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Research Article

A grandmother-inclusive approach to maternal nutrition is associated with improved maternal diet, health-seeking practices, and birthweights in rural Sierra Leone

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Highlights/Key Messages
- Maternal nutrition education focused on mothers may miss grandmother influencers
- A grandmother-inclusive approach is linked to improved maternal nutrition practices
- Engaging grandmothers strengthened support for maternal nutrition practices
- Improved maternal practices were associated with higher infant birthweights
- Family-centered strategies may offer scalable, culturally grounded nutrition gains

Background
In many communities across the Global South, senior women are key advisors on nutrition and health to younger women. Yet most maternal nutrition and health education continues to focus on the mother–child dyad with limited results. Formative research in rural Sierra Leone identified grandmothers as influential advisors on maternal diet and health practices. Based on these findings, World Vision and partners piloted the grandmother-inclusive approach (GMIA) to improve maternal diets, health-seeking practices, and birth outcomes.

Objective
This pilot study compared a family systems approach focused on grandmothers as change agents with the traditional mother-focused education approach to improve maternal nutrition and health practices.

Methods
Using a quasi-experimental design, we compared maternal dietary practices, health-seeking behaviors, and birth outcomes in GMIA intervention communities with other communities receiving standard nutrition and health education in rural Sierra Leone. This paper reports findings from the quantitative endline survey of 375 households with pregnant women and children under two years in intervention and comparison communities. Differences in maternal dietary practices, health-seeking behaviors, and birthweights were assessed using multiple regression analysis, adjusting for sociodemographic characteristics.

Results
In adjusted models, women in intervention communities had greater odds of achieving minimum dietary diversity (adjusted odds ratio [AOR] 13.5; 95% CI: 4.9–37.3), consuming more frequent meals (mean difference=0.5; 95% CI: 0.2, 0.9) and reporting four or more antenatal care visits (AOR 9.1; 95% CI: 1.8–45.2) than women in comparison communities. Women in intervention communities also reported higher adherence to daily iron–folic acid supplementation (AOR 6.4; 95% CI: 2.3–17.3). Mean birthweights were higher in intervention communities, with an adjusted difference of 0.22 kg (95% CI: 0.07–0.36).

Conclusion
Findings from this pilot study suggest that a grandmother-inclusive approach may improve maternal nutrition and health practices and increase birthweights in rural Sierra Leone.

Keywords: maternal nutrition, diet diversity, birthweights, grandmothers, Grandmother-inclusive approach, nutrition education

Introduction

Inadequate intake of energy, protein, and micronutrients during pregnancy contributes to numerous adverse maternal and neonatal health outcomes, including anemia, hemorrhage, eclampsia, intrauterine growth restriction, and congenital anomalies. Maternal malnutrition remains highly prevalent in low- and middle-income countries (LMICs) and continues to contribute substantially to preventable maternal and child morbidity and mortality (Dassie et al., 2026; Victora et al., 2021; Wu et al., 2012). Inadequate dietary diversity—commonly used as an indicator of nutrient adequacy and overall diet quality—has also been associated with increased risks of maternal anemia, low birthweight, and, in some cases, preterm birth (Quansah & Boateng, 2020; Rammohan et al., 2019; Tareke et al., 2024; Zerfu et al., 2016). Beyond these immediate health risks, poor maternal nutrition during pregnancy has long-term intergenerational consequences, contributing to higher child morbidity and mortality, impaired growth, and reduced human capital development. Despite the high prevalence of maternal nutritional deficiencies in LMICs, relatively few interventions have demonstrated measurable improvements in maternal nutrition and health outcomes, particularly counseling-based interventions implemented without food or nutrient supplementation (Dewidar et al., 2023; Shenoy et al., 2023). Achieving global nutrition targets—including a 50% reduction in maternal anemia and a 40% reduction in child stunting by 2030—will require greater prioritization and investment in strategies that address maternal malnutrition (Arndt et al., 2024; Mason et al., 2014; Victora et al., 2021).

Effective strategies to improve maternal nutrition before and during pregnancy are well established, yet their impact remains limited largely due to low coverage, weak implementation fidelity, and insufficient investment in scaling interventions (Bhutta et al., 2013; Ramakrishnan et al., 2012; Shrimpton, 2012; Victora et al., 2012). For example, IFA supplementation is known to reduce maternal anemia and iron deficiency (Peña-Rosas et al., 2015), but adherence and coverage remain suboptimal in many LMICs.

In Sierra Leone, nationally representative surveys provide limited information on maternal dietary practices, making it difficult to monitor trends in maternal nutrition. Birthweight and perceived size at birth are therefore commonly used as proxy indicators. Data from the Sierra Leone Demographic and Health Surveys (SLDHS) suggest that improvements in these indicators have been modest. Among infants with recorded birthweights, 11% in 2008, 7% in 2013, and 5% in 2019 weighed less than 2.5 kg. However, birthweight data were available for fewer than half of births (33% in 2008 and 48% in 2013) during the period of the research, increasing to 65% in 2019, but are unlikely to be representative of all births (i.e., more reported in urban areas and among those of higher wealth). Women's perceptions of infant size at birth (provided by all women surveyed) may therefore provide a more complete indicator. In 2008, 13% of women perceived their infants to be smaller than average and 7% as very small at birth; similar proportions were reported in 2013 (12% and 7%, respectively) (Statistics Sierra Leone & ICF Macro, 2009; Statistics Sierra Leone & ICF International, 2014), with a decrease in 2019 to 8% and 5%, respectively (Statistics Sierra Leone & ICF, 2020). These patterns suggest limited progress in improving maternal nutrition and pregnancy outcomes at the time of the research.

Nutrition education and counseling during pregnancy—traditionally directed at mothers—are widely used to promote recommended practices such as increased consumption of micronutrient-rich foods, daily iron and folic acid (IFA) supplementation, reduced workloads, and increased rest. These interventions are typically delivered through health worker counseling, community health education sessions, and mother-to-mother support groups. However, systematic reviews report limited and inconsistent impacts. One review found modest reductions in maternal anemia and improvements in birthweight, particularly when counseling was combined with nutritional supplements (Girard & Olude, 2012), while another reported improvements in energy and protein intake but no effect on anemia (Dewidar et al., 2023). Both reviews highlighted uncertainty about effectiveness due to the low quality of available evidence. These limited impacts may reflect program designs that insufficiently account for the social and cultural contexts in which maternal behaviors occur. Few interventions incorporate formative research on household decision-making, draw explicitly on behavior change theory, or design activities tailored to adult learning. In many communities across the Global South, maternal health and nutrition practices are shaped not only by mothers themselves but also by influential family members. Senior women—commonly referred to as grandmothers—often play central roles in advising, supervising, and supporting younger women during pregnancy and early childcare. These experienced women may include mothers-in-law and other biological grandmothers, aunts, traditional birth attendants, female religious elders, and traditional healers (Aubel, 2024; Aubel et al., 2021). Their influence on maternal and child health and nutrition (MCHN) norms and practices has been documented across Africa, Asia, and South America (Alam et al., 2020; Concha & Jovchelovitch, 2021; Karmacharya et al., 2017; MacDonald et al., 2020; Pike et al., 2021; Schneiders et al., 2021; Suri et al., 2025; Thuita et al., 2021; Usman et al., 2021). Ecological and family systems perspectives emphasize that maternal behaviors are embedded within broader household and community structures, suggesting the need to move beyond a narrow focus on the mother–child dyad toward family-centered and community-centered approaches (Aboud & Singla, 2012; Aubel et al., 2021; Chung et al., 2020; Concha & Jovchelovitch, 2021; Schneiders et al., 2021; Schrijner & Smits, 2018; Suri et al., 2025).

Despite this evidence, most maternal nutrition programs continue to focus primarily on pregnant women, and only a small number of interventions have intentionally engaged other family or community members. While some programs have involved fathers (Tokhi et al., 2018), grandmothers have largely been overlooked despite their documented influence. The few participatory grandmother-inclusive interventions that have been implemented have demonstrated improvements in maternal and child nutrition knowledge, attitudes, and practices, as well as improvements

in infant and young child feeding practices and reductions in child undernutrition (Aubel et al., 2004; Aidam et al., 2020; Bezner Kerr et al., 2008; Bezner Kerr et al., 2011). These findings suggest that engaging grandmothers may represent an underutilized opportunity for strengthening maternal nutrition interventions.

Recognizing the culturally designated role of grandmothers as advisors and caregivers, the Grandmother Project–Change through Culture developed the GMIA (Aubel, 2014). This approach draws on formative research and participatory adult learning methods to strengthen grandmothers' knowledge, confidence, and ability to support improved MCHN practices. In southern Sierra Leone, formative qualitative research identified grandmothers as key influencers of maternal nutrition and health behaviors within family systems. Based on these findings, World Vision (WV) and partners implemented the Mamanieva project—a pilot GMIA intervention designed to strengthen maternal nutrition and health practices during pregnancy by engaging grandmothers as change agents.

To date, no study in Sierra Leone has evaluated a grandmother-inclusive intervention targeting maternal nutrition and birth outcomes without providing additional food or nutrient supplementation. The Mamanieva pilot—meaning "for our grandmothers" in the local Mende language—was designed to address this gap by building on grandmothers' existing roles as advisors and caregivers for mothers and children. This paper describes the GMIA intervention and reports endline differences in maternal nutrition-related knowledge, attitudes, and practices during pregnancy, as well as birthweights, between intervention and comparison communities. Findings from the formative research and results related to infant and young child feeding are reported elsewhere (MacDonald et al., 2020; Aidam et al., 2020). This study contributes to the limited evidence on family-centered approaches to maternal nutrition and provides insight into the potential of engaging grandmothers as influential actors within household systems to support improved maternal nutrition and birth outcomes in LMIC settings.

Methods

The development, implementation, and evaluation of the Mamanieva project followed the GMIA, which builds on grandmothers' culturally designated role as caregivers and advisors by placing them at the center of the intervention. Summarized here and described in detail elsewhere (Aubel, 2014), the approach is grounded in a conceptual model informed by formative research and previous studies demonstrating that grandmothers are key advisors to mothers on nutrition and health matters. It aims to strengthen grandmothers' beliefs and optimal practices while increasing their knowledge and self-efficacy in maternal nutrition. As they become more informed and confident, they provide improved guidance and support to mothers on recommended practices, helping shift household and community social norms toward optimal maternal nutrition (Aidam et al., 2020).

Study Site

The Mamanieva project was implemented by WV from 2013 to 2016 in Bum Chiefdom in Bonthe District, Southern Province of Sierra Leone. The Mende tribe predominates in Bum Chiefdom; their main economic activities are agriculture, fishing, and petty trading. The chiefdom comprises two main habitats, the mainland and the riverine areas, with most of the population living on the mainland.

Study Design and Intervention Description

The pilot study used a quasi-experimental design with mixed methods to evaluate the effects of the GMIA intervention, comparing a family systems approach with a primarily mother-focused approach. A full description of this GMIA pilot study design is provided by Aidam et al. (2020) and summarized briefly below. Two geographically delineated administrative sections of Bum Chiefdom (Torma and Fikie) were purposively selected for the pilot based on year-round accessibility and presence of WV's program. The two sections were similar in population size, culture, climate, economic activities, and access to health care. The Torma section of the Bum Chiefdom (population 2,527) received the intervention (GMIA) and the Fikie section (population 2,747) served as the comparison area. Allocation was purposive based on capacity of WV staff and likelihood of success of the pilot project with allocation of geographic sections to intervention and comparison based on WV infrastructure within sections and ability to implement the pilot. To partially compensate for the lack of a randomized design, we created a three-level exposure variable to capture degree of participation in project activities, as described below.

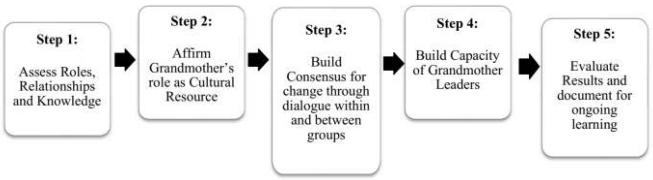

Figure 1: Implementation steps of the Grandmother Inclusive Approach for the Mamanieva Pilot Project in Sierra Leone. Figure adapted with permission from Aubel (2014).

The GMIA builds on the culturally designated role and influence of grandmothers and grandmother leaders (GMLs) on MCHN and involves five key steps (Figure 1). These steps are fully detailed elsewhere (Aubel, 2014) and are described briefly below. Following this approach, we first conducted a mixed methods formative assessment consisting of qualitative research (April 2013) and a quantitative sociodemographic and nutrition knowledge and attitudes survey in January to March, 2013, prior to the rainy season (April/May to November) implemented by Njala University. A detailed report of the qualitative component of the research and the sociodemographic knowledge, attitudes and beliefs surveys are published elsewhere (MacDonald et al., 2020; Girard & Mui, 2015; Girard, 2017). Briefly, the baseline sociodemographic and nutrition knowledge and attitudes survey included 474 mothers and pregnant women, of which 217 and 126 were mothers with young children from intervention and comparison communities, respectively, and

78 and 53 were pregnant women from intervention and comparison communities. Selected findings from this assessment are presented in this paper to illustrate community characteristics at the start of the intervention.

From these formative findings, grandmother-inclusive activities and curriculum were developed using adult education methods (Aubel, 2014; Drost, 2013; Mui & Girard, 2013) and implemented by WV staff based in Torma (intervention) section. WV staff who facilitated Mamanieva activities had prior experience in community development and participatory adult education approaches. Adult education experts supported the project team to develop, pretest, and adapt culturally grounded curriculum and tools targeting grandmothers, including songs, games, picture discussion cards, and stories-without-an-ending. These consultants provided ongoing support and training to WV staff in the first months of project implementation.

Mamanieva activities affirmed the important and active role of grandmothers in MCHN, and included 1) community-wide "days of praise" of grandmothers, 2) monthly dialogue sessions with all grandmothers in intervention communities, 3) monthly intergenerational forums for all young mothers and all grandmothers, and 4) building the capacity of apparent natural GMLs (Aubel, 2014). During the community-wide "days of praise", grandmothers' roles and experience were acknowledged through songs praising them and stories describing their important roles. The aim of these special days was to boost grandmothers' self-esteem, and increase their openness to new ideas (APA Dictionary of Psychology, n.d.; Aubel, 2014). Monthly dialogue sessions with grandmothers sought to build consensus for positive change in MCHN practices by reinforcing grandmothers' positive knowledge and experience, sharing new information with them, and challenging them to consider how they might modify their existing practices. A similar approach was taken during intergenerational forums, which sought to improve relationships between family members and increase household support for positive MCHN practices. The intergenerational forums primarily targeted mothers and grandmothers, but husbands and elder men were also invited. Each month, a different MCHN topic was emphasized (see Box 1).

In addition to monthly group sessions, GMLs were selected by their communities based on community-defined criteria (e.g., well respected, experience caring for pregnant women and mothers with young children, traditional birth attendants). The GMLs attended quarterly stakeholder meetings, facilitated by WV or Bonthe District Ministry of Health (MoH) staff, where their leadership abilities and facilitation skills were strengthened, and their understanding of optimal MCHN practices was reinforced. After the first year of implementation, GMLs began co-facilitating and then leading dialogue sessions, intergenerational forums, and other community nutrition education activities (e.g., group nutrition education for pregnant women at clinics). GMLs were not remunerated.

Both intervention and comparison communities received the standard of care for nutrition education, targeted primarily to the mother-child dyad, delivered by the MoH through antenatal and postnatal care visits and home visits for households with pregnant women and children under two by community health workers (CHWs). Key topics covered by CHWs during home visits included pregnancy diets, health-seeking behaviors, facility deliveries, optimal infant and young child feeding practices, newborn care, and care for sick children. In both sections, CHWs were trained by WV staff to implement the WV evidence-based model of Timed and Targeted Counselling for home visits (Al–Rabadi & Sharif, 2017; WV, 2014).

Box 1: Topics covered in the monthly Mamanieva grandmother dialogue sessions and the intergenerational forums

1. Roles of grandmothers in community and maternal and child health
2. Linkages between healthy diets and well-being -- emphasis on diverse diets
3. Diets, workloads, and health-seeking during pregnancy
4. Anemia during and after pregnancy and the importance of IFA supplements
5. Early initiation of exclusive breastfeeding and avoiding prelacteals
6. Supporting exclusive breastfeeding in the family and community
7. Complementary feeding -- timing, consistency, and frequency
8. Complementary feeding -- dietary diversity and recipe development
9. Hygiene and health-seeking

Endline Sampling and Participant Eligibility

The endline survey was implemented by Emory University just prior to the rainy season, from May 16 - 22, 2016, following pilot testing and revision. The target populations for the endline survey were women of reproductive age (WRA) over 17 years of age, either 1) pregnant or 2) with children <24 months old. Grandmothers residing with eligible WRA as well as senior women >45 years living in the community but not residing with eligible mothers also participated in a survey that assessed their project participation, knowledge and attitudes towards MCHN, generalized self-efficacy and self-efficacy in providing care to women and children. This manuscript reports only on data collected from WRA.

Available sample sizes were estimated prior to data collection using Sierra Leone census-based population estimates from 2004 and 2015 (https://www.statistics.sl/) for the formative sociodemographic, knowledge, and attitudes survey and the endline survey, respectively. Due to the limited number of potentially eligible respondents in each section, exhaustive census-based sampling measures were

employed. Respondent screenings and household listings in each village were conducted 1-2 weeks prior to survey administration to identify all eligible respondents. Screening questions for eligibility were asked at the beginning of the survey, prior to informed consent, to ensure the respondent was eligible. If there was more than one child under 2 in the household, the enumerator selected the index child by coin flip.

Survey Data Collection

The endline survey collected data on MCHN knowledge, attitudes, and beliefs, as well as household sociodemographic and respondent characteristics, including the respondent's and household head's education, age, occupation, and marital status. Household food deprivation was assessed using the Household Hunger Scale (Ballard et al., 2011). Additionally, indicators of maternal diet and nutrition practices assessed included 1) number of meals consumed during pregnancy; 2) workload, and 3) receipt and consumption of IFA tablets during pregnancy. Women's meal frequency and diet diversity were assessed using the Food and Agriculture Organization's (FAO) 24-hour open recall method (FAO & FHI 360, 2016). Current pregnancy and/or obstetric history data, including the number of antenatal care visits, delivery location, complications during delivery, and birthweight, were collected from child health cards or maternal recall when a health card was unavailable. Knowledge of pregnant women and mothers with young children was assessed through a series of 20 maternal, infant, and young child nutrition-related knowledge questions. Knowledge questions pertained to diets and workloads during pregnancy, and infant and young child feeding. In the intervention communities, information on the frequency and most recent participation in various Mamanieva intervention activities was also collected from respondents.

Endline enumerators employed tablet-based data collection using the Open Data Kit (ODK) platform. The team uploaded survey data to the ODK server at the end of each day. A total of 375 pregnant women and women with children under 2 years participated in the endline survey, 225 from intervention communities and 150 from comparison communities. One hundred and one women were pregnant at the time of the survey: 24.0% in intervention communities and 31.3% in comparison communities.

The endline survey was conducted in the local language, Mende, in respondents' homes and lasted approximately 1-1.5 hours. During baseline and endline training, interviewers, aided by professional translators, reviewed each question and agreed on the English-to-Mende translations. "Role plays" were also included in the enumerator training to allow interviewers to practice interviewing in Mende and to refine the translations.

Ethical Approvals

All study procedures and tools were approved by the national research review board in Sierra Leone and Emory University's Internal Review Board. All participants provided written and verbal informed consent prior to beginning surveys. Copies of the consent form and the research team's contact information were provided to participants.

Analysis

Statistical analyses were performed using SASv9.1. The number of correct responses to 16 of the maternal nutrition and IYCF knowledge questions was summed to create maternal and child nutrition (MCN) knowledge scores with values ranging from 0 to 16 (Supplemental Table 1). Four of the questions were excluded from score tabulation because they were open-ended questions related to food taboos. Women's dietary diversity score and adequacy of women's diet diversity were calculated using the FAO method (FAO & FHI 360, 2016) with ⩾ 5 food groups indicative of adequate diet diversity.

Normally distributed continuous variables were analyzed using T-tests and F-tests; non-normally distributed continuous variables were analyzed using the Wilcoxon Rank Sum test. Categorical variables were analyzed with the chi-square test.

Women were categorized into one of three exposure groups to Mamanieva activities. The comparison group included those residing in comparison communities who did not receive any Mamanieva activities. Among women in intervention communities, exposure was further categorized by participation in dialogue sessions and intergenerational forums: those with low participation reported attending monthly dialogue sessions and intergenerational forums only "a few times", while those with high participation reported attending several times per year or more. Notably, even women with limited or no direct participation may have experienced indirect exposure through community norm changes mediated by grandmothers involved in the intervention.

Multiple regressions models were developed for outcomes related to maternal diets during pregnancy, maternal health-seeking behaviors, and birthweight. These models were adjusted for differences in sociodemographic variables at endline, including maternal schooling, parity, and pregnancy status; schooling and occupation of household head; and household hunger category. Logistic regression models were used for categorical outcomes and linear regression models for continuous outcomes. Analyses were conducted in SASv9.4.

Results

Descriptive Characteristics of Respondents at Baseline

Detailed results of the mixed methods formative assessment are presented elsewhere (MacDonald et al., 2020; Girard & Mui, 2015) but are briefly summarized here to provide context. At the time of the formative assessment, women and heads of household in intervention communities had significantly more education (3.0 and 2.0 vs. 3.8 and 2.9 years, respectively; both, $p=0.01$), larger households (7.7 vs. 6.8; $p<0.01$) and a greater proportion had grandmothers residing in their households (83% vs. 63%; $p<0.001$) than comparison communities. Participants in the two areas did not differ in other sociodemographic characteristics. Regarding sub-optimal MCHN beliefs at baseline, both comparison and intervention formative qualitative research

participants reported that pregnant women should eat the same amount or decrease the amount of food consumed during pregnancy to avoid having a big baby and a complicated delivery.

Descriptive Characteristics of Respondents at Endline

At the endline survey, and across all groups, women (those pregnant and with children under two years of age) were on average 26 years old, and over 70% had more than 2 children. No differences were found between intervention and comparison groups in the average age of women, the proportion pregnant at the time of the survey, the number of children, employment, marital status, and percentage living with parents (Table 1). However, a greater proportion of women and household heads in comparison communities had never attended school. The primary occupation of both women and household heads was agriculture in all areas, though a greater proportion of household heads in comparison communities were engaged in agriculture. A much greater proportion of respondents in comparison communities reported household hunger. These differences were adjusted for in the regression models, as noted above.

Table 1. Sociodemographic characteristics of mothers with children <24 months and pregnant women at endline

Characteristic	Overall n=375	Intervention n=225	Comparison n=150	p-value
Maternal age, years[1]	25.8 ± 6.0	25.6 ± 6.0	26.1 ± 6.1	0.58
Pregnant at endline[2]	101 (26.9)	54 (24.0)	47 (31.3)	0.12
Parity[2]				0.07
0	20 (5.3)	8 (3.6)	12 (8.0)	
1	66 (17.6)	47 (20.9)	19 (12.7)	
2–3	125 (33.3)	75 (33.3)	50 (33.3)	
>3	164 (43.7)	95 (42.2)	69 (46.0)	
Maternal schooling[2]				**0.004**
Never attended	223 (59.6)	118 (52.7)	105 (70.0)	
Some primary, incomplete	49 (13.1)	34 (15.2)	15 (10.0)	
Completed primary or more	102 (27.3)	72 (32.1)	30 (20.0)	
Employment[2]				0.30
Not employed outside home	25 (6.7)	16 (7.1)	9 (6.0)	
Agriculture	317 (84.5)	186 (82.7)	131 (87.3)	
Informal business/trade	20 (5.3)	12 (5.3)	8 (5.3)	
Other	13 (3.5)	11 (4.9)	2 (1.3)	
Marital status[2]				0.52
Married/partnered, monogamous	280 (74.7)	171 (76.0)	109 (72.7)	
Married/partnered, polygamous	67 (17.9)	40 (17.9)	27 (18.0)	
Widowed/divorced/separated/single	28 (7.5)	14 (6.2)	14 (9.3)	
Lives with own or husband's parents[2]	255 (68.0)	149 (66.2)	106 (70.7)	0.36
Head of household[2]				0.26
Husband	169 (45.1)	96 (42.7)	73 (48.7)	
Respondent	5 (1.3)	4 (1.8)	1 (0.7)	
Mother-in-law	34 (9.1)	25 (11.1)	9 (6.0)	
Father-in-law	40 (10.7)	23 (10.2)	17 (11.3)	
Respondent's father	54 (14.4)	32 (14.2)	22 (14.7)	
Respondent's mother	25 (6.7)	19 (8.4)	6 (4.0)	
Other	48 (12.8)	26 (11.6)	22 (14.7)	
Head of household schooling[2] [3]				**<0.001**
Never attended	282 (77.9)	152 (71.0)	130 (87.8)	
Some primary, incomplete	14 (3.9)	8 (3.7)	6 (4.1)	
Completed primary or more	66 (18.2)	54 (25.2)	12 (8.1)	
Head of household occupation[2] [4]				**0.03**
Agriculture	320 (86.5)	184 (83.3)	136 (91.3)	
Other	50 (13.5)	37 (16.7)	13 (8.7)	
Household hunger (previous month)[2]				**<0.01**
Little to no hunger	283 (75.9)	209 (92.9)	74 (50.0)	
Moderate to severe hunger	90 (24.1)	16 (7.1)	74 (50.0)	

Notes: Values are n (%) unless otherwise indicated. [1]Mean ± SD (age available for n=216; intervention n=132, comparison n=84); [2] χ^2 test used for categorical variables; [3]Thirty-eight respondents did not know the schooling of the household head; five respondents were themselves the household head; [4]Five respondents were heads of their own households. Bold p-values indicate $p < 0.05$.

Nutrition knowledge, intentions, and practices among pregnant women and women with children under two years at endline

At endline, intervention women categorized as high participation had higher knowledge scores than women in comparison communities; scores did not differ between comparison communities and women categorized as low participation (Table 2).

Table 2. Adjusted endline differences in women's nutrition knowledge and practices by intervention participation level

Outcome	Comparison (C) n=150	Low participation (L) n=42	High participation (H) n=167	Adjusted effect estimate (95% CI)[1]
Nutrition knowledge score[2]	10.9 (10.2–11.7)	11.5 (10.5–12.5)	12.1 (11.3–12.8)	Mean difference: LvC 0.6 (−0.4–1.5) Mean difference: HvC 1.1 (0.5–1.8)* Mean difference: HvL 0.6 (−0.3–1.5)
Adequate diet diversity[3]	98 (65.3)	38 (90.5)	161 (96.4)	Odds ratio: LvC 3.72 (1.17–11.9)* Odds ratio: HvC 13.5 (4.9–37.3)* Odds ratio: HvL 3.7 (1.8–7.5)*
Meal frequency[2]	2.5 (2.3–2.8)	3.1 (2.7–3.4)	3.0 (2.8–3.3)	Mean difference: LvC 0.5 (0.2–0.9)* Mean difference: HvC 0.5 (0.2–0.7)* Mean difference: HvL −0.01 (−0.4–0.3)

Notes:

[1] Models adjusted for maternal schooling, parity, and pregnancy status; schooling and occupation of the household head; and household hunger category.; [2] Values are least-squares means (95% CI) among all women (pregnant women and mothers of children <2 years).; [3] Adequate diet diversity defined as ⩾5 food groups consumed in the previous 24 h; values shown are n (%).; Abbreviations: C, comparison; L, low participation; H, high participation; LvC, low participation vs comparison; HvC, high participation vs comparison; HvL, high participation vs low participation. * $p < 0.05$.

We found a greater proportion of women in the intervention communities achieving adequate dietary diversity than those in comparison communities (Table 2). After adjusting for key sociodemographic differences at endline, the odds of achieving adequate dietary diversity were higher among women categorized as high participation than among those in the low participation and comparison groups. Women in intervention communities, irrespective of whether they had high or low participation, also consumed a greater number of meals in the previous 24 hours than women in comparison communities, as reflected in the mean differences.

In adjusted analyses, intervention women with children under 2 years, in both low- and high-participation intervention groups, had higher odds of attending 4 or more antenatal care (ANC) visits and of attending ANC earlier in their pregnancy than did those in the comparison group (Table 3). The adjusted odds of increased food consumption, increased meal frequency, reduced workloads and daily IFA consumption during pregnancy were also higher among intervention women compared to those in comparison communities. Further, those with high participation had greater odds of daily IFA consumption than their lower-participation counterparts. No differences were found in adjusted analyses of women delivering at a health facility (all groups were >90%), nor in gestational age at the first ANC visit (Table 3).

Table 3. Adjusted endline maternal health-seeking and dietary practices during the most recent pregnancy and birth outcomes by intervention participation

Outcome during most recent pregnancy	Comparison (C) n=107	Low participation (L) n=32	High participation (H) n=145	LvC (95% CI)	HvC (95% CI)	HvL (95% CI)
⩾4 ANC visits	80 (80.8)*	27 (96.4)	102 (98.1)	OR 5.2 (0.6–48.2)	OR 9.1 (1.8–45.2)	OR 2.5 (0.8–8.3)
Weeks gestation at first ANC visit	11.5 (9.4–13.6)	9.2 (6.2–12.2)	8.0 (5.8–10.2)	MD −2.2 (−5.1–0.6)	MD −3.5 (−5.4–−1.6)	MD −1.3 (−4.0–1.4)
Delivery at health facility	97 (90.7)	30 (93.8)	141 (97.2)	OR 0.9 (0.1–5.1)	OR 2.6 (0.5–11.9)	OR 2.0 (0.7–5.4)
Increased food intake	68 (63.6)*	29 (90.6)	138 (95.2)	OR 6.5 (1.7–25.6)	OR 13.2 (4.9–36.0)	OR 3.0 (1.5–6.0)
Increased meal frequency	63 (58.9)*	29 (90.6)	140 (96.6)	OR 6.8 (1.8–26.2)	OR 20.8 (7.1–60.9)	OR 4.0 (1.9–8.5)
Reduced workload	81 (75.7)*	30 (93.8)	132 (91.0)	OR 4.2 (0.8–20.9)	OR 3.1 (1.3–7.7)	OR 1.3 (0.7–2.7)
Took iron tablets daily†	75 (75.8)*	29 (93.6)	136 (94.4)	OR 4.2 (0.8–20.4)	OR 6.4 (2.3–17.3)	OR 2.1 (1.0–4.5)
Birthweight, kg	3.08 ± 0.43*	3.37 ± 0.57	3.33 ± 0.46	MD 0.26 (0.02–0.49)	MD 0.21 (0.06–0.36)	MD −0.04 (−0.26–0.17)
Low birthweight (<2.5 kg)	8 (7.8)	1 (4.3)	3 (2.4)	OR 0.5 (0.0–5.3)	OR 0.2 (0.1–1.1)	OR 0.5 (0.2–1.5)

Notes

Models adjusted for maternal schooling, parity and pregnancy status; schooling and occupation of the household head; and household hunger category. Values are n (%) unless otherwise noted. Continuous outcomes are least-squares means (95% CI) or mean ± SD.; †Among women who received iron tablets.
Abbreviations: ANC, antenatal care; C, comparison; L, low participation; H, high participation; LvC, low participation vs comparison; HvC, high participation vs comparison; HvL, high participation vs low participation; OR, odds ratio; MD, mean difference.; *$p < 0.05$ for comparison vs intervention (combined L + H).

Results for the intended uptake of health services and nutrition practices by the pregnant women in the intervention groups of high and low participation were combined at endline, due to small sample sizes; comparisons were between intervention and comparison only. We found that pregnant women in intervention communities had higher odds of intending to eat more food, to eat more frequent meals, and to work less during their current pregnancy (Table 4). Also, among those receiving IFA, a greater proportion of intervention women reported currently taking their IFA daily than women in comparison communities (Table 5).

Table 4. Adjusted endline intentions for maternal health service use and nutrition practices among pregnant women

Intended practices during pregnancy	Comparison n=47	Intervention n=54	Adjusted OR (95% CI)[1]
	n (%)	n (%)	
Intend to deliver at health facility	43 (91.5)*	54 (100)	NE
Intend to increase food intake	23 (48.9)*	48 (88.9)	7.46 (2.00–27.86)
Intend to increase meal frequency	22 (46.8)*	49 (90.7)	11.70 (2.83–48.19)
Intend to reduce workload	32 (68.1)*	51 (94.4)	8.91 (1.82–43.59)

Notes
[1] Models adjusted for maternal schooling, parity and pregnancy status; schooling and occupation of the household head; and household hunger category. Odds ratios (OR) and 95% confidence intervals (CI) reported. NE indicates not estimated due to insufficient variation. It is very likely that these minor differences are insignificant.; *p < 0.05 (χ^2 test).

Table 5. Adjusted endline health and nutrition practices among pregnant women

Practices during pregnancy	Comparison n=47	Intervention n=54	Adjusted OR (95% CI)[1]
	n (%)	n (%)	
Confirmed pregnancy at health facility	41 (87.2)	52 (96.3)	NE
Received ANC at health facility	39 (95.1)	51 (98.1)	NE
Received/purchased IFA tablets	37 (78.7)*	51 (94.4)	4.00 (0.72–22.28)
Among recipients, taking IFA daily	26 (70.3)[2]	48 (94.1)[3]*	11.53 (2.14–62.12)

Notes
[1] Models adjusted for maternal schooling, parity, and pregnancy status; schooling and occupation of the household head; and household hunger category. Odds ratios (OR) and 95% confidence intervals (CI) are reported. NE indicates not estimated due to insufficient variation. It is very likely that these minor differences are insignificant.; [2] n=37.; [3] n=51.
Abbreviations: ANC, antenatal care; IFA, iron–folic acid; * p < 0.05 (χ^2 test).

Birthweights of infants of women with children under 2 years at endline

For those infants with available birthweight data (n=254), the adjusted mean difference in birthweight was significant, approximately 0.2 kg higher among combined low and high participation women compared with the comparison group; no differences were observed between participation groups (Table 3). The proportion of infants born weighing less than 2.5 kg was 2.4% in the high participation group, 4.3% in the low participation group, and 7.5% in comparison communities (p=0.05), although odds of low birthweight were not significant between groups, possibly due to small sample sizes.

Discussion

In this paper, we evaluate the Mamanieva pilot project, implemented by WV in southern Sierra Leone, a participatory GMIA that explicitly engaged grandmothers as change agents for MCHN (Aubel, 2014). Endline findings suggested significantly improved maternal dietary and health-seeking practices in intervention communities compared with comparison communities. Women in intervention communities were more likely to achieve adequate dietary diversity, consume more frequent meals, intend to increase food intake during pregnancy, adhere to daily IFA supplementation, and attend antenatal care services. High program participation further amplified these improvements. Differences remained significant after adjusting for maternal education and household food deprivation, suggesting that the GMIA intervention contributed directly to these outcomes. However, while the indicator of household hunger is a robust and valid indicator of severe food insecurity, it does not fully capture food insecurity, and thus other aspects of food insecurity may be contributing to the differences. Overall, the intervention effect is plausible because the effects are large and consistent, many are stronger in the high participation group, and the findings align with the theory of change.

Formative research identified mechanisms through which grandmothers influence maternal nutrition (MacDonald et al., 2020). Grandmothers play a central role in supervising and advising pregnant women on diet and health behaviors. Mothers reported that when health worker advice conflicted with grandmothers', they often followed grandmothers' guidance due to their authoritative role within family systems. Historically, maternal health programs in the region underestimated this influence, often assuming that grandmothers were resistant to change or incapable of learning. However, grandmothers participating in formative research expressed strong interest in acquiring new knowledge to better support younger women (MacDonald et al., 2020).

Grandmothers' capacity to learn and influence practices is supported by previous studies. Aidam et al. (2020) found higher nutrition knowledge among grandmothers in intervention communities, mirrored by improved knowledge among pregnant women and mothers of young children. These findings suggest that positive maternal nutrition outcomes were mediated by grandmothers' knowledge and support. In multi-generational households, grandmothers' enhanced knowledge likely improves meal preparation, increases dietary diversity, and reduces pregnant women's workload by assisting with domestic chores such as food preparation, childcare, laundry, and income-generating activities (MacDonald et al., 2020). Reduced workload and financial contributions from grandmothers may further enable pregnant women to access nutritious foods and attend health services (Pike et al., 2021). Ongoing research is

exploring these mediating pathways.

Although anthropometric measures were beyond the scope of this study, birthweights were significantly higher in intervention communities at endline, with an adjusted increase of approximately 220 g. High-participation mothers demonstrated substantial improvements in food intake, dietary diversity, meal frequency, and IFA adherence compared with women in comparison communities, which could contribute to higher birthweights. These findings align with evidence from Bangladesh and Ethiopia indicating that increased maternal dietary diversity is associated with higher birthweights (Chowdhury et al., 2022; Zerfu et al., 2016).

The magnitude of observed changes is programmatically meaningful and consistent with other family-inclusive interventions. In Bangladesh, the Alive and Thrive program documented a 30-percentage-point improvement in diet diversity adequacy and a 63-percentage-point increase in IFA receipt among intervention participants (Nguyen et al., 2017). Similarly, in Senegal, the implementation of GMIA reduced women's workload and increased food consumption during pregnancy (Aubel et al., 2004). In Bangladesh, interventions that included mothers-in-law and husbands also increased maternal dietary diversity and birthweights (Chowdhury et al., 2022). Collectively, these findings highlight the effectiveness of engaging influential family members to strengthen maternal nutrition interventions.

Despite growing interest in family-focused interventions since 2010, evidence remains limited. A 2021 systematic scoping review found that only one-third of family-centered nutrition studies used formative research to guide intervention design, and few engaged grandmothers or assessed maternal nutrition outcomes (Martin et al., 2021). Participatory grandmother-inclusive approaches without additional material incentives remain underrepresented in the literature. Past interventions in Senegal, Malawi, Kenya, and Bangladesh suggest that grandmother-inclusive approaches can improve maternal practices, household diet diversity, child growth, and dietary diversity, though maternal outcomes were rarely reported (Aubel et al., 2004; Bezner Kerr et al., 2011; Bezner Kerr et al., 2019; Martin et al., 2015; Thuita et al., 2021; Alam et al., 2020; Chowdhury et al., 2022). Thus, the Mamanieva findings strengthen the limited but growing evidence that grandmothers can positively influence maternal nutrition and child outcomes when appropriately engaged.

Scaling GMIA approaches will require reorienting policies and programs from a narrow mother–child dyad focus to a broader family systems perspective, actively engaging influential household members. Formative research is critical to understand local cultural norms, household relationships, and authority structures to inform intervention design (Aubel et al., 2021). Training community health and development workers in participatory, empowering communication methods—emphasizing respect, listening, dialogue, and consensus-building—is essential, as relational aspects of education are critical when engaging senior women (Aubel, 2024; MacDonald et al., 2020).

Because GMIA leverages existing family influencers, it offers a sustainable pathway for improving maternal nutrition practices. Once knowledge and supportive behaviors are adopted by key family members, these practices may be transmitted across generations, sustaining positive change even in the absence of ongoing external support.

Limitations

The findings of this study should be interpreted in light of several limitations related to the pilot nature and design of the research. The Mamanieva project was implemented primarily to assess the feasibility of the GMIA and was conducted in an area where WV had established programs, community relationships, and logistical access. As such, the analyses were intended to inform program implementation and generate preliminary estimates of potential program effects and effect sizes to guide future research rather than to provide definitive causal evidence.

A main confounder in this study was the large difference in food security at endline, with baseline differences unknown. As noted previously, household hunger was adjusted for in the models; however, it captures only severe food insecurity, and thus, there is likely variability that this variable was not able to take into account.

The endline survey employed exhaustive census-based sampling in both intervention and comparison communities, ensuring representativeness of the study population. However, the number of eligible households identified at endline was smaller than anticipated based on the original sampling frame derived from existing census data, resulting in limited statistical power for several outcomes. Consequently, some null or non-estimable findings may reflect insufficient power rather than the absence of program effects. Small sample sizes also resulted in wide confidence intervals, reducing precision in estimated effect sizes and limiting confidence in effect attribution. Nevertheless, for several key outcomes—including dietary diversity and daily IFA consumption—higher levels of program participation were associated with significantly improved outcomes within intervention communities, suggesting a positive contribution of the intervention.

Another limitation is the absence of baseline data on several key maternal practice indicators. The formative assessment focused primarily on community characteristics and antecedent factors influencing maternal and child health and nutrition practices, including knowledge, attitudes, and culturally defined family roles. Few differences were observed between communities at baseline; when differences did exist, such as attitudes toward exclusive breastfeeding and nutrition knowledge, they favored the comparison communities (Aidam et al., 2020). Although baseline birthweight data were not collected for the study, contextual information from the 2013 Sierra Leone Demographic and Health Survey (SLDHS) provides some perspective. The SLDHS reported that 8.7% of infants born in Bonthe were perceived as smaller than average at birth, and 3.1% weighed less than 2.5 kg. At endline, the prevalence of low birthweight in comparison communities (7.8%) was similar to this estimate, whereas in intervention

communities it was lower (2.7%; p=0.05). Although small sample sizes limit interpretation, this pattern suggests a possible protective effect of the intervention. Baseline maternal dietary indicators could not be approximated, as maternal diet data are not collected in the SLDHS, and differences in sampling approaches further limit comparability.

A further limitation is the lack of randomized assignment of communities to intervention and comparison groups. Although the three-level exposure model suggested improved outcomes among women with higher program participation, interpretation was constrained by the small number of respondents categorized as having low participation. In addition, several intervention activities—such as praise sessions and grandmother dialogue sessions—were community-wide, meaning that social and cultural norm changes may have influenced women's practices beyond direct program participation.

Conclusions

The Mamanieva project, informed by formative research engaging grandmothers as change agents within family and community systems, was associated with more positive MCHN attitudes and practices and may have contributed to improved birthweights in southern Sierra Leone. Consistent with evidence from grandmother-inclusive interventions in Senegal, Malawi, and Kenya, these findings highlight the potential of leveraging grandmothers' influence to strengthen maternal nutrition programs across the Global South where formative research finds it to be appropriate, underscoring the value of family-centered approaches that engage key household actors beyond mothers.

Ongoing analyses will further examine links between grandmothers' participation in Mamanieva activities and their knowledge, beliefs, and self-efficacy, as well as pathways to changes in maternal and child dietary outcomes. Nonetheless, further research using adequately powered, well-designed evaluations with appropriate counterfactuals is needed to strengthen causal inference and inform broader adoption. Overall, the pilot suggests that grandmothers' commitment to family well-being, combined with their capacity to learn and adapt practices, represents a promising and potentially sustainable resource for improving maternal nutrition.

Author Contributions

AWG, BA, JA, and CM designed the intervention, evaluation strategy and evaluation tools. All authors contributed to the acquisition of the formative, baseline and/or endline data collection. AWG and RW conducted data analysis and developed the first draft of the manuscript. All authors reviewed and provided final approval of the submitted version of the manuscript.

Declaration of Generative AI and AI-Assisted Technologies in Scientific Writing

AI (ChatGPT) was used to edit some sections of the paper and reformat tables.

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Data Availability Statement

The data underlying this article are available at Figshare: https://figshare.com/articles/dataset/Datasets_and_Questionnaires_for_Grandmothers_as_Change_Agents_in_Sierra_Leone/8016383

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Conflict of Interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplemental Table

Supplemental Table 1. Maternal and infant diet and nutrition knowledge questions in the Mamanieva formative and endline surveys, Bum ADP. If mothers answered correctly, they were allotted 1 point. Points were summed to create a knowledge score with a maximum value of 16.

Pregnancy knowledge
Pregnant women should eat more
Pregnant women should work less
IYCF knowledge
Should breastfeed immediately after delivery
Should feed baby first yellow milk
Should not give baby anything before it is put to breast for first time
Should not give baby anything other than breastmilk in first week of life
Baby should be at least 6 months before receiving water for first time
Baby should be 6-7 months old before it receives light porridge for the first time
Baby can receive thick porridge beginning at 6-7 months old
Baby can receive eggs for the first time at 6-7 months
Baby can receive meat or fish for the first time at 6-7 months
Baby can receive vegetables or fruits for the first time at 6-7 months
Baby can receive mashed beans, peas, lentils, or nuts for the first time at 6-7 months
6-9 month olds should be fed foods other than breastmilk at least 2-3 times a day
9-12 month olds should be fed foods other than breastmilk at least 3 times a day
12-24 month olds should be fed foods other than breastmilk at least 4 times a day