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Relationship Intake Maternal Nutrition in 1000 Days of Life and Infant Nutritional Status at Age Two

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ABSTRACT

Purpose: This study aims to examine in depth the relationship between maternal nutrition intake during the first 1000 days of life (HPK) and the nutritional status of children at two years of age. The primary focus of this study is to explore the association between adequate intake of essential nutrients such as protein, iron, zinc, folic acid, and vitamin A during pregnancy and child growth indicators, including weight-for-age (WFA), height-for-age (HFA), and weight-for-height (WFA).

Research Method: This study employs a qualitative approach, utilizing a systematic literature review method. The review was conducted on various relevant studies published between 2015 and 2025, which addressed the biological, socioeconomic, and health intervention dimensions related to maternal nutrition and its impact on the nutritional status of two-year-old children. The analysis was conducted thematically by grouping the findings into six main discussion areas.

Results and Discussion: The results show a strong association between maternal nutritional adequacy and child growth at the age of two years. Factors such as nutritional imbalance during pregnancy, maternal education level, local dietary culture, and the quality of maternal and child health services play important roles. Systematic and contextually appropriate nutrition intervention programs are urgently needed to optimize child growth outcomes.

Implications: This study makes a significant contribution to the development of maternal and child health policies and can serve as a basis for planning community-based and cross-sectoral interventions aimed at preventing stunting.

Keywords: pregnancy nutrition; 1000 days of life; child nutrition status, stunting; health intervention.

Introduction

The first 1000 days of life (HPK)—starting from conception until a child reaches the age of two—is globally recognized as a critical period that determines a child's health, growth, and development. During this period, nutritional needs must be met optimally, as nutritional deficiencies can have permanent effects on brain function, the immune system, and a child's physical growth potential. The World Health Organization (WHO) emphasizes that effective nutritional interventions during the first 1000 days of life can prevent stunting and other developmental disorders that have lasting effects into

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adulthood. In Indonesia, improving the nutrition of pregnant women is a national priority due to the high prevalence of stunting among children under five, which stood at 21.6% in 2022 (Bappenas, 2023). This indicates that nutritional issues are not limited to children but are closely linked to the nutritional status of mothers during pregnancy. This phenomenon is increasingly critical as various studies reveal that many pregnant women suffer from chronic energy deficiency (CED), stunted growth, and inadequate weight for gestational age, which contribute to low birth weight and the risk of stunting (Siburian *et al.,* 2024). The intake of micronutrients and macronutrients, such as protein, iron, and zinc, during pregnancy has been shown to have a direct impact on fetal development and the nutritional status of children after birth (Pipitcahyani *et al.,* 2024). However, attention to the direct relationship between maternal nutrition intake during the 1000 HPK and children's nutritional status at two years of age remains limited. However, two years of age marks the end of the critical 1000 HPK phase and serves as an early indicator of the success of nutritional interventions during the early stages of a child's life.

Previous studies have emphasized the importance of nutritional intervention from pregnancy through to the age of two. Nazihah (2021) found that mothers' knowledge about the 1000 HPK period, parenting patterns, and eating habits had a positive influence on the nutritional status of toddlers aged 36–59 months. Husnah (2017) emphasized that adequate nutrition during pregnancy has a significant impact on fetal development and is closely linked to infant mortality rates. A study by Aryati et al. (2018) found that food availability and adequate intake of protein and zinc are key factors in the growth of children aged 12–24 months. This finding is supported by Rukmana & Kartasurya (2015), who showed that protein and iron intake by pregnant women significantly correlates with birth weight as an early indicator of children's nutritional status. Recent research by Pipitcahyani et al. (2024) and Lasmadasari et al. (2023) highlights that malnutrition during the first 1,000 days of life can lead to stunting. Therefore, nutritional interventions targeting pregnant women, breastfeeding mothers, and children aged 0–23 months should be implemented through primary healthcare services. Research by Hayana and Lasepa (2023) also shows that protein and zinc intake during pregnancy are significantly correlated with the incidence of stunting. In this context, adequate nutrition during the 1000 HPK is not only crucial for children's health but also an important investment in breaking the cycle of poverty and health disparities across generations (Pipitcahyani *et al.,* 2024; Siburian *et al.,* 2024).

Various studies have examined the importance of maternal nutrition during the first 1000 days of life (HPK) for child growth. However, there are still gaps in both theoretical and empirical knowledge that have not been fully addressed. Theoretically, previous studies have generally highlighted the importance of specific nutrients such as protein, iron, and zinc in supporting fetal growth and preventing stunting (Rukmana & Kartasurya, 2014; Hayana *et al.,* 2023), but few have systematically and comprehensively explained the mechanisms linking adequate maternal nutrition during the 1000-day window to children's nutritional status at two years of age. Research examining the direct trajectory between maternal dietary quality and child nutritional status at the end of the 1000 HPK period has not been conducted comprehensively or across different regional contexts. From an empirical perspective, most previous studies have focused on the prevalence of stunting or children's nutritional status within the toddler age range without specifically examining the contribution of the pregnancy and breastfeeding phases to children's final nutritional status at two years of age (Ainun Nazihah, 2021; Aryati *et al.,* 2018). Meanwhile, contextual aspects such as the influence of socioeconomic factors, local dietary culture, and the quality of maternal health services have not been sufficiently integrated into a holistic analytical framework.

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This study presents a novel approach by systematically examining the relationship between maternal nutrition during the first 1,000 days of life (HPK) and the nutritional status of children at two years of age, a focus that has not been thoroughly and comprehensively studied in previous studies. Unlike previous studies that tend to isolate nutritional variables or focus solely on the postnatal period, this study aims to comprehensively identify the contribution of nutrition during pregnancy to children's nutritional status during this critical phase of growth and development. Additionally, this study considers contextual factors such as socioeconomic status and the quality of health services, which are often overlooked but have a significant impact on achieving maternal and child nutrition. The primary objective of this study is to conduct a systematic and analytical literature review, providing a scientific foundation for evidence-based maternal nutrition intervention policies and stunting prevention programs that are more targeted and aligned with current empirical evidence.

Literature Review and Hypothesis Development

Nutritional Intake for Pregnant Women

Nutritional intake during pregnancy refers to all nutrients consumed by women during pregnancy, including both macronutrients (carbohydrates, proteins, and fats) and micronutrients (vitamins and minerals), which are necessary to support optimal health for both the mother and fetal development (Mousa *et al.,* 2019). Pregnancy is one of the most critical phases in the life cycle, where energy and nutrient requirements increase dramatically as maternal and fetal tissues develop. This increased nutritional requirement must be met to prevent competition between the mother's and fetus's needs, which could potentially lead to health issues for both. Jouanne *et al.,* (2021) revealed that adequate iron intake during pregnancy is closely associated with increased birth weight and reduced risk of maternal anemia. Similar findings were reported by Lee *et al.,* (2021), who demonstrated that nutritional deficiencies during the first trimester of pregnancy can disrupt the formation of vital fetal organs and increase the risk of preterm birth and cognitive developmental disorders in infants. Tyagi, (2023) explains that adequate energy and protein intake are crucial, as deficiencies in these nutrients can hinder fetal tissue and organ growth.

In addition to the amount of intake, the quality and diversity of the types of food consumed by pregnant women are also equally important aspects. A diverse diet, which includes various food groups such as vegetables, fruits, grains, animal protein, and dairy products, shows a strong correlation with the nutritional status of infants and birth outcomes. Javadi *et al.,* (2024) emphasize that mothers who follow a highly diverse diet tend to give birth to babies with normal birth weight and a lower risk of stunting. This suggests that dietary diversity provides the spectrum of micronutrients needed for fetal growth. Focus on micronutrients such as zinc and iron is also crucial. Keats *et al.,* (2021) reported that adequate zinc intake during the first trimester of pregnancy has a significant impact on fetal growth and reduces the likelihood of low birth weight. Similar research conducted by De Benedictis *et al.,* (2023) documented high prevalence of zinc deficiency among pregnant women in Europe and its impact on fetal growth retardation. Kabahenda & Stoecker, (2024) emphasize that low micronutrient content in the daily diet of pregnant women is directly correlated with an increased risk of growth delay in the second trimester of pregnancy. This underscores the importance of monitoring dietary patterns not only in terms of quantity but also in terms of the quality of holistic nutrient intake.

To address nutritional issues in pregnant women that may affect child growth and development, various interventions have been implemented, including the provision of multivitamins and mineral

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supplements. Supplementation is a proven practical approach, particularly in the context of pregnant women with limited access to nutritious food. Keats *et al.,* (2021) demonstrated that nutritional interventions, including supplements containing iron, folate, vitamin A, and zinc, can significantly reduce the incidence of pregnancy complications, increase birth weight, and improve maternal health status. Supplementation is also important in developing countries where the prevalence of micronutrient deficiencies remains high. Jouanne *et al.,* (2021) found that regular iron intake during pregnancy was associated with increased birth weight and lower rates of maternal anemia. However, the effectiveness of interventions is not solely determined by the provision of supplements but also by factors such as maternal education levels, awareness of the importance of nutrition, and support from primary healthcare services. Nutrition intervention programs must be designed comprehensively with a multidisciplinary approach that combines education, social support, and access to healthy food. This approach will not only improve pregnancy quality but also lay a strong foundation for preventing stunting and nutritional issues in children during their early years of life.

The Concept of the First 1000 Days of Life (HPK)

The concept of the first 1,000 days of life (HPK) is a crucial period spanning from conception to the age of two, often referred to as the golden phase of human growth and development. In the context of public health and nutrition science, this period is considered a pivotal time in shaping the foundations of an individual's future health, intelligence, and productivity. Various studies indicate that during the 1000 HPK, processes such as organ growth, neural network formation, immune system development, and bone structure formation occur at an extremely rapid pace, making them highly influenced by adequate nutrient intake and overall health status, particularly in mothers and children. Panzeri *et al.,* (2024) state that micronutrient deficiencies during this period can have long-term effects, including reduced intelligence, increased susceptibility to non-communicable diseases, and metabolic disorders. Meanwhile, Zhou & Xu, (2023) note that the mother's nutritional status before and during pregnancy influences placental formation and nutrient transport to the fetus, thereby directly affecting birth weight and preterm birth rates. Therefore, ensuring adequate intake of essential nutrients such as protein, iron, folic acid, zinc, and iodine is a key focus in efforts to improve the quality of life for future generations. Aguilera Vasquez & Daher, (2019) also emphasize that the success of interventions during this period not only reduces stunting rates but also fosters healthy, intelligent, and adaptable individuals capable of navigating social and economic changes.

Not only from a biological perspective, the concept of 1000 HPK has also become a focus in global health policy interventions that prioritize pregnant women, breastfeeding mothers, and young children. This is because investments in nutrition and health during this period yield significantly higher returns compared to interventions implemented later. Vir & Suri, (2023) mention that 1000 HPK has been adopted as the primary strategy in sustainable development programs, especially in reducing the high prevalence of stunting in developing countries. In practice, the interventions carried out include nutrition counseling for pregnant women, iron and folic acid supplementation, child growth monitoring, and improving access to maternal and child health services. Frontiers in Pediatrics, (2024) states that programs integrating nutrition services, immunization, sanitation, and parenting education have been shown to improve child growth and development significantly. Additionally, a multisectoral approach demonstrates that cross-sectoral collaboration in providing nutritious food and basic health services has a direct impact on increasing birth weight and reducing the risk of stunting. In this context, Feskens

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et al. (2022) emphasize that the role of primary health workers, posyandu cadres, and primary health facilities is vital, as they are the frontline implementers of this strategy. Interventions implemented effectively during the first 1,000 days of life even contribute to the development of higher-quality human resources, both economically and socially.

Although the urgency of the 1000 HPK concept has been widely discussed in various policies and scientific publications, the biggest challenge that remains is the low level of understanding and nutritional literacy among the public, especially pregnant and breastfeeding women. Indrio et al. (2023) reported that in many areas, many mothers remain unaware of the importance of adequate nutrient intake, including iron, iodine, and animal protein, during pregnancy. This has led to a high prevalence of anemia among pregnant women, low birth weight, and chronic energy deficiency, which ultimately results in growth disorders in children. Therefore, more effective and comprehensive educational approaches are needed through local media, community-based outreach programs, and the involvement of community leaders and families in nutrition interventions. Onsomu & Ng'eno, (2025) emphasize that family-based nutrition education has proven effective in improving mothers' adherence to supplementation programs and enhancing their understanding of the importance of visiting health facilities. Additionally, a more responsive monitoring system is needed, such as the use of digital health records and nutrition status monitoring apps to detect early signs of nutritional issues in mothers and children.

Nutritional Status of Infants

Infant nutritional status is a condition that reflects the adequacy or imbalance of nutrient intake received by infants compared to their physiological needs to support growth, development, and immune function. This status can be assessed using anthropometric indicators such as weight-for-age (WFA), length-for-age (LFA), weight-for-length (WFL), and head circumference and upper arm circumference (Fitriyanto & Mahfudz, 2020). Infant nutritional status is a crucial foundation that determines the quality of a child's life in the future. According to Zhou & Xu, (2023) the early stages of life, particularly the first two years, are a critical period during which nutritional interventions must be maximized to ensure optimal development of the brain, immune system, and other organs. Inadequate nutrient intake during this period poses risks of growth disorders such as stunting, wasting, and being underweight, which will have long-term impacts on the quality of a nation's human resources. Hedderson et al. (2024) state that a child's nutritional status cannot be separated from the mother's nutritional status during pregnancy, as the fetus is entirely dependent on the mother's nutrients. Tahreem et al. (2024) also emphasize the importance of nutrients such as protein, iron, zinc, vitamin A, and essential fatty acids, which play a crucial role in forming body tissues and brain development in infants.

Feeding patterns in infants are an essential factor that significantly influences their nutritional status, particularly during the first six months of life and during the transition to complementary feeding (MP-ASI). Exclusive breastfeeding for the first six months, followed by the introduction of high-quality complementary foods, plays a crucial role in achieving optimal nutritional status. A study by Ismail *et al.,* (2022) showed that infants who received exclusive breastfeeding had a lower risk of malnutrition compared to those who were partially breastfed or not breastfed at all. Additionally, the introduction of balanced complementary foods must be timely and contain adequate amounts of protein, energy, and essential micronutrients. The World Health Organization (2023) emphasizes that the transition period

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from breastfeeding to family foods requires serious attention as it often marks a critical point in the decline of nutritional status. Maternal nutrition literacy is also a crucial aspect that should not be overlooked. Mothers with good nutrition knowledge are more likely to select, prepare, and serve foods that meet their children's nutritional needs. Tahreem *et al. (2024) demonstrate that empowering mothers through nutrition education significantly improves the quality of infant food consumption and reduces the risk of stunted growth*. Conversely, low maternal nutrition knowledge often leads to the provision of age-inappropriate or nutrient-poor foods.

Infant nutritional status is influenced not only by postnatal feeding patterns but also closely linked to the mother's nutritional status during pregnancy. The prenatal period is a critical phase because fetal growth is entirely dependent on the nutrients the mother provides during this time. Panzeri et al. (2024) emphasize that the dietary patterns of pregnant women, particularly the adequacy of protein, iron, and zinc intake, significantly influence birth weight and birth length. These two indicators are the primary determinants of a child's nutritional status in later life. Javadi *et al.,* (2024) also found that dietary diversity during pregnancy is positively correlated with children's nutritional status, particularly in preventing stunted growth. Chronic energy deficiency (CED) in pregnant women, as identified by Kabahenda & Stoecker, (2024) has been shown to reduce the placenta's ability to transfer essential nutrients to the fetus, leading to intrauterine growth restriction. The findings of Zhou & Xu, (2023) indicate that nutritional interventions initiated during pregnancy can significantly reduce national stunting rates.

Research Method

This study employs a qualitative approach, utilizing the Systematic Literature Review (SLR) method. This approach was chosen to explore in depth the relationship between maternal nutrition intake during the first 1000 days of life (HPK) and the nutritional status of infants at the age of two years. This study is exploratory and aims to formulate a broader theoretical understanding and delve deeper into existing empirical findings. A systematic literature review was conducted to identify, evaluate, and synthesize relevant studies published in reputable international journals, particularly those indexed by databases such as Elsevier, Springer, Emerald, and Wiley. The analysis focuses on articles published between 2015 until 2025 to ensure the novelty of the data and its relevance to the current context of maternal and child health.

The subjects of this study are scientific articles that explicitly discuss topics related to maternal nutrition and infant nutritional status. The inclusion criteria for this study include articles written in English or Indonesian, published in reputable scientific journals between 2015 and 2025, and focusing primarily on the relationship between maternal nutritional variables, 1000 HPK, and the nutritional status of two-year-old children. Articles that only discuss one variable without direct relevance to the other variables, as well as non-scientific publications such as opinions, editorials, or organizational reports without peer review, were excluded from this review. By establishing these criteria, it is hoped that the analyzed literature truly reflects a strong theoretical framework and empirically sound, scientifically accountable findings.

Data collection techniques in this study were conducted through systematic searches of scientific journals using keywords such as **"maternal nutrition," "pregnancy nutrition intake," "1000 days of life," "infant nutritional status,"** and **"stunting prevention".** The search was conducted through databases such as ScienceDirect (Elsevier), SpringerLink, Emerald Insight, and Wiley Online

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Library. The article selection process involved two stages: title and abstract screening, followed by full-text evaluation to ensure content relevance. The developed instrument is a literature synthesis matrix that includes study identification, objectives, methods, key variables, and key findings. This matrix facilitates the identification of patterns, similarities, and differences among studies, thereby providing a comprehensive understanding of the research topic.

The collected data were analyzed using a narrative synthesis approach, in which each finding in the selected articles was categorized based on relevant themes or variables, such as energy intake, micronutrient intake of pregnant women, the 1000 HPK period, and their impact on infant nutritional status. This analysis includes identifying the contribution of each study to strengthening existing theory, as well as comparing results across studies to identify consistency, contradictions, and research gaps. This approach also helps in developing conceptual arguments underlying the relationship between maternal nutrition and infant growth at the age of two years. The analysis results are then systematically organized into a scientific narrative discussing knowledge development, implementation challenges, and recommendations for further research.

Results and Discussion

Analysis Result

Nutritional Intake Patterns of Pregnant Women during the First 1000 Days of Life

The nutritional intake pattern of pregnant women during the first 1000 days of life (HPK) is a key determinant in determining the success of child growth and development. Pregnancy is the starting point of a series of biological processes that are greatly influenced by the adequacy of macro and micronutrients, including protein, iron, zinc, folic acid, and vitamin A. Nutritional imbalances during this phase can lead to fetal development disorders, increased risk of low birth weight, and lay the foundation for stunting (Hayana & Lasepa, 2023; De Benedictis *et al.,* 2023). Variations in dietary patterns, including meal frequency, dietary diversity, and nutrient density, have a direct impact on the nutritional needs of both the mother and the fetus. A study by Feskens *et al.,* (2022) highlights that regular consumption of nutrient-rich foods with high diversity can help ensure that energy and nutrient needs are met, supporting optimal intrauterine growth. However, in many developing countries, including Indonesia, pregnant women's dietary patterns are still influenced by economic constraints, limited nutrition education, and unhealthy eating myths and habits. This leads to chronic nutrient deficiencies, which are the root cause of child malnutrition.

Direct Relationship between Maternal Nutrition Intake and Nutritional Status of Children Aged 2 Years

The relationship between maternal nutrition during pregnancy and the nutritional status of children at two years of age represents an important pathway within the 1000 HPK framework that has not been fully explored systematically in many studies. Recent research confirms that adequate maternal nutrition during pregnancy, particularly in the second and third trimesters, has a direct contribution to birth weight, infant length, and growth indices such as weight-for-height (WHZ) and length-for-height (LNH) up to two years of age (Hedderson *et al.,* 2024; Aryati *et al.,* 2018). The biological mechanisms are related to nutrient transfer through the placenta, which supports the growth of fetal cells and tissues. If nutritional deficiencies occur during this period, it can lead to stunted growth in utero, which then continues into infancy and early childhood. A study conducted by Kabahenda and Stoecker (2024)

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revealed that mothers with low energy and protein intake during weeks 14–26 of pregnancy gave birth to children with lower birth weights and higher z-scores. Additionally, children of mothers who experienced iron-deficiency anemia during pregnancy were more likely to have higher risks of cognitive and physical developmental disorders. Understanding this direct pathway is crucial in developing integrated nutrition programs that bridge the prenatal and postnatal phases. This approach can address the knowledge gap between maternal nutrition interventions and the long-term growth outcomes of children up to two years of age.

Socioeconomic and Cultural Contributions to Maternal Nutrition Access

Socioeconomic and cultural factors significantly influence pregnant women's access to adequate and quality nutrition during pregnancy. Socioeconomic status, which encompasses family income and the mother's level of education, has been demonstrated to be strongly correlated with the ability to access nutritious food, obtain health services, and comprehend information about nutritional needs during pregnancy (Javadi *et al.,* 2024; Aguilera Vasquez & Daher, 2019). Mothers from low-income families are more likely to experience energy deficits and deficiencies in essential nutrients due to limited purchasing power and dietary diversity. Additionally, local dietary customs that impose certain food restrictions during pregnancy may further compromise maternal nutritional status, particularly in traditional communities that have not received adequate education. Research by Aryati *et al.,* (2018) indicates that household food availability and patterns of protein and zinc consumption are highly dependent on family economic conditions. In this context, nutrition education plays a crucial role in modifying consumption behavior and promoting nutritional awareness among the population. However, interventions focused solely on education are insufficient without efforts to improve food access, enhance distribution infrastructure, and strengthen social protection for vulnerable groups.

The Role of Maternal and Child Health Services in Supporting Nutritional Balance

Maternal and child health services play a crucial role in ensuring balanced nutrition during pregnancy, particularly within the first 1,000 days of life. The availability, accessibility, and quality of antenatal care (ANC) services are critical to the success of monitoring the nutritional status of pregnant women and the effectiveness of nutritional interventions provided. Programs providing iron and folic acid supplements, immunization, nutrition education, and nutritional counseling have proven effective in preventing pregnancy-related anemia and improving overall maternal nutritional status (Keats et al., 2021; Pipitcahyani *et al.,* 2024). Research by Lasmadasari *et al.,* (2023) demonstrates that nutrition education provided by health workers and nutrition cadres significantly enhances mothers' knowledge and behavior in meeting their nutritional needs during pregnancy and breastfeeding. However, there are still structural challenges in service delivery, including limited availability of health workers, a lack of ongoing training, and disparities in access in remote areas. The WHO report (2023) also notes that many developing countries lack real-time, data-driven monitoring systems for maternal and child nutrition, making it difficult to evaluate interventions effectively. In this context, community-based primary health care services are crucial for reaching vulnerable groups and ensuring the sustainability of nutrition interventions. Integrating nutrition services into the maternal and child health care system in a comprehensive manner is a strategic step in supporting the success of the 1000 HPK program and preventing chronic malnutrition, such as stunting, by the age of two.

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Disparities in the Implementation of Nutritional Interventions in the First 1000 Days of Life

Although the 1000 HPK program has become a priority on the national and global agendas for stunting prevention, significant gaps remain in the implementation of nutrition interventions at the local level. One of the main obstacles lies in the lack of coordination across sectors, particularly between health agencies, local governments, and social institutions, in distributing nutritional assistance effectively. A study by Vir & Suri, (2023) highlights the weakness in monitoring and evaluating nutrition programs as a cause of low achievement of optimal nutritional status among children under two years of age. Research by Tahreem *et al.,* (2024) indicates that maternal nutrition literacy and the knowledge of Posyandu cadres regarding appropriate interventions vary significantly, depending on the intensity of training and support from the local health system. Additionally, administrative challenges such as delays in distributing supplementary food, a lack of accurate tools for measuring nutritional status, and inadequate routine reporting hinder the sustainability of interventions. Disparities are also evident in the uneven distribution of resources between urban and rural areas, leaving marginalized communities at higher risk of not benefiting from the program. Therefore, a thorough evaluation of data-driven approaches and digital monitoring systems is needed to enhance the effectiveness of implementation. These approaches must integrate educational, technical, and social aspects to ensure that the 1000 HPK program truly reaches and improves the nutritional status of mothers and children sustainably and holistically.

Conceptual Model of Maternal and Child Nutrition Interdependence in the First 1000 Days of Life

As a synthesis of various studies, this research formulates a conceptual model that describes the relationship between maternal nutrition and the nutritional status of two-year-old children within the framework of 1000 HPK. This model encompasses the primary causal pathways linking maternal nutrient intake quality, as well as mediating factors such as infection, maternal health status, socioeconomic factors, and access to health services, ultimately influencing child nutritional status (Panzeri et al., 2024; Zhou & Xu, 2023). These pathways also incorporate the role of community-based interventions and national policies as systemic variables that can strengthen or weaken the impact of maternal nutrition on children. This model not only visualizes linear relationships but also highlights the dynamic interactions between individual and structural factors that influence children's development over time. For example, mothers with low economic status and limited access to adequate healthcare remain at high risk of malnutrition, even when food assistance programs are available. A study by Onsomu & Ng'eno, (2025) emphasizes that only through a multidimensional, health system-based approach can nutrition interventions achieve long-term impacts on children's quality of life. This conceptual model is expected to serve as a scientific and policy tool for designing integrated interventions that target key determinants of children's nutritional status during critical periods of development. It also constitutes a significant scientific contribution to research aimed at strengthening evidence-based and systemic efforts to reduce stunting prevalence.

Discussion

The research findings confirm a positive and significant association between adequate maternal nutrition during the first 1,000 days of life (HPK) and children's nutritional status at two years of age, as

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measured by anthropometric indicators, including weight-for-age (WFA), height-for-age (HFA), and weight-for-height (WFH). Pregnant women who consume high-quality protein—both from animal sources (meat, eggs, milk, and fish) and plant sources (legumes and grains)—as well as adequate iron, zinc, and folic acid through a balanced daily diet and prenatal supplements, tend to give birth to children with optimal anthropometric conditions. This nutritional pattern significantly increases fetal muscle mass and tissue, maintains blood health, and supports the development of the fetal nervous and immune systems. The effects are evident up to two years of age, with children exhibiting BB/U and TB/U measurements within the normal range according to WHO guidelines. These findings confirm that a maternal nutrition program, initiated during the first trimester and continuing through to the end of pregnancy, is crucial as a preventive strategy against malnutrition and stunting. Beyond contributing to healthy births, sustained prenatal nutrition interventions lay the foundation for stable child growth. Therefore, pregnancy-based nutrition policies must be a top priority in child health development to ensure the growth of a competitive and healthy generation.

Research findings indicate that maternal nutrition during pregnancy plays a crucial role in creating an intrauterine environment that supports optimal fetal growth. Protein provides essential amino acids as building blocks for fetal cells and tissues. At the same time, iron ensures optimal oxygen transport from the mother to the fetus via hemoglobin, while folic acid contributes to DNA synthesis and helps prevent neural tube defects. Zinc is equally important as it supports enzyme activity and immune system development. If any of these nutrients are insufficient during the first to third trimesters, intrauterine growth restriction (IUGR) occurs, resulting in low birth weight and long-term effects such as an increased risk of stunting. Additionally, adequate prenatal nutrition regulates the "metabolic programming" process, ensuring that postnatal growth pathways align with genetic potential. If prenatal nutrition is inadequate, the baby's adaptive metabolic efficiency may fail to align with postnatal environmental conditions, potentially leading to growth disorders or obesity. This study explains how maternal nutrient intake before and during pregnancy serves as the primary biological foundation for supporting infant growth up to two years of age, while emphasizing the importance of prenatal nutritional interventions as a preventive measure against future nutritional issues.

This study demonstrates that socioeconomic factors and dietary culture have a significant impact on the effectiveness of prenatal nutrition interventions. Family wealth significantly impacts pregnant women's ability to access nutrient-rich foods—such as meat, milk, fish, and fresh vegetables—which are essential for meeting daily nutritional needs. Women with higher educational backgrounds tend to have a broader knowledge of nutritional value and are better equipped to reject local information or myths that may hinder healthy eating practices. Conversely, women with low education or from low-income families are more likely to experience cultural biases during pregnancy, such as avoiding specific animal proteins. Geographical factors also play a role—rural communities often face challenges in distributing nutritious food. At the same time, urban areas tend to adopt modern lifestyles that sometimes overlook the importance of micronutrient content. These findings emphasize that prenatal nutrition intervention strategies should not only focus on medical aspects but must also incorporate contextual approaches that combine targeted nutrition education, subsidized nutritious food for low-income families, and local cultural wisdom that supports nutrient diversity. Thus, maternal nutrition programs will be more effective when integrated with adaptive and targeted social, cultural, and economic conditions.

Maternal and child health services (MCH) play a strategic role as a bridge between maternal nutrition and optimal child nutrition. Regular antenatal visits enable medical personnel to monitor the

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nutritional status and health of mothers from the first trimester to the end of pregnancy, as well as provide supplements such as iron, folic acid, and nutrition education. The provision of supplementary food distributed through health centers and Posyandu, along with the involvement of nutrition cadres and exclusive breastfeeding counselors, further supports the fulfillment of the nutritional needs of mothers and infants. Nutrition education conducted by health workers and cadres has had a tangible impact: nutritional adequacy has increased, and adherence to healthy diets during pregnancy and breastfeeding has improved significantly, resulting in optimal birth length and weight, as well as improved nutritional status of children at two years of age. However, field evaluations indicate challenges such as a shortage of competent health workers, uneven distribution of supplements, and limited use of digital nutrition information systems. Therefore, strengthening community-based services, providing ongoing training for community health workers, developing growth monitoring applications, and integrating cross-sectoral health, agriculture, and education services are crucial elements in enhancing and expanding the reach of prenatal nutrition interventions to reduce malnutrition and stunting rates.

The findings of this study reinforce the results of international and national studies on the relationship between prenatal nutrition and child growth. The studies by Hedderson *et al.,* (2024) and Aryati *et al.,* (2018) suggest that maternal nutrition during pregnancy has a direct impact on growth indicators in children aged 24 months, consistent with the results obtained in this study. However, this study expands the focus by adding socio-cultural dimensions and the strength of health services as mediating factors. This implies that maternal nutrition becomes more effective and sustainable when supported by a supportive socio-economic environment and quality public services. The study by Onsomu and Ng'eno (2025) demonstrates that maternal nutrition interventions, combined with cultural education and the distribution of locally available nutritious foods, lead to a more substantial reduction in stunting. However, this study also highlights that supplements alone are insufficient without nutritional education, food subsidies, and strengthening community capacity to utilize locally available nutritious foods. This comparison demonstrates that the success of prenatal nutrition strategies heavily depends on systemic and contextual interventions.

Conclusion

This study aims to examine the relationship between maternal nutrition intake during pregnancy in the first 1000 days of life (HPK) and the nutritional status of children at two years of age. Through a comprehensive and structured literature review, this study found that adequate intake of macronutrients and micronutrients, particularly protein, iron, zinc, and folic acid during pregnancy, plays a crucial role in determining the quality of children's growth, as reflected in indicators such as weight-for-age (WFA), height-for-age (HFA), and weight-for-height (WFH). Additionally, this study identified various factors that support children's nutritional status, including socioeconomic conditions, dietary patterns, and the effectiveness of maternal and child health services. Therefore, ensuring adequate maternal nutrition is not only a biological factor but is also influenced by intertwined social and institutional dynamics.

This study has strategic value in the development of community nutrition science and maternal and child health by providing an integrative framework between biological, social, and health service aspects. The originality of this research lies in its approach, which not only examines the relationship between maternal nutrition and child nutritional status but also links it to the socio-cultural context and

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the role of health services as an important mediator. Practically, the findings of this study can be utilized by local governments, health policymakers, and healthcare professionals to design more contextually appropriate, adaptive, and targeted nutrition intervention programs for vulnerable groups. From a managerial perspective, this study can serve as a reference for developing nutrition cadre training programs, optimizing community health posts, and establishing cross-sectoral policies between the health, education, and food security sectors.

This study has limitations in terms of the scope of empirical data used, as it is qualitative literature and has not tested quantitative relationships using primary data. In addition, the study's focus remains centered on the relationship between nutrition and child growth, without considering aspects of maternal mental health, postpartum parenting patterns, or living conditions that can also impact children's nutritional status. Therefore, future research is recommended to adopt a mixed-methods approach that combines primary data from the field with literature reviews, and further explore other variables such as social support, environmental sanitation, and exposure to educational media during pregnancy. Researchers are also encouraged to develop community-based intervention models that can be implemented in areas with diverse socioeconomic and cultural characteristics.

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