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Policies and strategies for the prevention and control of anemia and malnutrition in children and pregnant women: A systematic review

Obed Vargas-Salas[1+]
Lenia Victoria Teresa Caceres-Bellido[2]
Josefina Sonia Nunez-Chavez[3]
Fernando Alberto Fernandez-Fernandez[4]

[1]*School of Political Science and Government, Universidad Catolica de Santa Maria, Arequipa, Peru.*
Email: ovargas@ucsm.edu.pe
[2]*School of Dentistry, Universidad Catolica de Santa Maria, Arequipa, Peru.*
Email: lcaceresb@ucsm.edu.pe
[3]*Nursing School, Universidad Catolica de Santa Maria, Arequipa, Peru.*
Email: snunez@ucsm.edu.pe
[4]*Postgraduate School, Universidad Catolica de Santa Maria, Arequipa, Peru.*
Email: ffernandez@ucsm.edu.pe


(+ Corresponding author)

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ABSTRACT

Malnutrition and anemia among children and pregnant women remain significant global public health challenges, particularly in low- and middle-income countries. These conditions hinder physical growth and cognitive development in children and compromise maternal health, thereby reinforcing cycles of poverty, disease, and premature mortality. Addressing these issues requires effective, sustainable, and context-sensitive responses. This study aims to systematically organize and examine policies and intervention strategies designed to prevent and control anemia and malnutrition in children under five and pregnant women. A systematic review was conducted using databases such as Scopus, EBSCO, Web of Science, and Taylor & Francis, covering publications from 2000 to 2023. The review adhered to PRISMA guidelines and applied the Joanna Briggs Institute quality appraisal standards. From an initial pool of 554 records, 28 studies met the inclusion criteria and were analyzed. Most of the included studies employed quantitative research designs, while fewer utilized qualitative or mixed-method approaches. Common interventions identified include iron and folic acid supplementation, deworming, food fortification, nutrition education, dietary diversification, and behavior change communication. Iron and folic acid supplementation consistently demonstrated effectiveness, especially when combined with educational components. However, several challenges persist, including low adherence to supplementation, socioeconomic and cultural barriers, limited resources, weaknesses in implementation, and regional differences in intervention effectiveness.

Contribution/ Originality: This study contributes to the existing literature by systematizing global policies and strategies addressing anemia and malnutrition in children and pregnant women. The paper's primary contribution is providing new insights into the contextual effectiveness of interventions and documenting how multisectoral, culturally adapted approaches enhance sustainability and policy outcomes.

1. INTRODUCTION

Malnutrition and anemia have long been major public health challenges, particularly affecting vulnerable populations in developing countries. According to the World Health Organization [1], anemia prevalence has reached 40% in children aged 6-59 months and 37% in pregnant women worldwide. Simultaneously, since 2022,

malnutrition has affected 149 million children in terms of stunting, 45 million in terms of wasting, and 37 million in terms of overweight and obesity [2]. Unmet expectations in tackling malnutrition and anemia through policy formulation and implementation have created a disconnect in the efforts required to address these issues [3].

Numerous studies also highlight the need for contextual and multi-sectoral strategies. Gleason and Sharmanov [4] evaluated strategies such as nutrition education, iron supplementation, and food fortification. They emphasized the importance of fine-tuning protocols for pregnant women, ensuring safe supplementation for children, and encouraging community participation.

Similarly, in their review of maternal anemia strategies in China, Liu et al. [5] supported the need to lower anemia prevalence through multi-sectoral coordination among different ministries, suggesting this experience as a model for developing countries. However, their findings also highlighted a lack of technical advice, health insurance frameworks, and available personnel.

Within this broader global context, anemia remains a major public health concern in Asia, accompanied by large regional and socioeconomic inequalities. Sharif et al. [6] showed an overall 11.9% decrease in anemia prevalence from 1990 to 2021. However, prevalence continued to rise in less-developed nations like Afghanistan and Yemen, largely due to iron deficiency. Waghmare et al. [7] observed that countries like Bangladesh and Nepal achieved notable progress in reducing childhood anemia through strong nutritional policies, whereas in India and Pakistan, limited coordination and weak political commitment hindered success. Likewise, Knowles et al. [8] argued that the persistence of anemia in Asia is partly due to a lack of proper policy implementation and data collection in the region.

In the African context, Mukisa et al. [9] conducted a critical review of the long-existing policies on malnutrition in Namibia since 1990 and concluded that there was a lack of evidence related to the development and application of models in other regions, like Asia, and the lessons that could be learned.

Consequently, the primary problem addressed in this research is the scarcity of systematically organized knowledge regarding how global and regional policies for preventing anemia and malnutrition have been designed, implemented, and assessed. Therefore, the objective of this review is to provide insight into and a synopsis of the major policies and strategies for the prevention of anemia and malnutrition in pediatric and pregnant populations. The relevance and purposeful use of the subject content in this article depend on the presentation and implementation aspects. Thus, the paper is structured as follows: methodology, results, literature review, discussion, and conclusions.

2. LITERATURE REVIEW

2.1. Nutrition and Child Health

2.1.1. Definition of Malnutrition and Its Implications

According to Ayele et al. [10] and Gesese and Khot [11], malnutrition is defined as a disorder caused by an imbalance in macronutrient intake, whether it be a deficit or an excess of carbohydrates and protein. Malnutrition is a broad concept that encompasses both deficiencies and excesses of macronutrients in an individual's diet. It also includes disparities between the intake requirements and the actual nutritional needs of the body for these macronutrients. Such imbalances can disrupt metabolic processes, resulting in altered body composition and various health issues. Addressing malnutrition requires a comprehensive understanding of dietary intake, metabolic demands, and the importance of balanced nutrition for maintaining optimal health [12, 13].

According to Gebremaryam et al. [14], overnutrition falls under the umbrella of malnutrition. Excessive food intake leads to overweight and obesity, creating serious health issues in developing regions, even though undernutrition remains the primary challenge. In developing nations, malnutrition encompasses both undernutrition and overnutrition. However, undernutrition remains the dominant threat in these regions due to a lack of balanced food intake. Infants are particularly vulnerable due to inadequate care and nutrient-deficient diets.

In contrast, according to some authors, Seid et al. [15] and Mohseni et al. [16], one of the main effects of malnutrition is increased mortality rates among most children below the age of five years, especially in Asian and

African nations, due to the inability for most people within these nations to be cured from common diseases due to malnutrition. Moreover, its impact extends beyond survival, hindering children's physical growth, cognitive development, and overall productivity in later life [17].

2.1.2. Malnutrition Indicators

As reiterated by Mohseni et al. [16], low weight-for-age and weight-for-height are essential determinants used to measure child malnutrition. Acute malnutrition is characterized by sudden weight loss due to food insecurity or illness [10, 11, 18]. For instance, a child is considered acutely malnourished if their weight-for-height is below -3 standard deviations from the WHO standards, or if their mid-upper arm circumference (MUAC) is less than 11.5 cm [14].

2.2. Determinants of Child Nutritional Status

Malnutrition and anemia both have a multifactorial etiology [14, 19-22], which is explained further below.

2.2.1. Individual Factors

A key driver of acute malnutrition is inadequate food intake, often exacerbated by a high prevalence of communicable diseases, particularly diarrheal diseases, Tut and Tsegaye [13]. Ayana et al. [18] include other factors, such as low birth weight and lack of complete immunization. For anemia, iron deficiency remains the primary factor, despite adequate food intake [21, 23].

2.2.2. Family Factors

According to Ayana et al. [18] and Gesese and Khot [11], a cluster of family-level factors is related to acute child malnutrition. Factors include poverty, lack of parental education, poor caregiving, improper feeding practices, large household size, non-exclusive breastfeeding, family instability, unsanitary environments, and frequent childbearing.

Moreover, the importance of maternal health in child nutrition is emphasized in existing literature. Nwankwo et al. [24] argue that a mother's nutrition level before conception is a definitive factor in a child's later nutrition outcomes. Therefore, mothers play a crucial role in ensuring sound nutrition from the very beginning of a child's life. This is a significant indicator of the determinant and indicator roles played by child nutrition within the structural levels mentioned above, which are present within the framework of a larger society and serve an important role within those levels.

2.2.3. Cultural and Social Factors

Gesese and Khot [11] and Jebero et al. [12] link acute malnutrition to various cultural and social factors, such as seasonality, food shortages, rural residency, socioeconomic policy changes, lack of healthcare access, and disease outbreaks.

Gender roles play an added role in creating malnutrition disparities among the population. For example, a higher prevalence of iron-deficient anemia is seen among girls, due in part to menstruation, unequal food distribution within households, and child marriages, often entailing adolescent pregnancies Sharma et al. [25].

2.3. Impact of Nutrition on Child Development

2.3.1. Healthy Growth and Development

Gebremaryam et al. [14], however, underscore the importance of brain and neurological development beginning early in gestation and fully completed by the child's second birthday. During this sensitive period, the duration and severity of nutrient adequacy or inadequacy have dramatic, long-lasting effects on morbidity, mortality, and

dimensions of child growth and maturation [17]. Nutritional adequacy during a child's first few years of life significantly influences child morbidity and mortality rates, host immune function, and increases child intelligence levels [24, 26].

Conversely, maternal anemia is associated with increased child morbidity, stunted physical growth, vulnerability to cardiovascular diseases, and impaired cognitive and motor skills [27].

2.3.2. Importance of the Food Environment

As discussed by Jeyakumar et al. [17], environmental factors and age-associated factors definitely impact the eating habits of children. In agreement with Trübswasser et al. [28], the food environment is defined as the physical and social surroundings within which people live and interact with the food system. It plays a significant role in influencing food behaviors through a wide range of determinants, including food availability, accessibility, safety, and marketing dynamics.

The food environment is also embedded with food safety standards and food supply chain policies, and these standards impact the diversity, quality, and nutrient value of food in various ways. These influences can lead to the coexistence of different types of malnutrition within a given setting, including undernutrition, micronutrient deficiencies, overweight, and obesity. Ensuring proper implementation of standards and policies is essential to promote a balanced and nutritious food environment that supports overall public health.

2.4. Anemia

Osman et al. [21] and Weldekidan et al. [29] define anemia as a condition marked by a reduction in red blood cell size and number, or a low concentration of hemoglobin, thus hampering oxygen transport. Iron loss leading to a reduced synthesis of hemoglobin is a predisposing factor for iron-deficiency anemia, which is the most prevalent form of anemia worldwide [30]. Fifty percent of anemia cases generally, and 75% of cases in pregnant women, are attributed to iron deficiency, making it the most prevalent nutritional disorder worldwide. A prevalence of anemia within a population of a given area exceeding 40% indicates that anemia is a significant public health concern [31].

2.4.1. Causes of Anemia

Anemia has a broad range of underlying causes, resulting from a nexus of biological and environmental factors [27]. Nevertheless, micronutrient deficiencies, especially in the pregnant population, are increasingly being implicated among the causes, given the increased demand for iron in both the newborn and the expecting mother Amarasinghe et al. [19] and Deriba et al. [32]. Appiah et al. [23] also identify parasitic infections, deficiencies in vitamins B6 and B12, chronic illnesses such as HIV, and genetic disorders including sickle cell anemia as key contributors.

Women of childbearing age, newborns, and pregnant women are among the groups most prone to anemia. Anemia in pregnant women is particularly associated with inadequate nutrient intake, menstruation, blood loss, viral and parasitic diseases such as HIV/AIDS and malaria, chronic illnesses, hemolytic disorders, and frequent closely spaced births with insufficient recovery periods [32].

2.4.2. Consequences of Anemia

Anemia during pregnancy carries serious implications for both maternal and child health [19, 21, 23, 29]. Maternally, it can lead to fatigue, impaired mental performance, cardiovascular disease, diminished work performance, vulnerability to infections, and lung ailments. Anemia can also lead to impaired physical and psychological performance, increased risks of postpartum hemorrhages, and, in some cases, mortality [31].

For unborn, newborn, and infant cases, anemia is associated with extreme prematurity, low birth weight, impaired neural function, and increased risks of infant mortality [27, 32]. Iron-deficient anemia in childhood can lead

to profound inhibitory effects on functional outcomes in the brain, as well as disruptions in physiological and immune functions throughout an individual's lifetime. These effects are due to altered brain structures and functions, impacted hormonal levels, and impaired immune responses [30, 33, 34]. For school-age children, anemia can increase the risks of deficient attention, impaired learning potential, and diminished educational performance, with a lasting impact into adulthood, ultimately inhibiting economic functionality [22].

3. METHODOLOGY

In accordance with the study's aims, a systematic review was carried out following the PRISMA guidelines proposed by Page et al. [35]. To enhance the rigor of the methodology, the systematic review adhered to the criteria proposed by the Joanna Briggs Institute, ensuring both the quality and the generalizability of the findings [36].

3.1. Search Method

The review examined four primary academic databases: Scopus, EBSCO, Web of Science, and Taylor & Francis. It included only articles from peer-reviewed journals published between 2000 and 2023. The central research question guiding the review is as follows: What are the main findings and debates within the scientific literature concerning policies and strategies for the prevention and control of anemia and malnutrition?

Search terms were selected from the UNESCO Thesaurus, complying with ISO 25964 standards. The selected terms included "malnutrition," "policy making," "strategic planning," and "government," along with additional keywords such as "anemia," "undernutrition," "public," "guideline," "prevention," and "control." These terms were combined to formulate the following search equation: (Undernutrition OR malnutrition OR anemia) AND (Polic* OR strateg* OR govern* OR public OR activit* OR guideline*) AND (Prevent* OR control*).

To ensure the credibility of the search process, two researchers (L.V.T.C.B. and S.N.C.) independently conducted searches across all databases. This strategy aimed to eliminate bias in the search process and to ensure consistency in the methodology.

3.2. Criteria for Inclusion and Exclusion

Table 1 presents the criteria used to guide the screening and selection of studies included in this review, outlining the parameters applied to ensure the relevance, quality, and comparability of the literature analyzed.

Table 1. Table of criteria.

Inclusion criteria	Exclusion criteria
Articles with empirical evidence	Published prior to 2000
Studies on policies and strategies for the prevention and control of anemia and/or malnutrition.	Studies addressing prevention and control policies for other diseases
Published research papers between 2000 and 2023	Articles focusing on populations other than pregnant women and children under five.
Articles in English	Articles without full-text access
Articles focused on pregnant women and/or infants	Duplicate records across databases
-	Studies that are not structured as scientific articles

3.3. Selection Procedure for Documents

The selection process involved a series of clearly defined stages with strict criteria, as illustrated in Figure 1. Initially, 554 articles were identified from four selected databases for the systematic review. These articles were then subjected to a series of inclusion and exclusion criteria, including accessibility, publication date, and the removal of duplicate sources. This process narrowed the pool to 129 articles. Ultimately, 28 articles were deemed relevant after a comprehensive evaluation aligned with the review's objectives and the guiding conceptual question of the structured search process.

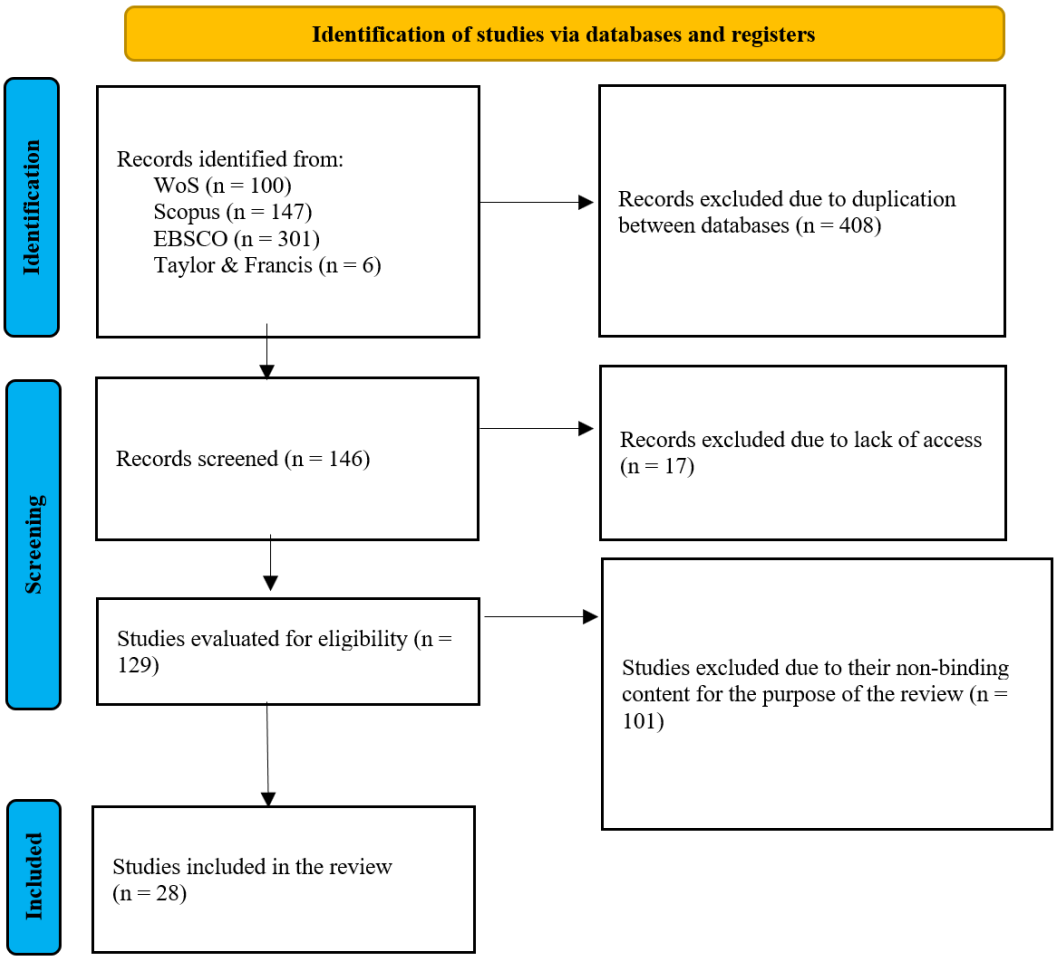

Figure 1. Item selection process according to the PRISMA protocol.

Two researchers (L.V.T.C.B. and S.N.C.) independently evaluated the relevance of the articles. Any disagreements were resolved through consensus with the assistance of a third reviewer (O.V.S.).

3.4. Data Extraction

A comparative matrix was designed to systematically synthesize the literature, including components such as publication year, source, theoretical framework, study design, and methodology.

3.5. Data Synthesis Approach

Data were synthesized using a narrative and thematic approach, as proposed by Popay et al [37]. This approach facilitated the integration of various types of evidence included in the synthesis, focusing on recurring themes, patterns, and perspectives related to anemia and malnutrition prevention among pregnant women and young children. The synthesis was conducted in three phases:

a. Coding relevant findings and policy components;
b. Grouping these elements into broader thematic categories, such as governance structures, implementation mechanisms, and community participation;
c. Interpreting the interconnections among these thematic clusters within diverse socioeconomic and cultural contexts.

This structured approach allowed for a nuanced and context-sensitive understanding of the policy landscape addressed in the reviewed literature.

4. RESULTS

4.1. Detection of Relevant Publications

The search strategy yielded a total of 554 records across the four selected databases. Table 2 presents the detailed distribution of articles retrieved from each database.

Table 2. Search results by database.

Search Equation	Scopus	EBSCO	Web of Science	Taylor & Francis	Sub-Total
(Undernutrition OR malnutrition OR anemia) AND (polic* OR strateg* OR govern* OR public OR activit* OR guideline*) AND (prevent* OR control*)	147	301	100	6	554
Total	147	301	100	6	554

Note: The asterisk (*) denotes the use of truncation in the search terms, allowing the retrieval of multiple word variants with the same root.

After applying the inclusion and exclusion criteria, a final set of 28 articles was selected for in-depth analysis.

To support a systematic and coherent synthesis, Table 3 provides an overview of the selected articles, summarizing key characteristics such as authorship, year, methodology, and location.

Table 3. Overview of the selected articles.

N°	Author	Year	Methodology	Study location
1	Amarasinghe, et al. [19]	2022	Quantitative	Sri Lanka
2	Appiah, et al. [23]	2020	Quantitative - Cross-sectional - Descriptive	Ghana
3	Ayana, et al. [18]	2015	Quantitative	Ethiopia
4	Ayele, et al. [10]	2020	Quantitative - Case-control study	Ethiopia
5	Balcha, et al. [31]	2023	Quantitative - Cross-sectional	Ethiopia
6	Cusick, et al. [33]	2007	Quantitative	United States
7	Deriba, et al. [32]	2020	Quantitative - Case-control study	Ethiopia
8	Ferreira, et al. [30]	2023	Quantitative - Exploratory - Cross-sectional	Brazil
9	Gebremaryam, et al. [14]	2022	Quantitative - Case-control study	Ethiopia
10	Gesese and Khot [11]	2023	Quantitative - Case-control study	Ethiopia
11	Ip, et al. [34]	2007	Mixed	Bangladesh
12	Jebero, et al. [12]	2023	Quantitative - Case-control study	Ethiopia
13	Jeyakumar, et al. [17]	2022	Quantitative	India
14	Jeyakumar, et al. [20]	2021	Mixed - Longitudinal	India
15	Konje, et al. [27]	2022	Quantitative - Cross-sectional	Tanzania
16	Menon, et al. [26]	2005	Qualitative	Haiti
17	Mohseni, et al. [16]	2019	Qualitative	Iran
18	Nwankwo, et al. [24]	2023	Quantitative - Descriptive - Transversal	Nigeria
19	Osman, et al. [21]	2020	Quantitative - Case-control study	Ethiopia
20	Parlesak, et al. [38]	2014	Quantitative	Mozambique
21	Paulino, et al. [39]	2005	Quantitative	Philippines
22	Seid, et al. [15]	2017	Quantitative - Case-control study	Ethiopia
23	Sharma, et al. [25]	2000	Quantitative - Experimental - Prospective	India
24	Sufiyan, et al. [22]	2011	Quantitative	Nigeria
25	Trübswasser, et al. [28]	2022	Qualitative	Ethiopia
26	Tut and Tsegaye [13]	2020	Quantitative - Case-control study	Ethiopia
27	Weldekidan, et al. [29]	2018	Quantitative	Ethiopia
28	Widyawati, et al. [40]	2015	Qualitative	Indonesia

4.2. Description of Included Publications

Geographically, the articles covered a wide range of regions, with a particular emphasis on Ethiopia, which had 12 articles. India followed with 3 articles, and Nigeria contributed 2 articles. Other countries represented in the collection included Bangladesh, Brazil, Ghana, Haiti, Iran, Mozambique, the Philippines, Sri Lanka, Tanzania, and the United States.

This geographical distribution reflects a strong research focus on developing countries, where anemia and malnutrition are critical public health issues. However, it also highlights a lack of research in other affected regions, such as Latin America and North Africa, which appear underrepresented.

The publication years ranged from 2000 to 2023. Notable concentrations occurred in 2020 (five publications), 2022 (five publications), and 2023 (five publications). Other years included 2005 (two publications), 2007 (two publications), 2015 (two publications), and single studies in 2000, 2011, 2014, 2017, 2018, 2019, and 2021.

This reflects a new interest in recent years, which is probably due to the new agendas of international nutrition, the Sustainable Development Goals, and the fact that initiatives related to maternal and child health have intensified in the post-pandemic period.

Based on the analysis, the objectives of the 28 studies were categorized into five main themes, as explained below.

a. Prevalence and determinants of anemia among pregnant women: Various studies were conducted by Amarasinghe et al. [19]; Ayele et al. [10]; Deriba et al. [32]; Konje et al. [27]; Osman et al. [21], and Weldekidan et al. [29] in order to determine the prevalence of anemia among pregnant women and the influencing determinants of its persistence. Together, these findings demonstrate the continued importance of biomedical and socioeconomic determinants, as well as gaps in knowledge regarding nutrition and antenatal care among pregnant women.
b. Strategies to prevent child undernutrition: Preventative methods against child undernutrition were evaluated in a study by Ayana et al. [18]; Gebremaryam et al. [14]; Jebero et al. [12]; and Tut and Tsegaye [13]. The common factor in these studies is the importance of identifying and preventing potential causes within the community among children under the age of five years. While these preventative methods can be significantly improved within a community setting, outcomes remain inconsistent.
c. Evaluation of supplementation practices and prevention policies: Appiah, et al. [23]; Cusick, et al. [33]; Ferreira, et al. [30]; Ip, et al. [34]; Jeyakumar, et al. [17]; Jeyakumar, et al. [20]; Paulino, et al. [39]; Sharma, et al. [25] and Sufiyan, et al. [22] evaluated the practices of nutrition supplement delivery and related policies for preventing anemia and malnutrition among children and pregnant women. The effectiveness of delivery mechanisms, such as daily versus intermittent supplement delivery, levels of compliance, and other supplementary strategies, including nutrition education and worm control campaigns, was evaluated in these articles. These articles highlight the importance of nutrition supplement delivery in preventing anemia and malnutrition; however, effectiveness is often hindered by low compliance and weak healthcare infrastructure.
d. Policies and food environment for reducing malnutrition: Researchers who attempted to better understand the national policies and food environment modifications aimed at enhancing consumption diversity and alleviating chronic malnutrition include Mohseni et al. [16]; Parlesak et al. [38], and Trübswasser et al. [28]. These authors argue that a discrepancy exists between policymaking and policy effectiveness, as changing food behaviors is often unpredictable despite environmental modifications.
e. Socioeconomic factors and knowledge in malnutrition prevention: Balcha et al. [31]; Gesese and Khot [11]; Menon et al. [26]; Nwankwo et al. [24], and Widyawati et al. [40] explored the influence of socioeconomic conditions and caregiver knowledge on malnutrition prevention. These studies reveal the complex interplay of poverty, gender inequality, education, and cultural norms, emphasizing the need for community empowerment and health education.

Regarding the methodology, twenty-two studies employed a quantitative design, four used a qualitative design, and two utilized a mixed-methods approach. Moreover, the target populations in these studies included children under five years old and pregnant women. For the quantitative studies, research instruments included questionnaires, anthropometric measurements, and blood tests.

While the dominance of quantitative methods reflects a demand for indicator-driven outcomes, it limits the analysis of contextual experiences. A more balanced approach would enhance the understanding of the social dynamics underlying nutritional vulnerability.

Table 4 presents a summary of the research tools utilized in the reviewed articles.

Table 4. Research tools utilized in the reviewed articles.

N°	Author	Purpose	Research tool
1	Amarasinghe, et al. [19]	To identify the true prevalence of anemia and its causes in pregnant women during the first trimester in the Anuradhapura district, Sri Lanka.	Questionnaire and physical examination to obtain clinical signs
2	Appiah, et al. [23]	To analyze the degree of compliance of pregnant women with anemia prevention strategies implemented in the district of Juaboso, Ghana.	Semi-structured questionnaire of sociodemographic characteristics and face-to-face interviews.
3	Ayana, et al. [18]	To study the main determinants of acute malnutrition in children aged 6-59 months in public hospitals located in the East Wollega zone of Ethiopia.	Structured questionnaire administered by a respondent and anthropometric measurements
4	Ayele, et al. [10]	To examine the relationship between maternal mental health and infant nutritional status at six months of age.	Socio-demographic questionnaire, WHO Self Reporting Questionnaire (SRQ-20), Household Food Insecurity Access Scale of the Food and Nutrition Technical Assistance Project, WHO-ASSIST V3.0
5	Balcha, et al. [31]	This study assessed mothers' knowledge of anemia and their adherence to preventive measures among women attending antenatal consultations in Pawi district, northwestern Ethiopia.	Structured interviewer-administered questionnaire adapted to the local context [23, 41-43] blood sample and measurement of the mid-upper arm circumference (MUAC)
6	Cusick, et al. [33]	To assess anemia incidence and duration in preschool-aged children from low-income U.S. families over one year.	Pediatric Nutrition Surveillance System (PedNSS)
7	Deriba, et al. [32]	This study identified factors associated with anemia in pregnant women receiving antenatal care in public hospitals in West Shewa Zone, Oromia Region, Ethiopia.	Interviews using standardized structured questionnaires [44] anamnesis, physical examination, and laboratory testing
8	Ferreira, et al. [30]	This study evaluated iron supplementation practices among children aged 6 to 59 months at Family Health Strategy units in Minas Gerais.	Structured questionnaire and anthropometry
9	Gebremaryam, et al. [14]	To identify factors related to severe acute malnutrition in children 6-23 months at public hospitals in Bahir Dar, Ethiopia.	Interviewer-administered structured questionnaire adapted from the World Health Organization instrument [45] and anthropometric measurements.
10	Gesese and Khot [11]	To determine the risk factors associated with acute malnutrition.	Standardized questionnaire [18, 46-52] and measurement of mid-upper arm circumference (MUAC).
11	Ip, et al. [34]	To compare daily and flexible dosing of micronutrient sprinkles on adherence, acceptability, and hematological outcomes in young children in rural Bangladesh.	Focus group discussions [53] hemoglobin measurement with Hemocue [54] structured questionnaire of socio-demographic information
12	Jebero, et al. [12]	This study identified factors associated with acute malnutrition in children under five at public health centers in Sodo, Ethiopia.	Standardized interviewer-administered questionnaires and anthropometric measurements
13	Jeyakumar, et al. [17]	To analyze child malnutrition at various ages, it is essential to examine specific practices related to infants and young children and to determine their relationship within urban slums of Pune, Maharashtra.	Cross-sectional survey
14	Jeyakumar, et al. [20]	To evaluate the ongoing anemia prevention actions, which include the identification of iron deficiencies, deworming, supplementation, malaria control, and nutritional education, carried out by non-governmental organizations and schools, and their influence on the hemoglobin status of adolescent girls.	Height and weight measurements, cyanmetahemoglobin [55] semiannual deworming, iron supplementation, nutritional education, stakeholder training, sustainability index [56]
15	Konje, et al. [27]	To assess anemia prevalence in women at term, evaluate compliance with prevention measures, and identify factors related to low adherence.	Capillary blood sample and questionnaire

N°	Author	Purpose	Research tool
16	Menon, et al. [26]	Create a knowledge base and communication strategy on infant feeding and care, and develop complementary foods fortified with local and affordable ingredients to be promoted within the BCC strategy.	Semi-structured interviews with individuals, semi-structured interviews with groups, and group recipe trials.
17	Mohseni, et al. [16]	To assess Iran's policies on preventing malnutrition in children under five.	Policy, legal and organizational document research and semi-structured interviews
18	Nwankwo, et al. [24]	To assess mothers' knowledge and practices in preventing child malnutrition.	Semi-structured questionnaire
19	Osman, et al. [21]	Identify anemia risk factors among pregnant mothers receiving prenatal care in Jigjiga, Somali Region, Ethiopia, 2019.	Dietary Diversity Questionnaire and Survey (DDQ)
20	Parlesak, et al. [38]	Assess whether, after conducting rigorous scientific studies, governments and donors should consider dietary diversification as a high priority to reduce the high prevalence of chronic malnutrition globally.	Linear programming
21	Paulino, et al. [39]	Launch a program in the Philippines to provide women of reproductive age with iron and folic acid supplements, assessing its impact on knowledge, attitudes, practices, and iron status. The program will also promote participation through social marketing and community engagement.	Intervention and survey
22	Seid, et al. [15]	To identify factors related to acute malnutrition in children aged 6-59 months in Dubti district, located in the Afar region of northeastern Ethiopia.	Structured questionnaire [57] and measurement of mid-upper arm circumference
23	Sharma, et al. [25]	To examine hemoglobin levels in low-income adolescents, compare weekly versus daily iron and folate supplementation, and assess the effect of ascorbic acid.	Intervention, anthropometry, and measurement of hemoglobin levels.
24	Sufiyan, et al. [22]	To assess the impact of deworming and hygiene education on anemia among children aged 6–15 in Gadagau, Giwa LGA, Kaduna State.	Questionnaire, training talks, deworming, anthropometric measurements, blood sample, and stool sample.
25	Trübswasser, et al. [28]	Assess the integration of food environment dimensions into Ethiopia's policy goals and interventions, and compare them with international best practices.	Documentary analysis
26	Tut and Tsegaye [13]	To identify risk variables for acute malnutrition (wasting) in children aged 6–59 months treated at public health centers in Gambella city.	Interviewer-administered structured questionnaire and anthropometric measurements
27	Weldekidan, et al. [29]	Identify the primary causes of anemia in pregnant women receiving antenatal care in Durame, southern Ethiopia.	Interviewer-administered structured questionnaire, venous blood sample, and stool sample.
28	Widyawati, et al. [40]	To examine how nurse-midwives in Yogyakarta Special Province provide prenatal care to pregnant women with anemia and how they perceive their skills in preventing anemia.	Semi-structured interviews

5. POLICIES AND STRATEGIES FOR NUTRITION AND THE PREVENTION OF ANEMIA IN CHILDREN AND PREGNANT WOMEN

5.1. BCC Program (Behavior Change Communication)

Menon et al. [26] emphasize that improving child nutrition requires more than just resource provision; it demands a shift in parental care practices. Behavior Change Communication (BCC) programs have demonstrated a better cost-efficacy ratio in reducing mortality rates compared to traditional schemes such as supplementary feeding alone.

BCC projects emphasize that the importance of sustainable nutrition improvement stems not only from changes in food access and nutrient supplement delivery but also from shifts in social norms and the empowerment of caregivers as changemakers. Combining a BCC strategy with a broader structural approach can enhance long-term outcomes by bridging the gap between knowledge and action.

Individual behavior is influenced by multiple levels: biological requirements, cultural beliefs regarding healthcare, and social factors such as gender roles, socioeconomic status, and education.

5.2. Interventions to Fight Malnutrition

Effective child nutrition best practices, including timely initiation and exclusive breastfeeding, adequate complementary feeding, and food diversification, among others [20], play a crucial role in achieving optimal growth and development. Effective progress can only be ensured through a joint strategy involving a wide range of sectors to address food environment policies [28]. Malnutrition is widely recognized as a systemic problem rather than solely an individual concern. Food and nutrition should be viewed through the lenses of economic growth and social equity, not merely from a clinical health perspective.

5.3. Anemia Prevention and Control Strategies

Delayed umbilical cord clamping during birth and exclusive breastfeeding for the first six months of an infant's life are recommended practices. The World Health Organization (WHO) advocates for the use of [30] iron supplements, intermittent sulfadoxine-pyrimethamine for malaria prevention, insecticide-treated bed nets, and prenatal deworming as strategies to prevent and control anemia. These interventions should be implemented with careful consideration of the timing and adherence rates, the current iron stores in the woman's blood at conception, and the overall quality of prenatal care provided [27].

Even so, anemia prevention campaigns during pregnancy primarily focus on preventing iron-deficiency anemia by implementing iron supplements, iron injections, deworming, and nutrition education campaigns [19, 31]. However, low compliance with these treatment regimens remains a significant challenge. To overcome this limitation, Ip et al. [34] suggest implementing "sprinkles", packets consisting of iron and other key micronutrients in a form easily mixed with these complementary foods and accepted by consumers. Another solution involves providing complementary foods through public health initiatives, although the effectiveness of this approach is debated, as it may negatively impact local economies by decreasing demand for local products [38].

The evidence is mixed, highlighting the need to balance technological advancements in supplements with sociocultural and economic analyses to avoid dependency and foster local ownership. This would imply the need for an analysis framework specific to the given contexts but extending beyond standard biomedical outcomes and incorporating other aspects such as social acceptance and economic factors beyond just cost-effectiveness.

For instance, rather than solely concentrating on a supplementary solution, Jeyakumar et al. [20] instead argue for a sustainable and holistically inclusive approach concerning broader aspects related to the solution of health issues such as anemia, instead developing an overall ability within a community's means to be able to deal with change itself rather than just a problem.

Accordingly, anemia can be prevented and controlled through well-administered, specific interventions addressing root causes [21], such as regular deworming campaigns and participatory hygiene education [22]. Moreover, pregnancy can be protected against health risks by means of adequate prenatal care with the intent of preventing any kind of medical problem related to the child and the mother's health [40]. In this context, localized interventions grounded in participatory health models not only improve compliance but also strengthen community trust in the healthcare system, thereby making prevention strategies more adaptive and resilient.

5.4. Prevention and Control Policies in Different Contexts

Various nations have adopted divergent policies and initiatives aimed at preventing and controlling anemia among children and pregnant women. For instance, Sri Lanka's public health care delivery system offers nutrition education, deworming, iron supplements, and referrals for further care when required [19].

Ghana has implemented several intervention projects to prevent anemia in pregnant women, including health education, nutritional support, malaria control (bed nets), deworming campaigns, and WASH initiatives [23]. The strategy implemented in Ghana demonstrates that a combination of medical and environmental interventions is worth considering, especially in view of the linkages among nutrition, disease control, and environmental sanitation.

In Brazil, the National Iron Supplementation Program aims to provide iron supplements to infants aged 6–24 months, pregnant women, premature infants, and women who are postpartum or post-abortion, with the goal of preventing iron deficiency [30]. The Brazilian example illustrates the challenges of sustained adherence in mass supplementation campaigns, underscoring the importance of monitoring and civic engagement.

A national nutrition policy has been formulated by the Federal Ministry of Health in Ethiopia to address micronutrient deficiencies among pregnant women [29]. Nutritional assessments, iron/folic acid supplements, and deworming programs related to pregnancy are included in the strategy. The National Nutrition Program was initiated in 2016 with the goal of reducing malnutrition in all its forms [14]. Subsequently, there was a heightened focus on nutrition with the launch of the fourth Health Sector Development Program (HSDP-IV) in Ethiopia. This program is part of the Growth and Transformation Plan, with a particular emphasis on decreasing rates of acute malnutrition [11].

These policies reflect an evolving understanding of nutrition, integrating it into broader frameworks of sustainable growth.

Iran has established its National Nutrition and Food Security Document by incorporating international frameworks, conducting national reviews of previous reports, and analyzing consultations on food and nutrition security [16]. This policy synthesis approach makes a critical contribution toward localizing international nutrition policies because it emphasizes evidence-based adaptation for achieving food and nutrition security.

Iron fortification for pregnant women and lactating mothers in the Philippines has remained in effect for over three decades. However, progress has been limited by factors such as side effects leading to non-compliance, lack of awareness among healthcare professionals, financial constraints, and limited access to healthcare services [39]. The Philippine example shows that simply because a program can be sustained, it is not necessarily effective.

For instance, in Indonesia, care standards were established by the Ministry of Health in 2007 for prenatal, intranatal, postnatal, neonatal, under-five, and reproductive health care services [40]. This is a comprehensive example of an integrative strategy for the care of both mothers and children within a continuum of care framework. In the Tanzanian context, a specific antenatal care approach provides iron and folic acid supplements, intermittent preventive treatment of malaria with sulfadoxine–pyrimethamine, anthelmintics such as albendazole or mebendazole, and insecticide-treated bed nets to every pregnant woman, regardless of her background [27]. This approach demonstrates a strategy for aligning policy and promoting equity in program access. It can serve as a best practice example for other areas facing similar resource constraints, providing an effective strategy for a fully integrated maternal care approach.

6. DISCUSSION

The systematic analysis of policies and strategies for controlling anemia and malnutrition reveals areas of convergence and divergence among researchers and policymakers. A common theme is that education and awareness among pregnant women and mothers are essential for improving health and nutrition outcomes. Multiple authors, including Appiah et al. [23] and Ayana et al. [18], emphasize that insufficient knowledge regarding anemia and preventive strategies represents a major barrier to adherence and intervention success. This finding aligns with a broader understanding of malnutrition as a multidimensional phenomenon that extends beyond food scarcity. It involves complex nutritional and metabolic interactions influenced by social and environmental factors, emphasizing the importance of comprehensive interventions.

However, the efficacy of iron supplementation programs for infants remains a subject of ongoing debate. Some research works, such as those carried out by Paulino et al. [39] and Ip et al. [34], describe issues concerning non-adherence with established iron supplement schedules and emphasize the need for flexible supplement delivery, including the use of powdered iron supplements. Others, Sharma, et al. [25] have found one daily dose of iron and folic acid supplements to be most effective when given on a weekly schedule rather than a daily schedule.

While standardized thresholds and regimens facilitate international comparisons, they must be interpreted within the context of local food habits, accessibility, and seasonality.

There is variation in terms of comprehension and control of the root causes of anemia and malnutrition among pregnant females and children. There are some studies, for example, Balcha et al. [31] and Weldekidan et al. [29] focus on the biomedical aspects, such as iron-deficiency anemia, parasites, and low food diversity. The existence of a wide range of causes shows the need for an expanded approach, including an emphasis on infection reduction and enhanced nutrient accessibility, rather than just looking into a factor alone. Unsatisfactory outcomes may arise from a lack of comprehensiveness in addressing the problem, considering the complex interplay of social and biomedical factors.

In contrast, others point to broader structural and social determinants, such as education [18], mental health [10], family size [32], and income level [11], highlighting the multidimensional nature of these conditions. Specifically, poor maternal mental health can have social, economic, and psychological implications, potentially leading to child growth restriction and impaired cognition.

Moreover, vulnerability patterns related to gender indicate that the level of nutrition is affected by social norms and gender roles rather than by gender itself. Therefore, gender-specific programs aimed at ensuring food equity and delaying child marriages would be effective in reducing anemia among adolescents. Collectively, these relationships suggest that investing in early childhood nutrition yields long-term social benefits and supports sound social policy.

Regarding research gaps, there is a notable scarcity of literature examining the combined impact of multiple risk factors on anemia and malnutrition. Even when maternal education and iron supplementation are considered key components, surprisingly, very little is known about the joint impact of these factors with other aspects such as food security, access to medical care, and socioeconomic inequality. A comprehensive food environment study with a systematic approach may reveal that individuals' food preferences and choices occur within a broader structural context, including market dynamics and legislative frameworks, which influence the feasibility and attractiveness of various food options.

Additionally, further research is needed to evaluate the effectiveness of existing policies, as strategies successful in one setting may fail in others due to cultural and socioeconomic differences. The persistent high prevalence of anemia despite substantial efforts highlights the limitations of current public health approaches. This underscores the necessity for a multisectoral strategy that extends beyond purely medical interventions, considering the etiological complexity of anemia. A medical approach alone tends to oversimplify the problem, which involves biological vulnerability and deprivation, making it a biosocial issue that requires comprehensive solutions across various sectors.

7. CONCLUSIONS

7.1. Implications for Policy and Practice

The amount of scientific evidence available concerning the strategies and policies designed for preventing and controlling anemia and malnutrition among children and pregnant women is vast and diverse, highlighting the need for a multifaceted approach in addressing these issues. It is evident that education plays a crucial role in achieving optimal levels of health and nutrition among pregnant and parenting women. Iron fortification programs have yielded mixed results, with some studies showing low compliance with iron fortification regimens, while others demonstrate the effectiveness of daily iron and folic acid supplementation. These findings underscore the importance of tailored interventions and continuous monitoring to improve health outcomes in vulnerable populations.

Taking into consideration the variability described above, it is evident that a single approach is insufficient to combat anemia and malnutrition. A region-specific strategy is essential, taking into account local food habits, accessibility, and healthcare infrastructure. This is particularly relevant in regions experiencing rapid growth, such as Asia, where abrupt lifestyle changes are common.

7.2. Limitations

The heterogeneity of study designs, policies, and methodologies limits the generalizability of these findings. Moreover, the predominance of cross-sectional studies restricts the ability to attribute long-term effects and causality.

7.3. Future Research Directions

Future research should focus on understanding the intersection of co-existing risk factors. Comparative studies across different cultural settings are necessary to align intervention strategies with local needs. There is a recommendation for longitudinal and mixed-methods research to understand the long-term effects of current intervention strategies for this purpose.

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