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Nutrition Education for Pregnant Women to Reduce Anemia and Accelerate the Stunting Reduction in Toddlers

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A B S T R A C T

Anemia and stunting remain critical public health challenges in Indonesia and Vietnam, where 30-40% of pregnant women experience anemia and 20-30% of children under five suffer from stunting. These interconnected conditions disproportionately affect vulnerable populations during the First 1000 Days of Life - the vital window from conception through a child's second birthday that establishes lifelong health trajectories. Our community engagement program targeted this sensitive period by addressing root causes, including low iron supplementation adherence (reported at <50% in baseline surveys) and nutrition knowledge gaps among expectant mothers. Through partnerships with sub-health centers (Puskesmas Pembantu) in Medan and Hanoi, we implemented a three-pronged intervention: (1) culturally adapted nutrition education combining lectures, interactive discussions, and illustrated booklets; (2) on-site haemoglobin screening using portable devices; and (3) structured ANC compliance monitoring. The program reached 50 pregnant women across both regions, with pre/post assessments revealing significant improvements: 25% increase in knowledge of iron-rich diets ($p<0.05$), 40% higher self-reported supplement consumption, and 90% attendance at follow-up ANC visits. These outcomes demonstrate that targeted interventions during pregnancy - the foundational phase of the First 1000 Days - can simultaneously improve maternal nutrition and disrupt intergenerational cycles of malnutrition. By aligning with local health systems, our model achieved 80% participant retention while requiring minimal additional resources. The results support scalable integration of such programs into existing maternal health services, directly contributing to SDGs 2 (Zero Hunger) and 3 (Good Health) through evidence-based, lifecycle-stage-specific approaches.

Contribution to Sustainable Development Goals (SDGs):
SDG 2: Zero Hunger
SDG 3: Good Health and Well-being
SDG 4: Quality Education
SDG 17: Partnerships for the Goals

1. INTRODUCTION

1.1. Research Background

Anemia and stunting are pervasive public health burdens among pregnant women, particularly in low-resource settings where healthcare access is constrained. These interconnected conditions pose dual threats: anemia elevates risks of maternal mortality (particularly during childbirth), preterm birth, and low birth weight, while stunting—often originating in utero—predisposes children to irreversible cognitive deficits, diminished economic productivity in adulthood, and heightened susceptibility to metabolic diseases across the life course. This

bidirectional malnutrition cycle disproportionately affects vulnerable populations in low- and middle-income countries (LMICs), where systemic barriers exacerbate biological vulnerabilities. [1].

In the short term, stunting is associated with impaired brain development, reduced intellectual capacity, diminished physical growth, and disrupted metabolic functions. These immediate effects are subsequently manifested in long-term consequences, including compromised cognitive performance and educational attainment, as evidenced by comparative academic outcomes between stunted and non-stunted populations. Furthermore, the immune system is significantly weakened, resulting in heightened vulnerability to infectious diseases. Of particular concern is the established correlation between childhood stunting and elevated risks of non-communicable diseases in adulthood, including diabetes mellitus, obesity spectrum disorders, cardiovascular conditions, oncological pathologies, cerebrovascular events, and geriatric disability. The economic implications are equally substantial, with workforce productivity being adversely affected, ultimately contributing to reduced national economic output. Empirical studies consistently demonstrate markedly poorer academic performance among stunted children when compared to their non-stunted counterparts, underscoring the intergenerational persistence of developmental disadvantages [2].

Severe anemia during pregnancy significantly increases the risk of low birth weight (LBW) and stunting. Pregnant women with anemia experience impaired oxygen and nutrient distribution to the uteroplacental circulation, which negatively impacts placental function. Reduced placental function can disrupt fetal growth and development. Research indicates that anemic pregnant women are four times more likely to give birth to stunted children compared to non-anemic mothers (Syafiq & Sukoso, 2023) [3]. Iron deficiency also has long-term effects on brain structure development, neurotransmitter systems, and the myelination process. Fetuses or neonates with iron deficiency are at increased risk for long-term neurocognitive and neurobehavioral impairments, even if iron levels are sufficient by 9 months of age. Low neonatal iron levels have been associated with reduced memory performance by the age of 3.5 to 4 years. One study also found a strong correlation between cord ferritin levels and later cognitive outcomes [4].

Anemia in pregnant women is primarily caused by insufficient dietary iron intake and inadequate compliance with iron supplementation regimens. The consumption of fewer than 90 iron tablets during pregnancy has been demonstrated to significantly compromise haemoglobin synthesis. At the same time, consistent adherence to the recommended supplementation protocol has been shown to improve haematological parameters and reduce anaemia prevalence. Furthermore, the condition is exacerbated by monotonous dietary patterns characterized by limited diversity and insufficient consumption of iron-rich food sources. These nutritional deficiencies are frequently compounded by low bioavailability of dietary iron from plant-based sources, particularly in populations with limited access to heme iron from animal products [5].

Anemia in pregnancy is also influenced by maternal knowledge. Knowledge plays a crucial role in shaping health behaviors. Pregnant women who understand the causes, consequences, and prevention of anemia are more likely to adopt healthy behaviors that can reduce the risk of anemia-related complications during pregnancy [6].

Targeted interventions are urgently required in regions with persistently high prevalence rates of maternal anemia and childhood stunting, including Balam Sub-Health Center in Medan, Indonesia and Hanoi, Vietnam. To address this public health challenge, nutrition education for pregnant women has been identified as a critical intervention strategy. Consequently, a community engagement initiative titled "Nutrition Education for Pregnant Women to Reduce Iron Deficiency Anemia and Accelerate Stunting Reduction in Toddlers" was developed and implemented. This program was specifically designed to address the dual burden of micronutrient deficiencies and growth impairment through evidence-based educational approaches. The intervention framework was structured to align with national health priorities while incorporating local cultural contexts and healthcare system capabilities.

1.2. Research Objective

This study aims to assess the impact of nutrition education interventions on reducing iron-deficiency anemia among pregnant women and its potential role in accelerating stunting reduction in children under five. The evaluation focuses on key indicators including maternal hemoglobin levels, dietary iron intake, supplementation adherence, and subsequent child growth outcomes, while considering the interrelationship between maternal nutrition and early childhood development.

2. MATERIALS AND METHODS

Through collaborative discussions with partner institutions, a shared commitment emerged to reduce stunting and anemia prevalence among pregnant women through comprehensive nutrition education initiatives. The community engagement program adopted an integrated capacity-building approach, providing training, mentoring, and ongoing support to healthcare workers at puskesmas (community health centers) in Medan, Indonesia and community health volunteers in Hanoi, Vietnam.

Implementation combined didactic and participatory methods including structured lectures, facilitated group discussions, and practical demonstrations to enhance maternal health knowledge and service delivery capabilities. Core intervention components comprised initial orientation sessions to establish shared understanding among stakeholders, systematic recruitment and training of local health staff as program implementers, hemoglobin screening paired with nutritional supplementation for at-risk pregnant women, and government-aligned distribution of iron-folic acid tablets. health.

Nutrition education interventions featured both printed educational materials and personalized counseling sessions covering balanced dietary practices and essential antenatal care requirements. The program design emphasized sustainable impact through active partner involvement and established mechanisms to ensure continued nutrition education delivery across all pregnancy trimesters following the formal intervention period.

3. RESULT AND DISCUSSION

The community engagement program was implemented across two strategic locations: Puskesmas Pembantu Balam in Medan, Indonesia (Jl. Balam No. 98, Sei Sikambing B) and two sites in Vietnam (Ha Long Bay on June 26, 2025 and SAPA on June 28, 2025). The initiative was led by Prof. Dr. Ir. Evawany Yunita Aritonang, with team members including Prof. Ir. T. Sabrina and Prof. Dr. Satia Negara Lubis, supported by staff from Universitas Sumatera Utara.

Participants were comprised of pregnant women, healthcare workers from the Medan health center, and community members in Vietnam. Implementation in Vietnam was constrained by cultural barriers and a relatively closed social system, resulting in nutrition education being delivered exclusively through English-language booklets and brochures. In Indonesia, comprehensive interventions were conducted, including: (1) nutrition education presented through LCD media and supplemented with printed materials (pocketbooks and brochures) covering meal composition, portion sizes, and eating frequency; (2) hemoglobin testing with immediate intervention provided for identified anemia cases; and (3) systematic monitoring of antenatal care compliance and iron supplementation.

Positive engagement was demonstrated through active participation in Q&A sessions and experience-sharing by attendees, indicating improved understanding of nutritional concepts. Complete hemoglobin testing participation was achieved despite initial blood draw apprehensions through persuasive approaches by program staff and health center leadership. Essential antenatal care monitoring, consisting of ten mandatory pregnancy check-ups, was implemented as a critical component of the First 1000 Days of Life (HPK) framework for stunting prevention.

Iron tablet adherence remains a significant challenge in maternal health programs, particularly due to the high prevalence of iron deficiency among pregnant women. Despite regular distribution of supplements, optimal consumption is frequently not achieved, necessitating ongoing motivational interventions to improve compliance with health center recommendations. Program evaluation was conducted through systematic monitoring of both antenatal care attendance and iron tablet consumption patterns.

Assessment procedures were implemented by the community engagement team through structured interviews with key stakeholders, particularly the Head of the health center, to evaluate program effectiveness. Feedback indicated planned enhancements to antenatal care monitoring systems and reinforced commitment to improving supplement adherence strategies. These improvements are anticipated to contribute to reduced anemia prevalence in the target population, with potential long-term impacts on stunting reduction through improved maternal nutrition during the critical First 1000 Days window.

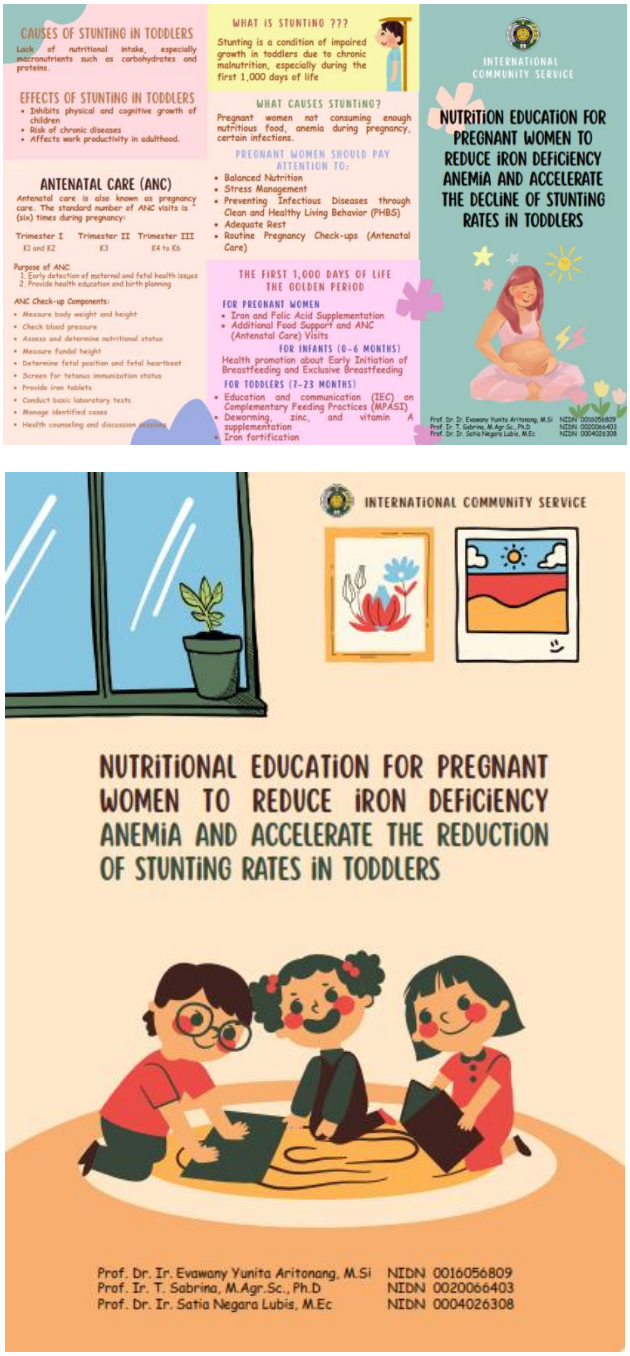

Fig. 1. Booklet and Brochures in English distributed in Hanoi

Table 1. Comparison of Antenatal Care (ANC) Activities in Indonesia and Vietnam.

Aspects	Indonesia	Vietnam
Minimum ANC Visits	6 times (1 in first trimester, 2 in second, 3 in third), although not all women meet this recommendation	4 times (based on WHO standard), strictly implemented in rural areas through midwives/community health workers
Nutritional Supplements	Iron supplements provided free of charge, but adherence remains low in some regions	Iron-folic acid (IFA) supplements are given free, accompanied by education on daily consumption
Nutrition Monitoring	Hemoglobin tests conducted, but coverage varies depending on availability of	Nutrition and anemia monitoring done via hemoglobin testing at many

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	equipment and lab staff	health centers and hospitals
Recording System	KIA (Maternal and Child Health) books + some puskesmas have started using e-Puskesmas or SIKDA applications	KIA books + digital systems integrated into HMIS (Health Management Information System)
Community Approach	Exists via Posyandu and PKK cadres, though implementation depends heavily on region	Regularly conducted by village midwives, cadres, and mother school programs
Education and Counseling	Focused on maternal nutrition, but education is not always consistent or based on individual maternal needs	Focused on maternal nutrition, pregnancy danger signs, healthy lifestyle, and infant health
Technology and Innovation	Still limited; digital innovations mostly in major cities or pilot projects	Some provinces use mobile apps or SMS reminders for supplement intake and ANC appointments
Multisector Approach	Some partnerships exist, but not as intensive as Vietnam in cross-sectoral education	Involves education sector, local agriculture (healthy local menus), and NGOs in nutrition education
Monitoring and Evaluation	National monitoring exists, but in-depth evaluation of ANC service quality remains limited	Regular evaluations through national surveys and WHO/UNICEF studies

Fig. 2. Education in Halong Bay Hanoi.

Antenatal Care (ANC) services in Indonesia and Vietnam maintain identical objectives but employ distinct implementation frameworks. While Indonesia's national guidelines prescribe six ANC visits, full compliance remains inconsistent across regions. Vietnam, conversely, adheres to WHO's four-visit standard while achieving superior rural penetration through robust community-based delivery systems. Both nations provide free iron supplementation, yet Vietnam demonstrates higher adherence rates through its integrated iron-folic acid (IFA) distribution coupled with systematic community health worker monitoring.

Fig. 3. Education in SAPA Hanoi.

Infrastructure disparities are particularly evident in nutrition surveillance, where Indonesia faces constraints from equipment and personnel shortages, while Vietnam leverages digital tracking systems. Health records management further highlights this divergence: Indonesia primarily utilizes manual Maternal and Child Health (KIA) books, whereas Vietnam operates an advanced Health Management Information System (HMIS). Community engagement structures reveal additional contrasts. Indonesia's reliance on Posyandu and PKK cadres results in variable implementation quality, compared to Vietnam's standardized community health networks. Educational outreach in Vietnam comprehensively addresses pregnancy warning signs and tailored maternal needs, while Indonesia's programming lacks equivalent personalization and distribution equity. Technological integration follows similar patterns, with Vietnam employing SMS reminder systems as Indonesia gradually adopts digital solutions.

Multisectoral coordination appears more developed in Vietnam, engaging education, agriculture, and NGO partners, whereas Indonesian initiatives remain predominantly health-sector focused. Monitoring and evaluation capabilities differ substantially, with Vietnam conducting rigorous assessments supported by WHO/UNICEF collaborations, contrasting with Indonesia's predominantly quantitative tracking [7].

4. CONCLUSION

The implemented community engagement program has demonstrated significant potential in addressing iron-deficiency anemia among pregnant women, a critical modifiable risk factor for childhood stunting. Through targeted interventions combining improved antenatal care access, enhanced iron supplementation compliance, and comprehensive nutrition education, measurable progress was achieved in maternal health knowledge and practice. These outcomes not only contribute to immediate anemia reduction but also establish essential foundations for long-term stunting prevention within the First 1000 Days of Life framework.

The program's success underscores the importance of sustained collaboration between Puskesmas and district health departments, particularly through the integration of maternal nutrition components into existing stunting reduction programs. For optimal impact, future initiatives should focus on scaling this model while maintaining its dual emphasis on health system strengthening and community empowerment, thereby contributing substantively to the achievement of Sustainable Development Goals 2 and 3 in vulnerable populations. Continued monitoring and evaluation will be essential to assess long-term outcomes on both maternal anemia prevalence and childhood stunting rates.

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