Int. j. adv. multidisc. res. stud. 2024; 4(5):1365-1377

Received: 05-09-2024
Accepted: 15-10-2024

International Journal of Advanced Multidisciplinary Research and Studies

ISSN: 2583-049X

Nutrition Literacy Conceptual Framework for Addressing Knowledge Gaps in Low- and Middle-Income Communities

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DOI: https://doi.org/10.62225/2583049X.2024.4.5.5139
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Abstract

Nutrition literacy, defined as the ability to obtain, process, understand, and apply basic nutrition information for informed dietary choices, is increasingly recognized as a critical determinant of health outcomes. In low- and middle-income communities (LMICs), persistent knowledge gaps regarding food quality, dietary diversity, and nutritional requirements contribute significantly to the dual burden of undernutrition and rising diet-related noncommunicable diseases. A structured conceptual framework for nutrition literacy is therefore essential to guide interventions that address these challenges systematically and equitably. The proposed framework situates nutrition literacy at the intersection of individual, community, and systemic determinants of health. It emphasizes three interlinked domains; functional literacy, which relates to basic comprehension of nutrition facts and guidelines; interactive literacy, which encompasses communication, cultural adaptation, and community engagement in nutrition-related decision-making; and critical literacy, which enables individuals and groups to evaluate, contextualize, and apply nutrition information within broader social, economic, and environmental contexts. This framework acknowledges the influence of demographic variables such as age, gender, and education, as well as structural factors including food systems, healthcare infrastructure, and policy environments. By integrating behavioral science, public health nutrition, and community-based participatory approaches, the framework supports the design of targeted interventions such as culturally relevant educational programs, school-based nutrition curricula, digital health tools, and community health worker initiatives. Furthermore, it provides a lens for evaluating how food marketing, misinformation, and socioeconomic disparities shape nutrition-related knowledge and behaviors in LMICs. Ultimately, the nutrition literacy conceptual framework advances a comprehensive strategy for addressing knowledge gaps that perpetuate poor dietary practices and health inequities. By strengthening nutrition literacy, LMICs can empower individuals, enhance community resilience, and improve population-level dietary outcomes, thereby contributing to sustainable development and global health equity.

Keywords: Nutrition Literacy, Health Literacy, Low- and Middle-Income Countries, Dietary Knowledge, Nutrition Education, Functional Literacy, Interactive Literacy, Critical Literacy, Health Behavior

1. Introduction

Nutrition literacy, broadly defined as the capacity to access, interpret, and apply nutrition-related information in everyday decision-making, has emerged as a vital component of public health (Abass *et al*., 2022; Umoren *et al*., 2023) [2, 70]. It extends beyond basic reading or comprehension skills, encompassing the ability to critically evaluate dietary information, navigate food systems, and translate knowledge into practice (Umezurike *et al*., 2024) [69]. Nutrition literacy is increasingly recognized as an essential determinant of individual and population health, particularly in contexts where poor dietary practices contribute significantly to the global burden of disease (Tiamiyu *et al*., 2024; Uddoh *et al*., 2024) [67, 68]. Its importance lies in empowering individuals and communities to make informed food choices that promote health, prevent malnutrition, and reduce the risk of diet-related noncommunicable diseases (NCDs).

The link between nutrition literacy, dietary practices, and health outcomes is well established. Individuals with higher nutrition literacy are more likely to consume balanced diets, adhere to dietary guidelines, and avoid harmful patterns such as excessive consumption of processed foods, sugar, and fats (Sobowale *et al*., 2020 [66]; Oluoha *et al*., 2024). Conversely, limited nutrition literacy often translates into poor dietary diversity, inadequate intake of essential micronutrients, and vulnerability to misinformation about diets and health (Omisola *et al*., 2024 [58]; Omolayo *et al*., 2024). This, in turn, contributes to a spectrum of adverse outcomes, from undernutrition, stunting, and anemia to overweight, obesity, and NCDs such as diabetes and cardiovascular disease. At the population level, low nutrition literacy perpetuates cycles of poor health, reduced productivity, and increased healthcare costs, further constraining national development goals (Romo *et al*., 2024; Shah *et al*., 2024) [64, 65].

Knowledge gaps are particularly pronounced in low- and middle-income countries (LMICs), where structural inequalities, limited access to formal education, and weak health systems hinder the development of adequate nutrition literacy. Communities in LMICs often face a "triple burden" of malnutrition: undernutrition, micronutrient deficiencies, and rising rates of obesity and diet-related NCDs. Many households lack awareness of dietary diversity, safe food handling practices, or the long-term health implications of poor diets. Furthermore, aggressive marketing of unhealthy foods, limited availability of culturally relevant nutrition information, and weak regulatory systems exacerbate the problem (Osamika *et al*., 2024; Oyeyemi *et al*., 2024) [62, 63]. These gaps disproportionately affect vulnerable populations such as women, children, and the socioeconomically disadvantaged, who often have the least access to reliable nutrition education and healthcare services (Omolayo *et al*., 2024; Osabuohien, 2024 [61]).

The rationale for developing a conceptual framework for nutrition literacy in LMICs lies in the need for structured, context-specific guidance to inform interventions. Without such a framework, initiatives may remain fragmented, failing to address the multifactorial determinants of nutrition literacy, including cultural norms, socioeconomic barriers, and systemic inequities (Olulaja *et al*., 2024 [55]; Oluoha *et al*., 2024). A conceptual framework provides a roadmap for understanding how different domains of nutrition literacy—functional, interactive, and critical—interact with individual, community, and structural factors. It also helps align interventions with local realities, ensuring they are culturally appropriate, sustainable, and impactful (Komi *et al*., 2024; Odezuligbo *et al*., 2024 [43]). By bridging theory and practice, such a framework can guide the design of school-based nutrition education, community health worker programs, digital tools, and public health campaigns that not only impart knowledge but also build the skills and confidence required for lasting behavioral change (Olinmah *et al*., 2024; Oloruntoba and Omolayo, 2024) [53, 54].

Nutrition literacy is a cornerstone of improved dietary practices and better health outcomes. Addressing the knowledge gaps in LMICs requires a holistic and systematic approach, underpinned by a robust conceptual framework. Such a framework is essential to design effective interventions, reduce health inequities, and support the global agenda for sustainable development and health equity.

2. Methodology

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) methodology guided the systematic review process undertaken to develop a nutrition literacy conceptual framework tailored to addressing knowledge gaps in low- and middle-income communities. The approach began with the formulation of the central research objective, which was to identify, synthesize, and evaluate existing literature on nutrition literacy, its determinants, and its implications for health outcomes in resource-constrained settings.

A comprehensive search strategy was applied across major scientific databases including PubMed, Scopus, Web of Science, Embase, and Google Scholar. To capture a wide range of perspectives, additional searches were performed in grey literature sources such as reports from international organizations, government policy documents, and non-governmental organization publications. Search terms combined keywords and Boolean operators such as "nutrition literacy," "health literacy," "dietary knowledge," "food practices," "low- and middle-income countries," and "nutrition education." No strict date restrictions were applied in order to capture both foundational and emerging studies, though the search prioritized literature published in English.

Eligibility criteria were defined using the PICOS framework, focusing on populations within low- and middle-income regions, interventions or programs related to nutrition knowledge and practices, conceptual or empirical frameworks addressing nutrition literacy, and outcomes linked to dietary behaviors, health awareness, and community nutrition improvements. Both qualitative and quantitative studies were included, provided they offered relevant insights into how nutrition literacy is conceptualized, measured, or operationalized in vulnerable populations. Studies conducted exclusively in high-income countries were excluded unless they offered transferable frameworks that could inform adaptation in resource-limited settings.

Screening followed a two-stage process, with initial title and abstract review conducted independently by two reviewers, followed by full-text assessment of potentially eligible articles. Discrepancies were resolved through discussion or the involvement of a third reviewer. The process was documented in alignment with the PRISMA flow diagram, detailing the number of records identified, screened, excluded, and included.

Data extraction involved systematic collection of study characteristics including author, year, country, study design, population, definitions and measures of nutrition literacy, interventions or frameworks proposed, and key findings. To ensure consistency, a standardized data extraction form was used, and data were cross-checked among reviewers. Quality assessment of included studies was conducted using appropriate appraisal tools depending on study design, such as the CASP checklist for qualitative studies and the Joanna Briggs Institute tools for observational or intervention studies.

The synthesis approach combined narrative and thematic analysis, aimed at identifying recurring constructs of nutrition literacy relevant to low- and middle-income communities. Key themes included access to nutrition information, comprehension of dietary guidance, practical food selection and preparation skills, cultural influences on

dietary knowledge, and the role of socioeconomic constraints in limiting nutrition literacy. Insights from intervention studies were also synthesized to identify effective strategies and gaps in program implementation.

The final stage of the review involved integrating the evidence into a conceptual framework that positions nutrition literacy as a multidimensional construct, linking individual knowledge and skills with broader environmental, cultural, and structural determinants. The framework emphasizes how addressing knowledge gaps requires not only improving access to information but also adapting content to local contexts, strengthening communication channels, and fostering enabling environments for behavior change.

This PRISMA-guided review ensured transparency, rigor, and reproducibility in the process of developing a conceptual framework for nutrition literacy. By systematically identifying and synthesizing existing evidence, the methodology supports the creation of a framework that is evidence-based, context-sensitive, and capable of informing targeted interventions in low- and middle-income communities.

2.1 Conceptual Basis of Nutrition Literacy

Nutrition literacy has emerged as a central concept within public health, recognized as a determinant of dietary behavior and health outcomes. It can be understood as a specialized subset of health literacy, focusing specifically on the knowledge, skills, and competencies required to access, interpret, and apply nutrition-related information. Just as health literacy enables individuals to make informed decisions about healthcare, nutrition literacy empowers individuals and communities to make sound dietary choices that promote health and prevent disease (Okereke *et al*., 2024; Okuwobi *et al*., 2024) [51, 52]. This conceptual positioning within health literacy underscores its importance, as nutrition is a fundamental driver of population health, influencing growth, development, and the risk of both communicable and noncommunicable diseases. By situating nutrition literacy as part of a broader health literacy framework, researchers and policymakers can better identify how gaps in understanding contribute to inequities in diet and nutrition outcomes.

Nutrition literacy can be examined across three interrelated dimensions: functional, interactive, and critical literacy. Functional literacy refers to basic skills in reading, writing, and numeracy that enable individuals to comprehend nutrition labels, follow dietary guidelines, or interpret basic nutrition messages. Interactive literacy goes further, emphasizing the capacity to engage with health professionals, use digital resources, and apply communication skills to make informed food-related choices in diverse contexts (Ojonugwa *et al*., 2024; Okare *et al*., 2024) [49, 50]. Critical literacy involves the ability to critically evaluate and challenge nutrition information, assess the credibility of sources, and understand the broader social, cultural, and environmental influences on food systems. These three dimensions provide a comprehensive lens for understanding nutrition literacy, as they highlight the progression from basic comprehension to empowered action and critical engagement with structural determinants of dietary health.

The determinants of nutrition literacy are multifaceted and reflect both individual and contextual factors. Education plays a central role, as literacy and numeracy form the foundation upon which nutrition-specific knowledge is built. Individuals with higher levels of formal education are generally better equipped to interpret nutrition information and adopt healthier diets. Cultural factors also exert significant influence. Food preferences, taboos, and traditions shape how nutrition messages are understood and acted upon, while cultural attitudes toward health and body image can reinforce or hinder dietary improvements (Ogunwale *et al*., 2024; Ojeikere *et al*., 2024) [47, 48]. Socioeconomic status is another critical determinant, as poverty often limits access not only to nutritious foods but also to reliable sources of nutrition education. Socioeconomic disadvantage also restricts access to healthcare services, community resources, and digital technologies that could support improved nutrition literacy. Gender, age, and geographic location intersect with these determinants, further shaping opportunities for individuals to acquire and apply nutrition knowledge. For example, women in many low- and middle-income countries bear primary responsibility for food preparation, yet they may have less access to education or decision-making power, limiting their capacity to apply nutrition literacy effectively.

Given these diverse determinants, a conceptual framework for nutrition literacy serves as a critical tool to bridge knowledge and practice. Frameworks provide structured approaches for understanding how nutrition literacy develops, how it influences behavior, and how interventions can be designed to strengthen it. A well-developed framework situates individual skills within broader social and environmental contexts, recognizing that knowledge alone does not guarantee behavioral change. Instead, behavior is shaped by the interplay of literacy skills, cultural norms, food environments, and policy structures. By mapping these relationships, a framework helps identify leverage points for interventions that go beyond individual education to include community-based initiatives, systemic reforms, and culturally tailored programs (Odujobi *et al*., 2024; Ogedengbe *et al*., 2024) [45, 46].

Moreover, frameworks serve as a guide for practitioners and policymakers to align interventions with the different dimensions of nutrition literacy. For example, school-based programs may focus on functional literacy by improving knowledge of dietary guidelines and food groups, while digital platforms may target interactive literacy by encouraging engagement with nutrition information and healthcare providers (Ochefu *et al*., 2024; Odezuligbo *et al*., 2024) [42, 43]. Critical literacy interventions might involve training communities to recognize misleading food marketing practices or to advocate for healthier local food environments. By applying a framework, interventions can be systematically designed to address gaps at multiple levels—individual, community, and structural—thus increasing their potential to improve dietary outcomes.

In addition, a conceptual framework ensures that nutrition literacy initiatives are evidence-informed and context-specific. In low- and middle-income countries, where health systems are often under-resourced, a framework can help prioritize interventions that address the most pressing knowledge gaps and vulnerabilities. For instance, focusing on maternal nutrition literacy may yield substantial benefits for child health and reduce intergenerational cycles of malnutrition. Similarly, integrating nutrition literacy into existing health and education programs can maximize

resources and foster sustainability (Abass *et al*., 2019; Adeleke and Olajide, 2024) [1, 3].

Nutrition literacy is best understood as a multidimensional construct nested within the broader concept of health literacy. Its functional, interactive, and critical dimensions reflect the diverse skills required to navigate today's complex food and health environments. The determinants of nutrition literacy—ranging from education and culture to socioeconomic status—underscore the need for comprehensive, context-sensitive interventions. A conceptual framework provides the essential bridge between knowledge and practice, offering a structured lens through which to design, implement, and evaluate programs that empower individuals and communities to make informed dietary choices (Isa, 2024; Komi *et al*., 2024). By advancing both theoretical clarity and practical guidance, such frameworks are vital for improving nutrition outcomes and reducing health disparities worldwide.

2.2 Core Components of the Framework

Developing a nutrition literacy conceptual framework for low- and middle-income communities requires a multidimensional approach that accounts for influences operating at the individual, household, community, and system levels. Nutrition literacy is not only a matter of acquiring factual knowledge but also of translating this knowledge into actionable behaviors within socioeconomic and cultural constraints (Adeleke *et al*., 2024 [4]; Adenekan *et al*., 2024). The framework integrates personal, social, and structural factors to capture the diverse determinants that shape nutrition awareness, decision-making, and practices. By examining the interplay of these components, the framework provides a basis for designing interventions that address knowledge gaps and promote healthier dietary behaviors in vulnerable populations.

At the individual level, nutrition literacy begins with cognitive skills and basic literacy, which determine an individual's ability to access, interpret, and apply nutrition information. In many low- and middle-income settings, literacy gaps present significant barriers to understanding food labels, dietary guidelines, and health education materials. Cognitive abilities influence whether individuals can evaluate the credibility of information sources, distinguish between marketing claims and evidence-based guidance, and make informed food choices. Equally important is awareness of fundamental nutrition concepts such as the roles of macronutrients, micronutrients, and food groups. A lack of knowledge about protein, vitamins, or iron, for example, contributes to persistent undernutrition and diet-related deficiencies. Personal beliefs, perceptions, and attitudes toward food further shape individual nutrition behaviors. Misconceptions, such as the belief that nutritious foods are inherently expensive or that certain food groups are only suitable for specific demographics, can reinforce unhealthy dietary practices. Positive attitudes, conversely, can motivate individuals to adopt healthier diets when resources allow, highlighting the critical interplay between knowledge and motivation.

Household-level factors constitute another vital dimension of the framework, as food choices are often made collectively rather than individually. Household food security and resource availability strongly influence the capacity to translate nutrition literacy into practice. Even when individuals understand the benefits of balanced diets, financial limitations and inconsistent food access can restrict choices, leading to reliance on energy-dense, nutrient-poor foods. Gender roles in food selection and preparation also play a central role in shaping household nutrition outcomes. In many low- and middle-income settings, women are primarily responsible for purchasing, preparing, and serving food, yet their decision-making power may be constrained by cultural or financial norms. Interventions that empower women with nutrition knowledge while addressing gender inequities can improve household dietary practices. Family dynamics, including parental influence on children's food preferences and intergenerational dietary habits, further shape outcomes. For example, parental modeling of healthy food consumption often determines whether children adopt lifelong nutritious eating habits.

Community-level factors extend the framework beyond the household, emphasizing the social and cultural context in which nutrition literacy is developed. Access to local nutrition information and resources, such as community health centers, agricultural extension services, or local markets, determines the availability and visibility of nutrition-related knowledge. Where reliable information is scarce, communities often rely on informal channels, which can perpetuate misinformation. Cultural food norms and traditional practices deeply influence perceptions of what constitutes a healthy or acceptable diet. In many communities, staple foods and preparation methods are entrenched, sometimes supporting but at other times limiting nutritional diversity. For instance, heavy reliance on refined grains may limit the intake of protein-rich legumes or micronutrient-dense vegetables. Peer and community support systems also reinforce dietary behaviors, as social acceptance and communal practices often dictate what is eaten at gatherings, religious events, or within neighborhood networks (ADESHINA and NDUKWE, 2024; Adeyelu *et al*., 2024) [7, 8]. Harnessing these social structures for nutrition education campaigns can amplify the adoption of healthier practices at scale.

At the system and policy level, broader structural factors provide the enabling environment within which nutrition literacy is operationalized. Public health education campaigns are a cornerstone of improving nutrition awareness, particularly when they are culturally tailored and accessible in local languages. These campaigns, when designed effectively, can shift population-level knowledge and attitudes toward healthier diets. School-based nutrition programs also represent a powerful system-level intervention, as they not only provide direct nutrition to children through feeding schemes but also integrate nutrition literacy into curricula. Educating children at an early age creates long-term benefits by establishing foundational knowledge and influencing family dietary behaviors through intergenerational transfer of knowledge. Food labeling regulations and supportive policies further strengthen nutrition literacy by making healthy choices more transparent and accessible. For example, front-of-package warning labels, standardized nutritional information, and restrictions on misleading marketing empower consumers to make informed food choices, even in environments where commercial pressures favor unhealthy products.

The integration of these four components underscores the holistic nature of nutrition literacy in low- and middle-income communities. Individual knowledge and motivation are necessary but insufficient without household support,

community reinforcement, and system-level enabling environments. Addressing only one layer of the framework risks limiting the impact of interventions, whereas multisectoral strategies that operate across all levels offer the potential for transformative change.

The core components of the nutrition literacy conceptual framework highlight the interplay between personal capabilities, household dynamics, community norms, and structural systems. By recognizing these interconnected layers, policymakers, educators, and health practitioners can design context-sensitive interventions that bridge knowledge gaps and translate awareness into sustained behavior change (Ajayi *et al*., 2024 [9]; Ajiga *et al*., 2024). This framework provides not only an analytical lens for understanding nutrition literacy but also a practical guide for developing integrated strategies to combat malnutrition and promote dietary resilience in low- and middle-income communities.

2.3 Domains of Nutrition Literacy

Nutrition literacy is a multidimensional construct that encompasses the skills, knowledge, and competencies required to make informed dietary choices and manage food-related decisions in everyday life. It reflects not only the ability to understand nutrition information but also the capacity to apply, evaluate, and critically engage with it within personal, social, and structural contexts. Scholars often categorize nutrition literacy into three interrelated domains; functional, interactive, and critical as shown in figure 1. Each domain represents a level of literacy that builds upon the previous one, forming a comprehensive framework for understanding how individuals and communities can use nutrition information to improve health outcomes.

Functional Nutrition Literacy forms the foundational level and emphasizes basic skills needed to access and comprehend nutrition information. A critical component of this domain is the ability to read and interpret food labels, which provide details about nutrient content, serving sizes, and ingredients (Appoh *et al*., 2024; Awe *et al*., 2024 [15]). Individuals with functional nutrition literacy can distinguish between healthier and less healthy options by comparing nutrient values, such as sodium, sugar, and saturated fat content. Another essential aspect is understanding portion sizes and dietary guidelines. Misjudging portion sizes is a common contributor to overeating and poor diet quality. Competence in this area involves recognizing recommended serving sizes, aligning daily intake with nutritional needs, and applying this knowledge in meal preparation. Furthermore, functional nutrition literacy includes basic knowledge of nutrient functions, such as the role of proteins in growth and repair, carbohydrates as energy sources, and vitamins and minerals in regulating bodily processes. This foundational understanding allows individuals to appreciate the significance of balanced diets and the risks associated with deficiencies or excesses.

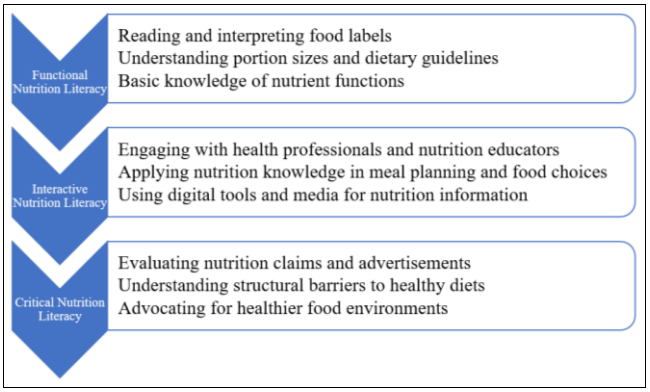

Fig 1: Domains of Nutrition Literacy

Interactive Nutrition Literacy builds on functional skills by incorporating the ability to apply knowledge in practical contexts and engage in dialogue about nutrition. One crucial element is the capacity to interact effectively with health professionals, nutrition educators, and community workers. Individuals who are nutritionally literate at this level can ask informed questions, seek clarification, and actively participate in decisions about their diet and health. Applying nutrition knowledge in meal planning and food choices is another key aspect. For example, families with interactive literacy can translate dietary guidelines into balanced meals, adapt recipes to improve nutritional value, and consider cultural and financial factors in food selection. This domain also emphasizes the use of digital tools and media for accessing nutrition information. With the proliferation of mobile applications, online platforms, and social media, individuals increasingly rely on digital resources for dietary advice. Interactive literacy equips people with the skills to navigate these resources, assess their reliability, and incorporate insights into daily routines.

Critical Nutrition Literacy represents the highest domain and focuses on the capacity to evaluate, question, and act upon nutrition information within broader social, political, and environmental contexts. A major aspect of this domain is the ability to critically assess nutrition claims and advertisements. In an era where food marketing is pervasive, individuals with critical nutrition literacy can discern misleading or exaggerated claims, evaluate the scientific basis of dietary fads, and make informed decisions that resist commercial pressures. This level of literacy also involves understanding structural barriers to healthy diets, such as food deserts, socioeconomic inequities, and policy environments that favor ultra-processed food production and consumption. Recognizing these barriers allows individuals to contextualize personal dietary challenges within systemic constraints rather than attributing them solely to individual choices. Finally, critical nutrition literacy encompasses advocacy for healthier food environments. Individuals and communities equipped with this literacy can participate in policy dialogues, support community-based food initiatives,

and mobilize collective action for structural changes, such as improved food labeling laws, subsidies for healthy foods, or restrictions on marketing unhealthy products to children (Balogun *et al*., 2023; Benjamin *et al*., 2024) [16, 17].

The three domains of nutrition literacy are not isolated but rather interconnected and complementary. Functional literacy provides the necessary foundation of knowledge and skills. Interactive literacy enables individuals to apply that knowledge in dynamic, social, and digital contexts, while critical literacy extends these capabilities to societal engagement and advocacy. Together, they create a holistic framework for empowering individuals and communities to achieve healthier diets. This progression highlights the importance of designing interventions that target multiple domains simultaneously, ensuring that individuals not only understand nutrition information but also know how to use it, evaluate it, and influence broader food systems.

The domains of nutrition literacy—functional, interactive, and critical—capture the multifaceted skills required to navigate today's complex nutrition landscape. Functional literacy ensures basic comprehension and application of nutrition information, interactive literacy emphasizes practical engagement and informed decision-making, and critical literacy empowers individuals to challenge structural determinants and advocate for systemic change. Recognizing and strengthening all three domains is essential for promoting healthier dietary practices and addressing nutrition-related health disparities across diverse populations (Bukhari *et al*., 2024; Chianumba *et al*., 2024) [18, 19].

2.4 Pathways Linking Nutrition Literacy to Health Outcomes

Nutrition literacy, defined as the capacity to obtain, understand, and apply nutrition information for informed food and health decisions, plays a pivotal role in shaping dietary behaviors and long-term well-being. In low- and middle-income communities, where structural and resource limitations intersect with cultural and informational barriers, improving nutrition literacy offers a powerful strategy to combat malnutrition and reduce preventable disease burdens (Didi *et al*., 2023; Eneogu *et al*., 2024) [20, 21]. The pathways through which nutrition literacy influences health outcomes are multifaceted, involving immediate changes in food choices, improved dietary diversity, reductions in under- and overnutrition, enhanced maternal and child health, and the long-term prevention of non-communicable diseases (NCDs) as shown in figure 2. Understanding these pathways underscores the importance of embedding nutrition literacy within broader public health and development strategies.

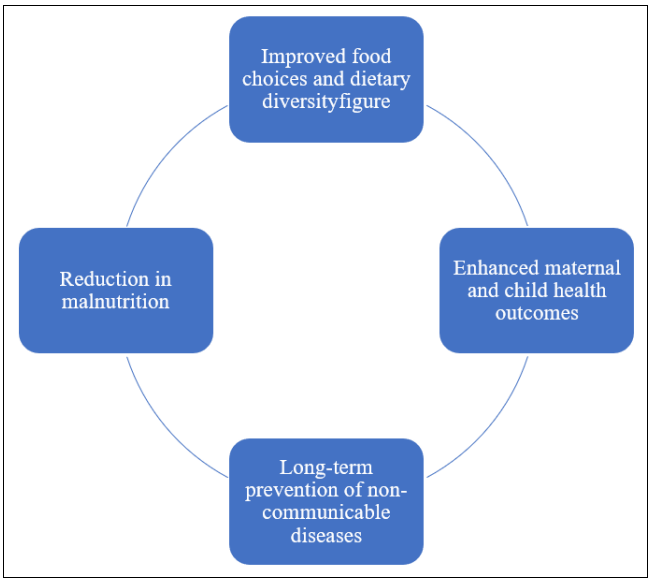

Fig 2: Pathways Linking Nutrition Literacy to Health Outcomes

One of the most direct pathways linking nutrition literacy to better health outcomes is through improved food choices and dietary diversity. Individuals with higher levels of nutrition literacy are better equipped to understand the importance of consuming a balanced mix of food groups, recognize nutrient-dense options, and avoid misleading marketing of ultra-processed foods. In resource-limited settings, where choices are often constrained by affordability and availability, nutrition literacy empowers individuals and households to maximize nutritional value from accessible foods. For instance, greater awareness of the protein and micronutrient content of legumes, leafy vegetables, and locally available fruits can encourage households to diversify diets even within financial constraints. Such choices improve energy balance, support healthy growth in children, and reduce reliance on starchy staples that dominate diets in many low-income regions. By guiding individuals toward informed substitutions and creative food preparation methods, nutrition literacy strengthens dietary resilience against seasonal fluctuations in food availability.

The second pathway operates through the reduction of malnutrition in its multiple forms: undernutrition, micronutrient deficiencies, and obesity. Undernutrition remains a pressing challenge in many low- and middle-income countries, manifesting as stunting, wasting, and underweight, particularly among children. Nutrition literacy helps caregivers recognize the signs of inadequate diets and

adopt feeding practices that support growth, such as exclusive breastfeeding and timely introduction of complementary foods. Similarly, micronutrient deficiencies—such as anemia from iron deficiency or impaired immunity from vitamin A deficiency—are mitigated when communities understand the sources and importance of these nutrients. On the other end of the malnutrition spectrum, rising obesity and overweight in low- and middle-income regions are often fueled by rapid dietary transitions toward processed foods high in sugar, salt, and fat (Komi *et al*., 2024; Kufile *et al*., 2024 [40]). Nutrition literacy fosters critical evaluation of such products, encouraging individuals to moderate consumption and opt for healthier alternatives. Thus, by addressing both undernutrition and overnutrition, nutrition literacy offers a holistic strategy for tackling the double burden of malnutrition.

A third pathway involves the enhancement of maternal and child health outcomes, which are particularly sensitive to nutritional status. For women of reproductive age, nutrition literacy is linked to better dietary intake during pregnancy and lactation, reducing risks of maternal anemia, low birthweight, and birth complications. Mothers with higher nutrition literacy are more likely to adhere to antenatal nutrition advice, use supplements effectively, and prioritize nutrient-rich foods that support fetal development. For infants and young children, maternal knowledge is crucial for practices such as exclusive breastfeeding, introduction of complementary foods at the appropriate age, and ensuring adequate dietary diversity during early childhood. These practices reduce the risk of childhood stunting, wasting, and impaired cognitive development, laying the foundation for lifelong health. Beyond infancy, nutrition-literate households are also more attentive to school-aged children's dietary needs, supporting growth, learning capacity, and resilience to infections. By improving maternal and child health, nutrition literacy contributes not only to survival but also to human capital development and intergenerational health gains.

The final pathway through which nutrition literacy impacts health is the long-term prevention of non-communicable diseases. As dietary risk factors are among the leading contributors to NCDs such as cardiovascular disease, diabetes, and certain cancers, empowering individuals with nutrition knowledge is a preventive strategy of significant importance. Nutrition literacy encourages sustained consumption of diets low in trans fats, refined sugars, and sodium, while promoting the intake of fruits, vegetables, whole grains, and lean proteins. Over time, these dietary patterns reduce obesity, improve metabolic health, and lower blood pressure, thereby decreasing the incidence of heart disease and diabetes (Akpe *et al*., 2024; Adenekan *et al*., 2024). Moreover, improved literacy enables individuals to critically interpret food labeling, navigate food environments increasingly dominated by unhealthy products, and adopt dietary habits aligned with long-term health. In low- and middle-income countries facing rapid epidemiological transitions, building nutrition literacy into preventive health strategies provides a cost-effective approach to curbing the growing burden of NCDs.

The pathways linking nutrition literacy to health outcomes operate across immediate, intermediate, and long-term dimensions of well-being. Improved dietary diversity strengthens everyday resilience; reductions in malnutrition address urgent public health crises; enhanced maternal and child nutrition fosters intergenerational health; and prevention of NCDs secures healthier futures. By recognizing and harnessing these pathways, policymakers, educators, and health practitioners can design interventions that transform nutrition literacy from a theoretical construct into a practical tool for reducing health inequities. In resource-constrained environments, where the impact of poor diets is most severe, advancing nutrition literacy represents not only an educational goal but also a cornerstone of sustainable public health.

2.5 Barriers to Nutrition Literacy in LMICs

Nutrition literacy, the ability to access, understand, and apply nutrition information for healthier dietary decisions, is increasingly recognized as a vital determinant of health. In low- and middle-income countries (LMICs), however, multiple barriers constrain the development of nutrition literacy, limiting its potential to improve health outcomes and reduce malnutrition. These barriers emerge from structural, socioeconomic, cultural, and institutional contexts that shape how individuals and communities engage with food and health information as shown in figure 3 (Essien *et al*., 2024; Fidel-Anyanna *et al*., 2024 [24]). Understanding these barriers is crucial for designing interventions that are context-sensitive and effective in bridging knowledge gaps.

A central barrier is low general literacy and limited educational attainment, which directly impedes the ability to interpret nutrition information. In many LMICs, large segments of the population—particularly women and rural residents—have minimal or no formal education. Without basic literacy and numeracy skills, individuals struggle to understand food labels, interpret dietary guidelines, or assess health information disseminated through written or digital media. Even when nutrition education programs are available, low literacy limits the ability to fully benefit from them, reinforcing cycles of poor knowledge and unhealthy practices. The problem is compounded when health promotion materials are produced in complex or technical language rather than being simplified and translated into local dialects.

Poverty and competing survival priorities represent another formidable barrier to nutrition literacy. In contexts where households struggle with daily food insecurity, the immediate priority is securing enough food to stave off hunger rather than optimizing dietary quality. Poverty limits both the time and resources available for engaging with nutrition education, as individuals prioritize income-generating activities over learning opportunities. Even when people understand the importance of balanced diets, financial constraints often restrict the ability to act on this knowledge. For example, awareness of the benefits of fruits, vegetables, or animal-source proteins may not translate into consumption if these foods are unaffordable or unavailable. Thus, poverty diminishes both the motivation and capacity to integrate nutrition literacy into practice.

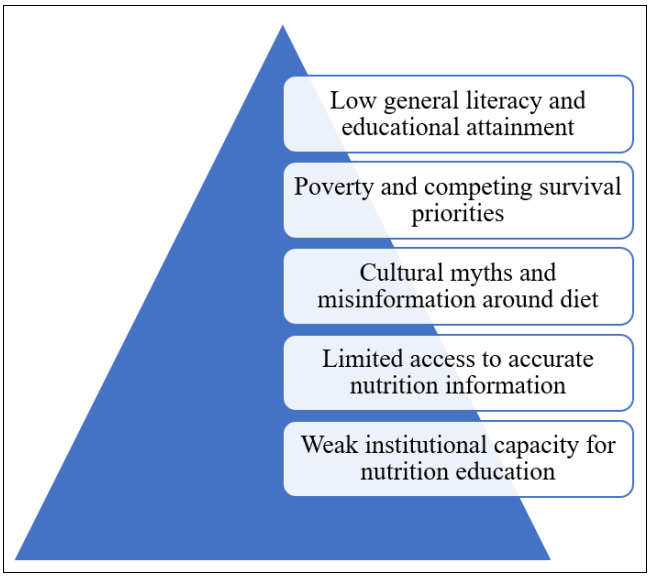

Fig 3: Barriers to Nutrition Literacy in LMICs

Limited access to accurate nutrition information further undermines nutrition literacy in LMICs. Many communities rely on informal sources of knowledge, such as peers, family members, or local markets, where information is often incomplete or inaccurate. Access to formal nutrition education through schools, clinics, or mass media is uneven, particularly in rural or marginalized areas. Inadequate dissemination of dietary guidelines, limited public health communication, and a lack of context-specific messaging create gaps that are filled by misinformation. Digital platforms, while expanding in reach, also expose populations to unverified claims and marketing of unhealthy foods. Without trusted and consistent sources of knowledge, individuals are left without the tools to make informed dietary choices.

Cultural myths and misinformation around diet present an additional barrier that shapes perceptions of food and health. In many LMICs, traditional beliefs influence dietary practices, sometimes reinforcing beneficial habits but often perpetuating harmful ones. Examples include taboos against pregnant women eating certain protein-rich foods, misconceptions that children do not need animal-source foods, or the belief that processed foods signify higher social status. These cultural narratives can hinder the adoption of evidence-based nutrition practices, especially when they are deeply entrenched and passed down across generations. Moreover, the aggressive marketing of ultra-processed foods often aligns with these cultural dynamics, framing packaged products as modern or aspirational, thereby displacing traditional nutrient-dense foods.

Weak institutional capacity for nutrition education further exacerbates the barriers to improving nutrition literacy. Many LMICs lack comprehensive public health programs dedicated to nutrition awareness, with limited resources allocated to training educators, producing culturally relevant materials, and sustaining outreach initiatives. Health systems in resource-constrained settings are often overburdened with infectious disease control and maternal-child health services, leaving nutrition education as a low priority (Ajiga *et al*., 2024; Appoh *et al*., 2024). Schools may lack formal nutrition curricula, and community health workers may have insufficient training to deliver reliable nutrition guidance. The absence of coordinated strategies and institutional commitment means that nutrition literacy remains fragmented and inconsistently promoted.

Collectively, these barriers create a landscape in which nutrition literacy is difficult to achieve and sustain. Low literacy levels limit comprehension, poverty reduces practical application, poor access to information leaves gaps, cultural myths shape unhealthy behaviors, and weak institutions fail to provide consistent guidance. Addressing these barriers requires integrated approaches that combine education with economic empowerment, culturally sensitive messaging, and stronger institutional support. For example, nutrition programs could be designed in local languages, delivered through oral or visual methods for low-literacy populations, and coupled with subsidies or social protection schemes that improve access to nutritious foods. Empowering women, strengthening school curricula, and training community health workers are additional strategies to break down barriers.

The barriers to nutrition literacy in LMICs are complex and interlinked, rooted in structural inequities and cultural contexts. Without deliberate action to address these obstacles, nutrition literacy initiatives risk being ineffective or unsustainable. However, by recognizing and tackling these barriers holistically, governments, non-governmental organizations, and communities can unlock the transformative potential of nutrition literacy to reduce malnutrition, improve health outcomes, and strengthen resilience against future health challenges (Komi *et al*., 2024; Obadimu *et al*., 2024 [41]).

2.6 Strategies for Strengthening Nutrition Literacy

Improving nutrition literacy is an essential step toward addressing malnutrition, preventing diet-related diseases, and promoting healthier populations, particularly in low- and middle-income countries (LMICs). Strengthening nutrition literacy requires a multifaceted approach that combines educational, communicative, policy-driven, and capacity-building strategies. These approaches recognize that nutrition literacy is not only about imparting information but also about enabling individuals and communities to access, interpret, and apply knowledge within their cultural and socioeconomic contexts.

Educational Interventions provide the foundation for strengthening nutrition literacy by embedding knowledge within daily life and community structures. Community-based workshops and peer education programs are especially effective in LMICs, where access to formal education may be limited. These initiatives leverage trusted community members to share knowledge on topics such as balanced diets, food preparation, and maternal and child nutrition (Frempong *et al*., 2024; Frndak *et al*., 2024) [25, 26]. Peer education fosters relatability and encourages community ownership of health behaviors. Integrating nutrition into school curricula is another powerful strategy, as schools provide an ideal platform for establishing healthy dietary habits early in life. By incorporating lessons on food groups, portion sizes, and practical cooking skills, schools can nurture long-term changes in attitudes and practices. Using local languages and culturally relevant content further enhances the effectiveness of educational interventions. Tailoring content to reflect local food systems, traditions, and literacy levels ensures that nutrition messages are not only understood but also accepted and applied.

Communication and Media channels play a critical role in expanding the reach of nutrition literacy initiatives beyond formal settings. Mobile health (mHealth) applications provide a low-cost, scalable method for delivering tailored nutrition messaging. SMS reminders, interactive apps, and voice-based services can be used to reinforce dietary guidelines, promote breastfeeding, or provide tips on affordable healthy eating. Social marketing campaigns tailored to LMIC settings can help shift community norms by promoting positive dietary behaviors such as reducing sugar intake or increasing consumption of locally available fruits and vegetables. These campaigns, when designed with cultural sensitivities in mind, can mobilize public support and drive social change. Additionally, traditional media outlets such as radio and community theatre remain powerful tools for outreach in resource-constrained areas. Radio programs in local languages can deliver nutrition education to large audiences, including rural populations, while community theatre offers interactive and relatable storytelling methods to spark dialogue and encourage collective action.

Policy and Structural Interventions are vital for creating enabling environments that reinforce nutrition literacy efforts. Strengthening food labeling and regulation is a crucial policy strategy. Clear, standardized labels with simplified nutrition information empower consumers to make healthier choices while holding food industries accountable. National guidelines for nutrition education programs also provide a unified framework for governments, schools, and health institutions to promote consistent, evidence-based nutrition messages. Partnerships with non-governmental organizations (NGOs) and international agencies further amplify these efforts by mobilizing resources, technical expertise, and advocacy. Such collaborations are especially important in LMICs, where health systems often face financial and infrastructural constraints. Structural approaches ensure that nutrition literacy is not treated solely as an individual responsibility but rather as a collective goal supported by public health policies and food systems.

Capacity Building complements these efforts by equipping professionals and institutions with the skills and tools needed to promote nutrition literacy sustainably. Training health workers in nutrition literacy promotion is a critical step, as they often serve as trusted sources of health information in communities. Equipping them with skills in culturally sensitive communication, counseling, and nutrition education allows them to provide tailored guidance to diverse populations. Developing context-specific toolkits for educators and practitioners further enhances their effectiveness. Toolkits that include visual aids, locally relevant dietary examples, and interactive activities help simplify complex nutrition concepts and make them accessible to different audiences, including those with limited literacy (Gbabo *et al*., 2024; Gobile *et al*., 2024) [27, 28].

Strategies for strengthening nutrition literacy must be comprehensive, context-specific, and multidimensional. Educational interventions foster foundational skills and knowledge; communication and media extend the reach of messages; policy and structural measures create supportive environments; and capacity-building initiatives empower frontline workers and educators. Together, these strategies create a robust framework for improving nutrition literacy, ultimately enabling individuals and communities to make informed dietary choices, reduce nutrition-related health risks, and contribute to broader public health goals. By addressing both individual competencies and systemic factors, these strategies ensure that nutrition literacy becomes a sustainable driver of health equity and well-being.

2.7 Monitoring and Evaluation of Nutrition Literacy Framework

Monitoring and evaluation (M&E) are integral to the effective implementation of a nutrition literacy framework, particularly in low- and middle-income countries where evidence-based approaches are essential for addressing persistent malnutrition and diet-related health challenges (Halliday, 2021; Essien *et al*., 2024). A robust M&E system ensures that interventions are not only delivered as intended but also yield measurable improvements in knowledge, practices, and health outcomes. By combining indicators, assessment tools, outcome evaluations, and feedback mechanisms, stakeholders can create adaptive frameworks that remain responsive to the needs of individuals, households, and communities.

The first step in monitoring nutrition literacy involves defining indicators that measure levels of nutrition knowledge, skills, and behaviors. Indicators should capture both cognitive and functional dimensions of nutrition literacy. Cognitive indicators might include understanding of macronutrients and micronutrients, ability to identify healthy food groups, or awareness of dietary guidelines. Functional indicators measure the application of this knowledge in daily life, such as the ability to interpret food labels, select balanced meals, or prepare foods in nutrient-preserving ways. Composite indices, which combine knowledge and behavioral measures, can provide a more comprehensive picture of nutrition literacy across populations. Disaggregated indicators by age, gender, and socioeconomic status are also essential to identify inequities and target vulnerable groups more effectively.

Tools and surveys provide the methodological foundation for assessing nutrition literacy levels and practices. Standardized questionnaires, such as the Nutrition Literacy Assessment Instrument (NLAI) or the Newest Vital Sign adapted for nutrition, have been used in various contexts, though they often require cultural adaptation for LMICs. Locally tailored surveys can include context-relevant food items, dietary practices, and cultural norms. Household food frequency questionnaires, 24-hour dietary recalls, and market surveys can complement literacy assessments by linking knowledge with actual food consumption patterns. Visual and oral tools—such as picture-based surveys or community discussions—are particularly valuable in low-literacy populations. Advances in digital health also offer opportunities for mobile-based surveys and interactive platforms that can collect real-time data while simultaneously delivering nutrition education content.

Evaluating the impact of nutrition literacy frameworks on dietary intake and health outcomes is a critical component of M&E. Intermediate outcomes include improvements in dietary diversity, increased consumption of nutrient-dense foods, and reductions in the intake of ultra-processed products. These can be measured using tools like the Household Dietary Diversity Score (HDDS) or Minimum Dietary Diversity for Women (MDD-W). Long-term health

outcomes, such as reductions in child stunting, anemia prevalence, or obesity rates, provide evidence of broader public health impact. Linking nutrition literacy programs with existing health surveillance systems allows for more efficient monitoring of these outcomes. Randomized controlled trials, longitudinal studies, and quasi-experimental designs can strengthen causal attribution between literacy interventions and observed health improvements (Isa, 2024; Iziduh *et al*., 2024 [33]). However, given the complexity of food systems, evaluations should account for confounding factors such as income, food availability, and policy environments.

Feedback mechanisms are essential for ensuring continuous improvement of nutrition literacy frameworks. Regular community consultations, participatory evaluations, and stakeholder workshops allow implementers to adapt interventions in real time. For example, feedback from mothers in a community nutrition program may highlight barriers in applying recommended feeding practices, leading to program adjustments that better reflect local realities. Digital platforms, such as SMS-based surveys or mobile applications, can provide rapid two-way communication, enabling communities to share experiences and challenges with program implementers. At the institutional level, feedback loops ensure that policymakers and educators receive timely evidence on what works, fostering accountability and informed decision-making. Integrating M&E findings into national nutrition strategies and scaling successful models also contributes to sustainability.

Monitoring and evaluation are not peripheral activities but central to the effectiveness of nutrition literacy frameworks. Indicators provide measurable benchmarks of knowledge and practices, while surveys and tools generate data that reveal both gaps and progress. Evaluations of dietary intake and health outcomes ensure that interventions achieve meaningful impact, and feedback mechanisms enable adaptive responses to evolving challenges. Together, these elements create a dynamic system that transforms nutrition literacy from an abstract concept into a practical driver of health equity in low- and middle-income settings. By investing in strong M&E systems, stakeholders can ensure that nutrition literacy initiatives are accountable, context-sensitive, and capable of reducing the burden of malnutrition across generations (Jejeniwa *et al*., 2024; Johnson *et al*., 2024) [34, 35].

3. Conclusion

Nutrition literacy is a critical determinant of public health, particularly in low- and middle-income countries (LMICs) where the dual burden of undernutrition and rising diet-related non-communicable diseases continues to strain fragile health systems. The ability of individuals and communities to understand, interpret, and apply nutrition knowledge directly influences dietary practices, food choices, and overall health outcomes. In contexts where limited resources, cultural diversity, and structural barriers shape access to healthy diets, strengthening nutrition literacy becomes an indispensable strategy for improving population health and reducing inequities.

A conceptual framework for nutrition literacy provides a structured roadmap for designing, implementing, and evaluating targeted interventions. By addressing functional, interactive, and critical dimensions of literacy, the framework ensures that individuals not only gain basic nutritional knowledge but also develop the skills to engage with health systems, critically evaluate information, and advocate for healthier environments. This multidimensional approach highlights the importance of tailoring interventions to local realities, incorporating cultural practices, socioeconomic conditions, and existing food systems. The framework bridges the gap between knowledge and practice, enabling evidence-based strategies that are both scalable and sustainable in LMIC settings.

Achieving meaningful improvements in nutrition literacy requires coordinated action across sectors. Governments, health professionals, educators, civil society organizations, and international agencies must work together to address the persistent knowledge and practice gaps that undermine dietary health. Cross-sector collaboration is essential to align education, communication, policy, and capacity-building initiatives with broader public health and development goals. By investing in integrated approaches that combine community engagement, policy support, and innovative communication strategies, stakeholders can ensure that nutrition literacy becomes a cornerstone of health promotion. Ultimately, advancing nutrition literacy strengthens resilience, empowers communities, and contributes to long-term improvements in health and well-being across LMICs.

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