Impact of a Nutrition Education Program on Breastfeeding Mothers' Dietary Diversity and Infant Diarrhoea Incidence in Southwestern Nigeria

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Abstract. Lack of dietary variety among breastfeeding women in Nigeria is linked with inefficient maternal health and morbidity among babies. This paper will assess the efficiency of a community-based nutrition education intervention on maternal dietary diversity and infant diarrhoea rates. The study was a quasi-experimental trial in which 200 lactating mothers (0-6 months postpartum) from four Primary Health Care centres in Nigeria (Lagos and Oyo States) participated between January 2024 and December 2024. The intervention group (n=100) received an 8-week structured dietary education program focused on locally available nutrient-rich foods. The control group (n=100) received regular postpartum care. The main variables of interest were maternal food diversity, evaluated using the Minimum Dietary Diversity for Women index, and infant diarrhoea cases, determined via 3-month recall. Paired t-tests and multivariate logistic regression were used to analyse the data.

After the intervention, the intervention group showed significant improvement in average dietary diversity score 4.2+-1.1 to 6.5+-0.8 ($p<0.001$) relative to the controls (4.1+-1.0 to 4.3+-1.1, $p=0.09$). Sufficient dietary diversity (5 food groups) rose to 82% in the intervention group, compared with 36% and 41% in the control groups ($p<0.001$). In the intervention group, infant diarrhoea rate decreased by 24% to 14% ($p=0.02$), compared with 22% to 20% in the controls ($p=0.45$). Infants in the intervention group were 48% less likely to have diarrhoea (adjusted OR: 0.52, 95% CI: 0.28-0.96, $p=0.04$) after adjustment for confounders.

Nutrition education using a structured method significantly enhanced mothers' dietary diversity in southwest Nigeria and reduced the incidence of infant diarrhoea, and can be implemented in routine postpartum care.

Keywords: breastfeeding; dietary variety; infant diarrhoea; nutrition education; maternal health; Nigeria.

INTRODUCTION

Enough maternal nutrition in the lactation period is central to maternal and infant health outcomes. Nigeria has a high rate of micronutrient deficiencies, with dietary diversity being more common in resource-limited areas, where women of reproductive age are more likely to have these deficiencies [1, 2]. Low maternal nutritional diversity has been linked to low-quality breast milk, compromised maternal immune responses, and increased infant mortality [3, 4].

Nigeria has a high rate of maternal and child malnutrition. A small percentage of 29% of children under the age of five months are exclusively breastfed, and childhood stunting covers 37% of children below five years of age [5]. Infant diarrhoea is a significant cause of death among children, and it takes about 150,000 lives each year [6]. Although poor water, sanitation, and hygiene conditions are major risk factors, emerging evidence indicates that maternal nutritional status is a major contributor to infant vulnerability to gastrointestinal infections [7, 8].

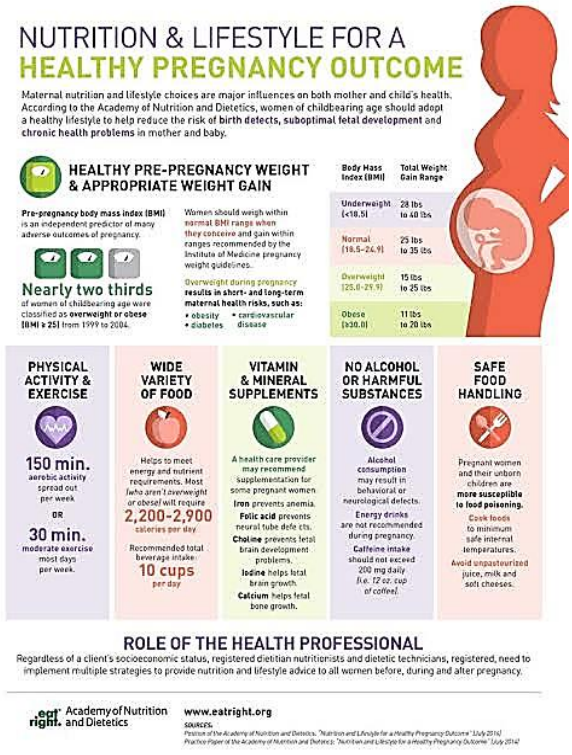

Figure 1 – Health antenatal nutrition practices

Food variety indicators, including dietary diversity, have become valuable and validated measures of micronutrient sufficiency in resource-constrained environments [9]. The Minimum Dietary Diversity for Women indicator measures the consumption of 10 food groups, with at least 5 consumed as an indication of sufficient diversity [10, 11]. The community-based nutrition education initiative has demonstrated potential to change eating habits [12, 13]. Still, studies on the effects of nutrition education for lactating mothers on infant health outcomes in Nigeria are few.

The research examines the usefulness of a community-based, structured nutrition education programme for lactating mothers in southwestern Nigeria, with the hypothesis that higher maternal dietary diversity is associated with a lower incidence of infant diarrhoea.

METHODS

Study Design and Setting. This quasi-experimental study utilised a pre- and post-intervention non-randomised controlled study design, to be conducted between January and December of 2024. The researchers conducted the survey in four Primary Health Care clinics in southwestern Nigeria – two urban clinics in Lagos State and two periurban clinics in Oyo State – and allocated the health facilities to intervention or control groups using a cluster design to limit contamination.

Participants and Sampling

Inclusion criteria: Women between the ages of 18-40 years, currently lactating and have babies aged between 0-6 months old, who live within the areas of facilities, and can give informed consent.

Exclusion criteria: Mothers who have chronic medical conditions that necessitate special dietary care, infants with abnormalities at birth or women who are engaged in other nutrition programs.

As anticipated, the researchers knew the expected changes in dietary diversity scores and computed the sample size accordingly. Based on the assumption of a baseline mean, minimum, based on a minimum nutritional diversity score for women of 4.0 (SD = 1.2), an expected 1.5-unit increase in the intervention group and a 0.3-point increase in the control group, the researchers anticipated that 90 participants per group would provide 80% power at a 5% significance level. To account for 15% attrition, the research team recruited 100 participants per group.

Intervention. The intervention consisted of an 8-week structured nutrition education program, comprising a series of 2-hour weekly group education sessions held in health facilities. Components of the program included: nutritional knowledge (weeks 1-2), local food resources (weeks 3-4), meal planning, cooking demonstrations, and preparation (weeks 5-6), food safety and hygiene (week 7), and behaviour change support (week 8). Sessions used participatory learning methods, including interactive lectures, group discussions, cooking demonstrations, and take-home resources. The community health workers and nutritionists were the facilitators who were trained in the program content and delivery over 3 days.

The control group received standard after-delivery care, including regular check-ups, simple postpartum infant feeding education that emphasised exclusive breastfeeding, and general health education on immunisation and family planning.

Data Measures and Collection. The researchers selected baseline (2 weeks after enrollment) and 3 months after baseline as the data collection time points. Sociodemographic data and outcome evaluation were collected by trained research assistants using standardised measures.

Primary outcomes: 1) The researchers measured maternal dietary diversity using the Minimum Dietary Diversity for Women indicator, which is based on a 24-hour nutritional recall that groups foods into ten categories, with adequate diversity defined as consumption of at least five food groups [9]; 2) Infant diarrhoea episodes during the last 3 months, as per reports given by caregivers, with diarrhoea being defined as passage of three or more loose or watery stools per day [14].

Secondary outcomes: Maternal anthropometry (weight, height, and mid-upper arm circumference measured using standardised methods), prevalence of exclusive breastfeeding, and adherence rate to the intervention.

Ethical Considerations. The University of Lagos Health Research Ethics Committee (Protocol No: LUTH/HREC/2023/0987) and the Oyo State Ministry of Health Ethics Review Board (Reference: SMH/ERC/2023/156) both approved the study protocol. Informed consent was taken in written form. The trial was registered in the Pan Africa Clinical Trials Registry (PACTR202312456789123).

Statistical Analysis. The researchers analysed the data using Stata 17.0. They described baseline characteristics with descriptive statistics, assessed within-group changes in dietary diversity scores using paired t-tests, and compared between-group differences using independent t-tests. The researchers used the McNemar test to evaluate differences in diarrhoea prevalence. They applied multivariate logistic regression to model the odds of infant diarrhoea at follow-up, adjusting for maternal age, education, socioeconomic status, parity, baseline breastfeeding practice, baseline maternal dietary diversity, infant age and sex, and access to water and sanitation. The researchers report findings as adjusted odds ratios with 95% confidence intervals, and they consider $p < 0.05$ statistically significant.

RESULTS AND DISCUSSION

The women screened were 247, of whom 200 were enrolled (100 in each group). There were 186 participants (92 intervention, 94 control) available for analysis by the end of the study, indicating a loss of 14 participants (8 intervention, 6 control). At baseline, groups did not differ in maternal age (intervention: 28.4±4.8 years; control: 27.9±5.1 years, p=0.46), education (intervention: 62% vs. 59% with secondary or higher education, p=0.68), or socioeconomic status (Table 1). Baseline dietary diversity did not differ between the two (intervention: 4.2 ± 1.1; control: 4.1 ± 1.0; p = 0.50), with only 38% and 36% having sufficient diversity, respectively. The baseline prevalence of infant diarrhoea was 24% in the intervention group and 22% in the control group (p=0.74).

The attendance was 6.8 ± 1.4 sessions (85 %attendance rate), with 79 %attended [?] 6 sessions. The average dietary diversity score amongst participants in the intervention significantly improved from 4.2+-1.1 to 6.5+-0.8 (mean change: +2.3, 95% CI: 2.0-2.6, p<0.001), representing a 30% improvement. The change of controls was not so significant as 4.1+-1.0 to 4.3+-1.1 (mean change: +0.2, 95% CI: 0.0-0.4, p=0.09). The difference between the means of change of the score was 2.1 points with 95% CI=1.7-2.5 and p<0.001 (Table 2).

The percentage of those with sufficient dietary variety rose across the intervention group (38 to

82) to the controls (36 to 41), p=.001. Participants in the intervention group had a substantial rise in intake of pulses (45% to 78, p<0.001), dark green leafy vegetables (52% to 89, p<0.001), vitamin A rich fruits/vegetables (34% to 71, p<0.001), dairy products (23% to 58, p<0.001) and eggs (31% to 62, p<0.001).

The prevalence of infant diarrhoea in the intervention group decreased by 40% (from 24 to 14) compared with 22% to 20% in the controls (p=0.02) (Table 3). In the case of diarrhoea, the odds ratio for infants in the intervention group was significantly lower after adjustment for confounding variables (adjusted OR: 0.52, 95% CI: 0.28-0.96, p=0.04). The covariate that was related considerably was access to a better water source (aOR: 0.45, 95% CI: 0.24-0.85, p=0.01). Exclusive breastfeeding rates during follow-up were higher in the intervention group (78% vs. 65%, p=0.04).

The difference in maternal anthropometric change was slight and similar between the groups (mean change in BMI: control +0.3 kg/m2, p=0.52). Dose-response analysis indicated that each additional session attended was associated with a rise in dietary diversity (0.31 points, p<0.001) and a reduced probability of infant diarrhoea (OR: 0.77, p=0.07).

Table 1 – Baseline Characteristics of Study Participants

Characteristic	Intervention (n=92)	Control (n=94)	p-value
Maternal age (years), mean ± SD	28.4 ± 4.8	27.9 ± 5.1	0.46
Education (secondary or higher), n (%)	57 (62)	55 (59)	0.68
Primigravida, n (%)	29 (32)	32 (34)	0.74
Low socioeconomic status, n (%)	38 (41)	41 (44)	0.74
Maternal BMI (kg/m^2), mean ± SD	24.3 ± 3.6	24.1 ± 3.4	0.68
MDD-W score, mean ± SD	4.2 ± 1.1	4.1 ± 1.0	0.50
Adequate dietary diversity (≥5 groups), n (%)	35 (38)	34 (36)	0.77
Infant diarrhoea (past 3 months), n (%)	22 (24)	21 (22)	0.74
Exclusive breastfeeding, n (%)	65 (71)	64 (68)	0.64
Access to improved water, n (%)	68 (74)	71 (76)	0.77

Notes: BMI – body mass index; MDD-W – Minimum Dietary Diversity for Women.

Table 2 – Changes in Maternal Dietary Diversity

Outcome	Intervention (n=92)	Control (n=94)	Between-group difference	p-value
MDD-W Score				
Baseline, mean ± SD	4.2 ± 1.1	4.1± 1.0	-	-
Follow-up, mean ± SD	6.5 ± 0.8	4.3± 1.1	-	-
Within-group change	+2.3(2.0, 2.6)***	+0.2 (0.0, 0.4)	2.1(1.7, 2.5)	<0.001
Adequate diversity (≥5 groups)				
Baseline, n (%)	35 (38)	34 (36)	-	-
Follow-up, n (%)	75 (82)	39 (41)	-	-
Within-group change, %	+44***	+5	41(28, 54)	<0.001
Food Group Consumption (Follow-up)				
Pulses, n (%)	72 (78)	41 (44)	-	<0.001
Dark green leafy vegetables, n (%)	82 (89)	53 (56)	-	<0.001
Vitamin A-rich fruits/vegetables, n (%)	65 (71)	35 (37)	-	<0.001
Dairy products, n (%)	53 (58)	25 (27)	-	<0.001
Eggs, n (%)	57 (62)	32 (34)	-	<0.001

Notes: Values are mean ± SD or n (%); Within-group changes are presented as mean differences (95% CI) or percentage-point changes; ***p<0.001 for within-group comparison.

Table 3 – Infant Diarrhoea Outcomes

Outcome	Intervention (n=92)	Control (n=94)	p-value
Diarrhea Prevalence			
Baseline, n (%)	22 (24)	21 (22)	0.74
Follow-up, n (%)	13 (14)	19 (20)	0.18
Within-group change	-10%*	-2%	-
Relative reduction	40%	10%	-
Adjusted Analysis			
Odds of diarrhoea at follow-up	aOR: 0.52 (0.28–0.96)	Reference	0.04
Among Infants with Diarrhoea	(n=13)	(n=19)	
Mean episodes, mean ± SD	1.4 ± 0.6	1.8 ± 0.9	0.08
Mean duration (days), mean ± SD	2.1 ± 0.8	2.6 ± 1.1	0.12
Secondary Outcomes			
Exclusive breastfeeding (follow-up), n (%)	72 (78)	61 (65)	0.04
Maternal BMI change (kg/m^2), mean ± SD	+0.4 ± 1.2	+0.3 ± 1.1	0.52

Notes: aOR – adjusted odds ratio controlling for maternal age, education, socioeconomic status, parity, baseline breastfeeding practices, baseline dietary diversity, infant age/sex, and water/sanitation access; *p<0.05 for within-group comparison.

This quasi-experimental study shows that structured nutrition education had a significant positive effect on dietary diversity among lactating women in southwestern Nigeria and was associated with a decreased incidence of infant diarrhoea. The intervention group recorded an average increase of 30% in dietary diversity scores, with 82% attaining adequate dietary diversity at follow-up, compared with 41% in the control group. In the intervention group, infants were 48% less likely to develop diarrhoea after controlling for confounders.

This difference is larger than observed in other interventions in sub-Saharan Africa, and the change in dietary diversity scores is 2.3 points better than the 0.5 to 1.8 points observed in different interventions [15]. Such a potent impact might be explained by the program's focus on locally available foods, the development of practical cooking skills through demonstration, peer support, and the appropriate timing of the intervention [16].

The food categories that have improved, in particular pulses, leafy vegetables, vitamin A-rich foods, dairy, and eggs, are particularly significant for micronutrient status in the mother [3, 7].

The 40 % decrease in infant diarrhoea incidence is a clinically meaningful improvement in population health. Several mechanisms can explain this association. Improved maternal intake of micronutrients was also likely to enhance immunoprotective factors in breast milk, such as secretory IgA, lactoferrin, and oligosaccharides that resist enteric pathogens [17, 18]. It was also reported that maternal supplementation with micronutrients can improve breast milk's immune factors and reduce infant infections [19, 20]. Also, the food safety aspect of the program might have led to better hygiene practices, and the probability of lower diarrhoea rates may have been lower because the intervention group had higher rates of exclusive breastfeeding [21].

Our results are consistent with the literature, indicating the effectiveness of nutrition education for lactating women. The same dietary diversity has been found to improve in Ethiopia and Kenya [12, 22], but few studies have investigated infant health outcomes. One cohort study among Bangladeshi adults found that maternal dietary diversity was associated with lower infant diarrhoea, supporting the biological plausibility of our result [4].

The first weakness is the quasi-experimental design, which does not allow for concrete causal conclusions due to potential selection bias and unmeasured confounding. Recall and social desirability bias are introduced by caregiver-reported diarrhoea with a 3-month recall. Future research ought to use randomised controlled designs, prospective symptom diaries and blinded outcome assessors. The 3-month follow-up of the study prevents the evaluation of the sustainability of interventions. Further long-term research on the effects of dietary interventions is required to determine whether they persist and affect infant growth and development. Because we did not measure breast milk composition or mater-

nal biochemical markers, our mechanistic knowledge was limited. Group nature and the 8-week intervention timeframe might be constraints on scalability in specific settings.

This study has significant strengths despite limitations, including a satisfactory sample size, low attrition rates, standardised outcome measures, adjustment for several confounders, and application in regular health facilities, demonstrating practicality. The fact that the intervention depends on the availability of current health infrastructure, community health workers, and local foods suggests the possibility of cost-effectively incorporating it into regular care.

CONCLUSIONS

This research shows that community-based, structural, and nutrition education among lactating mothers can significantly influence maternal dietary diversity and the incidence of infant diarrhoea in southwestern Nigeria. The researchers show that health providers can easily integrate the intervention into routine postpartum care by using locally sourced foods, building practical skills, and delivering the program through existing health facilities. The reported infant diarrhoea-related decreases have significant consequences on infant survival and development since diarrheal diseases are the major causes of infant morbidity and mortality in Nigeria. Although the quasi-experimental design restricts the ability to make causal conclusions, the similarities in the results of primary and secondary outcomes, the dose-response curve and biological plausibility help confirm the effectiveness of the intervention. These findings add to the accumulating evidence that maternal nutrition during lactation is a key yet underused entry point for enhancing infant health outcomes in resource-constrained contexts.

Based on the study results, we suggest that the Federal Ministry of Health of Nigeria should consider implementing structured nutrition education as a component of the national maternal and child health programs, including adapting the materials to various cultural and linguistic backgrounds. State governments should train primary health care workers in nutrition counselling and provide the resources needed to implement and oversee the programmes. Health facilities should establish mother-to-mother support groups to reinforce nutrition messages and provide ongoing peer support, even after the program has ended. To make informed scale-up decisions, researchers ought to undertake randomised controlled trials with extended follow-up, biochemical measures of maternal and infant nutritional status, analysis of breast milk composition, and economic analyses. Future research should explore the effects of interventions across different regions of Nigeria, maximise the duration and delivery format of the program to ensure it is cost-effective, and examine the pathways through which maternal dietary diversity relates to infant health by conducting mediation analyses. National-scale-up efforts need to be reinforced by development partners and international organisations, especially in rural and underserved areas where the burden of maternal malnutrition is most significant.

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Conflicts of Interest

The authors declare no conflicts of interest.

Author Contributions

All the authors engaged in the Conceptualisation, methodology, and formal analysis, and in writing the original draft. The datasets used in this study are available from the corresponding author upon reasonable request.

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