregnancy complications such as gestational diabetes and preeclampsia, which can modify placental transport capacity and metabolic regulation.

Genetically derived from both parents, the placenta is uniquely positioned to bring maternal and fetal bloodstreams into close proximity while maintaining selective separation through specialized transport systems. Nutrient transfer occurs via multiple mechanisms, including simple diffusion, facilitated diffusion, active transport, and receptor-mediated endocytosis. Hydrophilic channels permit the movement of lipid-insoluble molecules, while the extensive placental surface area supports gas diffusion. Specific transporters for glucose, amino acids, and lipids are expressed on both the microvillous and basal membranes of the syncytiotrophoblast and may be altered in pathological states (Myatt & Thornburg, 2018). Water transfer is driven by osmotic gradients; amino acids and ions utilize dedicated transport proteins; and antibodies, iron-containing proteins, and certain lipids are conveyed via receptor-mediated pathways. Although the integration of these transport processes is not fully elucidated, cellular coordination is critical, particularly under maternal stress conditions that may impair placental efficiency. Dysfunction in placental transport systems is associated with fetal growth restriction and can contribute to adverse outcomes such as preterm birth. While the precise contribution of poor maternal diet to spontaneous preterm birth remains uncertain (Gete & Waller, 2020), nutritional status likely influences placental performance. Infants born preterm, small for gestational age, or with intrauterine growth restriction face increased long-term risks of chronic disease, reflecting the impact of adverse intrauterine environments. Placental morphology, including variations in shape and thickness, may serve as indicators of compromised function. Advancing understanding of placental biology and its interaction with maternal nutrition is essential for developing both population-level and individualized strategies aimed at optimizing maternal, placental, and fetal health outcomes.

Early Childhood Development

In Bangladesh, early childhood development (ECD) demonstrates substantial variability across socioeconomic strata. The World Health Organization identifies key domains of ECD as physical growth, cognitive development, language acquisition, and socioemotional competence (WHO, 2018). National survey data indicate that children from wealthier households and those with more educated mothers consistently achieve superior developmental outcomes (Islam et al., 2023). Despite these insights, important evidence gaps persist, particularly in urban contexts where population density, poverty gradients, and service disparities may uniquely influence child development, underscoring the need for more focused urban research (Hamadani et al., 2014).

The supplement incorporates robust original investigations examining determinants of early developmental trajectories. A study conducted in Vietnam reported no significant association between maternal hemoglobin concentrations during pregnancy and subsequent child health or developmental outcomes (Young et al., 2023), findings that contrast with earlier research linking maternal hemoglobin status to neurodevelopmental performance and structural brain development (Nakahara et al., 2022). These inconsistencies highlight the complexity of maternal–fetal nutritional interactions and the necessity for further context-specific research, particularly in resource-constrained settings. Beyond biological factors, environmental and caregiving conditions critically shape developmental potential. Limited cognitive stimulation, inadequate responsive caregiving, and restricted early learning opportunities are associated with suboptimal cognitive and behavioral outcomes (Trude et al., 2021). Maternal bonding and time investment are central to healthy development; however, evidence from rural India suggests that while mothers allocate substantial time to household responsibilities, only a fraction is devoted directly to childcare during infancy, with caregiving time decreasing further as children age due to shifts toward income-generating and leisure activities (Batura et al.). Such patterns, particularly in low-resource households, may constrain opportunities to promote optimal caregiving practices and early developmental support.

Effects of Nutrition on Child Development

Optimal growth and development require a balanced supply of essential nutrients, particularly during the first 1,000 days—from conception to a child′s second birthday when maternal and child health are biologically interconnected. Adequate maternal nutrition before conception, throughout pregnancy, and during lactation is fundamental to ensuring favorable lifelong outcomes. Nutritional deficits during this critical window are difficult to reverse after early childhood, making timely intervention essential. To support survival, growth, and developmental potential, the World Health Organization (WHO) and UNICEF established the Global Strategy for Infant and Young Child Feeding, emphasizing appropriate maternal and early-life nutrition. Maternal undernutrition during pregnancy or the first two years of life can impair physical and cognitive development, with consequences that often persist into adulthood. Children are entitled to adequate nutrition, healthcare, and nurturing environments to support healthy maturation. Growth is influenced by complex interactions among diet, genetic and epigenetic regulation, and hormonal pathways (Pietrobelli & Agosti, 2017). Key nutrients during this period include carotenoids (lutein and zeaxanthin), choline, folate, iodine, iron, omega-3 fatty acids, and vitamin D, alongside magnesium, vitamin A, B vitamins, and trace minerals. Notably, folate and iodine deficiencies remain common in pregnancy despite their critical roles in neurodevelopment. Early-life stunting and fetal growth restriction are associated with irreversible outcomes, including lower birth weight, reduced adult stature, diminished educational attainment, and decreased economic productivity, underscoring the long-term impact of early nutritional status.

Table 1. Development stages of a child

Serial No.	Stage of Development
1	0–9 months: Pregnancy
2	0–6 months: Exclusive breastfeeding
3	6–12 months: Introduction of complementary/solid foods
4	12 months and beyond: Transition to family diet

Nine Months to Zero Months: Pregnancy

Optimal nutrition before conception and throughout pregnancy is fundamental for supporting fetal growth and establishing adequate maternal nutrient reserves for lactation. Pregnant women are generally advised to follow balanced dietary patterns consistent with recommendations for the general population, with only a modest increase in energy intake during late gestation—approximately 10% above non-pregnant requirements. Maternal pre-pregnancy weight, dietary quality, and overall nutritional status significantly influence conception, placental development, embryogenesis, fetal growth, and perinatal outcomes. Both undernutrition and overnutrition, as well as inappropriate maternal weight, are associated with reduced fertility and heightened risks of adverse maternal and neonatal outcomes (Beluska-Turkan et al., 2019).

Consumption of diverse foods in appropriate proportions ensures adequate intake of essential macronutrients and micronutrients. Protein is required for the synthesis and repair of maternal tissues, expansion of blood volume, uterine growth, and fetal tissue development. Iron is vital for hemoglobin formation and oxygen transport, particularly as maternal blood volume increases to meet fetal demands. Vitamin C contributes to collagen synthesis, wound healing, and the development of fetal bones and teeth. Calcium supports skeletal formation, neuromuscular function, cardiac activity, and fluid regulation. Folic acid is indispensable for neural tube formation, spinal and brain development, and maternal erythropoiesis. Adequate folate intake during early pregnancy can prevent up to 70% of neural tube defects, underscoring its critical role in periconceptional care.

Zero to Six Months: Breastfeeding

Breast milk constitutes the optimal source of nutrition for infants during the first six months of life, as it is uniquely tailored to meet their physiological and developmental requirements. It contains all essential macronutrients and micronutrients in appropriate proportions to support growth, organ maturation, and metabolic regulation. Colostrum, produced in the initial days postpartum, is particularly rich in immunoglobulins and bioactive compounds that enhance immune protection and reduce the risk of early-life infections. As lactation progresses, the composition of breast milk dynamically adapts to the infant′s changing nutritional and developmental needs, ensuring continued adequacy. Exclusive breastfeeding during the first six months provides balanced nutrition during a critical developmental window and is strongly recommended by pediatric authorities. During this period, supplementation with glucose water, sugar, honey, plain water, or other prelacteal feeds is unnecessary and discouraged (Koletzko et al., 2019).

Human milk sufficiently fulfills nearly all nutritional requirements in early infancy, with vitamin D representing a notable exception. Accordingly, breastfed infants or those consuming less than approximately 27 ounces of formula daily that should receive a vitamin D supplement providing at least 400 IU per day beginning shortly after birth. Most full-term infants are born with adequate iron stores to meet physiological demands for the first six months. Additionally, human milk contains omega-3 docosahexaenoic acid (DHA), an important component for neural and visual development, a nutrient also incorporated into most commercial infant formulas.

Six to 12 Months: Introduction of Solid Food

Providing nutrient-dense complementary foods during infancy supports the establishment of healthy eating patterns, even though breast milk or infant formula remains the primary source of nutrition during the first year of life. Around six months of age, certain micronutrient gaps particularly iron that may emerge, making the introduction of complementary feeding necessary. At this stage, solid and semi-solid foods should be considered complementary rather than replacements, as most energy and nutrients continue to be derived from breast milk or formula. Introducing solids can be challenging for caregivers, as readiness depends on developmental maturity, appetite cues, and growth patterns. The American Academy of Pediatrics recommends initiating semi-solid foods at approximately six months, a period that generally coincides with neuromuscular development sufficient for safe swallowing and coordinated feeding (Scott JA, 2020).

Initial complementary foods often include iron-fortified cereals or simple grains such as rice cereal, which help meet increased iron requirements essential for growth and neurodevelopment. Wheat-based products may be introduced cautiously due to potential allergenicity. Fruits such as mashed banana, peach, or applesauce can be offered in pureed form, optionally blended with breast milk or formula to achieve appropriate texture. Highly acidic citrus fruits are best deferred during the first year, and added sugars should be avoided to prevent excessive caloric intake and future obesity risk. Limited quantities of 100% fruit juice may be introduced after seven months in a cup rather than a bottle, ideally diluted and free of pulp; sugar-sweetened beverages should be avoided due to risks of dental caries and unnecessary calorie exposure. Vegetables can be prepared similarly to fruits without added salt, as excessive sodium may strain immature renal function. Protein-rich foods—including finely pureed poultry, meat, tofu, or legumes that can also be introduced using breast milk or formula for suitable consistency (Likhar & Patil, 2022). Thoughtful, developmentally appropriate complementary feeding practices are fundamental to supporting optimal growth and long-term health.

>12 Months: Transition to Family Diet

During the toddler period, the rate of physical growth moderates compared with infancy, yet nutritional requirements remain substantial to support ongoing development. This stage represents an important transition in feeding practices, as caregivers are encouraged to discontinue bottle use and promote independent eating and drinking skills. Once complementary foods are introduced and a child begins consuming a diverse range of solid foods, ensuring dietary adequacy becomes essential. Although toddlers commonly exhibit selective or inconsistent eating behaviors, repeated exposure to a variety of foods should be encouraged, as acceptance may require multiple offerings that often between eight and fifteen attempts. As children mature, they typically self-regulate intake in response to growth demands. With advancing age, requirements for protein, vitamins, and minerals increase alongside energy needs (Marshall et al., 2022). By approximately 12 months of age, guidance from the American Academy of Pediatrics recommends an intake of around 1,000 kilocalories per day, including approximately 700 mg of calcium, 600 IU of vitamin D, and 7 mg of iron to support healthy growth and development.

Nutrition and the Modern Food Culture

Growth velocity declines modestly during the toddler period compared with infancy; however, nutritional adequacy remains fundamental to supporting ongoing somatic growth, neurodevelopment, immune maturation, and behavioral regulation. This developmental stage also represents a critical transition in feeding practices, as caregivers gradually discontinue bottle use and promote self-feeding skills, thereby fostering autonomy and healthy eating behaviors. With the introduction of complementary foods and progression to a diversified family diet, toddlers require balanced meals that supply sufficient energy and micronutrients while accommodating their emerging preferences and appetite variability. Although selective eating and food neophobia are common at this age, repeated and varied exposure to nutrient-dense foods is an evidence-based strategy to improve acceptance. A novel food may need to be offered multiple times where often between eight and fifteen exposures before it is willingly consumed. Patience, positive modeling, and structured meal routines are therefore essential components of effective feeding practices. As children mature, their nutritional requirements expand in parallel with increases in body size, metabolic activity, and organ development. In addition to adequate caloric intake, sufficient protein is necessary to sustain tissue growth and enzymatic function, while vitamins and minerals play indispensable roles in skeletal mineralization, hematopoiesis, immune defense, and cognitive development (Marshall et al., 2022). By approximately 12 months of age, guidance from pediatric authorities such as the American Academy of Pediatrics recommends an average daily intake of around 1,000 kilocalories to meet energy needs, alongside 700 mg of calcium to support bone accretion, 600 IU of vitamin D to facilitate calcium absorption and skeletal integrity, and 7 mg of iron to prevent iron deficiency and support neurodevelopment. Establishing balanced dietary patterns during this formative period not only promotes healthy physical growth but also lays the foundation for long-term dietary behaviors and chronic disease prevention (Morrison, J.L.; Regnault, 2016).

CONCLUSION

Optimal nutrition across the life course that particularly during the first 1,000 days from conception to two years of age constitutes a decisive determinant of individual health trajectories and national development outcomes. Evidence consistently demonstrates that maternal nutritional status before and during pregnancy influences placental function, fetal growth, organ development, and long-term metabolic programming. Both undernutrition and excess caloric intake with poor dietary quality disrupt intrauterine homeostasis, increasing susceptibility to adverse birth outcomes, impaired neurodevelopment, preterm birth, and chronic diseases such as obesity, type 2 diabetes, cardiovascular disorders, and neurocognitive deficits later in life.

The placenta serves as a dynamic mediator of maternal–fetal nutrient exchange, integrating maternal dietary intake, metabolic reserves, and endocrine signals. Nutritional stress whether through micronutrient deficiencies, hyperglycemia, inflammatory dietary patterns, or metabolic dysfunction that can alter placental transport mechanisms and fetal adaptations, predisposing offspring to lifelong health risks. These biological processes are further compounded by sociocultural determinants, including maternal autonomy, food insecurity, mental health status, caregiving practices, and access to quality antenatal care. Breastfeeding, appropriate complementary feeding, and transition to a balanced family diet reinforce early nutritional foundations, while responsive caregiving and stimulating environments synergistically support physical, cognitive, and socioemotional development. Conversely, the global shift toward ultra-processed, proinflammatory dietary patterns and nutritionally imbalanced weight-loss regimens poses transgenerational risks that extend beyond immediate maternal outcomes. Therefore, addressing maternal and early childhood nutrition must remain central to public health strategies and sustainable development agendas. Interventions should prioritize nutrient-dense, culturally appropriate dietary patterns; equitable access to antenatal and postnatal care; mental health support; and policies that counteract unhealthy food environments. Strengthening maternal nutritional health is not only essential for optimizing perinatal outcomes but also represents a foundational strategy for preventing chronic disease and fostering human capital across generations.

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DECRALATION

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Not Applicable

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Artificial intelligence–assisted technology was used to improve language clarity during manuscript preparation. All substantive content, analyses, interpretations, and conclusions are the sole responsibility of the author.

Consent for publication
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Availability of data and materials
The data used in this study are available upon reasonable request and subject to standard data access procedures.

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The authors declare that they have no conflicts of interest.

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Authors' contributions

Arifa Sultana: Web-Survey Design, Supervised the Data Collection Process, And Checked Writing, Approved Methodology, Manuscript Editing and All Steps

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