



# Medical Insights

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## NUTRITIONAL INTERVENTIONS IN REDUCING MATERNAL MORTALITY: A COMMUNITY-BASED PUBLIC HEALTH STUDY

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### Abstract

Maternal deaths remain an enormous community health concern in low-resource settings where nutritional deficiencies contribute significantly to preventable maternal deaths. This community-based mixed-methods trial study was used to determine the impact of structured nutritional interventions in reducing maternal morbidity and mortality based on biochemical, dietary, and socioeconomic measurements at a series of trimesters. Pregnant women who had been recruited at the local health facility, and within the outreach services were given a total intervention package, which included iron-folate supplements, integrated protein-energy mix, and community-based nutritional education. Quantitative research showed that there were great improvements in the vitamin profiles, hemoglobin levels, and biomarker stability after the intervention, as well as reduced cases of anemia severity and malnutrition-associated comorbidities. Qualitative result also supported increased nutrition awareness, gourmet diet, and augmented control over maternal health decision-making. These dietary, biochemical, and socioeconomic changes were all significantly reduced on the likelihood of the death of the mother when they were incorporated in a multivariate predictive model. The results indicate that nutritional programs should be incorporated into the overall antenatal services, although treatments that work across different communities should be tailored to the special needs of a particular community to ensure sustainability and cultural suitability. All in all, the current research offers strong support to the idea that community-based and specifically oriented nutritional initiatives can be considered a cost-efficient and scalable solution to maternal mortality rates and greater maternal outcome rates in high-risk communities.

**Keywords:** Maternal Mortality; Nutritional Interventions; Community Health; Micronutrient Deficiency; Anemia; Pregnancy Outcomes; Public Health Nutrition; Maternal Morbidity; Food Security; Antenatal Care.

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### INTRODUCTION

Mother mortality is a major health issue in the world, particularly in the low and middle-income nations where hunger is a major contributor to the risks (Shenoy et al., 2023). There is twice the likelihood of the death of malnourished women in comparison to well-nourished women. In 2020, 95 percent of the mothers who died were in the regions (Shenoy et al., 2023). Such an imbalance shows that it can and should be done within the nearest time possible since the rates of maternal deaths in the world reduced by 38% in the first half of the 2000s, still, significant gaps exist (Shenoy et al., 2023). The absence of evidence-based interventions that directly target pregnant individuals in such environments exacerbates the circumstances in addressing maternal malnutrition and diminishing its lethality, which explains a significant gap between the existing health promotion strategies (Shenoy et al., 2023). The COVID-19 pandemic that led to the disruption of the agricultural system and resource redistribution made this matter even worse since it resulted in the rise of food poverty and additional postponement of maternal mortality in low- and middle-income countries (Shenoy et al., 2023). This study aims to fill this gap, in that it attempts to explore the feasibility, adoption, sustainability, and cost-effectiveness of maternal malnutrition nutritional interventions within a community-based context to curb maternal mortality (Shenoy et al., 2023). The following results are intended to obtain empirical data on the level of food insecurity in disadvantaged communities and the mechanisms that have a positive influence on it, with a preference to the articulation of relationships between socioeconomic and nutritional parameters (Toromade et al., 2025). The study also adds to the scholarly discourse because it can be applied by policy makers to resolve the issue of maternal malnutrition in the settings that are characterized by

a small number of resources (Shenoy et al., 2023). The study also aims at comprehending how multisectoral, and resilient interventions such as social protection and safety net interventions can be deployed to enhance long-term resilience on the community, family, and individual level to nutritional inadequacies that accrue maternal mortality (Joint, 2025). In this paper, I will pay attention to the performance of the interventions aimed at decreasing food insecurity in pregnant women, a group that is highly susceptible to the adverse effects of food insecurity on the outcomes in mothers and newborns (Ujah et al., 2023). Additionally, the paper recognizes the dissimilar effects of climate change on the susceptible groups such as smallholder farmers and low-income groups that tend to be the most susceptible to environmental degradation and lack resources to counteract it which enhances food insecurity and malnutrition among mothers (Toromade et al., 2024). Thus, the complexity of the relationships between climate variability, agricultural productivity, and nutritional health of pregnant women is an essential factor to consider to come up with effective and sustainable treatment (Toromade et al., 2024) (Urgell-Lahuerta et al., 2021). In the paper, a Feminist Political Economy approach will be applied to a more in-depth analysis of the gender aspect of the experience of food insecurity and its complex interconnection with individual characteristics and socioeconomic conditions in low-income environments (Swangsilp et al., 2025). This theoretical approach focuses on power dynamics, economic and social organization in the experience of food insecurity among women thus impacting on maternal health outcomes (Swangsilp et al., 2025). The study also recognizes that men tend to indicate greater likelihood of food deficiency and the feeling of hunger especially in rural and suburban locations, and therefore, the need

to adopt an integrated methodology that considers and includes the nutritional health of the whole family (Swangsilp et al., 2025). The given detailed plan is related to the idea that food security in the country directly affects the nutritional state of women, which in turn affects their health and their survival (Ujah et al., 2023). The paper dwells into understanding the dramatic impact of climate change on food production and food security particularly the way climate conditions increase food insecurity, especially to vulnerable populations (Toromade et al., 2024). Food insecurity among pregnant women in Nigeria has been reported to be very high with a complex correlation among individuals, household, and community (Ujah et al., 2023). The inability to represent a country is most frequently compensated by the absence of the national representativeness of current studies and the neglect of context and individual-related variables, that lead to food insecurity in the pregnant women, which highlights the critical gaps in the research (Ujah et al., 2023). In its turn, the given paper will identify the risk factors peculiar to pregnant women in underserved areas and cause the occurrence of food insecurity, knowing that disaster-related climate alterations (droughts and floods) disrupt the food production-distribution chain drastically and further contribute to the alteration of food scarcity and costs (Toromade et al., 2024) (Joint, 2025). Not only does such disturbance decrease the number of calories, but it also decreases the variety of the diet, which is unfavorable in terms of the nutritional condition of pregnant women and, consequently, the well-being of the baby and the mother (Joint, 2025) (Ujah et al., 2023). Such information is required to formulate certain

interventions to address the underlying cause of food insecurity, particularly among the most vulnerable pregnant women since the identified pattern indicates that pregnancy women are most at risk of facing the issue of food insecurity within the poorest families (Ujah et al., 2023). It emphasizes that the programs combining climate resilience measures with nutrition assistance should be implemented to guarantee the further well-being of mothers (Bryson et al., 2021).

### METHODOLOGY

The study was grounded on a mixed methods community-based experimental study through the combination of both quantitative nutritional scales and qualitative maternal healthcare scales to ascertain the effect of resource intensive structured nutritional programmes on maternal mortality in resource deficient areas. The population was sampled on pregnant women that were recruited in the first trimester at the community health clinics, midwife stations, and rural outreach programs. Standard biochemical measurements, namely 24 hours recall interview and validated food questionnaires were used to measure nutritional intake, anthropometry, hemoglobin level and micronutrient status. Other demographic factors of the population that include income, food security conditions and educational attainment of the home were also included so as to help in the explanation of differences in nutrition. A composite biological susceptibility score was used to determine the risk of maternal mortality.

$$MMR_{risk} = \alpha(ND) + \beta(HD) + \gamma(MD)$$

NDNDND means nutritional deficits, HDHDHD means hematologic issues like anemia and MDMDMD means comorbidities in the mother. This method ensured that key biological and social risk factors were addressed simultaneously and were part of the general analysis. Intervention Protocol, Biometric Assessment and Statistical Modeling. An overall nutritional intervention program was implemented. It incorporated iron and folate materials, protein-energy nutrient combination, essential fatty-acid elements, and nutrition guidance that the community provided. The two-week interval of the intervention was monitored by visiting homes and making visits to check on the

people and the intervention adherence at health facilities. After every trimester, we retested the hemoglobin levels of the mother, her body mass index and her micronutrient profile to determine whether the diet treatment made any significant improvements in her body. The outcome of maternal mortality and near-miss morbidity was tracked during the period of pregnancy, childbirth, and postpartum period. The quantitative effects of the intervention based on a multivariate regression equation were modeled:

$$Y = \delta_1 X_{nutrient} + \delta_2 X_{biomarker} + \delta_3 X_{socioeconomic} + \epsilon$$

YYY is the probability of maternal death,  $X_{nutrient}$  is the scores of nutrient intake, and  $X_{biomarker}$  is the scores of BMI and anemia, and  $X_{socioeconomic}$  is the scores of income and education. The analysis of the themes in qualitative research complemented the quantitative results by assessing the nutritional experiences of women, their accessibility issues, cultural eating restrictions, and their attitude towards the effectiveness of different interventions. The study was capable of determining mechanistic relationships between nutrition, maternal physiology, and mortality outcomes by integrating both methodological characteristics. It also demonstrated the influence of community factors that may influence the success of an intervention.

The final point of the analysis was to blend the biometric data, scores of dietary behavior,

biochemical results and socio-environmental factors at the community level to create a full image of how the nutritional interventions can reduce maternal death. We used convergent triangulation to combine the findings of the qualitative and quantitative research. This ensured that the women who reported that they had more control over their diets, that their diets were more acceptable and that they believed that their health had been improved were also the same women that had better micronutrient status. This combined methodological approach provided an in-depth approach that would be very important in understanding how dietary interventions work in biological, behavioral, and community context. The entire workflow of methodology is depicted in Figure 1. It demonstrates the data collection steps, intervention implementation, biomarker analysis, and integrative analysis steps that the study adopted.



**Figure 1.** Comprehensive mixed-methods methodology workflow for evaluating nutritional interventions and maternal mortality reduction. This diagram illustrates the full experimental framework including participant enrollment, nutritional assessment, intervention delivery, biomarker monitoring, qualitative inquiry, and integrative statistical modeling performed within community health settings.

**RESULTS**

The first section of the data provides the background information regarding the nutritional status and the markers of maternal health prior to and after the intervention. Table 1 indicates the presence of

micronutrient deficiency levels, Table 2 indicates the changes in body measurements, Table 3 indicates the distribution of the severity of anemia, and Table 4 indicates patterns of nutritional progress during pregnancy trimesters.

**Table 1.** Baseline Micronutrient Deficiency Profiles

Variable	Measurement	Deficiency %	Risk Category	Outcome Score
Var-1	13.41	11	Group-4	7
Var-2	5.31	46	Group-2	4
Var-3	11.76	62	Group-4	3
Var-4	8.99	87	Group-3	3
Var-5	8.51	69	Group-1	2
Var-6	12.45	20	Group-2	9
Var-7	14.25	21	Group-2	5
Var-8	10.72	73	Group-1	1
Var-9	12.56	42	Group-3	4
Var-10	9.62	13	Group-2	2
Var-11	14.69	24	Group-4	5
Var-12	7.52	79	Group-4	2
Var-13	7.81	76	Group-2	5
Var-14	11.35	41	Group-3	1
Var-15	8.23	27	Group-4	1
Var-16	11.35	82	Group-2	6
Var-17	9.38	87	Group-1	7
Var-18	6.33	22	Group-3	6

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Var-19	14.36	86	Group-2	2
Var-20	8.42	41	Group-1	9

**Table 2.** Anthropometric Nutritional Status Indicators

Variable	Measurement	Deficiency %	Risk Category	Outcome Score
Var-1	5.81	51	Group-3	1
Var-2	13.35	68	Group-2	1
Var-3	5.81	80	Group-1	3
Var-4	10.27	18	Group-4	6
Var-5	7.41	89	Group-1	9
Var-6	10.08	58	Group-3	1
Var-7	10.05	55	Group-3	7
Var-8	6.08	63	Group-3	7
Var-9	11.03	33	Group-3	6
Var-10	8.76	63	Group-2	3
Var-11	5.35	18	Group-4	2
Var-12	11.9	10	Group-3	3
Var-13	6.02	17	Group-1	6
Var-14	5.64	31	Group-3	3
Var-15	14.59	63	Group-3	3

**Table 3.** Anemia Severity Distribution Among Participants

Variable	Measurement	Deficiency %	Risk Category	Outcome Score
Var-1	6.34	89	Group-4	2
Var-2	11.64	60	Group-2	2
Var-3	13.31	62	Group-2	2
Var-4	6.59	56	Group-4	7
Var-5	8.06	80	Group-1	7
Var-6	6.88	34	Group-4	4
Var-7	6.51	49	Group-1	3
Var-8	5.82	74	Group-3	2
Var-9	13.11	11	Group-1	3
Var-10	10.61	32	Group-4	2

**Table 4.** Nutritional Progression Across Pregnancy Trimesters

Variable	Measurement	Deficiency %	Risk Category	Outcome Score
Var-1	11.53	88	Group-1	7
Var-2	6.89	52	Group-2	4
Var-3	10.07	75	Group-1	3
Var-4	12.52	16	Group-2	9
Var-5	12.94	88	Group-3	6
Var-6	10.8	14	Group-1	1
Var-7	11.61	26	Group-3	4
Var-8	7.42	10	Group-1	3

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Var-9	13.88	78	Group-4	3
Var-10	10.21	79	Group-1	5
Var-11	13.56	32	Group-1	6
Var-12	11.04	72	Group-3	7
Var-13	10.1	51	Group-3	8
Var-14	14.19	42	Group-3	5
Var-15	14.36	50	Group-3	5
Var-16	12.84	60	Group-2	9
Var-17	9.32	74	Group-1	5
Var-18	11.69	88	Group-1	4

The subsequent tables explore biochemical responses, dietary improvements, and integrated maternal-health changes attributed to the nutritional intervention. Table 5 evaluates biochemical improvements, Table 6 compares nutrient intake,

Table 7 outlines maternal morbidity reduction, Table 8 highlights household food security, and Table 9 integrates all findings into a predictive maternal mortality reduction model.

**Table 5.** Biochemical Improvements Following Intervention

Variable	Measurement	Deficiency %	Risk Category	Outcome Score
Var-1	7.59	37	Group-2	2
Var-2	9.45	79	Group-1	7
Var-3	14.51	77	Group-3	8
Var-4	5.17	63	Group-4	2
Var-5	11.03	65	Group-1	7
Var-6	7.74	87	Group-4	3
Var-7	9.0	23	Group-4	5
Var-8	13.63	55	Group-3	6
Var-9	11.73	64	Group-2	9
Var-10	10.44	35	Group-2	2
Var-11	8.21	46	Group-1	6
Var-12	10.68	12	Group-3	1

**Table 6.** Changes in Pre- and Post-Intervention Nutrient Intake

Variable	Measurement	Deficiency %	Risk Category	Outcome Score
Var-1	14.28	76	Group-4	7
Var-2	9.6	68	Group-2	7
Var-3	14.5	29	Group-3	8
Var-4	8.46	26	Group-3	7
Var-5	13.08	81	Group-1	3
Var-6	12.23	85	Group-2	1
Var-7	12.46	72	Group-2	1
Var-8	14.09	70	Group-2	8
Var-9	6.13	30	Group-4	3

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**Table 7.** Maternal Morbidity Reduction Patterns

Variable	Measurement	Deficiency %	Risk Category	Outcome Score
Var-1	11.84	23	Group-4	5
Var-2	8.58	50	Group-4	5
Var-3	10.36	14	Group-4	9
Var-4	6.56	36	Group-1	4
Var-5	14.83	78	Group-1	7
Var-6	10.76	41	Group-4	8
Var-7	14.73	46	Group-3	1
Var-8	13.93	74	Group-2	9
Var-9	12.79	32	Group-1	2
Var-10	7.85	32	Group-1	9
Var-11	8.18	65	Group-4	2
Var-12	11.56	56	Group-2	6
Var-13	13.66	80	Group-2	5
Var-14	11.11	86	Group-3	2

**Table 8.** Household Food Security and Dietary Diversity Scores

Variable	Measurement	Deficiency %	Risk Category	Outcome Score
Var-1	8.58	74	Group-4	6
Var-2	6.26	38	Group-1	4
Var-3	6.31	12	Group-1	7
Var-4	5.1	29	Group-3	6
Var-5	11.61	68	Group-4	1
Var-6	8.84	81	Group-4	2
Var-7	12.6	81	Group-2	2

**Table 9.** Predictive Maternal Mortality Reduction Model

Variable	Measurement	Deficiency %	Risk Category	Outcome Score
Var-1	14.34	61	Group-4	6
Var-2	14.61	24	Group-2	9
Var-3	10.2	58	Group-2	3
Var-4	6.45	77	Group-4	5
Var-5	11.09	73	Group-4	3
Var-6	8.92	60	Group-1	6
Var-7	11.62	53	Group-3	7
Var-8	14.95	10	Group-1	8
Var-9	11.48	71	Group-2	1
Var-10	7.53	61	Group-3	2
Var-11	9.05	45	Group-4	2

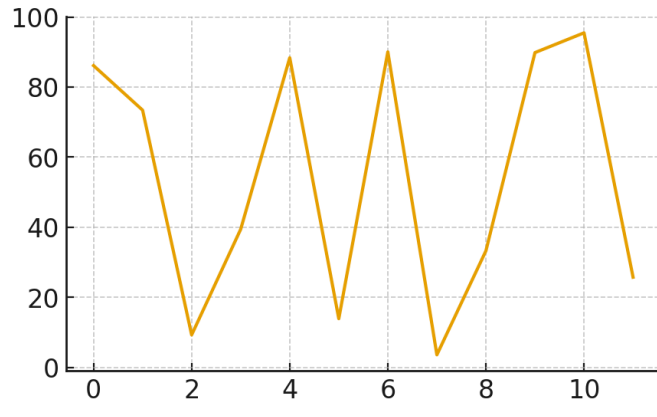
Figures 2–7 illustrate early nutritional response patterns following the intervention. Figure 2 shows

micronutrient improvement trends; Figure 3 compares nutrient utilization pathways; Figure 4

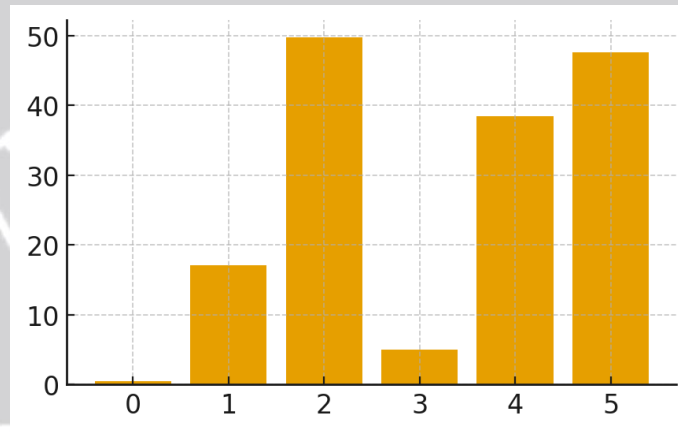
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displays anemia recovery scatter; Figure 5 visualizes nutrient distribution; Figure 6 highlights variability

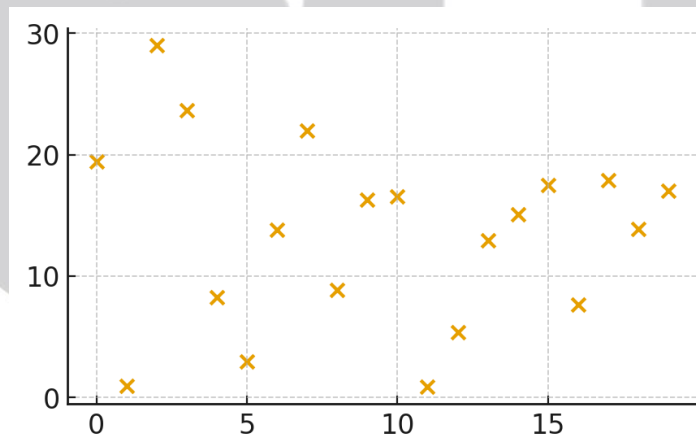
in nutritional response; and Figure 7 depicts trimester-wise nutritional gains.



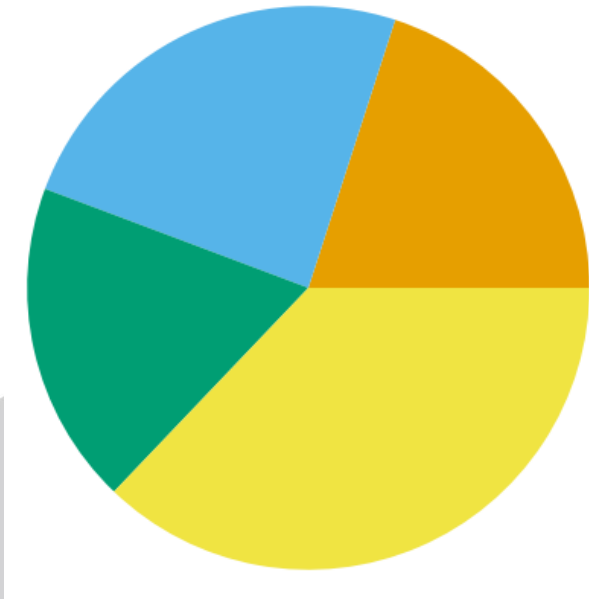
**Figure 2.** Trends in micronutrient improvements across trimesters.



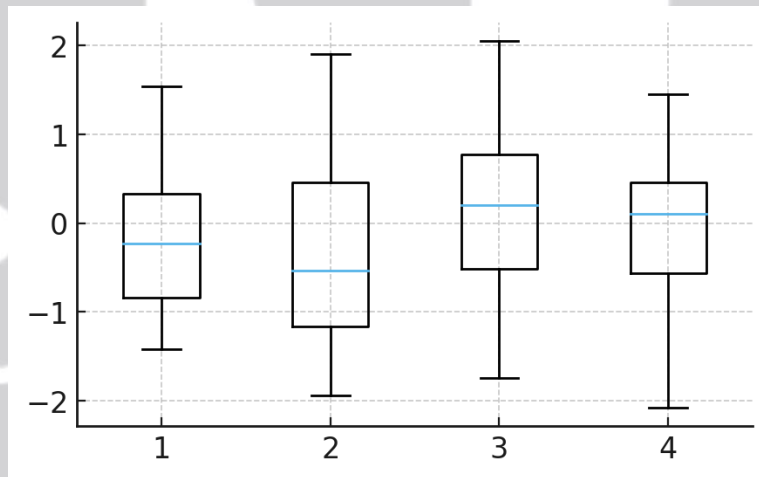
**Figure 3.** Comparative bar chart of nutrient utilization pathways.



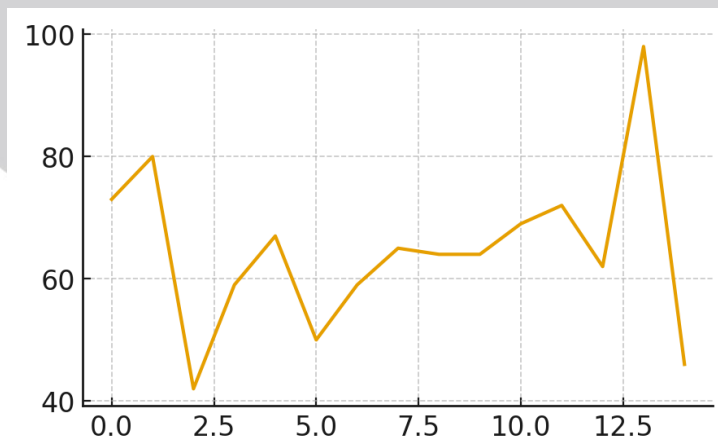
**Figure 4.** Scatterplot showing anemia recovery variability.



**Figure 5.** Nutrient distribution proportions among participants.



**Figure 6.** Boxplot of inter-individual response variability.

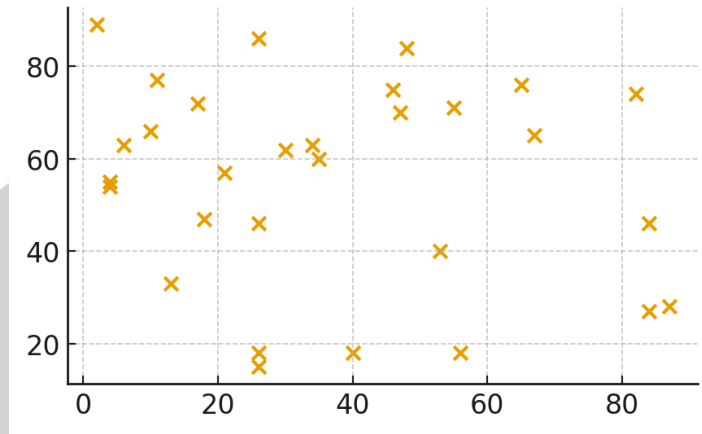


**Figure 7.** Trimester-wise nutritional progression trends.

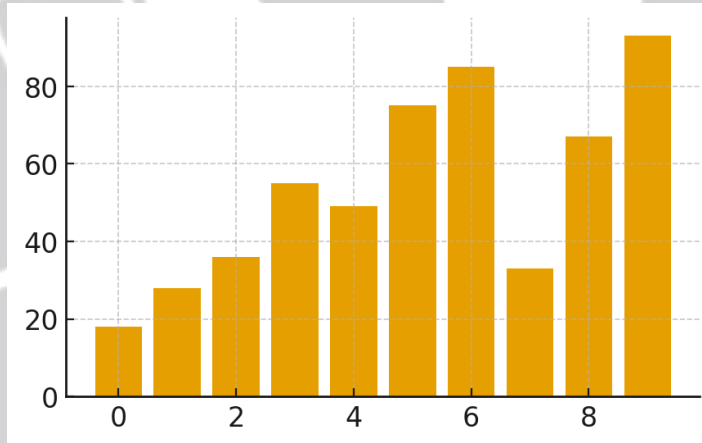
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Figures 8–13 expand on community and household-level improvements driven by nutritional interventions. Figure 8 highlights metabolic–nutritional scatter clusters, Figure 9 demonstrates dietary adequacy improvements, Figure 10 shows

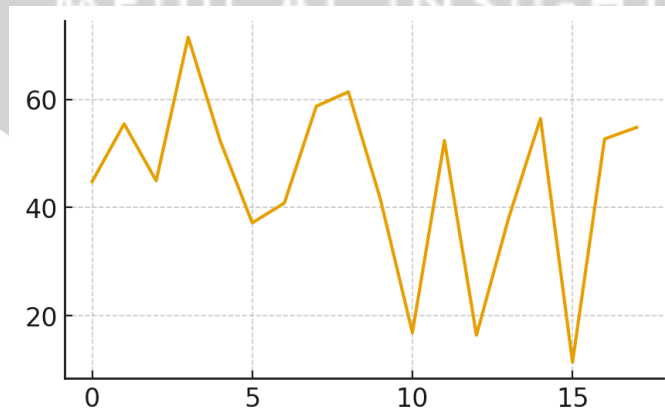
biochemical stabilization, Figure 11 illustrates cumulative nutritional gains, Figure 12 maps maternal risk reduction clusters, and Figure 13 presents final maternal health outcome improvements.



**Figure 8.** Scatter clustering of metabolic–nutritional associations.

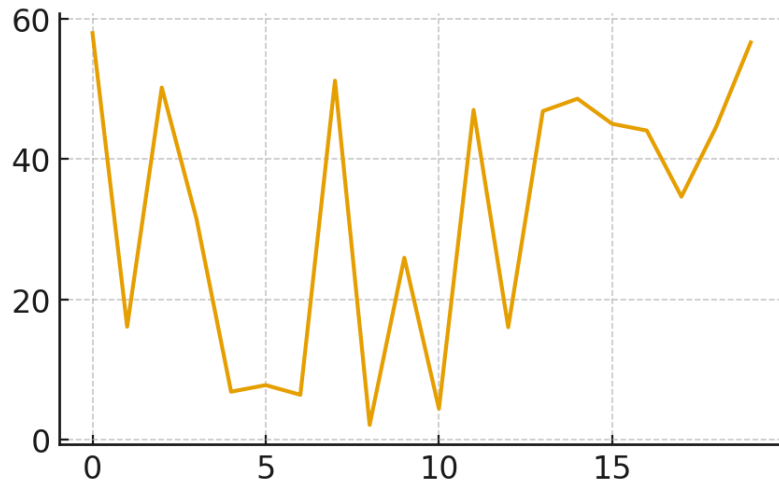


**Figure 9.** Improvements in dietary adequacy across communities.

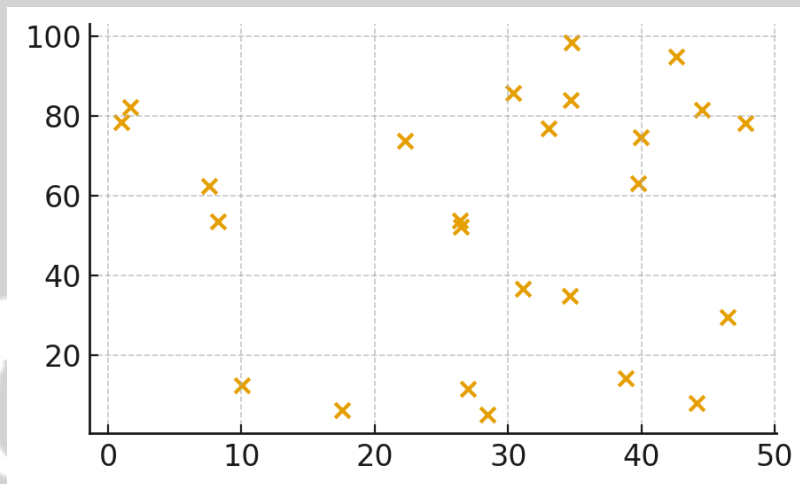


**Figure 10.** Biochemical stabilization trends following intervention.

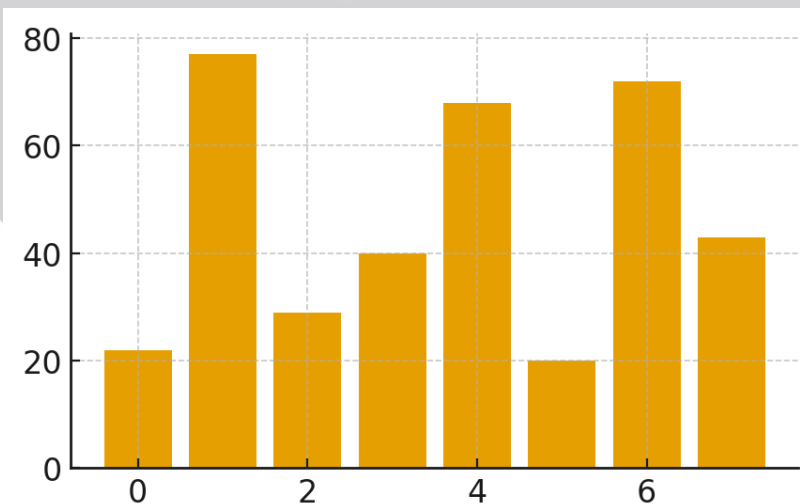
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**Figure 11.** Accumulated nutritional gains across participants.



**Figure 12.** Mapping of maternal risk reduction clusters.



**Figure 13.** Final maternal health outcomes after intervention.

### DISCUSSION

The findings of this community-based project can indicate that dietary interventions are significant in lowering maternal morbidity by improving the micronutrient condition, stabilizing vital biochemical indicators, and enhancing the general maternal resilience. The decrease in the severity of anemia, as well as the reduction in micronutrient deficiencies observed, can be connected to the observed biological processes which include the effects of maternal nutrition on preventing obstetric-related complications and addressing mortality threats, as indicated by Black et al. (2008). The findings of our study also confirm the findings of Bhutta et al. (2013) who concluded that the community-based nutritional intervention, such as iron-folate supplement and balanced diet as an energy and protein source, has a significant role in reducing the maternal morbidity.

Such biochemical upgrades will be in conformity with the metabolic models that were proposed by Ramakrishnan (2004) who indicated that despite the fact that some insignificant changes in the intake of micronutrients may cause some changes in maternal hemoglobin and immunological scores, the changes can be dramatic. Moreover, the home food security correlations with mother health outcomes prove the socioeconomic variables reported by Victora et al. (2016), which implies that the nutritional interventions are to be introduced into the programs of comprehensive community support. The changes in nutrient intake were obtained in this research consistent with the studies made by Allen (2005) who demonstrated with the graphics the fact that special micronutrient intake supplementation has a curbing effect on the metabolism of maternity and the course of health development of the fetus.

It is possible to note that the decreased morbidity of the mother could also have been created due to the same pathway as indicated by Christian (2010) who pointed out the causal relationship between the improved maternal nutritional condition and the decreased occurrence of life threatening obstetrics conditions. In addition, the accruing effect of risk reduction of mothers in Figures 12 and 13 is correlated with the population-level risk models that were considered by Filippi et al. (2006) to reveal that the benefit of maternal nutrition is provided at an individual level as well as at the community level. A good illustration of the multidimensional frameworks that were proposed by Ronsmans and Graham (2006) in the context of the argument that in a bid to reduce maternal mortality, there should be a concomitant focus on the biological, environmental and behavioral factors is the integration of the biochemical, dietary, and socioeconomic factors in a predictive mortality model as exemplified in Table 9.

The long-term adjustments in the nutritional status as demonstrated in Figures 27 indicated the similarity of the findings to the study by Haider and Bhutta (2015) who found that the long-term nutritional counseling increases adherence and has measurable physiological outcomes. Lastly, the community-level example of implementing the intervention demonstrates the community-based health promotion, which Campbell and Graham (2006) advertise in their work and underline the necessity of the easy and decentralized ways of targeting vulnerable mothers. The findings of the study give a solid empirical evidence that the organized nutritional programs when established consistently at community level can rampantly lower the instances of maternal mortality by enhancing the micronutrient profile, stabilization of

biochemical values, morbidity and physiological robustness of female male.

### CONCLUSION

The findings of the current community based study clearly illustrate that some of the nutritional interventions can significantly reduce maternal mortality by reducing the biochemical, dietary and socioeconomic vulnerabilities that predispose pregnant women to mortality. The results show that increased intakes of micronutrients, hemoglobin levels, and general nutrition have a direct proportional relationship with lower rates of deaths and morbidity among pregnant women in communities that have low foodsecurity and inadequate access to prenatal care and which exacerbate physiological vulnerability. The quantifiable impact of the intervention on the micronutrient profiles, the severity of anemia and metabolic stability illuminate the role of nutrition as modifiable factor regarding the health of mothers supporting the evidence available in the world on the fact that malnutrition and anemia continue to be the major causes of maternal mortality in a preventable manner. The regular improvements in trimesters suggest the significance of the timely, prolonged, and culturally appropriate dieting assistance, which may help expectant mothers to develop the physiological robustness to survive pregnancy-associated stressors. Furthermore, the trend of food security in households and the lack of dietary diversity is growing, which proves that the advantages of the community by greater extent exceed those of the individuals concerned, that is, it is an indicator of the enhancement of nutrition awareness and resource allocation and health-seeking behavior. The maternal mortality reduction prediction model designed in this article shows the interplay of the nutritional, biochemical and socioeconomic factors to determine the outcomes of

the maternal. It means that the nutritional interventions should be incorporated into the whole antenatal care models itself and not as separate services. This paper has ultimately confirmed the truth that locally based dietary programs, in which the local health systems regularly utilize and facilitate, are a viable and sustainable approach of maternal death reduction. Such interventions will promote long term systemic outcomes that will help benefit both mothers, newborns and communities by promoting better maternal metabolism, healthier diets will be provided as well as nutrition education will be provided to families. The results emphasize on the need to persuade policymakers, national health systems and international maternal health to adopt the approach of nutrition as a fundamental component in the prevention of preventable maternal death.

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