

Improving women's dietary diversity in Kenya: Results from a cluster-randomized trial on chicken production and nutrition education

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Abstract

Background: Micronutrient deficiencies among women in low- and middle-income countries pose a significant threat to maternal and child health. Limited dietary diversity—marked by heavy reliance on staple foods and low consumption of nutrient-rich options—exacerbates these deficiencies.

Objective: This cluster-randomized controlled trial evaluated whether promoting chicken production, with or without nutrition education, could improve women's dietary diversity, as measured by the Minimum Dietary Diversity for Women (MDD-W) indicator.

Methods: The trial was conducted in Kakamega and Bomet counties, Kenya, with participants randomized into three groups: (1) chicken provision only, (2) chicken provision plus nutrition education, and (3) control. Dietary diversity was assessed using the 10-food group MDD-W score.

Results: At baseline, the average dietary diversity score was low (mean: 4.27 ± 1.25), and only 35% of women met the MDD-W threshold. Diets were primarily composed of cereals (21.6%), dairy (20.0%), and leafy vegetables (16.7%), with limited intake of protein-rich and vitamin A-rich foods. The combined chicken and nutrition education intervention led to a significant improvement in dietary diversity in Kakamega (mean difference: 0.323; $p = 0.002$), but not in Bomet. Despite improvements, 62–68% of participants still failed to meet the minimum dietary diversity threshold post-intervention.

Conclusion: Nutrition education enhanced the effectiveness of food-based interventions in one of the two counties. However, persistent dietary inadequacies suggest that integrated strategies combining food access, behavior change communication, and agricultural diversification are necessary to sustainably improve women's diet quality and micronutrient intake.

Keywords: Dietary diversity; Food groups; Micronutrients; Diet quality; Women

Introduction

Micronutrient deficiencies pose significant health risks for women, adversely impacting both maternal and child health through mechanisms such as intrauterine growth retardation (Issa et al. 2024). Dietary diversity is a critical measure of food consumption patterns and overall nutrient adequacy (Shashikantha et al. 2016). The Minimum Dietary Diversity for Women (MDD-W) has been validated as a reliable proxy for assessing micronutrient sufficiency (Masito 2020). In many low- and middle-income countries (LMICs), diets are monotonous, primarily composed of starchy staples and lacking sufficient fruits, vegetables, and animal-source foods. This dietary pattern significantly contributes to malnutrition-related morbidity and mortality (Hanley-Cook et al. 2020).

Despite notable improvements in agricultural productivity across Africa, child stunting remains alarmingly persistent (Stevens et al. 2012; UNICEF 2023), highlighting the limitations of productivity-focused interventions and underscoring the urgent need for nutrition-sensitive agricultural approaches.

As emphasized by Ruel et al. (2018), agricultural programs must be deliberately designed to incorporate nutrition objectives to effectively combat malnutrition among vulnerable populations. Dietary diversification is a proven, food-based strategy to address micronutrient deficiencies and improve food security by encouraging the consumption of a broader range of nutrient-rich food groups (Chakona and Shackleton 2017).

This study assesses women's dietary diversity in Bomet and Kakamega counties in Kenya using the ten food groups defined by the MDD-W indicator. It addresses a critical evidence gap at the intersection of agriculture and nutrition (Webb and Kennedy 2014). Specifically, the study evaluates the impact of introducing nutrient-rich foods (e.g., chicken products) alongside targeted nutrition education on women's dietary diversity. By quantifying changes in MDD-W scores post-intervention and identifying region-specific barriers to dietary improvement, the findings aim to inform the design of more effective, context-specific nutrition education programs. Ultimately, this work contributes to global efforts to leverage agricultural interventions to enhance

Women's dietary diversity and nutrition trial in Kenya

nutrition outcomes, particularly for women and children in LMICs (Ruel et al. 2018; Chakona and Shackleton 2017).

Materials and methods

This study was conducted in Kakamega and Bomet counties in Kenya. Kakamega County (0°05'–0°53'N, 34°20'–35°09'E), located in western Kenya, borders seven other counties and has an economy primarily based on subsistence agriculture, with maize and beans being the dominant crops (Bosuben, 2018). Bomet County (0°29'–1°03'S, 35°05'–35°35'E) lies in the central Rift Valley region and shares borders with four counties. Its agricultural economy is centered on tea farming and dairy production, with maize as the primary staple crop (Bosuben, 2018).

A cluster-randomized controlled trial design was employed to evaluate the impact of two interventions on dietary diversity among women of reproductive age (15–49 years) in poultry-producing households. Villages were randomly assigned to one of three arms: (1) Chicken Alone (provision of improved poultry breeds), (2) Chicken plus Nutrition (provision of poultry combined with nutrition education), or (3) Control (no intervention). Dietary diversity was assessed using the tenfold group classification defined by the Minimum Dietary Diversity for Women (MDD-W) indicator. Baseline data were collected prior to the implementation of interventions, and endline data will be gathered following the intervention period.

The study population included women aged 15–49 years residing in participating households. The age distribution of participants was as follows: 40.4% were over 45 years (classified as elders), 37.9% were between 30 and 45 years (middle-aged), and 21.7% were aged 18–29 years (youth). Educational attainment varied, with 30% of participants having completed primary education, 50% secondary education, and 20% tertiary or higher education. The average household comprised six members, including an average of four children per household. Participants were evenly distributed across the three study arms: Chicken Alone, Chicken plus Nutrition, and Control.

A total of 324 households were enrolled between August and September 2023, with 108 households assigned to each study arm. The sample size was calculated based on an expected difference in dietary diversity scores, assuming a 5% significance level and 80% statistical power. Each village contributed 36 households, and dietary diversity was designated as the primary outcome variable. Nutrition surveys were conducted at baseline and are scheduled to be repeated at endline.

Dietary data were collected through face-to-face

interviews using structured 24-hour dietary recall questionnaires administered via electronic Open Data Kit (ODK) forms. Trained enumerators conducted the interviews after obtaining informed consent from all participants. The primary outcome—dietary diversity—was measured using the MDD-W scoring system. Data analysis was conducted using Python version 3.8.13. One-way ANOVA was used to compare mean dietary diversity scores across the three study arms, with statistical significance set at $p < 0.05$. Preliminary analysis revealed statistically significant differences in dietary diversity scores between intervention groups ($p < 0.05$), suggesting differential impacts of the interventions on women's dietary diversity.

Results

Women's Educational Status: Baseline data revealed marked educational disparities between Bomet and Kakamega counties. Illiteracy was significantly more prevalent in Bomet, where 45% of women were classified as illiterate, compared to only 10% in Kakamega. A larger proportion of women in Kakamega had completed primary education (40%) compared to Bomet (15%). The disparity was even greater in higher education: 25% of women in Kakamega had attained college or university education, more than double the proportion in Bomet (10%).

Dietary Diversity Scores: Baseline dietary assessments indicated widespread nutritional inadequacy among women in both counties. More than 60% of participants failed to meet the minimum dietary diversity threshold of five food groups. The situation was slightly more severe in Bomet, where 67.8% of women were below the threshold, compared to 61.9% in Kakamega. These figures highlight a pervasive lack of access to or consumption of diverse, nutrient-rich foods among women of reproductive age in both regions.

Food Group Consumption Patterns: Analysis of food group consumption revealed a heavy reliance on staple foods with limited variety. Nationally, cereals dominated women's diets, accounting for 21.6% of total food group intake. In contrast, the consumption of other fruits and vegetables was critically low, comprising only 0.84% (Figure 1). At the county level, Kakamega women consumed more cereals (22.0%) and dark green leafy vegetables (17.4%), while Bomet women relied more heavily on dairy products (23.0%) and cereals (22.4%) (Figure 2).

Among the intervention groups, similar patterns were observed. In Kakamega, women in the Chicken + Nutrition group consumed 20.8% cereals and dairy

Women's dietary diversity and nutrition trial in Kenya

products but had little to no intake of fruits or other vegetables. In Bomet, participants in the same group consumed 22.7% dairy, with limited consumption of eggs and meat (6.0%). These patterns suggest that

while certain food groups were consistently consumed, others remained largely underrepresented across all groups.

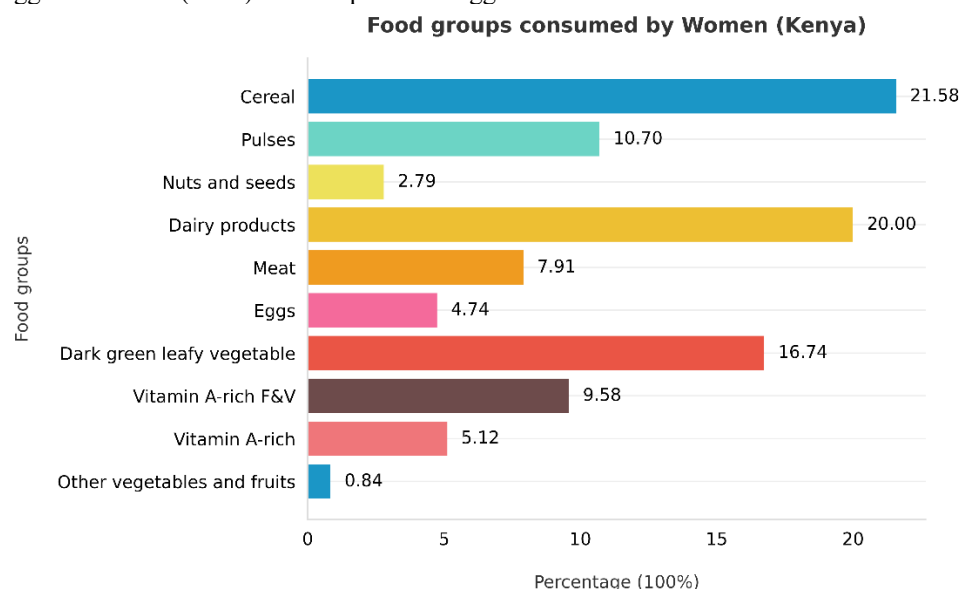


Figure 3: Food groups consumed by women in Kenya, at baseline

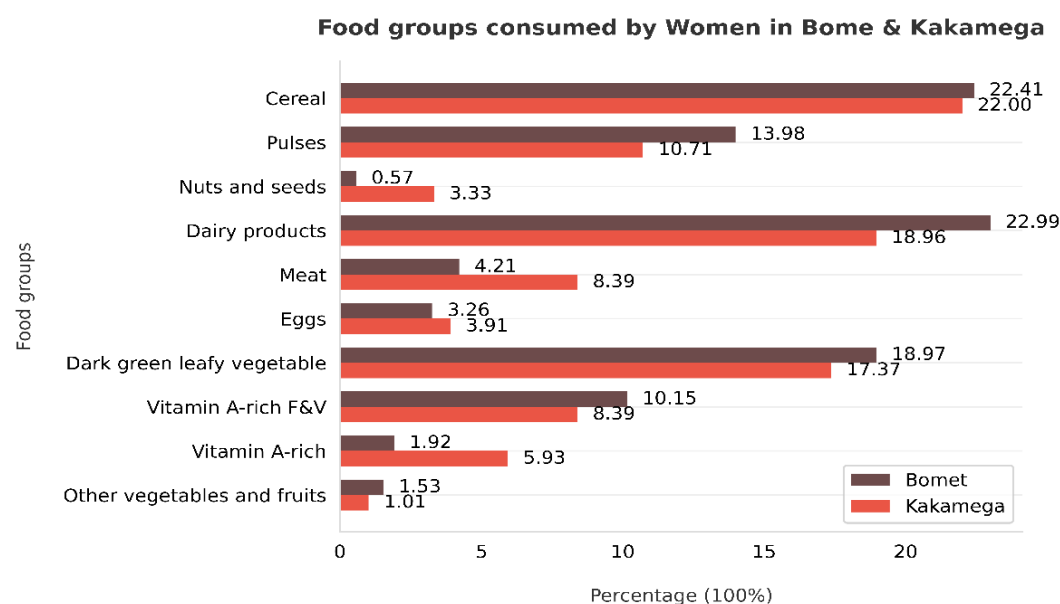


Figure 2: Food groups consumed by women in Kakamega and Bomet counties at baseline

Dietary Diversity by Treatment Arms in Bomet County: Figures 3 to 5 illustrate the baseline dietary diversity by treatment arms in Bomet County. Women in the Chicken + Nutrition group primarily consumed cereals and dairy, with minimal intake of other nutrient-dense foods (Figure 3). In the Chicken Alone arm, dairy consumption was highest at approximately 22.7%, followed by cereals, while eggs and meat

combined represented only 6.0% of intake (Figure 4). Interestingly, the control group demonstrated a more balanced distribution across food groups, suggesting relatively higher dietary diversity (Figure 5).

Statistical analysis revealed that, at baseline, interventions in Bomet County were not associated with improved dietary outcomes. The Chicken +

Women's dietary diversity and nutrition trial in Kenya

Nutrition group showed no significant advantage over the Chicken Alone group (mean difference $\Delta = 0.090$, $p = 0.575$). In contrast, the Control group demonstrated significantly higher dietary diversity than both intervention groups (vs. Chicken + Nutrition: $\Delta = -0.327$, $p = 0.001$; vs. Chicken Alone: $\Delta = -0.417$, $p < 0.001$). These results suggest that the interventions had limited or even negative impacts in Bomet during the baseline phase.

Conversely, Kakamega County showed positive outcomes. The Chicken + Nutrition intervention significantly outperformed both the Chicken Alone ($\Delta = 0.323$, $p = 0.002$) and Control groups ($\Delta = 0.250$, $p = 0.022$), indicating that the integrated approach was more effective in improving dietary diversity in this context.

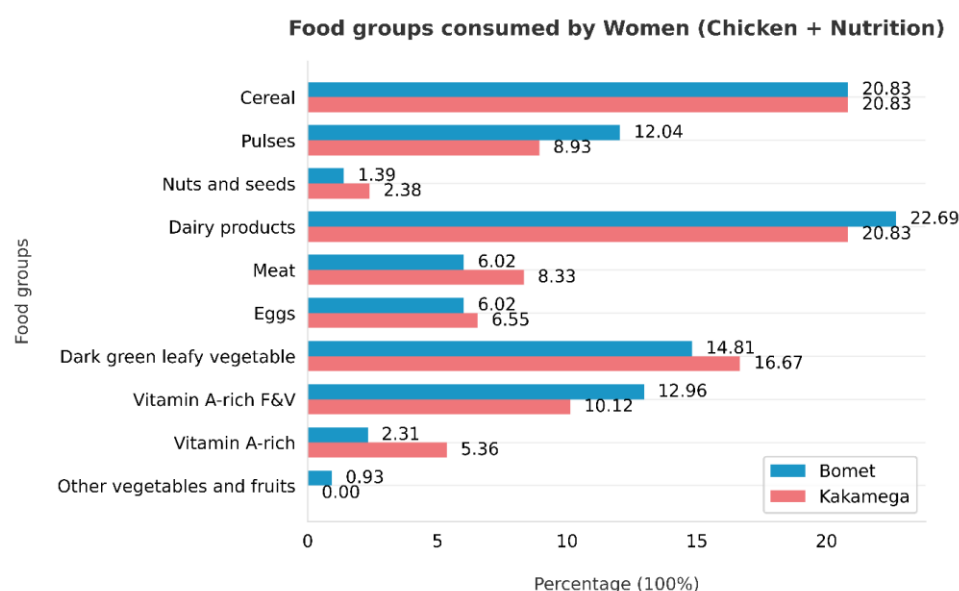


Figure 3: Food groups women consume within the chicken + nutrition arm in Bomet and Kakamega Counties at baseline

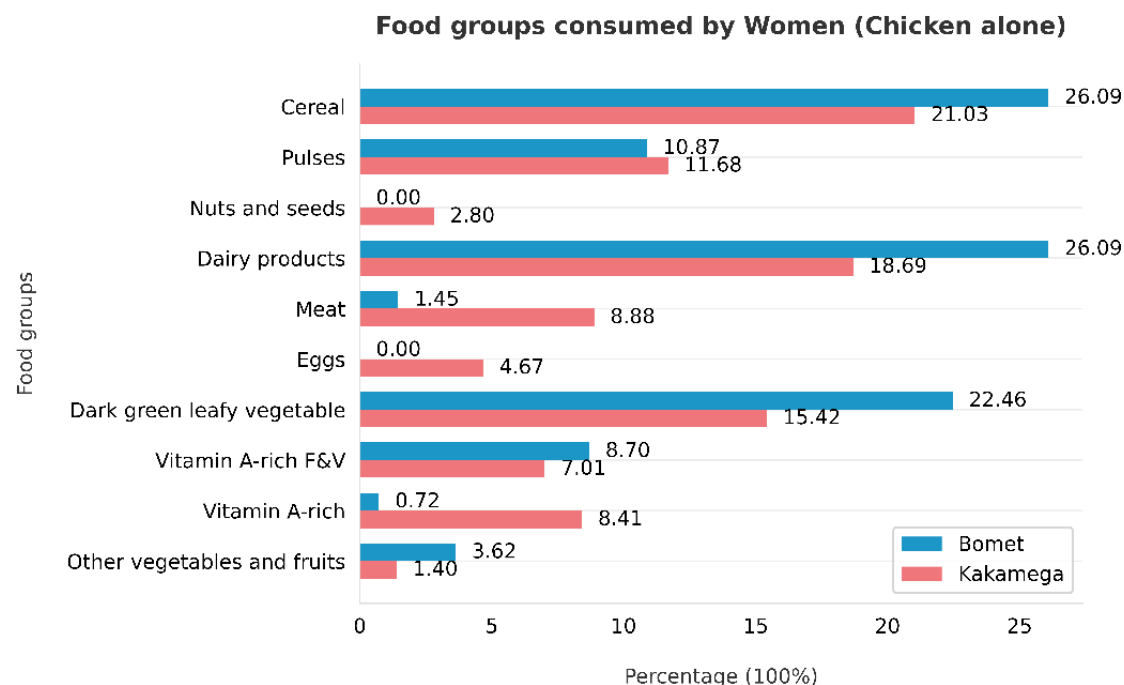


Figure 4: Food groups consumed by women within the chicken arm in Kakamega and Bomet counties at baseline

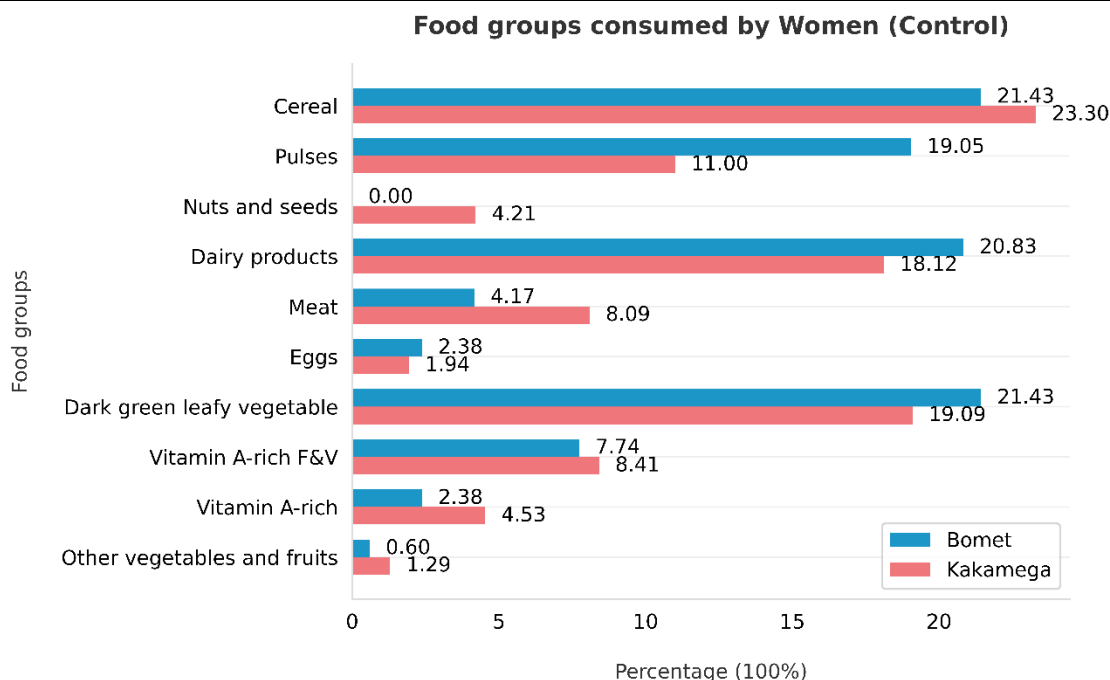


Figure 5: Food groups consumed by women within the control arm in Bomet and Kakamega Counties at baseline

Comparative Outcomes Across Sites: Further comparative analysis revealed stark differences in intervention effectiveness across locations. In Doyogena, the Chicken Alone intervention resulted in a sharp decline in the proportion of women meeting the minimum dietary diversity threshold, from 52% to 29% ($p < 0.001$). A similar decline occurred in Karat Zuria, where the proportion dropped from 29% to 6% ($p < 0.001$), demonstrating that provision of chickens alone—without complementary education—may be inadequate or even detrimental.

In contrast, the Chicken + Nutrition intervention produced positive outcomes. In Doyogena, dietary diversity improved modestly from 72% to 76% ($p = 0.045$). More notably, in Karat Zuria, this integrated approach significantly increased the proportion of women meeting the dietary threshold from 29% to 55% ($p = 0.002$). These findings underscore the importance of pairing resource-based interventions with behavior change strategies. Simply providing chickens did not guarantee improved nutrition; rather, combining asset transfers with targeted nutrition education proved substantially more effective, especially in resource-constrained settings.

Discussion

This study highlights significant challenges in achieving adequate dietary diversity among women in Bomet and Kakamega counties, with 64.5% of participants failing to meet the Minimum Dietary Diversity for Women (MDD-W) threshold of five food

groups (Masito, 2020). The mean dietary diversity score of 4.27 ± 1.25 indicates widespread inadequacy in micronutrient intake. These findings are consistent with prior research showing similar patterns among Kenyan women, where diets are largely dominated by cereals (21.6%) and dairy products (20.0%), while nutrient-dense foods such as eggs (4.7%), nuts and seeds (2.8%), and vitamin A-rich fruits and vegetables (9.6%) remain severely under-consumed (Wayua et al. 2020).

In Kakamega County, 62.0% of women failed to meet MDD-W standards. Although the region's warm climate supports vegetable production, consumption of other fruits (1.0%) and eggs (3.9%) was notably low (Ombogo 2017; Musotsi et al. 2023). The diet was primarily composed of cereals (22.0%) and dark green leafy vegetables (17.4%) (Wayua et al. 2020; Ombogo 2017). In Bomet County, dietary diversity was even lower, with 67.8% of women below the MDD-W threshold. Dairy (23.0%) and cereals (22.4%) dominated, reflecting a cultural preference for fermented milk products (Mwita 2019). However, intake of vitamin A-rich vegetables (1.9%) and other fruits (1.5%) was significantly limited, potentially due to agricultural practices like tea farming that constrain vegetable production (Gómez et al. 2020).

Intervention outcomes revealed significant differences between the two counties. In Kakamega, the Chicken + Nutrition intervention led to a statistically significant improvement in dietary diversity compared to the

Women's dietary diversity and nutrition trial in Kenya

Chicken Alone group (mean difference = 0.323, $p = 0.002$), demonstrating the added value of coupling food provision with targeted nutrition education (Wiafe et al. 2023). In contrast, in Bomet County, the control group showed higher dietary diversity than both intervention groups (Chicken + Nutrition: $\Delta = -0.327$, $p = 0.001$; Chicken Alone: $\Delta = -0.417$, $p < 0.001$), suggesting that existing interventions were either ineffective or poorly adapted to the local context (Bastian et al. 2021). The lack of improvement in the Chicken Alone group further reinforces evidence that food provision without accompanying education is insufficient to drive meaningful dietary change (Durao et al. 2020).

These findings carry several important implications. First, the effectiveness of the integrated Chicken + Nutrition model in Kakamega (95% CI: 0.03–0.47) supports the broader use of combined agricultural and educational approaches in nutrition-sensitive interventions (Margolies et al. 2022; Connolly et al. 2022). Second, the divergent results in Bomet underscore the importance of developing culturally and contextually appropriate nutrition education strategies that align with local food systems, cultural preferences, and literacy levels (Papp et al. 2023). Lastly, the persistently low consumption of nutrient-rich foods across both counties highlights a systemic need for improved food production, access, and availability—particularly for vitamin A-rich fruits and vegetables, as well as protein sources such as eggs and legumes.

While the study provides valuable baseline insights, its limitations must be acknowledged. The results reflect pre-intervention conditions; thus, the actual impact of the interventions will need to be evaluated using follow-up data. Furthermore, the observed regional differences in agriculture, cultural norms, and socioeconomic factors highlight the necessity of localized and adaptive program designs. Future research should assess the long-term effects of integrated interventions and explore strategies to overcome structural barriers to dietary diversity, such as limited food availability, income constraints, and inadequate agricultural diversification.

Overall, these results contribute to a growing body of evidence supporting multifaceted approaches to address micronutrient deficiencies in rural Kenya and similar low-resource settings (Wiafe et al. 2023; Durao et al. 2020; Papp et al. 2023).

Conclusion

This study highlights the critical issue of inadequate dietary diversity among women in Bomet and Kakamega counties, with over 64% failing to meet the

Minimum Dietary Diversity for Women (MDD-W) threshold. While the integrated Chicken + Nutrition intervention significantly improved dietary outcomes in Kakamega, its limited effectiveness in Bomet underscores the importance of context-specific approaches that consider cultural, agricultural, and educational factors. The findings demonstrate that food provision alone is insufficient and must be complemented by targeted nutrition education to effectively address micronutrient deficiencies. Overall, the results support the need for multifaceted, locally tailored strategies that combine agriculture, education, and behavioral change to enhance women's nutrition and promote sustainable improvements in diet quality across rural communities in Kenya.

Recommendation

Based on the findings, we recommend implementing context-specific nutrition education programs, with particular attention to replicating and scaling the successful Chicken + Nutrition model observed in Kakamega County. In Bomet County, interventions should be tailored to the local context, taking into account dietary preferences, agricultural constraints, and education levels. Future programs should integrate local knowledge and practices, continuously monitor outcomes, and remain flexible to adapt to changing needs. Policymakers should prioritize region-specific strategies that link nutrition education with sustainable agricultural development to enhance dietary diversity and combat micronutrient deficiencies across Kenyan communities.

References

- Bastian GE, Buro D & Palmer-Keenan DM (2021). Recommendations for integrating evidence-based, sustainable diet information into nutrition education. *Nutrients*, 13(12): 4170.
- Bosuben MC (2018). Barriers facing women in access to, control over and ownership of land in Bomet East Subcounty, Bomet County, Kenya. University of Nairobi.
- Chakona G & Shackleton C (2017). Minimum dietary diversity scores for women indicate micronutrient adequacy and food insecurity status in South African towns. *Nutrients*, 9(8): 812.
- Connolly G, Clark CM, Campbell RE, Byers AW, Reed JB & Campbell WW (2022). Poultry consumption and human health: how much is really known? A systematically searched scoping review and research perspective. *Advances in Nutrition*, 13(6): 2115–2124.
- Durao S, Visser ME, Ramokolo V, Oliveira JM, Schmidt BM, Balakrishna Y, et al. (2020). Community-level interventions for improving access to food in low- and middle-income

Women's dietary diversity and nutrition trial in Kenya

- countries. *Cochrane Database of Systematic Reviews*, 2020(5): CD011505.
- Gomez G, Nogueira Previdelli A, Fisberg RM, Kovalskys I, Fisberg M, Herrera-Cuenca M, et al. (2020). Dietary diversity and micronutrient adequacy in women of childbearing age: results from ELANS study. *Nutrients*, 12(7): 1994.
- Hanley-Cook GT, Tung JYA, Sattamini IF, Marinda PA, Thong K, Zerfu D, et al. (2020). Minimum dietary diversity for women of reproductive age (MDD-W) data collection: validity of the list-based and open recall methods as compared to weighed food record. *Nutrients*, 12(8): 2039.
- Issa MY, Diagana Y, Khalid EK, Coulibaly SM, Gueye A, Dehah RM, et al. (2024). Dietary diversity and its determinants among women of reproductive age residing in the urban area of Nouakchott, Mauritania. *BMC Public Health*, 24: 916.
- Margolies A, Kemp CG, Choo EM, Levin C, Olney D, Kumar N, et al. (2022). Nutrition-sensitive agriculture programs increase dietary diversity in children under 5 years: a review and meta-analysis. *Journal of Global Health*, 12: 05003.
- Masito SS (2020). Effects of edaphic factors and agronomic practices on cyanide content (bitterness) in improved cassava varieties in coastal Kenya. Pwani University.
- Musotsi AA, Ali U, Mungai A & Maingi Z (2023). Dietary diversity during COVID-19 pandemic: a case of households in Lurambi and Malava sub-counties, Kakamega County. *African Journal of Food, Agriculture, Nutrition and Development*, 23(2): 23263–23284.
- Mwita E (2019). Impact of information and communication technology-based extension services on dairy production and household welfare: the case of iCow service in Kenya. University of Nairobi.
- Ombogo J (2017). Food security problems in various income groups of Kakamega County. *Journal of Nutrition and Health Food Engineering*, 7(3): 222–226.
- Papp RE, Hasenegger V, Ekmekcioglu C & Schwingshackl L (2023). Association of poultry consumption with cardiovascular diseases and all-cause mortality: a systematic review and dose-response meta-analysis of prospective cohort studies. *Critical Reviews in Food Science and Nutrition*, 63(11): 2366–2387.
- Ruel MT, Quisumbing AR & Balagamwala M (2018). Nutrition-sensitive agriculture: what have we learned so far? *Global Food Security*, 17: 128–153.
- Shashikantha S, Sheethal M & Vishma B (2016). Dietary diversity among women in the reproductive age group in a rural field practice area of a medical college in Mandya District, Karnataka, India. *International Journal of Community Medicine and Public Health*, 3(3): 746–749.
- Stevens GA, Finucane MM, Paciorek CJ, Flaxman SR, White RA, Donner AJ, et al. (2012). Trends in mild, moderate, and severe stunting and underweight, and progress towards Millennium Development Goal 1 in 141 developing countries: a systematic analysis of population representative data. *The Lancet*, 380(9844): 824–834.
- UNICEF (2023). *The State of Food Security and Nutrition in the World 2023*. United Nations Children's Fund.
- Wayua F, Ndinya C, Makete N, Odendo M, Onyango E, Mudeheri M, et al. (2020). Participatory farmer evaluation of selected African indigenous vegetables for enhanced food and nutrition security in Western Kenya. *Journal of Medicinally Active Plants*, 9(4): 123–134.
- Webb P & Kennedy E (2014). Impacts of agriculture on nutrition: nature of the evidence and research gaps. *Food and Nutrition Bulletin*, 35(2): 126–132.
- Wiafe MA, Apprey C & Annan RA (2023). Dietary diversity and nutritional status of adolescents in rural Ghana. *Nutrition and Metabolic Insights*, 16: 11786388231158487.