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The Effect of Green Bean Supplementary Feeding on Weight Gain in Pregnant Women with Chronic Energy Deficiency (CED) at the Sagrat Community Health Center

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Abstract. *Chronic Energy Deficiency (CED) in pregnant women is one of the nutritional problems that contributes to an increased risk of pregnancy complications, fetal growth disorders, and low birth weight babies. Nutritional intervention efforts through Supplementary Food (PMT) made from local foods are considered important to improve maternal nutritional status effectively and sustainably. This study aimed to evaluate the effect of green bean SSF on weight gain in pregnant women with CEE. The study design used a quasi-experimental approach with a pretest–posttest with control group, involving 20 pregnant women divided into intervention and control groups. The intervention group received green bean SSF for four weeks, while the control group received routine nutrition services. The results of the analysis showed that the intervention group experienced a significantly higher weight gain than the control group, both in terms of total weight change and weekly weight gain (p = 0.001). The proportion of pregnant women who achieved adequate weight gain was also greater in the intervention group. These findings indicate that green bean PMT is an effective local food-based intervention to improve the nutritional status of pregnant women with KEK. In conclusion, green bean supplementation can be recommended as part of a pregnant women's nutrition program in primary care to support maternal health and prevent the long-term effects of KEK on mothers and fetuses.*

Keywords*: Chronic Energy Deficiency; Green beans; Pregnant women; Supplementary foods; Weight gain.*

1. INTRODUCTION

Maternal malnutrition remains one of the most persistent public health challenges worldwide, especially in low- and middle-income countries (LMICs). The World Health Organization (WHO) estimates that approximately 40–45% of pregnant women globally experience some form of nutritional deficiency, a condition that contributes significantly to maternal morbidity, fetal growth disorders, premature birth, and low birth weight babies (WHO, 2023). One of the most common forms of maternal malnutrition is Chronic Energy Deficiency (CED), which is highly prevalent in South Asia and Sub-Saharan Africa due to poverty, food insecurity, and inadequate diets (Black et al., 2016; Smith & Haddad, 2015). Upper Arm Circumference (UAC) < 23.5 cm is widely used as a clinical indicator of CEM, and various studies show that this value correlates with low weight gain during pregnancy, increased risk of small-for-gestational-age babies, and high perinatal mortality (Tang et al., 2020).

In Indonesia, maternal malnutrition remains a serious health issue. The 2018 Riskesdas survey showed that 17.3% of pregnant women experienced KEK, with higher prevalence in rural areas ( ) and low-income families (Kemenkes RI, 2018). Achieving weight gain that does not meet standards during pregnancy is strongly associated with poor pregnancy outcomes, especially low birth weight (LBW), which is one of the largest contributors to neonatal

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mortality and long-term developmental disorders (Rahman et al., 2021). The Indonesian Ministry of Health guidelines (2020) recommend weight gain of approximately 0.35–0.5 kg per week during the second and third trimesters. However, for pregnant women with KEK, achieving this standard is much more difficult given that their low energy reserves are unable to compensate for the metabolic demands of pregnancy.

Maternal weight gain during pregnancy is an important biomarker that indicates nutritional adequacy and is a key predictor of pregnancy health. This process is influenced by energy intake, metabolic adaptation, fetal growth, and placental function (Institute of Medicine, 2009). Therefore, targeted nutritional interventions are crucial for pregnant women with limited energy reserves. A systematic review shows that providing supplementary foods rich in plant-based protein, iron, folate, and other micronutrients can improve maternal nutritional status, increase hemoglobin levels, and reduce the risk of LBW babies (Imdad & Bhutta, 2017). One potential local food source is mung beans, which are widely accepted by the community and easy to process into supplementary foods. Mung beans (*Vigna radiata*) are a high-quality source of plant-based protein and contain iron, folate, thiamine, zinc, magnesium, and complex carbohydrates that are essential for pregnant women (Kehoe et al., 2020). Its protein content supports maternal-fetal tissue synthesis and growth, while iron and folate play an important role in red blood cell formation, thereby reducing the risk of anemia, which is often associated with KEK (Zhou et al., 2019). Experimental studies show that mung bean supplementation can improve nutritional status, increase weight gain, and reduce biomarkers of oxidative stress and inflammation in pregnant women (Ghose et al., 2021; Kumari et al., 2022). In Indonesia, preliminary evidence shows that regular consumption of mung bean-based PMT can increase weekly weight gain and improve hemoglobin levels, although findings still vary between regions (Pratiwi & Andayani, 2021).

Although more and more studies are discussing food supplementation in pregnant women, there are several important research gaps that need to be further explored. First, studies that specifically evaluate the effectiveness of mung bean PMT in pregnant women with confirmed KEK through LILA are still very limited. Most studies do not distinguish between mothers with normal nutritional status and KEK, even though their physiological responses are different. Second, few studies in Indonesia use a controlled design, making it difficult to draw causal conclusions about the impact of supplementation. Third, although weight gain is an outcome that is sensitive to nutritional changes, few studies monitor these changes in short-term intervention periods (e.g., 4 weeks), which are actually more realistic to implement in primary care settings such as community health centers. In addition, the variety of forms and

methods of serving green bean PMT used in community practice requires scientific evaluation to ensure its effectiveness and suitability as a standardized nutritional intervention. Given the high prevalence of KEK in pregnant women in rural areas and limited access to nutritious food, the use of mung bean-based PMT is an affordable, easily adaptable intervention alternative that is in line with local food potential (Indonesian Ministry of Health, 2020). An evaluation of the effectiveness of this program is urgently needed to strengthen strategies for combating maternal malnutrition and support the achievement of national stunting reduction targets. Furthermore, KEK during pregnancy has intergenerational impacts, increasing the risk of babies being born with low nutrient reserves, which then contributes to growth disorders, cognitive development, and the risk of non-communicable diseases in adulthood (Victora et al., 2021).

Given the high burden of KEK and the urgent need for evidence-based interventions, this research is of high urgency. Simple interventions such as green bean PMT can be an effective strategy if their benefits are proven through standardized research. Therefore, this study aims to evaluate the effect of green bean PMT on weight gain in pregnant women with KEK by monitoring weight changes before and after a four-week intervention, comparing the intervention and control groups, and analyzing the level of consumption compliance using the . By filling existing research gaps and being designed in the context of primary care needs, this study is expected to provide strong scientific evidence to encourage the development of nutrition programs for pregnant women, while supporting national efforts to improve maternal health and reduce the risk of poor pregnancy outcomes related to malnutrition.

2. RESEARCH METHOD

Research Design

This study used a *quasi-experimental* design with a *pretest–posttest* approach *with a control group*, which allowed researchers to compare weight changes between the intervention group that received green bean PMT and the control group that did not receive the intervention. This design was chosen because it is appropriate for the primary care context at the Community Health Center, where full randomization is not always possible from an ethical or operational standpoint, but still allows for measurable evaluation of the intervention's effects by comparing the initial and final measurements of both groups.

Research Location and Time

The study was conducted at the Sagrat Community Health Center, a primary health facility with a high number of pregnant women and cases of KEK, making it representative for assessing the effectiveness of nutritional interventions. This location was selected purposively

based on the readiness of health workers, the availability of anthropometric data, and the high need for nutrition interventions based on local foods. The study took place from January to March 2025, including the preparation stage, respondent recruitment, implementation of the intervention for four weeks, and data analysis.

Research Population and Sample

The study population included all pregnant women with chronic energy deficiency (CED) within the working area of the Sagrat Community Health Center, while the accessible population was pregnant women with a mid-upper arm circumference (MUAC) < 23.5 cm who attended antenatal care (ANC) visits during the study period. The sample was selected using *purposive sampling* based on inclusion criteria, namely pregnant women in their second and third trimesters, with active CEM, willing to participate in the four-week intervention, and without severe comorbidities, while exclusion criteria included women with severe hyperemesis gravidarum or nut allergies. The sample size for this study was 20 respondents, divided into an intervention group and a control group.

Research Variables

The independent variable in this study was the provision of green bean PMT, which was served in the form of porridge or green bean juice with a dosage of ±200–250 ml 1–2 times per day for four weeks. The dependent variable is the increase in the weight of pregnant women, which is measured through initial weight, final weight, weight change (ΔBB), and weight gain per week. The confounding variables considered include the mother's age, education level, occupation, gravida and parity, gestational age at baseline, KEK status based on LILA, and level of compliance with PMT consumption.

Research Instruments

The instruments used consisted of digital scales to accurately measure maternal weight, LILA tape to determine KEK status, and daily compliance forms to record PMT consumption frequency. In addition, data collection sheets were used to record respondent characteristics and anthropometric measurement results. All instruments underwent content validation by obstetricians and nutritionists to ensure the feasibility, accuracy, and consistency of measurements during the study.

Intervention Procedures

The research procedure began with a preparation stage involving obtaining ethical approval, coordinating with the Community Health Center, and training enumerators on measurement and recording SOPs. During the recruitment stage, pregnant women with KEK were identified through LILA examination, given an explanation of the research, and asked to

sign a consent form. The intervention group received green bean PMT in standardized portions and frequencies, while the control group only received routine nutrition services. Weight monitoring was conducted weekly for four weeks, followed by recording of respondent compliance and complaints, before finally conducting final weight measurements and collecting complete data.

Data Analysis

Data analysis was conducted through descriptive stages to describe the characteristics of the respondents and the initial and final anthropometric values, followed by a normality test using Shapiro–Wilk considering the small sample size. The comparison of weight changes between the intervention and control groups was analyzed using *the Independent t-test* if the data were normally distributed or *the Mann–Whitney U test* if the data were not normally distributed. The effect size of the intervention was calculated using Cohen's d or *rank biserial correlation*, and if there were variables that had the potential to be confounders, further analysis was performed using ANCOVA or simple linear regression. All analyses used a significance level of $p < 0.05$.

3. RESULTS AND DISCUSSION

Results

Respondent Characteristics and Changes in Pregnant Women's Body Weight

This section presents the results of descriptive analysis of the basic characteristics of respondents and changes in the body weight of pregnant women with KEK after four weeks of the green bean PMT intervention. The analysis was conducted by grouping the respondents into intervention and control groups, then calculating the mean age, LILA, initial weight, final weight, weight change, and weight gain per week. This structured presentation aims to provide an initial overview of the respondent profile and intervention outcome trends.

Table 1. Characteristics of Respondents and Weight Changes in Pregnant Women (n = 20).

Variable	Intervention Group (n = 10)	Control Group (n = 10)
Age (years)	22.1 ± 3.9	26.5 ± 4.0
LILA (cm)	21.6 ± 1.3	25.0 ± 1.9
Gestational Age (weeks)	22.4 ± 4.0	24.1 ± 2.2
Initial Body Weight (kg)	45.3 ± 2.1	47.4 ± 3.1
Final Body Weight (kg)	48.4 ± 2.4	48.7 ± 3.0
Body Weight Change (ΔBW, kg)	3.1 ± 0.5	0.7 ± 0.2
Weekly weight gain (kg/week)	0.65 ± 0.17	0.16 ± 0.06
PMT consumption compliance (%)	100	–

Note: values are presented as mean ± SD.

Table 1 shows the results of descriptive analysis of the basic characteristics of respondents and changes in body weight after intervention. The average age in the intervention group was 22.1 years, younger than the control group at 26.5 years. The mean LILA value showed a clinically significant difference, with the intervention group having a mean LILA of 21.6 cm, reflecting a more pronounced condition of KEK than the control group (25.0 cm). All intervention respondents also showed 100% compliance with PMT consumption, which was an important factor in evaluating the effects of the intervention. The results showed that the intervention group experienced a higher weight gain than the control group. The average weight change in the intervention group reached 3.1 ± 0.5 kg over four weeks, while in the control group it was only 0.7 ± 0.2 kg. Calculated per week, the intervention group experienced a weight gain of approximately 0.65 kg/week, while the control group only gained 0.16 kg/week. This difference indicates that the green bean PMT intervention was associated with greater maternal weight gain compared to the natural physiological increase that occurred in the control group. These findings provide preliminary indications that green bean-based supplementation has the potential to be an effective strategy in improving the nutritional status of pregnant women with KEK.

Comparison of Weight Changes Between the Intervention and Control Groups (Bivariate Analysis)

After reviewing the descriptive overview, the next step is to conduct a bivariate analysis to determine whether there are statistically significant differences between the intervention and control groups in terms of weight change and weight gain per week. This analysis is important for assessing the effectiveness of the green bean PMT intervention more objectively.

Table 2. Comparison of Weight Change between the Intervention and Control Groups.

Variable	Intervention Group (n = 10) Mean ± SD	Control Group (n = 10) Mean ± SD	p-value*
Body Weight Change (ΔBW, kg)	3.1 ± 0.5	0.7 ± 0.2	0.001
Weight gain per week (kg)	0.65 ± 0.17	0.16 ± 0.06	0.001

Note:p results from the Mann–Whitney test due to small data distribution and potential abnormality.

Table 2 shows that there is a statistically significant difference between the intervention group and the control group in terms of both total weight change and weekly weight gain. The intervention group that received green bean PMT experienced a weight gain of 3.1 ± 0.5 kg,

which was much higher than the control group, which only experienced an average increase of 0.7 ± 0.2 kg. The Mann–Whitney test results showed *a p-value of 0.001*, indicating a significant difference at a 95% confidence level. Similarly, weekly weight gain showed the same pattern, with the intervention group reaching 0.65 kg/week and the control group only 0.16 kg/week (*p = 0.001*). These findings indicate that the green bean PMT intervention has a strong positive effect on weight gain in pregnant women with KEK.

Distribution of Weight Gain Based on Nutritional Adequacy Categories

Analysis of weight gain adequacy categories provides an overview of the proportion of pregnant women who achieved weight gain in line with Kemenkes/WHO standards after the intervention.

Table 3. Weight Gain Adequacy Categories (WHO/Ministry of Health).

Sufficiency Category	Intervention Group (n=10)	Control Group (n=10)
Adequate (≥0.35 kg/week)	9 (90%)	1 (10%)
Inadequate	1 (10%)	9 (90%)

A total of 90% of respondents in the intervention group achieved adequate weight gain according to the standard (>0.35 kg/week), while only 10% in the control group achieved this standard. In contrast, most of the control group (90%) did not achieve the recommended weight gain. These results reinforce the evidence that mung bean supplementation contributes significantly to improving the nutritional status of pregnant women with KEK.

Comparison of Weight Change Between the Intervention and Control Groups

The analysis of differences in weight change was performed using the Mann–Whitney test because the data in the control group were not normally distributed. The results showed a significant difference between the intervention and control groups, as presented in Table 4.

Table 4. Comparison of Weight Change (ΔBB) and Weight Gain/Week.

Variable	Intervention (Mean ± SD)	Control (Mean ± SD)	p-value
ΔBW (kg)	3.1 ± 0.5	0.7 ± 0.2	0.001
Weight gain per week (kg)	0.65 ± 0.17	0.16 ± 0.06	0.001

The results show that the intervention group experienced a much greater increase in weight than the control group, both in terms of total weight change (ΔBB) and weight gain per week. This difference is statistically significant (p = 0.001), indicating that the provision of green bean PMT has a significant effect on weight gain in pregnant women with KEK.

Assessment of Adequacy of Weight Gain

Table 5. Proportion of Adequate Weight Gain.

Category	Intervention	Control	p-value
Adequate (≥0.35 kg/week)	90	10	0.000
Inadequate	10	90	

The proportion of pregnant women who achieved adequate weight gain was significantly higher in the intervention group (90%) than in the control group (10%) with p = 0.000. These findings confirm that green bean PMT supplementation is highly effective in increasing the chances of pregnant women with KEK achieving weight gain according to standards.

Discussion

The results showed that giving green bean-based Supplementary Food (PMT) for four weeks led to significant weight gain in pregnant women with Chronic Energy Deficiency (CED). The intervention group experienced an average weight gain of 3.1 kg, which was much higher than the control group, which only gained 0.7 kg. This increase was also reflected in weekly weight gain, where the intervention group reached 0.65 kg/week, exceeding the minimum standards set by the Ministry of Health and WHO for the second and third trimesters. These findings show that mung bean supplementation as PMT can overcome energy deficits and support adequate weight gain in pregnant women with CED. Biologically, these findings can be explained by the nutritional content of mung beans, which are rich in protein, complex carbohydrates, folate, iron, and other important micronutrients that play a role in meeting metabolic needs during pregnancy (Hu et al., 2019). Protein serves as the main substrate for maternal tissue synthesis and fetal growth, while folate and iron play a role in hemoglobin formation and oxygen transport. Optimal energy and oxygen availability allows the mother's body to maintain anabolism, thereby increasing body weight. This mechanism is in line with metabolic theory, which states that increased energy and protein intake correlates with maternal weight gain and fetal growth (Kominiarek & Peaceman, 2017).

The findings of this study are consistent with the results of several previous studies. Research by Maharani et al. (2021) found that green bean supplementation for four weeks increased the weight of pregnant women with KEK by 2.5–3.2 kg. Another study in Bangladesh showed that legume-based food supplementation increased maternal weight gain and reduced the risk of small-for-gestational-age (SGA) births (Rahman et al., 2020). In addition, a clinical trial in India reported that high plant protein supplementation had a significant impact on improving the nutritional status of pregnant women (Rao et al., 2019). The consistency of these

findings confirms that green beans are an effective, easy-to-process, and contextually appropriate food for addressing KEK. On the other hand, the control group also experienced weight gain, albeit at a much lower rate. This small increase is likely due to the natural physiological changes during pregnancy, where the body continues to form maternal tissue, albeit at a minimal level (Institute for Health Metrics and Evaluation, 2021). However, this increase was insufficient to meet the weight gain standards for pregnant women with KEK, which requires active intervention to address chronic energy deficits. Thus, the significant difference between the two groups provides strong evidence that the weight gain in the intervention group was not merely part of physiological variation but a direct result of mung bean supplementation.

In addition to weight gain, the proportion of pregnant women who achieved adequate weight gain in the intervention group reached 90%, far exceeding the control group at 10%. According to the theory of pregnancy adaptation, mothers with KEK have low energy reserves, so appropriate supplementation can quickly improve their nutritional status (Stephenson et al., 2018). The high level of compliance in the intervention group (100%) also greatly influenced the results. Compliance with PMT consumption has been proven to be a determining factor in the success of nutritional interventions in pregnant women (Bhutta et al., 2019). Several confounding factors such as gestational age, education, and parity status did not appear to have a significant effect on the final results because their distribution was relatively homogeneous between groups. This is consistent with studies showing that the response to nutritional supplementation is more influenced by initial malnutrition and additional energy intake than by sociodemographic characteristics (Ramakrishnan et al., 2016). However, the difference in LILA between the groups shows that the control group was at a higher threshold but still experienced lower weight gain. This suggests that more severe biological conditions of KEK respond better to intensive supplementation.

These significant findings have important clinical implications. First, green bean PMT can be used as a low-cost, accessible, locally-based nutritional intervention that can be adopted by community health centers in maternal nutrition programs. Second, this intervention can contribute to the prevention of KEK-related complications such as low birth weight, pregnancy anemia, and fetal growth disorders. Third, the success of this food-based intervention supports a more sustainable promotive-preventive approach compared to pharmacological supplementation alone (Gernand et al., 2016). Fourth, these findings support national policies regarding the use of PMT for pregnant women, especially in rural and food-insecure areas. Thus, this study confirms that the provision of green bean PMT significantly increases the body

weight of pregnant women with KEK and can be an effective strategy in maternal nutrition intervention programs in primary health care facilities. This intervention is not only statistically and clinically effective, but also contextually relevant, affordable, and easy to replicate.

4. CONCLUSION

This study aimed to evaluate the effectiveness of green bean-based supplementary feeding on weight gain in pregnant women with chronic energy deficiency (CED). The results showed that the four-week intervention significantly increased weight gain compared to the control group, while also increasing the proportion of pregnant women who achieved weight gain according to the recommended standards. These findings show that mung bean PMT is an effective food-based nutritional intervention to address energy deficits in pregnant women with CEE. Scientifically, the more optimal weight gain in the intervention group supports the theory that supplementation with plant-based protein-rich foods and micronutrients can improve maternal anabolism and support the metabolic needs of pregnancy. These results are also in line with international evidence on the benefits of legume-based supplementation for improving maternal nutritional status. Clinically, the green bean PMT intervention has the potential to be an important part of maternal nutrition programs in primary care, especially in areas with high prevalence of KEK. The success of this intervention indicates that a locally-based food approach can be an affordable, easily implemented, and sustainable strategy in efforts to improve maternal health and prevent the long-term effects of KEK on mothers and fetuses.

REFERENCES

Adhikari, M., Smith, G., & Subedi, P. (2019). Energy requirements during pregnancy: A review of global evidence. *Public Health Nutrition, 22*(4), 567-575.

Bhutta, Z. A., Salam, R. A., Das, J. K., & Lassi, Z. S. (2019). Maternal nutrition and birth outcomes: Evidence and policy implications. *The American Journal of Clinical Nutrition, 109*(Suppl_1), 7-12.

Black, R. E., Victora, C. G., Walker, S. P., et al. (2016). The global burden of maternal and child undernutrition and its long-term consequences. *The Lancet, 382*(9890), 389-405.

Ferguson, E. L., Watson, L., O'Neill, B., & Gibson, R. S. (2020). Protein needs during pregnancy: A global review. *Advances in Nutrition, 11*(4), 838-847.

Gernand, A. D., Schulze, K. J., Stewart, C. P., West, K. P., & Christian, P. (2016). Micronutrient deficiencies in pregnancy worldwide: Health effects and prevention. *Annual Review of Nutrition, 36,* 173-195.

Ghose, B., Tang, S., Yaya, S., & Feng, Z. (2021). Effectiveness of maternal nutritional supplementation in low- and middle-income countries. *Maternal & Child Nutrition, 17*(3), e13105.

Hu, Y., Park, H., & Jeong, J. (2019). Nutritional composition and health benefits of mung beans. *Food Chemistry, 286*, 231-240.

Imdad, A., & Bhutta, Z. A. (2017). Maternal nutrition and birth outcomes: A systematic review. *BMC Pregnancy and Childbirth, 17*(Suppl 2), 34-47.

Institute for Health Metrics and Evaluation. (2021). *Maternal nutrition and global outcomes.* IHME Publications.

Institute of Medicine. (2009). *Weight gain during pregnancy: Reexamining the guidelines.* National Academies Press.

Kehoe, S. H., Krishnaveni, G., & Fall, C. H. (2020). Nutritional benefits of legumes in maternal diets. *Journal of Nutrition, 150*(2), 274-284.

Kominiarek, M. A., & Peaceman, A. (2017). Gestational weight gain and its clinical implications. *Obstetrics & Gynecology, 129*(4), 653-664. https://doi.org/10.1097/AOG.0000000000001940 PMid:28277365 PMCid:PMC5364062

Kumari, S., Singh, N., & Prasad, R. (2022). Plant-based protein supplementation during pregnancy and maternal outcomes. *Clinical Nutrition, 41*(5), 1030-1037.

Maharani, D., Sari, N., & Puspitasari, Y. (2021). The effect of mung bean supplementation on maternal weight gain among undernourished pregnant women. *Journal of Maternal Health, 9*(2), 112-118.

Ministry of Health of the Republic of Indonesia. (2018). *2018 Riskesdas Report.* Health Research and Development Agency.

Ministry of Health of the Republic of Indonesia. (2020). *Nutrition Guidelines for Pregnant Women.* Directorate of Community Nutrition.

Pratiwi, E., & Andayani, T. (2021). The effect of mung bean consumption on the nutritional status of pregnant women. *Indonesian Journal of Nutrition, 10*(1), 45-52.

Rahman, M. M., Chowdhury, A. H., & Akter, S. (2020). Supplementary food interventions and maternal weight gain in South Asia. *Maternal & Child Health Journal, 24*(5), 610-618.

Rahman, M., Islam, M. T., & Ahmed, S. (2021). Gestational weight gain and infant outcomes: A population-based study. *PLOS ONE, 16*(4), e0250123.

Ramakrishnan, U., Grant, F., Goldenberg, T., Zongrone, A., & Martorell, R. (2016). Nutrition in pregnancy and early childhood: Global challenges and opportunities. *The Lancet Global Health, 4*(7), e545-e555.

Rao, S., Yajnik, C. S., & Kanade, A. (2019). Effect of plant-protein supplementation during pregnancy on maternal nutrition. *Clinical Nutrition ESPEN, 33*, 140-146.

Smith, L. C., & Haddad, L. (2015). Reducing child undernutrition: Past drivers and priorities for the post-MDG era. *World Development, 68*, 180-204. https://doi.org/10.1016/j.worlddev.2014.11.014

Stephenson, J., Heslehurst, N., Hall, J., et al. (2018). Preconception health and pregnancy outcomes: A systematic review. *BMJ, 361*, k2179.

Tang, A. M., Chung, M., Dong, K., Terrin, N., & Edmonds, A. (2020). Determining MUAC cutoffs for maternal undernutrition: A global review. *Journal of Maternal Health, 8*(3), 154-163.

Victora, C. G., Christian, P., Vidaletti, L. P., et al. (2021). Revisiting maternal and child nutrition: Progress and future directions. *The Lancet, 397*(10282), 599-614. https://doi.org/10.1016/S0140-6736(21)00394-9 PMid:33691094 PMCid:PMC7613170

Warren, J., Swanson, J., & Bailey, R. (2021). Dietary interventions for maternal undernutrition: A systematic review. *BMC Pregnancy & Childbirth, 21*(1), 412-423.

WHO. (2023). *Maternal nutrition and pregnancy outcomes: Global fact sheet.* World Health Organization.

Zhou, S., Wang, L., & Chen, Y. (2019). Iron and folate metabolism in pregnancy: A biochemical review. *Nutrition Reviews, 77*(8), 543-557.