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Review Article

The Role of Specific Micronutrients in Light of Their Importance in Contributing to Preterm Low Birth Weight Infants

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Abstract: Background: This article gives a comprehensive analysis of the current situation pertaining to the most important micronutrients contained in BD. Major Micronutrient Deficiency (MND) and Their Crucial Role This article discusses preterm infants with low birth weight, sufficient supplemental feeding, and nutritional fortification in the treatment of MND. In Bangladesh, preterm birth significantly increases the risk of vitamin deficiency (MND). The significance of micronutrients and the practice of supplementing the diets of infants with low birth weight in Bangladesh with micronutrients are explored. Micronutrient insufficiency is a big concern in rural Bangladesh (MND). Since the 1980s, the micronutrient status of children and women has been examined using data from nationwide surveys and select small surveys. Recent research finds that the majority of pregnant and breastfeeding women are anemic. Numerous factors, including insufficient diet, poor hygiene, illness, and infestation, may contribute to high levels of deficiencies. In a number of areas (such as quality and compliance), progress has been achieved, but there are still significant challenges to overcome. Despite the fact that existing intervention programs have had some success in treating the severe deficiencies, micronutrient deficiencies in Bangladesh remain a substantial problem, according to the report. Result: Most newborns with LBW were stunted by 24 months. MM boosted neonatal iron and zinc, and maternal vitamin D. My study found a favorable link between maternal micronutrient level and infant status for Ferritin, Vitamin, Zinc, folate, and vitamin B-12. MM is better than IFA. My study also indicated a decrease in anemia. Conclusion: Most vitamins and minerals are inadequate in children under 24 months' supplemental meals. Inadequacy does not explain the study's high stunting rate. After controlling for other causes, low birth weight is the leading cause of infant stunting. Improving the supplement's nutritional quality is crucial for development. This may not be adequate to reduce newborn stunting. Further study should discover synergistic techniques to reduce stunting and improve maternal health.

Keywords: Micronutrients, Low-Birth Weight, Preterm, Pregnancy, Maternal, Neonatal

1. Introduction

Micronutrient insufficiency affects 2 billion persons worldwide [1]. In low- and middle-income countries, various micronutrient deficiencies commonly occur simultaneously due to inadequate diet diversity, poor bioavailability, and insufficient micronutrient content, as well as poor cleanliness and infections [2]. Vitamin A and Zn deficiencies cause one million child deaths per year, and Fe deficiency causes 115 000 maternal fatalities per year [3]. Because of the amazing flexibility of different organs and their sensitivity to nutrition and other environmental cues at this stage, fetal development and infancy offer a crucial time window for determining future health [4]. The normal growth and development of newborns depends on their dietary needs being met, but nutritional deficiencies, even those that last just a short time, may have detrimental effects on long-term health [5]. Preterm

infants (born before 37 weeks of gestation) have high nutritional requirements, both in terms of macronutrients and micronutrients, due to the low level of nutrients in the body at birth, the immaturity of the body systems, the need for rapid postnatal growth, and the occurrence of acute illnesses. It has been urged that preterm infants get adequate and appropriate nutritional assistance to prevent malnutrition and reduce postnatal growth retardation, hence minimizing the requirement for quick catch-up development, which is related with late poor metabolic consequences [6, 7].

Micronutrient deficiencies are linked to an increased risk of mortality, lower resistance to infections, and delayed or impaired physical, mental, and psychomotor development [8, 9]. This affects people's quality of life and productivity [10]. Children and women need fewer vitamin deficits. A systematic evaluation of vitamin A supplementation studies in 6-59-month-olds indicated a 24% reduction in all-cause mortality and a 28% reduction in diarrhea-related mortality [11]. Preventive Zn supplementation reduced diarrhea by 13% and pneumonia by 19% in children under 5 [12]. A recent evaluation of several micronutrient supplements during pregnancy indicated a reduction in low birth weight, small-for-gestation, and preterm births [13].

The nutrition of the mother has a crucial influence in placental-fetal growth and development. Intrauterine growth restriction (IUGR), caused by maternal malnutrition during pregnancy, is related with increased perinatal morbidity and death. These children have a greater likelihood of developing metabolic syndrome as adults [14, 15]. In experimental animal studies, maternal undernutrition at the time of conception was associated with fewer cells in the inner cell mass, which is linked to reduced birth weight and postnatal growth, altered organ/body weight ratios, and the development of chronic diseases such as type 2 diabetes (T2DM), hypertension (HTN), coronary artery disease (CAD), etc [16]. In addition, there is evidence that perturbations during crucial phases of fetal development change the form or function of certain cells, organ systems, or homoeostatic pathways. Consequently, the patients will have a higher chance of acquiring cardiovascular disease and T2DM in the future [17].

Multiple studies have revealed a correlation between maternal malnutrition during early pregnancy and the incidence of coronary artery disease in the progeny. They have shown that exposure to starvation during late pregnancy is associated with reduced glucose tolerance, while exposure during early pregnancy is associated with atherogenic lipid abnormalities and obesity [18-20].

Low birth weight (LBW) is seen as a sign of maternal malnutrition. Epidemiological studies have shown that it is associated with a wide variety of negative outcomes in later life, including shorter stature, lower cognitive performance, and increased risk factors for chronic non-communicable diseases, such as type 2 diabetes, hypertension, coronary artery disease, chronic lung disease, and chronic kidney disease [21].

Even if the global prevalence of obesity is increasing, more than 20 million newborns (15.5% of all births) are born each year at LBW (2.5 kg). LBW is a problem concentrated in developing nations, with the majority of LBW infants being born in South and Central Asia [22]. More than 20 million newborns worldwide are born with low birth weight each year [23]. Approximately 3.6 million newborns die during the first 28 days of life [24]. Two-thirds of these fatalities occur in sub-Saharan Africa and southern Asia. It is believed that more than one-third of child mortality are linked to maternal and infant malnutrition [25]. In pregnant women, deficiencies in micronutrients such as folate, iron, zinc, and vitamins A, B6, B12, C, E, and riboflavin are common and may develop simultaneously. Micronutrient deficits are caused by insufficient consumption of meat, fruits, and vegetables, as well as infections. Multiple micronutrient supplementation in pregnant women may be an effective therapy for preventing unfavorable pregnancy outcomes by enhancing maternal nutrition and immunity [26]. Iron and folic acid supplements are presently recommended by the World Health Organization (WHO) to lower the risk of iron deficiency anemia in pregnant women. Due to the fact that many developing nations already have delivery infrastructure for iron and folic acid supplements, micronutrient supplements might be delivered with little extra expense [27].

Bangladesh has drastically reduced undernutrition and is expected to meet the nutrition MDG [28]. Despite decades of efforts, micronutrient insufficiency remains a major public health problem [29]. The recently concluded National Micronutrients Status Survey 2011-2012 (NMS 2011-2012), [30] along with analysis and discussions related to the development of a strategy to address micronutrient deficiencies, presented an opportunity to examine the current micronutrient status among children and women in the country and review the successes and challenges of existing interventions. This study examines micronutrient deficiency prevention and control measures in Bangladesh.

Objective of the Study: In this research, we aimed to determine The Role of Specific Micronutrients In Light Of Their Importance in Contributing to Preterm Low Birth Weight Infants.

2. Methodology

2.1. Literature Search

This literature-based study collected all published data from high-quality human observational and experimental studies that evaluated the impact of providing Multiple Micro Nutrients (MMN) on the course of pregnancy and pregnancy outcomes. From 2001 to 2022, an electronic search of the databases Medline, Pub Med, Health Internetwork Access to Research Initiative (HINARI), and Google Scholar was done. (Mothers" OR "Pregnancy" OR mother* OR maternal OR pregnancy OR infant OR infant mortality) AND ("Micronutrients" OR "multiple micronutrient*" OR micronutrient*) AND (supplement*) were used as search terms. During the search process, a tool that extracts similar papers and reference lists from research, reviews, and editorials was used. Except for the PubMed search, the

complete version of the English-language examined articles and abstracts of the majority of the identified papers were accessible throughout the selection process.

Publications in the English language, including observational studies, quasi-randomized trials, and prospective randomized controlled trials (RCTs), assessing various micronutrient supplementation in pregnant women, were considered. There were no restrictions on gestational age at the time of enrollment and supplementation duration. In addition to the evaluation of Small for Gestational Age and neonatal mortality, we did not analyze minor adverse effects of the supplements, such as nausea and vomiting in the mothers and infants.

This analysis analyzed all nationally representative surveys since the 2001 that reported on the prevalence of at least one micronutrient deficit in children (infants, preschool-age children, school-age children and/or adolescents) and/or women (NPNL, pregnant and/or lactating women). If national statistics weren't available, small-study data were used. Analyzed are reports on existing intervention programs and national policy texts. Official research institute/organization websites were checked for national surveys and policy publications. Lead research institutes/organizations were contacted for documents not available online. National surveys that didn't report anemia and/or micronutrient insufficiency in children and/or women were excluded. Due to inadequate data on Fe, Zn, and vitamin B12 deficits, non-representative studies were included.

From the original 1100 records obtained through the database search, only 11 matched the inclusion criteria for detecting Micronutrients in Light of Their Importance in Contributing to Preterm Low Birth Weight Infants. A summary of the most important findings from the research used in this review can be found in Table 1.

2.2. Inclusion Criteria

Micronutrients in Light of Their Importance in Contributing to Preterm Low Birth Weight Infants Editorials, comments, and narrative reviews also eligible.

2.3. Exclusion Criteria

National surveys that didn't report anemia and/or micronutrient insufficiency in children and/or women were excluded.

3. Results

Table 1. *Study characteristics of included studies.*

Author (year)	Title	Study population	Result
Sohely Yasmin (2001) 31	Neonatal mortality of low-birth-weight infants in Bangladesh	776	The neonatal mortality rate (NMR) for these infants was 133 per 1000 live births (95% confidence interval: 110–159). Eighty-four per cent of neonatal deaths occurred in the first seven days; half within 48 hours. Preterm delivery was implicated in three-quarters of premature deaths, but associated with only one-third of LBW neonates.
Selina Khatun (2008) 32	Socio-economic determinants of low birth weight in Bangladesh: A multivariate approach	1467	108 were LBW and 357 were normal birth weight (NBW). LBW (N=108) babies mostly come from the mother of 30 age group [88 (81.5%)], without education [66 (66.1%)], belongs to the family of below average per capita yearly income and started their antenatal care in the last trimester
Hussain et el., (2022) 33	Newborn micronutrient status biomarkers in a cluster-randomized trial of antenatal multiple micronutrient compared with iron folic acid supplementation in rural Bangladesh	333	Providing an RDA of 15 micronutrients improved newborn status of ferritin (160 ug/L), zinc (15.2 ug/L), and vitamin D (44 ug/L). The MM intervention enhanced newborn iron and zinc status directly, and vitamin D through improved maternal status. Maternal micronutrient status was typically the major determinant of newborn status, with maternal–newborn associations of folate (26 ug/L), vitamins B-12 (163 ug/L), D (0.09 ug/L), and E (49 (ug/L)), and zinc (9.9 (ug/L) and iodine (5.1 ug/L) status.
Engle-Stone et el., (2019 34	Replacing iron-folic acid with multiple micronutrient supplements among pregnant women in Bangladesh and Burkina Faso: costs, impacts, and cost-effectiveness	100000<	MMS avert over 15,000 deaths and 30,000 cases of preterm birth annually in Bangladesh. policy change would cost-effectively save lives and reduce life-long disabilities. Improvements in program delivery and supplement adherence would be expected to improve the cost-effectiveness of replacing IFA with MMS.
Schulze et el., (2019) 35	Antenatal Multiple Micronutrient Supplementation Compared to Iron–Folic Acid Affects Micronutrient Status but Does Not Eliminate Deficiencies in a Randomized Controlled Trial Among Pregnant Women of Rural Bangladesh	1526	Rural Bangladeshi women commonly entered pregnancy deficient in micronutrients other than iron and folic acid. Supplementation with MM improved micronutrient status, although deficiencies persisted. At 32 wk gestation, vitamin B-12, A, and D and zinc status indicators were 3.7–13.7% higher, and ferritin, γ-tocopherol, and thyroglobulin indicators were 8.7–16.6% lower, for the MM group compared with the IFA group.
Ahmed et el., (2016) 36	Micronutrient deficiencies among children and women in Bangladesh: progress and challenges	90000	While the severity of various micronutrient deficiencies has declined since the 1980s, a significant proportion of preschool-age children remains with deficiencies in vitamin A (20·5%), Zn (44·5%) and vitamin D (39·6%); about one-third of these children are anaemic, and 10·7% of the children are Fe deficient. A high proportion of non-pregnant and non-lactating women is deficient in Zn (57%) and I (42%), while one-quarter of women live with anaemia and vitamin B_{12} and vitamin D (21%) deficiencies. Nearly one-half of the pregnant and lactating women are anaemic.

Author (year)	Title	Study population	Result
Adams et el.,, (2017) 37	Impact of fortified biscuits on micronutrient deficiencies among primary school children in Bangladesh	351	Daily consumption of fortified biscuits by primary school children had a significant positive impact on mean levels of iron, folic acid, vitamin B12, retinol and vitamin D controlling for sex, baseline deficiency status, CRP, and H. pylori. Levels of anemia and vitamin D deficiency were also significantly reduced.
Lindstrom et el., (2011) 38	Prevalence of anemia and micronutrient deficiencies in early pregnancy in rural Bangladesh, the MINI Mat trial	740	Anemia was present in 28% of the women, 55% were zinc deficient, 46% were vitamin B-12 deficient and 18% were folate deficient. Anemia was not associated with iron deficiency but rather with vitamin B-12 deficiency. The high prevalences of zinc and vitamin B-12 deficiencies in early pregnancy are a concern, as it could lead to adverse pregnancy outcomes and increased health risks for both mother and child.
West et el., (2014) 39	Effect of Maternal Multiple Micronutrient vs Iron–Folic Acid Supplementation on Infant Mortality and Adverse Birth Outcomes in Rural Bangladesh The JiVitA-3 Randomized Trial	44 567	At 6 months, multiple micronutrients did not significantly reduce infant mortality; there were 764 deaths (54.0 per 1000 live births) in the iron–folic acid group and 741 deaths (51.6 per 1000 live births) in the multiple micronutrient group (relative risk [RR], 0.95; 95% CI, 0.86-1.06). Multiple micronutrient supplementation resulted in a non–statistically significant reduction in stillbirths (43.1 vs 48.2 per 1000 births; RR, 0.89; 95% CI, 0.81-0.99; P =.02) and significant reductions in preterm births (18.6 vs 21.8 per 100 live births; RR, 0.85; 95% CI, 0.80-0.91; P <.001) and low birth weight (40.2 vs 45.7 per 100 live births; RR, 0.88; 95% CI, 0.85-0.91; P <.001).
Sanin et el., (2018) 40	Micronutrient adequacy is poor, but not associated with stunting between 12-24 months of age: A cohort study finding from a slum area of Bangladesh	265	The prevalence of low-birth-weight (LBW) was about 28.7% and approximately half of the children were stunted by the age of 24 months. The average micronutrient intake was considerably lower than the recommended dietary allowance and the MAR was only 0.48 at 24 months of age compared to the optimum value of 1. However, the MAR was not associated with stunting between 12–24 months of age. Rather, LBW was the significant determinant (AOR = 3.03, 95% CI: 1.69–5.44) after adjusting for other factors such as age (AOR = 2.12, 95% CI: 1.45–3.11 at 24 months and AOR = 1.97, 95% CI: 1.49–2.59 at 18 months, ref: 12 months) and sex (AOR = 1.98, 95% CI: 1.17–3.33, ref: female).
Ahmed et el., (2021) 41	Association between maternal antenatal care visits and newborn low birth weight in Bangladesh: a national representative survey	4235	The overall prevalence of LBW among newborns were found to be 19.3% (95% CI: 17.8-20.9). Among the mothers who received antenatal care services 1-3 times during pregnancy, 35% had less possibility of having LBW babies [COR = 0.65, 95% CI: 0.50-0.85].

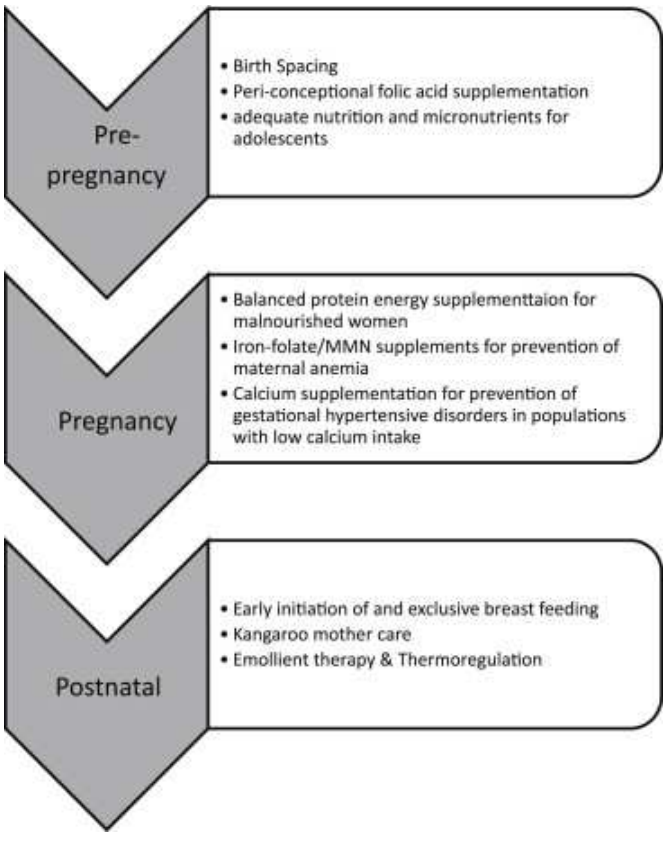

Figure 1. *Nutritional Management of the Low Birth Weight/Preterm Infant.*

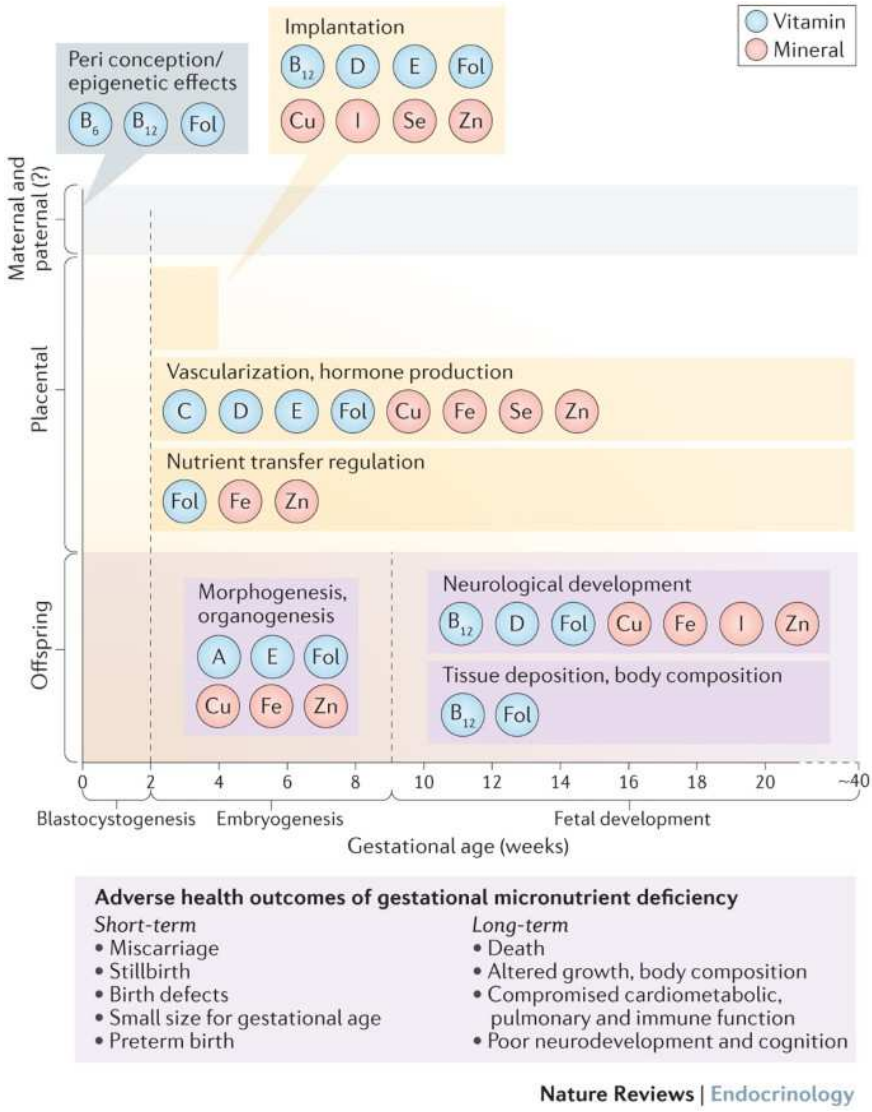

Figure 2. *Adverse Health Outcomes of Gestational Micronutrient Deficiency.*

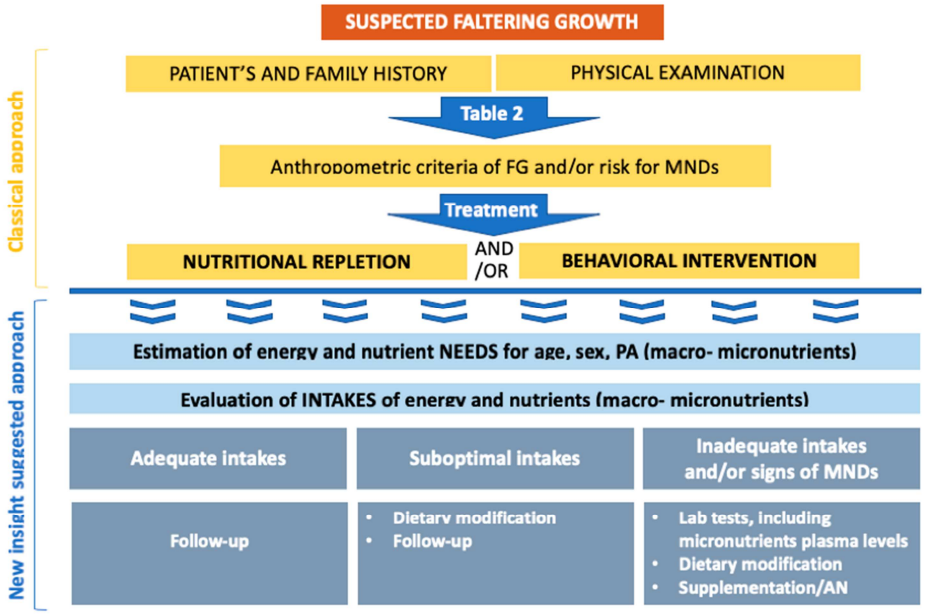

Figure 3. *Suspected Filtering Growth.*

4. Discussion

In my analysis, the prevalence of LBW was between 19-29% among newborn and most stunted their growth by the age of 24 months. Similar results are also found in Ethopia where the prevalence of LBW ranged from 6% to 29.1% [31]. In Spain, among live births to primiparous, the prevalence of LBW increased from 5.12% to 6.87% in 2008 and then stabilized at maximum values, whereas among live births to multiparous, the prevalence of LBW increased from 3.96% to a maximum of 5.20% and then decreased significantly [32]. In Canada, teenage moms exhibited a 56% rise in the prevalence of LBW (pOR 1.56, 95% confidence interval [CI] 1.24, 1.97), a 23% increase in PTB (pOR 1.23, 95% confidence interval [CI] 1.06, 1.47), and a 20% increase in stillbirth compared to adult mothers (pOR 1.20, 95% CI 1.05, 1.37) [33]. Burkina Faso, Ghana, Malawi, Senegal, and Uganda each had a prevalence of LBW of 13.4%, 10.2%, 12.1%, 15.7%, and 10 percent, respectively. In all nations except Ghana, underweight moms were more likely to give birth to LBW infants compared to normal-weight mothers. The correlation between maternal BMI and birth weight was shown to be statistically significant only in Senegal (OR=1.961 (95% CI: 1.259-3.055) [34].

MM intervention enhanced newborn iron and zinc status directly, and vitamin D through improved maternal status. Maternal micronutrient status was typically the major determinant of newborn status, with maternal–newborn associations such as Ferritin, Vitamin, Zinc, folate, vitamin B-12, has shown positive association in my analysis. MM supplementation as much more effective than IFA. My analysis also showed that there was decrease in anemia deficiency. In other study, also showed the MM intervention increased the iron and zinc status of newborns directly, and the vitamin D status of newborns through better maternal status. Typically, mother micronutrient status was the primary predictor of neonatal status, as shown by maternal–newborn relationships [35]. In 89 percent of women, FA supplementation was reported. The prevalence of both LBW and VLBW was 21% and 7%, respectively. 474 newborns (3%) died within 30 days after birth, 320 (66%) died within the first 24 hours, and 469 (99%) perished during the first week of life (early neonatal mortality). IFA supplementation during pregnancy was independently associated with a 56 percent reduction in neonatal mortality [(hazard ratio (HR): 0.44; 95 percent confidence interval (CI): 0.31, 0.61; P 0.0001] and a 26 percent reduction in VLBW (Relative risk (RR): 0.74; 95 percent confidence interval (CI): 0.60, 0.97; P = 0.007) [36]. While 100 IFA intake during pregnancy was shown to be linked with avoiding some forms of LBW and infant death in a separate research conducted in India, the wide difference in coverage of 100 IFA consumption among 640 districts is troubling [37].

Women's micronutrient intake adequacy is even lower than that of children, according to a research of Bangladeshi women. This is due to insufficient intake and restricted variety, which may be explained by their plant-based diet. Considering the poor nutrient adequacy of the supplemental food in our research, the quality of breast milk for these children may not be adequate to satisfy their nutritional needs [38].

5. Conclusion

The degree of micronutrient adequacy of supplemental foods for children under 24 months is insufficient for the majority of vitamins and minerals. However, this insufficiency does not explain the significant frequency of stunting seen in the research. After correcting for other variables, the history of low birth weight is the primary predictor of stunting in infants. Improving the nutritional value of supplemental foods is essential for optimal development. However, this may not be enough to reduce the prevalence of stunting among babies. In addition to focusing on mother's health, future research should discover other measures that might act synergistically to reduce the incidence of stunting.

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