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Food Environments and Their Influence on Early Childhood Nutrition in Low- and Middle-Income Countries (LMICs)

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Abstract: *Early childhood nutrition in low- and middle-income countries (LMICs) is critically shaped by the surrounding food environments, which influence the availability, accessibility, affordability, and acceptability of nutrient-rich foods. This narrative review synthesizes evidence on how physical, economic, socio-cultural, informational, and policy dimensions of food environments affect dietary diversity, nutrient adequacy, and growth outcomes among children under five. Findings indicate that limited market access, high food prices, cultural feeding norms, aggressive marketing of ultra-processed foods, and weak regulatory frameworks collectively contribute to stunting, wasting, micronutrient deficiencies, and emerging overweight. Integrated, context-specific interventions targeting these environmental determinants are essential to improve infant and young child feeding (IYCF) practices and advance global child nutrition goals. Strengthening food environments through policy, community engagement, and market interventions offers a promising pathway to reduce malnutrition and support healthy growth and development in LMICs.*

Keywords: *Food environments, early childhood nutrition, LMICs, dietary diversity, infant and young child feeding*

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1.0 Introduction

Optimal nutrition during the first 1,000 days of life remains one of the most influential determinants of child growth, cognitive development, and long-term health outcomes, particularly in low- and middle-income countries (LMICs). Research consistently shows that inadequate infant and young child feeding (IYCF) practices, limited access to nutrient-dense foods, and persistent food insecurity contribute significantly to high rates of stunting, wasting, and micronutrient deficiencies in these regions (UNICEF, WHO, & World Bank, 2023). These nutritional challenges are deeply rooted in the broader food environment, which encompasses the physical, economic, socio-cultural, informational, and political contexts in which caregivers access, prepare, and consume food. The food environments found across LMICs are often characterized by informal markets, seasonal variability, fluctuating prices, and infrastructural constraints, all of which influence the quality and diversity of foods available to young children (Turner *et al*., 2020).

Existing literature highlights marked changes in food systems across LMICs, where traditional diets increasingly coexist with readily accessible, affordable, ultra-processed foods. This trend has contributed to a rising double burden of malnutrition, with undernutrition persisting alongside escalating rates of childhood overweight and obesity (Popkin, Corvalan, & Grummer-Strawn, 2020). Studies conducted in Sub-Saharan Africa have shown that limited market availability of diverse foods directly restricts dietary diversity among children aged 6 to 23 months (Adu-Afarwuah *et al*., 2021). Similarly, evidence from South Asia demonstrates that high food prices and limited caregiver purchasing power strongly influence complementary feeding outcomes (Headey *et al*., 2020). In Latin

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America, rapid urbanization has increased children's exposure to low-nutrient processed snacks, frequently sold in community shops and school surroundings (Taillie *et al*., 2022). Research further indicates that socio-cultural norms, including food taboos and restrictive beliefs regarding appropriate foods for infants, significantly affect feeding practices (De-Bruyn *et al*., 2021). Additionally, aggressive marketing of breast-milk substitutes and processed foods continues to undermine optimal breastfeeding and complementary feeding in many LMICs, despite global regulations (Baker *et al*., 2021).

Although this body of work provides important insights, significant knowledge gaps persist. Much of the existing research focuses narrowly on household food security or caregiver behavior, with limited integration of the broader structural and environmental factors that shape children's diets. Few studies examine the combined influence of food availability, affordability, socio-cultural norms, marketing practices, and caregiver agency within a unified framework. Age-specific analyses that explore how these food environment components shape the nutrition of infants and young children remain limited, despite the unique nutritional needs of children in this age group. Additionally, research from LMICs often adapts frameworks originally developed in high-income countries, which do not fully capture the realities of informal markets, seasonality, and political instability that characterize many LMIC food systems. These gaps limit the development of holistic, context-appropriate interventions capable of improving early childhood nutrition.

The aim of this study is therefore to examine how the multiple dimensions of the food environment influence early childhood nutrition in LMICs, with a particular focus on availability, affordability, accessibility, socio-cultural norms, caregiver knowledge, household food security, and exposure to commercial marketing. By synthesizing current evidence, the study seeks to clarify the pathways through which food environments shape IYCF practices and to identify both opportunities and challenges for improving child nutrition through food environment-centered interventions.

The significance of this work lies in its potential to deepen understanding of the structural determinants of early childhood nutrition in LMICs. A comprehensive and integrative view of food environments provides essential insights for policymakers, development agencies, and public health practitioners seeking to design effective interventions that address not only caregiver behavior but also the systemic factors that constrain healthy feeding practices. Improving food environments offers a critical pathway for reducing stunting, addressing micronutrient deficiencies, preventing the rise in unhealthy food consumption among young children, and supporting progress toward global development goals, including Sustainable Development Goals 2 and 3. Additionally, the synthesis of existing gaps provides direction for future research aimed at creating culturally sensitive, evidence-based strategies to advance child health in vulnerable settings.

2.0 Conceptualizing Food Environments in LMICs

Food environments encompass the various contexts in which individuals and households acquire, prepare, and consume food, and they play a central role in shaping dietary behaviors and nutrition outcomes in low- and middle-income countries (LMICs). These environments include multiple overlapping dimensions that collectively determine the availability, affordability, cultural appropriateness, and desirability of foods consumed by infants and young children. The

physical food environment relates to the availability and accessibility of food outlets, including markets, shops, farms, and both formal and informal food vendors. In many LMICs, local diets are heavily influenced by informal markets and street vendors, which often serve as the primary sources of affordable foods for low-income households (Turner *et al*., 2020). The structure and density of these markets affect caregivers' ability to procure fresh, diverse, and nutrient-rich foods essential for early childhood nutrition.

The multidimensional nature of food environments in LMICs requires a structured framework to clearly illustrate how different environmental components influence early childhood nutrition. While the preceding discussion outlines the key domains—physical, economic, socio-cultural, informational, and policy environments—their interactions and specific impacts on child nutrition outcomes can be more effectively understood when presented in a synthesized format. Table 1 provides a comprehensive overview of these food environment dimensions, highlighting their defining characteristics, contextual examples within LMICs, and their implications for dietary diversity, nutrient adequacy, and child growth outcomes. This synthesis supports a clearer understanding of how environmental constraints and opportunities shape infant and young child feeding practices.

Table 1: Dimensions of Food Environments and Their Influence on Early Childhood Nutrition in LMICs

Food Environment Dimension	Key Characteristics	Examples in LMICs	Implications for Early Childhood Nutrition
Physical Environment	Availability and proximity of food sources; infrastructure; market access	Informal markets, street vendors, rural market scarcity, poor road networks	Limited access to diverse, nutrient-rich foods; reliance on staple-based diets; low dietary diversity
Economic Environment	Food prices, household income, purchasing power, price volatility	High cost of animal-source foods; seasonal food price fluctuations; low household income	Reduced affordability of nutritious foods; increased consumption of cheap, energy-dense foods; risk of undernutrition
Socio-cultural Environment	Cultural beliefs, food taboos, gender norms, caregiving practices	Restrictions on feeding eggs or meat to young children; gendered decision-making; traditional feeding norms	Inappropriate feeding practices; delayed or limited introduction of diverse foods; poor nutrient intake
Informational Environment	Nutrition education, food labeling, marketing, media exposure	Aggressive marketing of breast-milk substitutes and ultra-processed foods; limited access to accurate nutrition information	Increased consumption of unhealthy foods; undermining of breastfeeding and optimal complementary feeding practices

Policy Environment	Food policies, regulations, agricultural systems, social protection programs	Weak enforcement of food safety laws; limited implementation of the International Code of Marketing of Breast-milk Substitutes; cash transfer programs	Inconsistent food quality; limited support for nutritious diets; potential improvements through policy interventions

The economic environment is equally critical, as household income, food prices, and transportation costs directly influence purchasing power and dietary choices. Numerous studies show that fluctuations in food prices disproportionately affect poor households, leading to a reliance on cheaper, calorie-dense foods rather than nutrient-rich complementary foods appropriate for young children (Headey & Alderman, 2022). Seasonal variations in food production, common across African and South Asian countries, further exacerbate food price volatility and limit access to diverse foods.

The socio-cultural environment shapes dietary behaviors through caregiver beliefs, food taboos, traditions, and social support systems. Cultural norms strongly influence breastfeeding practices, the introduction of complementary foods, and the types of foods offered to young children. In some communities, nutrient-dense foods such as eggs, fish, or certain vegetables are restricted for young children due to misconceptions, ultimately contributing to poor dietary diversity (Aphane *et al*., 2023). Caregiver knowledge and intra-household decision-making dynamics also shape child-feeding practices, often determining whether children receive appropriate portions and nutrient-rich meals.

The information environment includes the channels through which caregivers receive messages about food, such as nutrition education, product labeling, and commercial marketing. Increasingly, LMICs are experiencing a rise in aggressive marketing of breast-milk substitutes, processed snacks, and sugar-sweetened beverages, which undermines optimal feeding practices and promotes unhealthy dietary patterns among children (Baker *et al*., 2021). Limited access to accurate nutrition information further complicates caregivers' ability to make informed decisions. Finally, the policy environment encompasses regulations, agricultural policies, food safety standards, and social protection programs. Weak regulatory oversight in many LMICs contributes to inconsistent food quality, inadequate enforcement of the International Code of Marketing of Breast-milk Substitutes, and limited investment in food system infrastructure (Herforth & Ahmed, 2022). Social protection initiatives, such as cash transfers or food subsidy programs, have shown potential to improve dietary diversity, but implementation gaps and coverage limitations reduce their effectiveness.

Together, these dimensions interact in ways that significantly influence what foods are available, affordable, and culturally acceptable for young children. In LMICs, food environments are often shaped by informal food economies, seasonal production patterns, poor infrastructure, and socioeconomic inequality. These factors create a complex set of constraints that determine the nutritional quality of children's diets. Understanding the interplay of these food environment components is essential for identifying effective strategies that can improve early

childhood nutrition and reduce the burden of malnutrition.

3.0 Early Childhood Nutrition in LMICs: Current Situation

Early childhood nutrition in low- and middle-income countries (LMICs) continues to be characterized by persistent and evolving forms of malnutrition, reflecting the deep structural, socio-economic, and environmental inequities that shape children's diets. Stunting remains one of the most widespread nutritional challenges, affecting millions of children under five across Sub-Saharan Africa, South Asia, and parts of Latin America. Chronic undernutrition—linked to inadequate caloric intake, poor maternal nutrition, infections, and low dietary diversity—has contributed to an estimated 148 million stunted children globally, with LMICs bearing more than 90% of this burden (UNICEF, WHO, & World Bank, 2023). Stunting not only impairs physical growth but also undermines cognitive development, school readiness, and future productivity.

Wasting continues to be a major concern, particularly in regions affected by humanitarian crises, recurring droughts, conflict, and food insecurity. Recent evidence suggests that approximately 45 million children under five experience wasting, with the highest prevalence in East Africa and the Sahel, where acute food shortages and displacement disrupt access to adequate nutrition and essential health services (FAO *et al*., 2023). Episodes of wasting often coincide with seasonal food scarcity, disease outbreaks, and the collapse of informal food markets, illustrating the strong links between food environments and acute malnutrition.

Micronutrient deficiencies also remain widespread, especially deficiencies in iron, zinc, and vitamin A, which collectively contribute to weakened immunity, anemia, impaired cognitive function, and increased risk of morbidity. Studies across LMICs show that iron deficiency anemia affects nearly 40% of children under five, while inadequate zinc intake and low dietary consumption of vitamin A–rich foods contribute significantly to preventable illnesses and mortality (Stevens *et al*., 2022). These deficiencies are strongly associated with limited access to nutrient-dense foods, low household purchasing power, and the absence of fortified products.

Poor dietary diversity is a defining feature of early childhood diets in many LMICs. Data from the Demographic and Health Surveys indicate that in several African and South Asian countries, fewer than 25% of children aged 6–23 months meet the minimum dietary diversity requirement (White *et al*., 2023). Many children rely heavily on starchy staples such as maize, cassava, rice, or sorghum, with limited consumption of animal-source foods, legumes, fruits, and vegetables. This narrow dietary pattern reflects the combined influence of food price fluctuations, seasonal availability, caregiver knowledge, and socio-cultural restrictions on child feeding.

At the same time, the emergence of overnutrition presents a growing public health challenge. Urban areas in LMICs are experiencing increasing rates of childhood overweight and obesity due to rising consumption of cheap, energy-dense, ultra-processed foods and sugar-sweetened beverages. These products are often more accessible and affordable than healthier alternatives and are aggressively marketed even in settings where undernutrition remains prevalent (Popkin *et al*., 2020). This dual burden of malnutrition—where undernutrition and obesity coexist within the same communities, households, or even individuals—reflects rapid transformations in food systems and food environments.

Together, these nutritional outcomes are inextricably linked to the food environments in which children live. Stunting, wasting, micronutrient deficiencies, and emerging overnutrition are shaped by the availability, affordability, cultural acceptability, and marketing of foods accessible to caregivers and young children. Understanding the current state of early childhood nutrition in LMICs therefore requires a systematic examination of how food environments constrain or support optimal feeding practices during the critical first years of life.

4.0 Linking Food Environments to Early Childhood Nutrition Outcomes

The relationship between food environments and early childhood nutrition outcomes in low- and middle-income countries (LMICs) is increasingly recognized as a critical determinant of child health and development. Food environments shape what foods are available, affordable, and desirable to caregivers, thereby influencing dietary patterns during the first years of life. In many LMICs, children live in settings where nutritious foods such as fruits, vegetables, legumes, and animal-source foods are either scarce or financially inaccessible, while inexpensive calorie-dense processed foods are widely available. These environmental constraints contribute to patterns of inadequate dietary diversity and insufficient nutrient intake during the complementary feeding period, ultimately heightening the risk of stunting, wasting, and micronutrient deficiencies (UNICEF, 2023).

Understanding the pathways through which food environments influence early childhood nutrition outcomes is essential for interpreting the complex interactions described in this review. While Section 4 discusses these relationships in narrative form, a visual representation provides a clearer synthesis of how multiple environmental dimensions interact to shape infant and young child feeding practices and nutritional status. Fig. 1 presents a conceptual pathway illustrating the links between food environment determinants, such as physical access, economic constraints, socio-cultural influences, informational exposure, and policy framework, and key early childhood nutrition outcomes, including dietary diversity, stunting, wasting, micronutrient deficiencies, and overweight. This framework highlights both direct and indirect mechanisms through which food environments operate in LMIC contexts.

Evidence from multiple regions shows that physical access to markets plays a significant role in determining the quality of young children's diets. Households located far from food markets or living in areas with limited transportation infrastructure tend to rely on monotonous staple-based diets, which reduce the likelihood of children consuming nutrient-rich foods that support optimal growth. Studies in Sub-Saharan Africa and South Asia have demonstrated that children in households with poor market access consistently have lower Minimum Dietary Diversity (MDD) scores, which directly correlate with stunting and underweight outcomes (FAO *et al*., 2022; Hirvonen *et al*., 2020).

Figure 2 presents a conceptual framework for improving early childhood nutrition through targeted food environment interventions in low- and middle-income countries (LMICs), delineating the pathways from structural challenges to nutritional impact.

The figure shows a logical progression starting from Key Food Environment Challenges—such as high food prices and aggressive marketing, to Strategic Intervention Areas including economic protection and policy strengthening. It maps how these interventions lead to Immediate Effects (e.g., increased affordability and caregiver knowledge), which ultimately translate into Improved Feeding

Practices and significant Early Childhood Nutrition Impacts, such as reduced stunting, wasting, and micronutrient deficiencies. The framework is underpinned by Cross-Cutting Enablers like multi-sectoral coordination and gender equality, which ensure the sustainability of these nutritional gains.

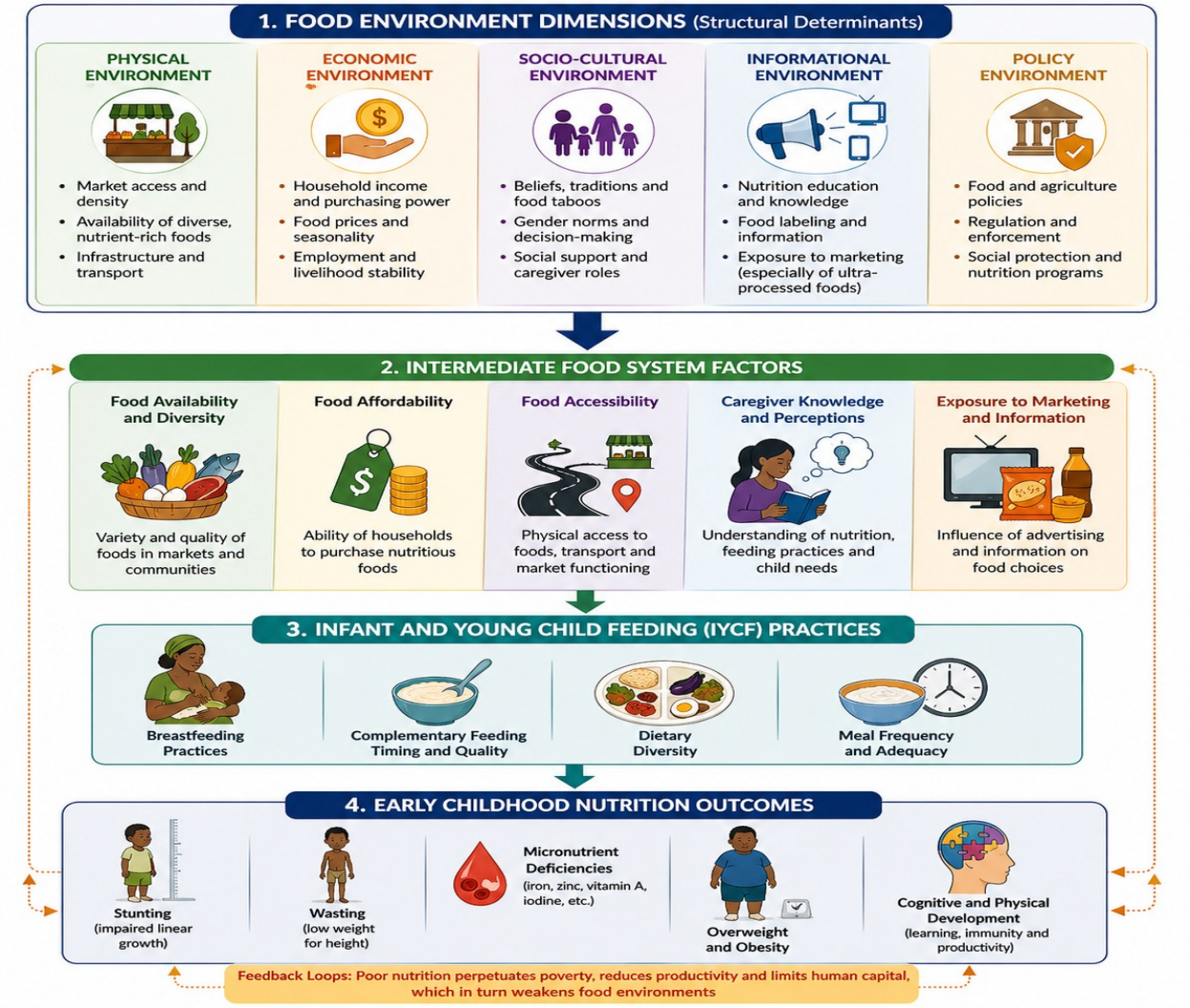

Fig. 1: Conceptual framework showing pathways through which food environments influence infant and young child feeding practices and early childhood nutrition outcomes in low- and middle-income countries (LMICs)

Economic conditions within food environments also exert a strong influence on child nutrition. In contexts where household purchasing power is low, caregivers often prioritize cheaper staple foods over more expensive sources of protein and micronutrients. Rising food prices, income volatility, and the seasonality of agricultural production further exacerbate household food insecurity, increasing the likelihood of inadequate nutrient intake among young children. Economic constraints have been shown to significantly reduce access to animal-source foods such as eggs, dairy, and meat,

which are essential for brain development and growth in early childhood (Headey *et al*., 2018).

Socio-cultural norms additionally shape feeding decisions and can either mitigate or amplify the effects of constrained food environments. In many LMIC settings, beliefs around appropriate complementary foods, gender norms that limit women's decision-Making power and traditional feeding practices influence the types of foods offered to children. These socio-cultural dynamics intersect with environmental limitations to create complex barriers to optimal feeding. For instance, even where nutritious foods are available, cultural norms may discourage mothers from feeding them to infants or may influence intra-household food allocation in ways that disadvantage young children (GLOPAN, 2021).

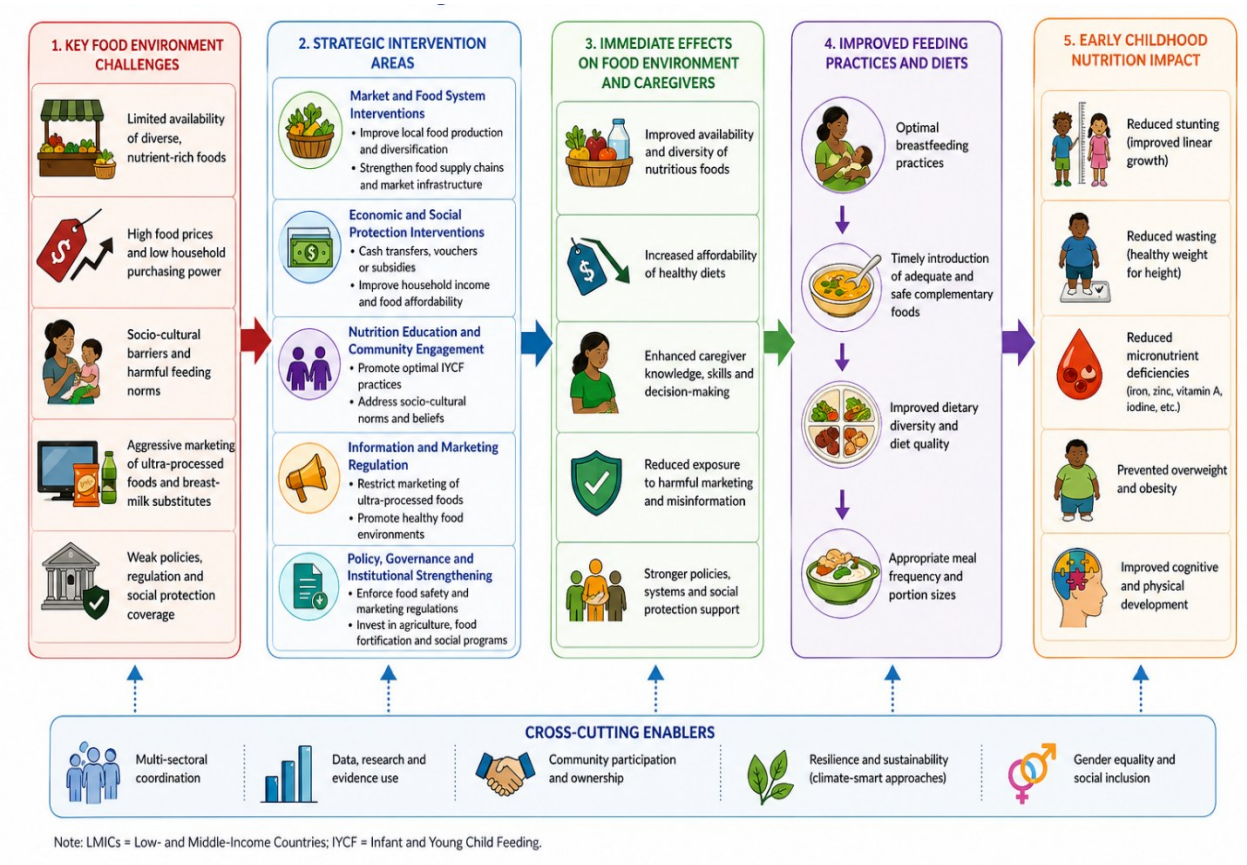

Fig. 2: Conceptual framework illustrating the pathways from food environment interventions to early childhood nutrition outcomes in LMICs

Information environments such as food marketing and nutrition education further interact with food access and affordability. The increasing penetration of ultra-processed foods in LMIC markets, combined with aggressive marketing strategies, has fueled growing interest among caregivers in low-cost, convenient snacks. These products often displace traditional nutrient-dense foods, contributing to the coexistence of undernutrition and overweight in young children. Research shows that exposure to marketing of sugar-sweetened snacks and beverages is strongly associated with unhealthy

dietary patterns among older infants and toddlers (WHO, 2022).

Policy environments also play a central role in shaping children's nutritional outcomes. Weak enforcement of food safety standards, inadequate social protection programmes, and limited investments in agricultural diversification can perpetuate food environments that undermine healthy feeding practices. Conversely, countries that have implemented integrated food systems policies, school feeding programmes, and agricultural reforms have recorded improvements in dietary diversity and reductions in childhood malnutrition. Effective policies create supportive environments that make nutritious foods more widely available, affordable, and acceptable to families (UNICEF & WHO, 2021).

Overall, early childhood nutrition outcomes in LMICs are the cumulative result of these interacting food environment dimensions. Children do not choose their diets; rather, their nutritional trajectories reflect a complex interplay of physical, economic, socio-cultural, informational, and policy conditions. Understanding these contextual factors is essential for designing interventions that address the root causes of malnutrition and support healthier diets for young children.

5.0 Methodology

This study employed a narrative review methodology to synthesize existing evidence on the influence of food environments on early childhood nutrition in low- and middle-income countries (LMICs). A narrative review approach was considered appropriate because it enables the integration of diverse forms of literature, including empirical studies, global nutrition reports, and conceptual frameworks, which together provide a comprehensive understanding of how food environments shape nutrition outcomes for children under five. This method supports the exploration of complex, multidimensional issues such as food availability, affordability, socio-cultural norms, and policy context, which cannot be adequately captured through a single methodological tradition.

The review process involved a systematic search of peer-reviewed journal articles, global health databases, and reports from reputable international organizations such as the World Health Organization (WHO), the Food and Agriculture Organization (FAO), the United Nations Children's Fund (UNICEF), and The Lancet series on Maternal and Child Nutrition. Databases including PubMed, Scopus, and Google Scholar were consulted to identify relevant studies published from 2015 to 2024, reflecting the period in which food systems and food environment research significantly expanded. Search terms included combinations of food environments, early childhood nutrition," "infant and young child feeding, "dietary diversity," "LMICs," "malnutrition," and "food systems.

After the initial screening, studies were evaluated based on relevance, methodological rigour, and alignment with the study aims. Only studies that focused on children under five or on complementary feeding practices within LMIC contexts were included. Global reports and multi-country analyses were incorporated to provide cross-regional perspectives and to capture trends not limited to individual case studies. The literature review also examined conceptual frameworks such as the UNICEF Nutrition Framework and the evolving food systems paradigms to contextualize empirical findings within broader theoretical constructs.

Data extraction involved identifying major themes regarding how different dimensions of food environments influence dietary practices, nutrient adequacy, and growth outcomes among young children. These themes included

market access, income and food pricing, cultural influences on feeding practices, caregiver access to nutrition information, and the role of food and agriculture policies. Attention was paid to both direct pathways, such as availability of nutrient-dense foods, and indirect pathways, such as marketing exposure or intra-household decision-making. This thematic synthesis allowed the study to articulate how multiple environmental factors interact to shape early childhood nutrition outcomes in LMICs.

The narrative synthesis was guided by an integrative approach that combined empirical evidence with conceptual insights in order to present a holistic understanding of the challenges and opportunities within LMIC food environments. This methodology facilitated a comprehensive analysis of existing knowledge, highlighted the intersections between food environments and child nutrition, and provided a structured basis for identifying critical knowledge gaps. The approach also ensured that findings were grounded in credible, verified data from authoritative sources.

This methodology does not aim to quantify the effect sizes of specific interventions or environmental determinants; rather, it seeks to contextualize and interpret existing evidence to inform future research and policy direction. The strengths of this approach lie in its ability to capture complexity and synthesize insights across multiple disciplines relevant to nutrition, public health, and food systems. However, its limitations include reliance on available literature, which may be uneven across regions, and the potential exclusion of unpublished or locally generated data. Nonetheless, the rigor of the search strategy and the inclusion of multiple high-quality sources ensure that the findings presented offer a reliable reflection of current knowledge on food environments and early childhood nutrition in LMICs.

6.0 Results, Findings and Discussion

The review identified consistent evidence demonstrating that food environments exert significant influence on early childhood nutrition outcomes across low- and middle-income countries (LMICs). The results indicate that children's diets and nutritional status are shaped by interconnected physical, economic, socio-cultural, informational, and policy dimensions of their environments, each contributing to either protective or harmful feeding practices during early childhood. Studies from Sub-Saharan Africa, South Asia, and Latin America show that food environments characterized by limited availability of nutrient-rich foods, high prices for animal-source foods, and widespread accessibility of ultra-processed products are strongly associated with inadequate dietary diversity and poor growth outcomes in children under five (FAO *et al*., 2022; UNICEF, 2023).

Given the wide range of studies examining the relationship between food environments and early childhood nutrition in LMICs, a structured synthesis of the evidence is essential to highlight consistent patterns and regional variations. While the narrative discussion outlines key findings, presenting selected studies in a comparative format enhances clarity and strengthens the analytical rigor of the review. Table 2 summarizes representative empirical and global studies, indicating the specific food environment factors examined, their geographic contexts, and the associated nutrition outcomes among children under five. This synthesis illustrates the convergence of evidence linking environmental determinants to dietary diversity, nutrient adequacy, and growth outcomes.

Table 2: Summary of Evidence Linking Food Environment Factors to Nutrition Outcomes in Children Under Five in LMICs

Study (Author, Year)	Region/Context	Food Environment Factor	Key Findings	Nutrition Outcome
Adu-Afarwuah *et al*. (2021)	Sub-Saharan Africa	Complementary feeding environment; food availability	Limited access to diverse foods constrains complementary feeding practices	Low dietary diversity; stunting risk
Headey *et al*. (2020)	South Asia	Food prices; household purchasing power	High food prices reduce access to nutrient-rich complementary foods	Poor dietary adequacy; undernutrition
Hirvonen *et al*. (2020)	Ethiopia and similar LMIC contexts	Market access; physical food environment	Proximity to markets improves dietary diversity among children	Improved Minimum Dietary Diversity (MDD)
Headey *et al*. (2018)	Multi-country LMIC analysis	Affordability of animal-source foods	High cost limits consumption of protein-rich foods	Increased stunting prevalence
FAO *et al*. (2022)	Global LMICs	Food systems; affordability; policy environment	Healthy diets remain unaffordable for many households	Widespread nutrient deficiencies
Stevens *et al*. (2022)	LMICs (global analysis)	Micronutrient availability	Inadequate intake of iron, zinc, and vitamin A is prevalent	Micronutrient deficiencies; anemia
Taillie *et al*. (2022)	Latin America	Availability of ultra-processed foods; urban food environments	Increased access to processed foods in urban areas	Rising overweight and poor diet quality
Baker *et al*. (2021)	Global LMICs	Commercial marketing; informational environment	Aggressive promotion of breast-milk substitutes influences feeding choices	Reduced breastfeeding; unhealthy diets
Popkin *et al*. (2020)	Global LMICs	Food system transformation;	Nutrition transition driving increased	Double burden of malnutrition

		processed food access	consumption of ultra-processed foods	
White *et al*. (2023)	Global LMICs	Dietary diversity; feeding practices	Low proportion of children meet minimum dietary diversity standards	Poor diet quality; growth risks

A key finding of the review is the prominent role of the physical food environment, particularly the proximity and functioning of formal and informal markets. Children living in rural or remote areas where markets are sparse and transportation systems are weak tend to consume diets dominated by starchy staples, with minimal intake of fruits, vegetables, and animal-source foods. These dietary patterns are reflected in higher rates of stunting and micronutrient deficiencies. The evidence also shows that even households located near markets may not achieve adequate dietary diversity if the markets lack affordable, diverse, and nutritious food options. This supports findings from multi-country analyses indicating that market quality and diversity are stronger predictors of child nutrition than market distance alone (Hirvonen *et al*., 2020).

Economic conditions emerged as another major determinant of early childhood nutrition. Household poverty, food price volatility, and income instability significantly reduce the capacity of caregivers to provide nutritionally adequate diets. Studies reveal that the high cost of nutrient-dense foods, particularly animal-source foods, is one of the primary barriers to meeting global recommendations for complementary feeding in LMICs. As a result, children from low-income households often receive inexpensive, calorie-dense foods that satisfy hunger but do not support optimal growth or cognitive development. These patterns align with broader evidence that food affordability is one of the strongest predictors of stunting prevalence across LMICs (Headey *et al*., 2018). The findings also indicate that economic shocks, such as inflation or loss of livelihoods, further exacerbate food insecurity and contribute to seasonal fluctuations in children's nutritional status.

The socio-cultural environment was found to deeply influence the types of foods offered to young children, often interacting with broader food system constraints. In many countries, traditional norms dictate when and how complementary foods are introduced, sometimes resulting in delayed introduction of nutrient-rich foods or inappropriate feeding practices. Gender norms that limit maternal autonomy or decision-making also restrict the ability of mothers to procure and prepare nutritious foods. Evidence from regions such as West Africa and South Asia shows that harmful beliefs around certain foods, perceptions of child readiness, and intra-household food allocation patterns can negatively affect dietary diversity even when nutritious foods are available in the community (GLOPAN, 2021). These findings suggest that interventions must address both the availability of nutritious foods and the cultural factors shaping caregiver behavior.

The informational environment also emerged as a crucial component, with increasing exposure to marketing of ultra-processed foods contributing to shifting dietary behaviors among young children. Multiple studies highlight that snacks, sugar-sweetened beverages, and processed cereals are aggressively marketed in LMICs, often portraying them as convenient and desirable for infants and toddlers. This marketing environment, combined with limited access to

accurate nutrition education, influences caregiver perceptions and normalizes early consumption of unhealthy foods. Evidence from WHO reports shows that children exposed to high levels of food marketing are more likely to consume energy-dense, nutrient-poor foods, leading to the coexistence of undernutrition and overweight in the same communities (WHO, 2022).

Policy environments were also shown to strongly shape food environments and, by extension, child nutrition outcomes. Countries with weak food regulation systems, inadequate agricultural support, and limited social protection programs often face more severe child malnutrition burdens. Conversely, policy interventions such as fortified complementary foods, cash transfer programs, agricultural diversification initiatives, and market stabilization policies have been linked to improvements in dietary diversity and reductions in stunting and micronutrient deficiencies. Multi-sectoral nutrition policies implemented in countries such as Peru, Ethiopia, and Rwanda demonstrate measurable success in improving child nutrition when coordinated across health, agriculture, and social protection sectors (UNICEF & WHO, 2021).

Overall, the findings highlight that early childhood nutrition outcomes in LMICs are shaped by the cumulative and interacting effects of these environmental factors. The discussion emerging from this review suggests that addressing child malnutrition requires an integrated approach targeting both the broader food environment and caregiver-level determinants. Improving early childhood nutrition cannot rely solely on individual behavior change but must involve structural interventions that make healthy foods accessible, affordable, culturally acceptable, and appropriately marketed.

The discussion also emphasizes the need for context-specific solutions. While market improvements and economic policies may be critical in some regions, shifting socio-cultural norms and improving nutrition literacy may be more impactful in others. Furthermore, the findings underscore the importance of strengthening food systems resilience, particularly in the face of climate change, economic shocks, and rapid urbanization, all of which disproportionately affect food environments in LMICs. Effective interventions must therefore combine food system reforms, social protection mechanisms, community-level nutrition programs, and stricter regulation of ultra-processed food marketing.

Finally, the findings highlight significant gaps in research and policy implementation. Many LMICs lack high-resolution data on food environments, and few studies capture the complex interactions between environmental, cultural, and economic determinants of feeding practices. This reinforces the need for interdisciplinary, longitudinal, and systems-based research to support targeted interventions capable of transforming food environments and improving nutrition outcomes for young children.

7.0 Summary of Findings, Conclusions, and Recommendations

This review highlights the complex and multifaceted role of food environments in shaping early childhood nutrition in low- and middle-income countries (LMICs). The findings indicate that physical, economic, socio-cultural, informational, and policy dimensions of food environments interact to influence dietary diversity, nutrient adequacy, and overall growth outcomes among children under five. Limited availability and accessibility of nutrient-rich foods, coupled with economic constraints and seasonal

fluctuations, consistently emerge as key barriers to achieving optimal diets for young children. Socio-cultural norms, including gendered decision-making and traditional feeding practices, further influence the types of foods offered to infants and toddlers, often restricting the inclusion of protein- and micronutrient-rich foods despite local availability. Additionally, the pervasive marketing of ultra-processed foods and inadequate nutrition education contribute to the early introduction of unhealthy foods, exacerbating the double burden of malnutrition characterized by persistent undernutrition alongside emerging overweight and obesity in urban LMIC settings. Policy environments, including weak regulation, insufficient social protection, and limited agricultural support, further shape these food environments and, consequently, child nutrition outcomes.

The conclusions drawn from this review suggest that early childhood nutrition in LMICs cannot be addressed solely through individual-level interventions or caregiver behavior change. Instead, holistic strategies targeting food environments are essential. Such strategies should improve the availability and affordability of nutrient-dense foods, ensure culturally appropriate feeding practices, and strengthen information systems to guide caregivers toward optimal feeding decisions. Multi-sectoral policy interventions that integrate health, agriculture, and social protection programs have demonstrated measurable improvements in dietary diversity and reductions in stunting and micronutrient deficiencies, underscoring the need for coordinated action across sectors.

Based on the findings, several recommendations emerge for policymakers, program implementers, and researchers. First, efforts to enhance market access, including the development of local food supply chains and the promotion of agricultural diversification, can increase the availability of nutrient-rich foods. Second, economic interventions such as targeted subsidies, cash transfers, or food voucher programs can improve household purchasing power and facilitate access to diverse diets for children. Third, culturally sensitive nutrition education and community engagement initiatives are essential to address socio-cultural barriers to optimal feeding practices. Fourth, regulations limiting the marketing of ultra-processed foods and promoting fortified complementary foods can mitigate the risks associated with poor dietary quality. Finally, there is a critical need for continued research employing interdisciplinary, longitudinal, and systems-based approaches to generate high-quality evidence on the interactions between food environments and early childhood nutrition, particularly in under-studied LMIC contexts.

In summary, the evidence underscores that transforming food environments is a prerequisite for improving early childhood nutrition in LMICs. Addressing structural, economic, cultural, and informational determinants collectively offers the most promising pathway to reduce stunting, wasting, micronutrient deficiencies, and the emerging challenge of overnutrition. By focusing on both the immediate and systemic factors influencing infant and young child feeding, stakeholders can create supportive environments that enable caregivers to provide nutritionally adequate diets and promote healthier growth and development outcomes for children.

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Ethics and Consent to Participate

Not applicable.

Consent to Publish

Not applicable

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Authors' Contributions

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