Journal of Current Health Sciences. 2026, 6(4): 193-204
DOI: https://doi.org/10.47679/jchs.2026185
ISSN 2809-3275 (print), ISSN 2809-2236 (online)

RESEARCH ARTICLE

Community-Based Positive Deviance Hearth for Improved Feeding Practices and Dietary Intake Among Children in Bomet County, Kenya

Gladys C. Koskei[1 2], Simon Karanja[1], Zipporah W. Ndungu[3], and Calvince O. Anino[2]

Published online: 30 October 2026

Abstract. Background: Inadequate complementary feeding contributes to child undernutrition in Kenya. This study assessed changes in feeding practices and dietary intake associated with a community-based Positive Deviance Hearth (PDH) intervention among moderately underweight children aged 6–59 months in Bomet County. Methods: A controlled, two-group, pretest–posttest quasi-experimental study enrolled 168 caregiver–child pairs (84 per group), with one ward assigned to each study arm. The intervention comprised 12 participatory PDH sessions and home visits over six months; controls received routine community health services. Endline data were available for 155 participants (76 intervention; 79 control). Five caregiver-reported feeding practices were primary outcomes; food-group consumption and estimated nutrient intake were secondary outcomes. Dietary intake was estimated using a single 24-hour recall at each assessment time point. Unadjusted difference-in-differences (DiD) estimates compared baseline-to-endline changes, with Holm adjustment for multiple comparisons. Results: All five feeding practices improved more in the intervention group. Study-defined adequate meal frequency increased by 23.5 percentage points (pp; 95% CI: 2.8–44.1), adequate dietary diversity by 27.4 pp (95% CI: 6.9–47.9), and child-specific meal preparation by 41.2 pp (95% CI: 21.4–61.0). Consumption of legumes, animal-source foods, and fruits and vegetables also increased more (DiD: 25.4–32.8 pp). Estimated protein intake increased across age groups (DiD: 2.3–4.9 g/day; Holm-adjusted $p < .001$). Iron and calcium intake increased in selected age groups, whereas energy intake showed no significant between-group differences. Conclusions: PDH participation was associated with improved feeding practices and selected dietary outcomes. Because each arm comprised one ward, causal attribution remains limited; multisite evaluations are warranted.

Keywords: Positive Deviance Hearth; complementary feeding; caregiver feeding practices; dietary diversity; nutrient intake; child undernutrition; Kenya.

INTRODUCTION

Child undernutrition remains a major global public health problem, disproportionately affecting low- and middle-income countries, and contributes to nearly half of all deaths among children under five years through increased susceptibility to infectious disease (UNICEF, WHO, & The World Bank, 2025; World Health Organization, 2024). It impairs growth, cognitive development, educational attainment, and economic productivity across the life course (Wells et al., 2020). In 2023, approximately 150 million children under five years were stunted and 44 million were wasted (UNICEF, 2023; World Health Organization, 2024). Progress towards Sustainable Development Goals 2 and 3 remains uneven, particularly in sub-Saharan Africa (United Nations Children's Fund, 2020). Child feeding practices are a key modifiable determinant of this burden. WHO recommends exclusive breastfeeding for six months, followed by safe, adequate complementary foods with continued breastfeeding to two years and beyond (World Health Organization, 2023). Adherence remains suboptimal. Conventional nutrition education, supplementation, and food-aid programmes have often failed to improve feeding durably because they overlook local socio-cultural constraints and intra-household decision-making (David et al., 2023; Keats et al., 2021; Shinde et al., 2025).

In Kenya, 18% of children under five years were stunted, 10% were underweight, and 5% were wasted in 2022, with a

[1] Department of Environmental Health and Disease Control, School of Public Health, Jomo Kenyatta University of Agriculture and Technology, Kenya

[2] Department of Public Health, University of Kabianga, Kericho, Kericho County, Kenya

[3] Department of Human Nutrition Science, School of Food and Nutrition Sciences (SOFNUS), Jomo Kenyatta University of Agriculture and Technology, Kenya

*) *corresponding author*

Gladys C. Koskei

Email: gladyscketer@gmail.com

Submitted: 07 June 2026 Revised: 09 October 2026 Accepted: 24 October 2026

considerably higher burden in food-insecure, agrarian counties such as Bomet (KNBS & ICF, 2023). Bomet County is characterised by poverty, tea-based and smallholder livelihoods, household food insecurity, and cultural feeding norms that constrain child feeding and dietary diversity (Korir et al., 2022; Mwangangi et al., 2019). The county reported a 22% prevalence of undernutrition among children under five years in 2022 (KNBS & ICF, 2023). Within Bomet, Kenya Health Information System (KHIS) data from 2018 to 2022 identified persistent undernutrition affecting more than 3,500 children under five years between 2018 and 2022 in Konoin Sub-County, attributed to low maternal education, cultural beliefs, and household food insecurity.

The Positive Deviance Hearth (PDH) approach is based on the observation that, within high-risk communities, some households achieve better child nutrition outcomes through uncommon but locally available and affordable behaviours despite similar constraints (Baxter & Lawton, 2022; Putri et al., 2024). Beyond a programme model, PDH can be understood as a mechanism of behaviour change grounded in social cognitive theory (Bandura, 1977, 1986). Identifying successful local practices provides credible, context-appropriate behavioural models. Caregivers of undernourished children acquire these behaviours through observational learning during cooking demonstrations and experiential learning during supervised practical feeding (Sari et al., 2023; World Vision, 2025).

Peer reinforcement and facilitator follow-up strengthen caregiver self-efficacy, which leads to changes in feeding behaviour, improved dietary intake, and potentially improved nutritional status. The evidence for this pathway is inconsistent. Some studies report short-term gains in caregiver knowledge, dietary intake, and nutrition outcomes (David et al., 2023; World Vision, 2025), while others report gains that are not sustained or that depend on scalability and contextual adaptation (Cohen et al., 2020; Young et al., 2021). Controlled evaluations of the effect of PDH on feeding practices in Kenya are few (David et al., 2023; Ombogo et al., 2026), leaving a gap in context-specific evidence for practice and policy. A systematic review and meta-analysis by Triatmaja et al. (2023) found no statistically significant pooled effects of positive deviance interventions on length-for-age, weight-for-age, or weight-for-height Z-scores among children under five, highlighting the need for further context-specific evaluations to clarify intervention effectiveness and its potential mechanisms.

This study therefore evaluated the effect of a community-based PDH intervention, compared with usual community health services, on feeding practices among moderately underweight children aged 6–59 months (weight-for-age Z-score between −3 and −2 SD of the WHO Child Growth Standards) in Konoin Sub-County, Bomet County, over six months. The primary outcomes were meal frequency and dietary diversity, and the secondary outcomes were consumption of nutrient-dense food groups and estimated macro- and micronutrient intake. We hypothesised that children in the PDH arm would show greater improvement from baseline to endline in these outcomes than children receiving usual care.

METHODS

Study Design and Settings

The study adopted a two-group, pretest–posttest quasi-experimental study in Konoin Sub-County, Bomet County, Kenya. Baseline data were collected in January–February 2025, the intervention was implemented from 9 to 21 March 2025, and endline data were collected in September 2025, approximately six months after the start of the intervention. The study therefore covered January to September 2025. The study involved intervention and control groups, particularly comparing a community-based Positive Deviance Hearth (PDH) intervention group with a comparison (control) group. The design allowed comparison of change over time in the two groups, thereby controlling for time-invariant baseline differences between them. The study is reported according to the TREND statement for non-randomized evaluations (Des Jarlais et al., 2004); the intervention is described following the TIDieR checklist (Hoffmann et al., 2014), and dietary assessment methods follow STROBE-nut (Lachat et al., 2016). Bomet County has a persistent burden of malnutrition among under five, with overall pervalence of 22% in 2022 (KNBS & ICF, 2023). This could be attributed to rural agrarian livelihoods, relatively higher poverty levels, food insecurity due to reliance on cash crop (tea) farming and suboptimal infant and young child feeding (IYCF) practices (Korir et al., 2022; Mwangangi et al., 2019).

Selection and Allocation of Study Wards

Konoin Sub-County was purposively selected because of its high malnutrition burden and two wards (Mogogosiek and Chepchabas) were randomly selected from the sub-county. Allocation to study arm was made at ward level, with one ward serving as the intervention site and the other as the comparison site. Study arms were assigned by programmatic considerations, such as the formative inquiry on positive deviant practices was conducted in Mogogosiek ward (the intervention ward), and Chepchabas was the comparison ward. To minimize contamination of the comparison group through community health volunteers (CHVs) and caregiver peer networks, PDH facilitators, and intervention materials were confined to the intervention ward, and no PDH activities were conducted in the comparison ward during the study.

Study Population and Eligibility

The study population comprised caregiver–child pairs. The primary caregiver was the adult household member responsible for the day-to-day feeding of the index child, regardless of biological relationship. Children were eligible if they were aged 6–59 months and moderately underweight, defined as a weight-for-age Z-score between −3 and −2 SD according to the WHO Child Growth Standards. Children with severe underweight (WAZ ≤ -3), congenital abnormalities, or medical conditions requiring specialized care that could influence feeding were excluded. Children identified with severe malnutrition were referred to the nearest health facility for appropriate care.

Sample Size and Sampling

An a priori sample-size calculation was performed using G*Power 3.1.9.7. A small effect size of f=0.122 was estimated from pilot data and used for the sample size calculation. With a two-sided α=0.05, 80% power, two measurement time points, a within-participant correlation of 0.50, and ε=1, the minimum required analyzable sample was 134 participants (67 per group). Allowing for 20% attrition, the recruitment target was calculated as 134/0.80=167.5 and rounded up to 168 participants (84 per group).

Community health promoters (CHPs), community nutritionists, and the principal investigators conducted case

identification over three weeks. They weighed and classified all children aged 6–59 months in each ward using WHO standards, which formed the sampling frame. Participants were drawn from the frame by simple random sampling until 84 per arm were enrolled. Caregivers who declined were replaced by the next randomly selected eligible child.

Intervention

The PDH intervention was implemented as a structured, community-based behavior change package grounded in the positive deviance approach. Positive deviant households were defined as households in the study area with well-nourished children (WAZ ≥ −2 SD) despite socio-economic constraints similar to those of their neighbours. They were identified through community anthropometric screening supported by CHPs, who know households with children aged 6–59 months (Figure 1). Forty positive deviant households in Mogogosiek Ward were purposively selected for formative inquiry, and four focus group discussions were held, each with ten primary caregivers. The commonly reported practices were at least four meals daily, daily consumption of at least three locally available food groups, separate preparation of the child's food, handwashing before food preparation and feeding, and responsive feeding.

These practices, together with the positive deviance approach, were used to develop a context-specific intervention manual. Each practice became a session module comprising demonstration, caregiver practice, and feedback using locally available ingredients, alongside IYCF, food preparation, hygiene, and responsive caregiving content. The primary mechanisms of behaviour change were observational learning through live demonstrations, experiential learning through caregiver food preparation and supervised child feeding, and peer reinforcement, coaching, and home-visit follow-up to build caregiver self-efficacy. Picture- and model-based job aids, charts, and short videos supported delivery. Their effectiveness relative to other delivery methods was not evaluated.

Twelve sessions of about 180 minutes each were delivered over 9–21 March 2025 to ten hearth groups (groups 1–6 had eight caregivers and groups 7–10 had nine). Ten CHVs and five community nutritionists facilitated the sessions, giving about one facilitator per 5–6 caregivers. They were trained for five days using a standardized PDH facilitator guide and developed intervention manual, covering the positive deviance protocol, IYCF, food preparation, hygiene, responsive caregiving, ethical engagement, facilitation, and recording. After the sessions, caregivers received home visits weekly for the first month and monthly for the remaining five months. Sessions and visits were recorded in attendance and home-visit registers. Fidelity was monitored using session checklists, supervisory observation by two supervisors and the principal investigator, and weekly review meetings with corrective feedback. Full participation was defined as attending at least 10 of the 12 sessions. Mean sessions attended, the proportion completing all 12 sessions, and home visits received. The intervention is described according to the TIDieR checklist (Hoffmann et al., 2014).

Control group

Control caregivers received the standard package under Kenya's primary health care and Community Health Strategy, without any PDH content. This comprised routine growth monitoring, immunization, vitamin A supplementation and deworming according to the national schedule, IYCF counselling during routine facility contacts, and household visits by CHPs. No supplementary feeding programme operated in either ward during the study. Control caregivers did not attend group sessions, cooking demonstrations, or supervised feeding sessions, and they received no intervention materials or additional home visits. Both arms were assessed at identical time points, but intervention caregivers had substantially more contact with study personnel.

Outcomes and Measurements

Trained research assistants administered a pretested, structured questionnaire to primary caregivers in face-to-face interviews at baseline (January-February 2025) and endline (September 2025). Feeding indicators were adapted from the WHO/UNICEF infant and young child feeding (IYCF) indicators (WHO & UNICEF, 2021). The questionnaire was translated into Kalenjin and pretested with 20 caregiver-child pairs in Boito Ward, who were excluded from the study. Internal consistency was acceptable (Cronbach's α = 0.76). The pilot yielded an estimated effect size of f = 0.122 for the primary outcome, which was used in the sample size calculation.

The primary outcomes were five binary feeding practices, reported by caregivers for children aged 6-59 months. Meal-frequency adequacy was defined as consumption of at least four meals or snacks comprising solid, semi-solid, or soft foods during the preceding 24 hours. Because breastfeeding status was not collected, breastfeeding-specific thresholds could not be applied; therefore, the same threshold was applied across the study age range. Dietary diversity was assessed using consumption of seven food groups during the preceding 24 hours: grains, roots and tubers; legumes; milk and dairy products; flesh foods; eggs; vitamin A-rich fruits and vegetables; and other fruits and vegetables. Breast milk was excluded. A dietary diversity score of at least four food groups was classified as adequate (coded 1) children who at less than four food groups were categorized as inadequate dietary diversity. Because breastfeeding was not collected, breastfeeding-specific thresholds could not be applied, and a single threshold, corresponding to the WHO/UNICEF non-breastfed standard (WHO & UNICEF, 2021) and the benchmark observed in positive deviant households, was used for all children.

Responsive feeding was classified as appropriate when the caregiver reported all three behaviours (each scored 0/1): recognising hunger and satiety cues, encouraging without forcing the child to eat, and staying with the child throughout the meal (Black & Aboud, 2011). Feeding during illness was classified as maintained/increased when the caregiver reported offering the same or more food and fluids during the child's most recent illness, and as reduced/stopped otherwise. Child-specific meal preparation was classified as present when the caregiver reported that the child's food was prepared separately, modified, or set aside before unsuitable ingredients were added, and as family meal only otherwise.

Secondary outcomes were consumption of six food-group categories in the previous 24 hours, with flesh foods and eggs combined for analysis but counted separately in the dietary diversity score. Estimated daily macronutrient intake such as energy, protein and carbohydrate, and selected micronutrient intake such as calcium, iron, zinc, vitamin A, vitamin C and folate were also assessed. Intakes were assessed using a single multiple-pass 24-hour recall at each time point (baseline and endline), with probes for mixed dishes, snacks, foods eaten outside the home,

leftovers and supplements. Portion sizes were estimated using calibrated utensils and household measures and converted to grams using locally derived conversion factors. Nutrient intakes were calculated in R using the Kenya Food Composition Tables (FAO & Government of Kenya, 2018), applying edible-portion and cooking-retention factors, and were analysed by age group (6-11, 12-36 and 37-59 months). Breast milk was not quantified, so intakes reflect all other foods and beverages.

Process outcomes were assessed among the 84 enrolled intervention caregivers. Attendance (mean ± SD sessions attended of 12; proportions attending all 12 and at least 10) was taken from session attendance registers, and home visits received (of nine planned) from home-visit logs. Fidelity was the proportion of sessions rated as delivered as planned on supervisor fidelity checklists. Adoption of promoted practices at home was recorded by community health volunteers during home visits.

Research assistants and community health volunteers fluent in Kalenjin and experienced in nutrition research received five days of training on ethical recruitment, questionnaire administration, 24-hour recall technique and portion quantification. Supervisors, led by the principal investigator, conducted daily spot checks, observed interviews, and checked completeness and consistency. Data were double-entered, cross-validated and cleaned.

Data Management and Analysis

Cleaned data were analyzed using R software v.4.5.2. Continuous variables are presented as mean ± SD and categorical variables as n (%); process outcomes were summarized descriptively. Baseline balance between arms was assessed using absolute standardized mean differences (|SMD|; Austin, 2009), with |SMD| < 0.25 indicating acceptable balance. Participants retained and lost to follow-up were compared using Fisher's exact test. Feeding practices were the primary outcomes; food-group consumption and nutrient intake were secondary. All available observations at each time point were analyzed. Intervention effects were estimated using unadjusted difference-in-differences (DiD), defined as the baseline-to-endline change in the intervention group minus that in the control group (Dimick & Ryan, 2014; Wing et al., 2018). For binary outcomes (feeding practices and food-group consumption), DiD was expressed in percentage points, with 95% CIs and p-values from Wald z-tests. For nutrient intakes, analyzed by age group (6-11, 12-36 and 37-59 months), DiD was the difference in mean change, with 95% CIs and p-values from Welch-Satterthwaite t-tests. Baseline and endline observations were analysed using group- and time-specific variances. Holm's correction (Holm, 1979) was applied across the five primary feeding practices and, within each age group, separately across macronutrient and micronutrient analyses. For food-group analyses were considered secondary and were reported without multiplicity adjustment. All tests were two-sided, with statistical significance defined as $p < 0.05$.

RESULTS OF STUDY

Participant flow and baseline characteristics

A total of 168 caregiver–child pairs were enrolled (84 per group). Of these, 76 intervention-group and 79 control-group participants completed the endline assessment (155 of 168; 92.3%); 8 (9.5%) and 5 (6.0%) were lost to follow-up, respectively. Thirteen participants were lost to follow-up, including six who relocated outside the study area, four who voluntarily withdrew (three during intervention implementation and one immediately after), and three who were lost to contact or repeatedly absent (Figure 2). The analysis included all available observations, baseline (n=84 per arm) and endline (n=79 for control group and n=76 for intervention group). Baseline characteristics were compared between participants who completed the endline assessment and those lost to follow-up, with no statistically significant differences observed across the characteristics assessed ($p > 0.05$). At baseline, the groups were similar in child age, child sex, caregivers' age and household size (SMD < 0.25) but showed potentially meaningful imbalances in marital status (|SMD| up to 0.49; 45.2% of control and 22.6% of intervention caregivers were single) (Table 1).

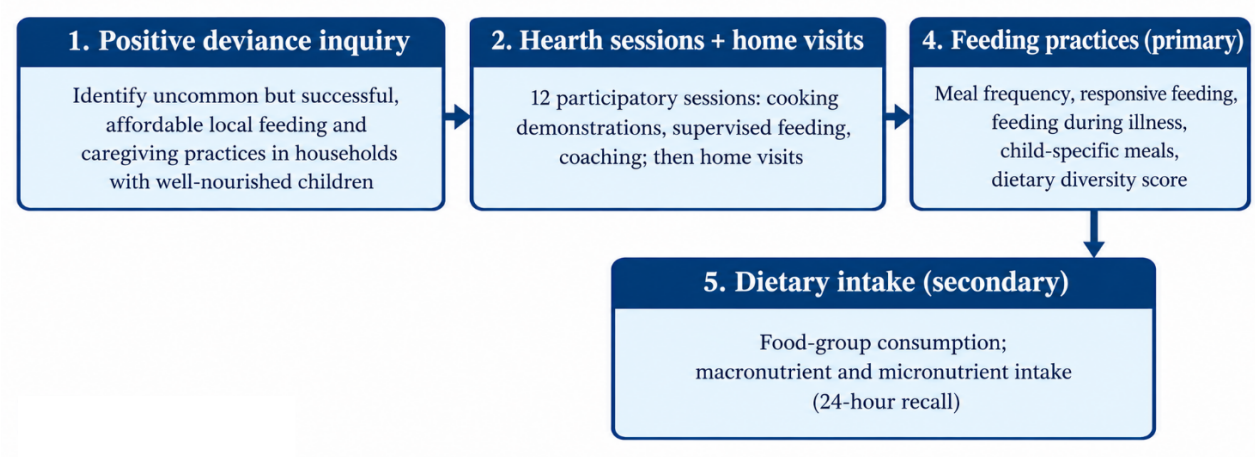


Figure 1. Pathway linking the Positive Deviance Hearth (PDH) intervention to feeding practices and dietary intake.

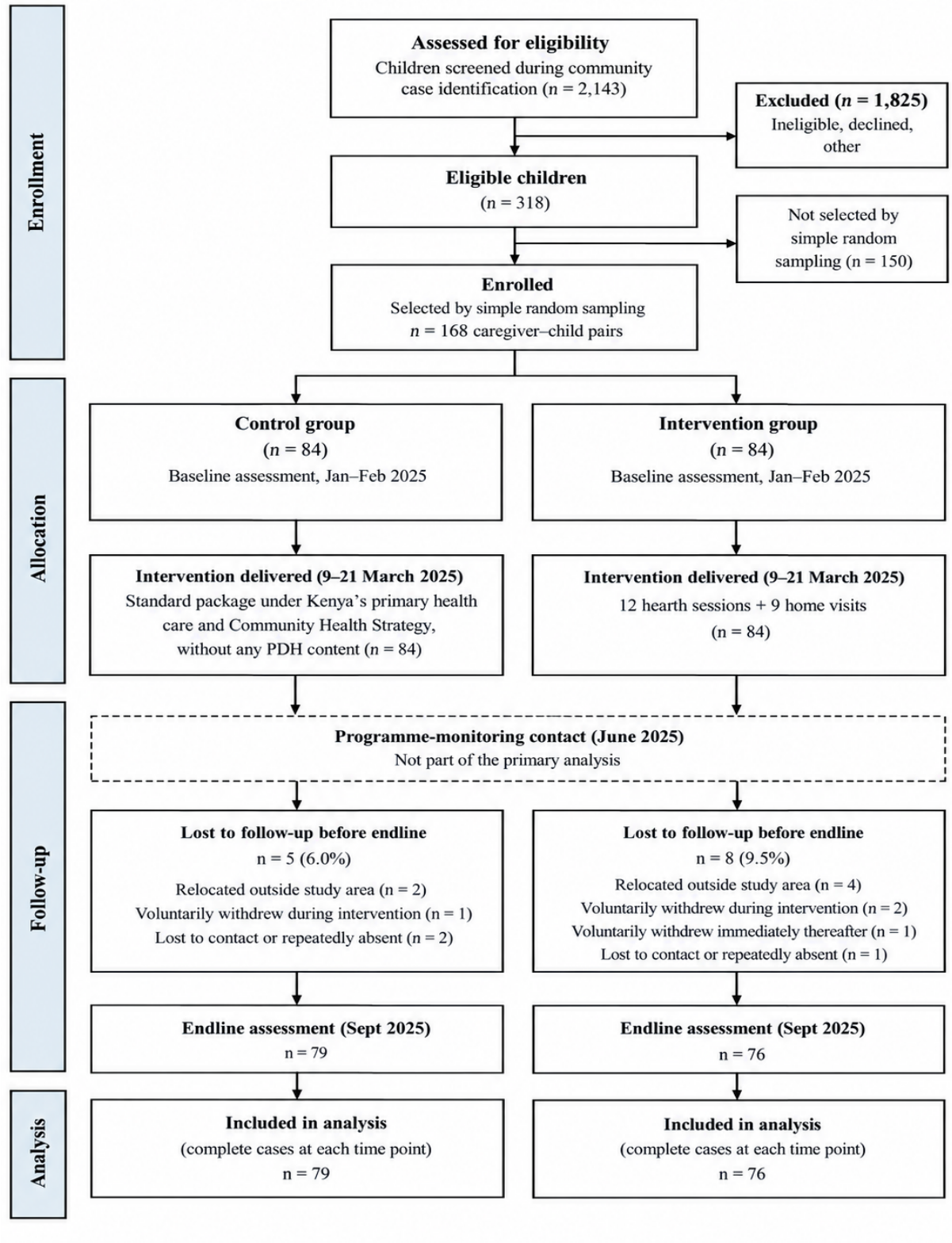


Figure 2. TREND flow diagram of participants through the study

Intervention implementation and fidelity

Caregivers in the intervention group attended a mean of 10.43 (SD 3.50) of the 12 sessions; 58 (69.0%) attended all 12 sessions, and 76 (90.5%) attended at least 10 sessions. Intervention caregivers received a mean of 8.1 home visits out of 9 planned home visits. The practices most frequently adopted at home were improved dietary diversity, handwashing at critical times, safe water handling, appropriate child feeding practices, and improved oral hygiene. Supervisors' fidelity checks rated 93.8% of sessions as delivered as planned.

Feeding Practices among participants

All five feeding practices improved significantly more in the intervention group than in the control group (Table 2). The largest difference-in-differences (DiD) was observed for child-specific meal preparation (+41.2 percentage points [pp], 95% CI 21.4–61.0), followed by responsive feeding

(+35.1 pp, 95% CI 15.0–55.2) and feeding during illness (+33.7 pp, 95% CI 13.4–54.0). Significant improvements were also observed for adequate dietary diversity score (+27.4 pp, 95% CI 6.9–47.9) and adequate meal frequency (+23.5 pp, 95% CI 2.8–44.1). All five effects remained statistically significant after Holm adjustment (adjusted p < 0.05).

Table 1. Baseline characteristics of children and caregivers by study group, with the endline analysis sample

Characteristic	Baseline (all enrolled)		SMD	Endline (analyzed)	
	Control n (%)	Intervention n (%)		Control n (%)	Intervention n (%)
Child age (months)					
6–11	14 (16.7)	20 (23.8)	0.18	13 (16.5)	19 (25.0)
12–36	30 (35.7)	26 (31.0)	0.10	29 (36.7)	24 (31.6)
37–59	40 (47.6)	38 (45.2)	0.05	37 (46.8)	33 (43.4)
Child sex					
Female	50 (59.5)	40 (47.6)	0.24	46 (58.2)	39 (51.3)
Male	34 (40.5)	44 (52.4)	0.24	33 (41.8)	37 (48.7)
Caregiver age (years)					
< 30	63 (75.0)	55 (65.5)	0.22	59 (74.7)	49 (64.5)
≥ 30	21 (25.0)	29 (34.5)	0.22	20 (25.3)	27 (35.5)
Caregiver sex					
Female	75 (89.3)	69 (82.1)	0.21	70 (88.6)	64 (84.2)
Male	9 (10.7)	15 (17.9)	0.21	9 (11.4)	12 (15.8)
Caregiver marital status					
Single	38 (45.2)	19 (22.6)	0.49	35 (44.3)	17 (22.4)
Married	43 (51.2)	62 (73.8)	0.48	41 (51.9)	56 (73.7)
Divorced/separated	3 (3.6)	1 (1.2)	0.16	3 (3.8)	1 (1.3)
Widowed	0 (0.0)	2 (2.4)	0.22	0 (0.0)	2 (2.6)
Household size (members)					
≤4	54 (64.3)	56 (66.7)	0.05	50 (63.3)	51 (67.1)
5–7	26 (31.0)	23 (27.4)	0.08	25 (31.6)	20 (26.3)
>7	4 (4.8)	5 (6.0)	0.05	4 (5.1)	5 (6.6)

Note: Percentages use the number enrolled (84 per group) at baseline and the number analyzed at endline (79 control, 76 intervention). |SMD| = absolute standardized mean difference between groups at baseline, |SMD| > 0.25 suggest a potentially meaningful imbalance.

Table 2. Feeding practices among participants in intervention and control groups

Outcome	Baseline		Endline		DiD, pp (95% CI)	*p*	Holm-adj. *p*
	Control	Intervention	Control	Intervention			
	N (%)	N (%)	N (%)	N (%)			
Meal frequency							
Adequate	38 (45.2)	40 (47.6)	43 (54.4)	61 (80.3)	+23.5 (2.8 - 44.1)	0.026	0.026
Inadequate	46 (54.8)	44 (52.4)	36 (45.6)	15 (19.7)			
Dietary diversity score							
Adequate	34 (40.5)	37 (44.0)	40 (50.6)	62 (81.6)	+27.4 (6.9 - 47.9)	0.009	0.018
Inadequate	50 (59.5)	47 (56.0)	39 (49.4)	14 (18.4)			
Responsive feeding							
Appropriate	33 (39.3)	36 (42.9)	37 (46.8)	65 (85.5)	+35.1 (15.0 - 55.2)	<0.001	0.002
Not appropriate	51 (60.7)	48 (57.1)	42 (53.2)	11 (14.5)			
Feeding during illness							
Maintained/increased	31 (36.9)	34 (40.5)	35 (44.3)	62 (81.6)	+33.7 (13.4 - 54.0)	0.001	0.003
Reduced/stopped	53 (63.1)	50 (59.5)	44 (55.7)	14 (18.4)			
Child-specific meal preparation							
Child-specific meal prepared	26 (31.0)	28 (33.3)	29 (36.7)	61 (80.3)	+41.2 (21.4 - 61.0)	<0.001	<0.001
Family meal only	58 (69.0)	56 (66.7)	50 (63.3)	15 (19.7)			

Note: DiD = difference-in-differences; pp = percentage points; CI = confidence interval. DiD estimates represent the between-group difference in change from baseline to endline. Holm-adjusted p values account for the five primary outcomes.

Food Group Consumption among participants

The participants heavily relied on grains, roots and tubers (≥90%) and milk and dairy products (71.4–72.6%) with low intake of legumes, animal-source foods, and fruits and vegetables at baseline. Consumption of several food groups improved more in the intervention group than in the control group at endline. The intervention was associated with greater increases in consumption of flesh foods and eggs (+32.8 percentage points [pp], 95% CI 13.5–52.0; p<0.001), followed by legumes (+29.4 pp, 95% CI 8.6–50.1; p=0.006), other fruits and vegetables (+26.8 pp, 95% CI 5.9–47.8; p=0.011), and vitamin A-rich fruits and vegetables (+25.4 pp, 95% CI 4.9–45.8; p=0.015). Changes in grains, roots and tubers (+2.2 pp; 95% CI −9.7 to 14.0; p = 0.72) and in milk and dairy products (+7.9 pp; 95% CI −11.4 to 27.2; p = 0.42) did not differ between groups (Table 3).

Macronutrient Intake among Under-Five Children

Protein intake increased significantly more in the intervention group than in the control group across all age groups, with DiD estimates of 2.3 g/day (95% CI 1.1 to 3.5), 4.9 g/day (95% CI 3.3 to 6.5), and 4.5 g/day (95% CI 2.7 to 6.3) among children aged 6–11, 12–36, and 37–59 months, respectively (all Holm-adjusted p <0.001). Carbohydrate intake showed a significant between-group increase only among children aged 6–11 months (DiD 13.8 g/day, 95% CI 2.3 to 25.3; Holm-adjusted p =0.041). No significant between-group differences were observed for energy intake (Table 4).

Micronutrient Intake among Under-Five Children

Micronutrient intake showed greater between group increases for selected nutrients. Among children aged 6–11 months, the intervention group had a greater increase in iron intake than the control group (DiD 0.80 mg/day, 95% CI 0.28 to 1.32; Holm adjusted p=0.019). Among children aged 12–36 months, greater increases were observed for calcium (DiD 39 mg/day, 95% CI 12.9 to 65.1; Holm adjusted p=0.025) and iron (DiD 0.90 mg/day, 95% CI 0.26 to 1.54; Holm adjusted p=0.033). Although several additional nutrients showed nominally significant between group differences before adjustment, these did not remain statistically significant after Holm correction (Table 5).

Table 3. Consumption of individual food groups at baseline and endline

Food group	Baseline		Endline		DiD, pp (95% CI)	*p*
	Control	Intervention	Control	Intervention		
	N (%)	N (%)	N (%)	N (%)		
Grains, roots and tubers	78 (92.9)	77 (91.7)	72 (91.1)	70 (92.1)	+2.2 (-9.7 −14.0)	0.72
Legumes	29 (34.5)	31 (36.9)	30 (38.0)	53 (69.7)	+29.4 (8.6 – 50.1)	0.006
Milk and dairy products	61 (72.6)	60 (71.4)	56 (70.9)	59 (77.6)	+7.9 (-11.4 – 27.2)	0.420
Flesh foods and eggs (fish, eggs, meat, other animal-source foods)	18 (21.4)	20 (23.8)	19 (24.1)	45 (59.2)	+32.8 (13.5 – 52.0)	<0.001
Vitamin A-rich fruits and vegetables	24 (28.6)	27 (32.1)	26 (32.9)	47 (61.8)	+25.4 (4.9 – 45.8)	0.015
Other fruits and vegetables	31 (36.9)	33 (39.3)	32 (40.5)	53 (69.7)	+26.8 (5.9 – 47.8)	0.011

Note: pp = percentage points; CI = confidence interval; DiD = difference-in-differences; Flesh foods and eggs are shown as a single category; for the seven-group DDS they are counted as two groups. Values are children consuming each food group ("Yes") in the previous 24 hours.

Table 4. Estimated energy and macronutrient intake and between-group differences in change, by child age group

Macronutrient	Baseline		Endline		DiD (95% CI)	*p* value	Holm adj. *p*
	Control	Intervention	Control	Intervention			
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD			
6–11 months							
Energy (kcal)	528 ± 98.4	533 ± 101.6	538 ± 101.2	619 ± 109.4	+76 (-4 – 156)	0.061	0.061
Protein (g)	5.9 ± 1.4	6.1 ± 1.3	6.3 ± 1.5	8.8 ± 1.8	+2.3 (1.1 – 3.5)	<0.001	<0.001
Carbohydrates (g)	76.4 ± 13.8	75.9 ± 14.6	78.3 ± 14.9	91.6 ± 16.2	+13.8 (2.3 – 25.3)	0.020	0.041
12–36 months							
Energy (kcal)	856 ± 148.7	841 ± 136.2	871 ± 157.8	913 ± 169.6	+57 (-44 – 158)	0.262	0.262
Protein (g)	7.3 ± 2.1	7.5 ± 2.3	7.6 ± 2.5	12.7 ± 2.8	+4.9 (3.3 – 6.5)	<0.001	<0.001
Carbohydrates (g)	98.5 ± 17.8	97.1 ± 19.1	102.8 ± 19.7	111.8 ± 21.6	+10.4 (-2.5 – 23.3)	0.111	0.222
37–59 months							
Energy (kcal)	1098 ± 163.6	1077 ± 171.2	1129 ± 169.5	1168 ± 182.4	+60 (-59 – 179)	0.314	0.629
Protein (g)	8.2 ± 2.3	8.5 ± 2.4	8.8 ± 2.5	13.6 ± 3.1	+4.5 (2.7 – 6.3)	<0.001	<0.001
Carbohydrates (g)	115.6 ± 20.3	116.4 ± 21.5	118.9 ± 22.2	125.1 ± 24.1	+5.4 (-9.9 – 20.7)	0.481	0.629

Note: DiD = difference-in-differences (intervention change minus control change); CI = confidence interval; kcal = kilocalories; g = grams. CIs unadjusted; Holm adjusted within age group across 3 tests; statistically significant difference at p < 0.05.

Table 5. Estimated daily micronutrient intake and between-group differences in change, by child age group

Micronutrient	Baseline		Endline		DiD (95% CI)	p value	Holm adj. p
	Control mean ± SD	Intervention mean ± SD	Control mean ± SD	Intervention mean ± SD			
6–11 months							
Calcium, mg/day	225 ± 42.0	231 ± 44.5	238 ± 45.7	273 ± 51.2	+29 (-2.4 – 60.4)	0.070	0.257
Iron, mg/day	5.5 ± 1.2	5.4 ± 1.3	5.8 ± 1.4	6.5 ± 1.5	+0.80 (0.28 – 1.32)	0.003	0.019
Zinc, mg/day	2.1 ± 0.6	2.0 ± 0.6	2.2 ± 0.7	2.5 ± 0.8	+0.40 (-0.10 – 0.90)	0.115	0.257
Vitamin A, µg/day	235 ± 58.0	228 ± 60.4	253 ± 63.5	286 ± 68.1	+40 (3.1 – 76.9)	0.034	0.171
Vitamin C, mg/day	27.5 ± 7.4	26.1 ± 7.1	30.1 ± 8.0	35.2 ± 8.6	+6.5 (-0.4 – 13.4)	0.064	0.257
Folate, µg/day	68 ± 14.8	66 ± 15.6	71 ± 16.4	78 ± 17.9	+9 (-4.8 – 22.8)	0.197	0.257
12–36 months							
Calcium, mg/day	310 ± 52.0	305 ± 54.1	320 ± 55.7	354 ± 61.8	+39 (12.9 – 65.1)	0.004	0.025
Iron, mg/day	5.4 ± 1.3	5.2 ± 1.5	5.8 ± 1.6	6.5 ± 1.7	+0.90 (0.26 – 1.54)	0.007	0.033
Zinc, mg/day	2.2 ± 0.6	2.1 ± 0.7	2.3 ± 0.8	2.7 ± 0.9	+0.50 (0.09 – 0.91)	0.018	0.062
Vitamin A, µg/day	258 ± 55.0	267 ± 58.4	271 ± 62.5	316 ± 67.1	+36 (7.1 – 64.9)	0.016	0.062
Vitamin C, mg/day	23.0 ± 7.1	21.8 ± 6.8	25.1 ± 7.8	31.2 ± 8.3	+7.3 (0.7 – 13.9)	0.031	0.062
Folate, µg/day	91 ± 21.0	89 ± 20.4	98 ± 24.5	112 ± 27.8	+16 (-2.0 – 34.0)	0.080	0.080
37–59 months							
Calcium, mg/day	430 ± 61.0	442 ± 63.5	450 ± 68.2	492 ± 76.4	+30 (-5.2 – 65.2)	0.093	0.187
Iron, mg/day	5.8 ± 1.5	5.9 ± 1.6	6.2 ± 1.7	7.1 ± 1.9	+0.80 (0.13 – 1.47)	0.020	0.121
Zinc, mg/day	3.1 ± 0.8	3.2 ± 0.9	3.5 ± 0.9	3.9 ± 1.0	+0.30 (-0.08 – 0.68)	0.119	0.187
Vitamin A, µg/day	275 ± 60.5	286 ± 61.8	290 ± 65.7	331 ± 70.3	+30 (2.4 – 57.6)	0.034	0.137
Vitamin C, mg/day	25.0 ± 7.3	24.2 ± 7.0	28.0 ± 8.0	35.0 ± 8.7	+7.8 (0.9 – 14.7)	0.027	0.137
Folate, µg/day	94 ± 23.0	92 ± 22.4	101 ± 26.0	125 ± 30.5	+26 (-1.2 – 53.2)	0.061	0.182

Note: DiD = difference-in-differences (intervention change minus control change); CI = confidence interval; mg = milligram; µg = microgram. Holm adjusted within age groups; CIs unadjusted. Statistically significant difference at $p < 0.05$.

DISCUSSION

In this quasi-experimental study of moderately underweight children aged 6–59 months, participation in a six-month Positive Deviance Hearth (PDH) programme was associated with greater improvement in all five caregiver-reported feeding practices, in consumption of legumes, animal-source foods and fruits and vegetables, and in estimated protein intake. Energy intake and consumption of grains and dairy products did not differ between groups, and iron and calcium intakes increased more only in selected age groups. These outcomes lie at different points on the pathway from programme to child nutrition and should not be conflated: feeding practices are caregiver-reported behaviours, food-group and nutrient outcomes are estimated dietary intakes from a single 24-hour recall, and nutritional status, the enrolment criterion, is not reported here. Better meal frequency or dietary diversity therefore does not by itself demonstrate weight gain, reduced wasting or growth recovery. This distinction is further supported by Triatmaja et al. (2023), whose systematic review and meta-analysis found no statistically significant pooled improvements in anthropometric Z-scores between positive deviance intervention and control groups. These findings suggest that improvements in feeding-related behaviors should not be interpreted as direct evidence of nutritional recovery without corresponding anthropometric measurements.

Evidence from other settings shows why the distinction matters: changes in feeding practices during PDH in Surabaya were not associated with children's nutritional status (Sari et al., 2023), and a PDH programme in Cambodia yielded only modest improvements in child nutrition, with no difference in height-for-age (Young et al., 2021). Weight-based evidence from the same sub-county (Ombogo et al., 2026) is complementary to, and cannot be inferred from, these dietary findings.

The direction and size of the feeding-practice effects are consistent with other PDH and participatory complementary-feeding evaluations. A systematic review found that both randomized PD/Hearth trials improved carers' feeding practices, although more than half of the programmes lacked a control group (Bisits Bullen, 2011); in Ecuador, a quasi-experimental PD/Hearth programme made mothers 1.3 to 5.7 times more likely to feed promoted foods (Roche et al., 2017); and demonstration-based education improved complementary diets in western Kenya, Malawi and Benin (Waswa et al., 2015; Kuchenbecker et al., 2017; Mizehoun-Adissoda et al., 2024). In Migori County, Kenya, feeding frequency was the caregiver practice most strongly associated with weight gain among PDH participants (Anino et al., 2015), a practice the intervention targeted. Behaviours that depend mainly on caregiver skill and decision-making (child-specific preparation, responsive feeding and feeding during illness) changed more than meal frequency and dietary diversity, which also depend on household food supply. This ordering is compatible with an intervention

built on demonstration, supervised practice and home-visit coaching, in line with social cognitive theory, although mechanisms were not measured. Food-group gains were concentrated in groups that few children consumed at baseline (legumes, animal-source foods, fruits and vegetables), consistent with PDH's emphasis on locally available, affordable foods. Grains, roots and tubers, consumed by over 90% of children at baseline, showed no change, probably reflecting a ceiling effect, and the estimate for dairy products was positive but imprecise (+7.9 percentage points; 95% CI −11.4 to 27.2), so neither a modest increase nor no change can be excluded. Limited purchasing power, seasonal availability and cultural preferences could constrain further change, but none was measured and they remain hypotheses.

Estimated protein intake rose consistently across ages, plausibly reflecting greater legume and animal-source food consumption, whereas estimated energy intake did not differ significantly (DiD +57 to +76 kcal/day, about 6–14% of baseline intervention-group intake). In Ecuador, intervention children consumed a higher percentage of recommended intakes of both protein and energy (Roche et al., 2017); differences in design, outcome definition and adjustment limit direct comparison, but our energy findings are less favourable. Protein accounts for only about 9–20 kcal/day of any energy difference, so higher protein intake does not imply higher energy intake. More frequent meals without a clear energy gain could reflect smaller portions or lower energy density at added eating occasions, or sessions that emphasized meal frequency, food groups and preparation rather than portion size; none was tested, and the study was not powered for age-stratified nutrient comparisons. Statistical significance should not be equated with nutritional significance. Because intakes derive from a single recall that excludes breast milk, whether increments of this size reduce energy or nutrient deficits cannot be established, and we draw no conclusion that requirements were met in any age group. Micronutrient outcomes are estimated dietary intakes, as no biomarkers were measured. After Holm adjustment, only iron (+0.8 and +0.9 mg/day at 6–11 and 12–36 months) and calcium (+39 mg/day at 12–36 months) differed, and absorbed iron may have increased by less than intake because legume- and cereal-based diets are rich in phytate (Gibson & Ferguson, 2008). All 18 micronutrient estimates favoured the intervention group, but most were imprecise and are hypothesis-generating.

The comparison group also improved by 5.7 to 10.1 percentage points across the feeding practices, showing that some change occurred without PDH. Because children were enrolled for low weight-for-age, regression to the mean, routine care and temporary recovery may account for part of this change and of the intervention-group change. Both wards were selected on the same criterion, so such effects are largely differenced out, although residual regression to the mean remains possible if wards differed in how far children had deviated from usual status at enrolment (Barnett et al., 2005). The findings suggest that a PDH package can shift locally specific feeding behaviours and food-group consumption among moderately underweight children, a necessary but not sufficient step towards nutritional recovery. The weaker energy and micronutrient responses imply that behaviour-change sessions alone may not close dietary deficits; programmes may need explicit guidance on portion size and energy density and attention to household food access, although neither was tested. Decisions on wider adoption should await adequately powered cluster-randomized evaluations with anthropometric outcomes and post-programme follow-up.

Strengths and limitations

Strengths include a concurrent comparison group with difference-in-differences analysis (Dimick & Ryan, 2014); pretested, translated instruments; multiple-pass recalls with locally derived portion sizes and the Kenya Food Composition Tables (FAO & Government of Kenya, 2018); 92.3% follow-up without significant baseline differences between retained and lost participants; documented fidelity (mean 10.4 of 12 sessions attended; 93.8% of sessions delivered as planned); and TREND, TIDieR and STROBE-nut reporting. Fidelity data reflect research-supported delivery, not feasibility or scalability.

Limitations include unadjusted estimates despite baseline marital-status imbalance (|SMD| = 0.49), with available observations analyzed as independent samples; untestable parallel trends with two time points (Wing et al., 2018); seasonal differences between waves; caregiver-reported practices with unequal staff contact; and one 24-hour recall per wave. Each arm was a single ward, so area-level influences cannot be excluded (Hayes & Moulton, 2017). Follow-up was short, one sub-county was studied, and anthropometry is unreported.

CONCLUSION

The Positive Deviance Hearth programme produced substantial improvements in complementary feeding practices among moderately underweight children aged 6–59 months. Compared with the control group, children in the intervention group had greater improvements in minimum meal frequency, minimum dietary diversity, responsive feeding, feeding during illness, and child-specific meal preparation. Consumption of legumes, flesh foods and eggs, vitamin A-rich fruits and vegetables, and other fruits and vegetables also increased more in the intervention group. Estimated protein intake increased consistently across all age groups, while selected micronutrient intakes, particularly iron and calcium, showed greater improvements in some age groups. Energy intake did not differ significantly between groups. Therefore, the Positive Deviance Hearth approach can substantially improve key feeding practices and dietary intake among moderately underweight young children and provide a strong community-based strategy for strengthening complementary feeding.

List of abbreviations

CHP, community health promoter; CI, confidence interval; DiD, difference-in-differences; FAO, Food and Agriculture Organization of the United Nations; IYCF, infant and young child feeding; KNBS, Kenya National Bureau of Statistics; PDH, Positive Deviance Hearth; pp, percentage points; SMD, standardised mean difference; UNICEF, United Nations Children's Fund; WAZ, weight-for-age Z-score; WHO, World Health Organization.

Acknowledgements

The authors gratefully acknowledge the support of the Bomet County administration, Konoin Sub County leadership, and local health providers in facilitating the study. We also thank Mr. Joel Wanzala for his valuable guidance and support throughout the study. Permission was obtained from all individuals named in this acknowledgement.

DECLARATIONS

Ethics approval and consent to participate

Ethical approval was obtained from the Institutional and Scientific Review Board of the University of Eastern Africa, Baraton (UEAB/ISERC/07/08/2024), and a research permit from NACOSTI (NACOSTI/P/24/39809). Permission was obtained from the Bomet County administration and relevant health authorities. Written informed consent was obtained from caregivers after explaining the study and their rights. Participation was voluntary, and privacy and confidentiality were maintained. Children identified with severe underweight or other health conditions requiring clinical care were referred to an appropriate health facility for assessment and management. The study was conducted in accordance with the Declaration of Helsinki.

Consent for publication

Not applicable.

Availability of data and materials

The datasets generated and analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests.

Funding

This research received no specific funding.

Use of Artificial Intelligence-Assisted Technology

During the preparation of this manuscript, the authors used ChatGPT (OpenAI) and Grammarly exclusively for language editing, grammatical corrections, and improvements in clarity, coherence, and readability. All AI-assisted suggestions were critically reviewed, verified where appropriate, and revised by the authors to ensure scientific accuracy and consistency with the original research content. These tools were not used to generate research data or conduct statistical analyses. The authors retain full responsibility and accountability for the accuracy, originality, scientific integrity, and final content of the manuscript.

Authors' contributions

Conceptualization: Gladys C. Koskei; Methodology: Gladys C. Koskei; Formal analysis and investigation: Gladys C. Koskei, Simon Kamau, Zipporah W. Ndungu & Calvince O. Anino; Writing - original draft preparation: Gladys C. Koskei; Writing - review and editing: Simon Kamau, Zipporah W. Ndungu & Calvince O. Anino; Resources: Gladys C. Koskei.

AUTHOR BIOGRAPHY

Gladys Chemutai Koskei holds a Master of Public Health (Nutrition) degree from Moi University and is currently a Ph.D candidate at Jomo Kenyatta University of Agriculture and Technology (JKUAT). Her doctoral research focuses on the effectiveness of the Positive Deviance Hearth (PDH) program in the sustainable rehabilitation of malnourished children aged 6–59 months in Konoin Sub-County, Bomet County, Kenya. She is a Lecturer in the Department of Public Health, School of Health Sciences, University of Kabianga. Her teaching and research interests include nutrition and dietetics, community nutrition, and principles of epidemiology, with a strong emphasis on community-based nutrition interventions and child health outcomes.

Simon Karanja is a Professor of Medical Epidemiology and Head of the Digital Health Research Centre (DHARC) at Jomo Kenyatta University of Agriculture and Technology and a member of the Department of Environmental Health and Disease Control, School of Public Health under the College of Health Sciences in the same institution. He holds a PhD in Epidemiology awarded from the Freie University of Berlin, Germany. Simon's research interests are in health system strengthening with emphasis on Operational Research to improve decision-making, planning, and implementation of health programs and policies. He is also a member of the Selection Working Group towards the selection of interventions for the assessment by the Benefits Package and Tariffs Advisory Panel and Mortality Technical Working Group supporting the Ministry of Health

Dr. Zipporah W. Ndungu holds a PhD from Kenyatta University, where her doctoral research focused on the validation of nutritional status assessment methods using stable isotope dilution techniques among school-aged children in Nairobi City County, Kenya. She is currently a Senior Lecturer in the Department of Human Nutrition Sciences, School of Food and Nutrition Sciences, Jomo Kenyatta University of Agriculture and Technology. Her academic and research interests include nutritional assessment methodologies, body composition analysis, and the application of advanced techniques in nutrition research to inform policy and practice.

Dr. Calvince Otieno Anino holds a PhD in Food Science and Nutrition from Jomo Kenyatta University of Agriculture and Technology. He is a Lecturer in the Department of Public Health, School of Health Sciences, University of Kabianga. His research interests span nutrition, food science, chronic diseases, and public health, with a focus on food composition, health education interventions, maternal and child nutrition, and infectious disease–related nutrition outcomes..

REFERENCES

Anino, O. C., Were, G. M., & Khamasi, J. W. (2015). Impact evaluation of positive deviance hearth in Migori County, Kenya. *African Journal of Food, Agriculture, Nutrition and Development, 15*(5), 10578–10596. https://doi.org/10.18697/ajfand.72.15395

Austin, P. C. (2009). Balance diagnostics for comparing the distribution of baseline covariates between treatment groups in propensity-score matched samples. *Statistics in Medicine, 28*(25), 3083–3107. https://doi.org/10.1002/sim.3697

Bandura, A. (1977). *Social learning theory*. Prentice Hall.

Bandura, A. (1986). *Social foundations of thought and action: A social cognitive theory*. Prentice Hall.

Barnett, A. G., van der Pols, J. C., & Dobson, A. J. (2005). Regression to the mean: What it is and how to deal with it. *International Journal of Epidemiology, 34*(1), 215–220. https://doi.org/10.1093/ije/dyh299

Baxter, R., & Lawton, R. (2022). *The positive deviance approach*. Cambridge University Press. https://doi.org/10.1017/9781009237130

Bisits Bullen, P. A. (2011). The positive deviance/hearth approach to reducing child malnutrition: Systematic review. *Tropical Medicine & International Health, 16*(11), 1354–1366. https://doi.org/10.1111/j.1365-3156.2011.02839.x

Black, M. M., & Aboud, F. E. (2011). Responsive feeding is embedded in a theoretical framework of responsive parenting. *The Journal of Nutrition, 141*(3), 490–494. https://doi.org/10.3945/jn.110.129973

Cohen, R., Gesser-Edelsburg, A., Singhal, A., Benenson, S., & Moses, A. E. (2020). What distinguishes positive deviance (PD) health professionals from their peers and what impact does a PD intervention have on behaviour change: A cross-sectional study of infection control and prevention in three Israeli hospitals. *Epidemiology & Infection, 148*, Article e259. https://doi.org/10.1017/S0950268820002484

David, V., Ngure, K., Musita, C., Muhamud, C. C., & Kerich, M. (2023). Effectiveness of the positive deviance hearth model in enhancing nutritional status among children in Kilifi County. *African Journal of Health Sciences, 36*(5), 610–620. https://doi.org/10.4314/ajhs.v36i5.13

Des Jarlais, D. C., Lyles, C., Crepaz, N., & the TREND Group. (2004). Improving the reporting quality of nonrandomized evaluations of behavioral and public health interventions: The TREND statement. *American Journal of Public Health, 94*(3), 361–366. https://doi.org/10.2105/AJPH.94.3.361

Development Initiatives. (2020). *2020 global nutrition report: Action on equity to end malnutrition*. https://globalnutritionreport.org/reports/2020-global-nutrition-report/

Dimick, J. B., & Ryan, A. M. (2014). Methods for evaluating changes in health care policy: The difference-in-differences approach. *JAMA, 312*(22), 2401–2402. https://doi.org/10.1001/jama.2014.16153

Food and Agriculture Organization of the United Nations, & Government of Kenya. (2018). *Kenya food composition tables*. Food and Agriculture Organization of the United Nations. https://openknowledge.fao.org/handle/20.500.14283/i8897en

Gibson, R. S., & Ferguson, E. L. (2008). *An interactive 24-hour recall for assessing the adequacy of iron and zinc intakes in developing countries* (HarvestPlus Technical Monograph No. 8). International Food Policy Research Institute and International Center for Tropical Agriculture. https://hdl.handle.net/10568/159279

Hayes, R. J., & Moulton, L. H. (2017). *Cluster randomised trials* (2nd ed.). Chapman and Hall/CRC. https://doi.org/10.4324/9781315370286

Hoffmann, T. C., Glasziou, P. P., Boutron, I., Milne, R., Perera, R., Moher, D., Altman, D. G., Barbour, V., Macdonald, H., Johnston, M., Lamb, S. E., Dixon-Woods, M., McCulloch, P., Wyatt, J. C., Chan, A.-W., & Michie, S. (2014). Better reporting of interventions: Template for intervention description and replication (TIDieR) checklist and guide. *BMJ, 348*, Article g1687. https://doi.org/10.1136/bmj.g1687

Holm, S. (1979). A simple sequentially rejective multiple test procedure. *Scandinavian Journal of Statistics, 6*(2), 65–70. https://www.jstor.org/stable/4615733

Keats, E. C., Das, J. K., Salam, R. A., Lassi, Z. S., Imdad, A., Black, R. E., & Bhutta, Z. A. (2021). Effective interventions to address maternal and child malnutrition: An update of the evidence. *The Lancet Child & Adolescent Health, 5*(5), 367–384. https://doi.org/10.1016/S2352-4642(20)30274-1

Kenya National Bureau of Statistics, & ICF. (2023). *Kenya demographic and health survey 2022*. https://dhsprogram.com/pubs/pdf/FR380/FR380.pdf

Korir, A. K., Omboto, P., & Musebe, R. (2022). Effect of natural capital on food security among smallholder tea farmers in Bomet County, Kenya. *Current Journal of Applied Science and Technology, 41*(30), 14–21. https://doi.org/10.9734/CJAST/2022/v41i3031803

Kuchenbecker, J., Reinbott, A., Mtimuni, B., Krawinkel, M. B., & Jordan, I. (2017). Nutrition education improves dietary diversity of children 6–23 months at community-level: Results from a cluster randomized controlled trial in Malawi. *PLOS ONE, 12*(4), Article e0175216. https://doi.org/10.1371/journal.pone.0175216

Lachat, C., Hawwash, D., Ocké, M. C., Berg, C., Forsum, E., Hörnell, A., Larsson, C., Sonestedt, E., Wirfält, E., Åkesson, A., Kolsteren, P., Byrnes, G., De Keyzer, W., Van Camp, J., Cade, J. E., Slimani, N., Cevallos, M., Egger, M., & Huybrechts, I. (2016). Strengthening the Reporting of Observational Studies in Epidemiology–Nutritional Epidemiology (STROBE-nut): An extension of the STROBE statement. *PLOS Medicine, 13*(6), Article e1002036. https://doi.org/10.1371/journal.pmed.1002036

Mizehoun-Adissoda, C., Morou, K., Edjrokinto, H., Padonou, G. S. R., Mahounou, J. R., Flénon, A., Wiafe, M. A., & Aglago, E. K. (2024). Participatory cooking demonstrations for mothers improve feeding practices of young children in southern Benin. *North African Journal of Food and Nutrition Research, 8*(17), 149–158. https://doi.org/10.51745/najfnr.8.17.149-158

Mwangangi, C. E., Gor, O. C., & Omunyin, E. M. (2019). Determinants of food crop diversification among smallholder maize farmers for enhanced food security in Bomet County, Kenya. *International Journal of Recent Research in Commerce Economics and Management, 6*(4), 55–66. https://www.paperpublications.org/upload/book/DETERMINANTS%20OF%20FOOD%20CROP-1412.pdf

Ombogo, L. A., Karanja, S., Terer, C. C., Otambo, P., Ng′eno, B. C., Muniu, E., Maina, J. N., Mbuka, J. S., & Wanjihia, V. (2026). Integrated approaches to improve the nutritional status of children under five: A positive deviance hearth model in Bomet County, Kenya. *BMC Nutrition, 12*, Article 75. https://doi.org/10.1186/s40795-026-01283-7

Putri, N. K., Wardhani, L. P., & Ernawaty. (2024). Positive deviance/hearth intervention in collaboration between academia and NGOs: A realist evaluation. *BMC Public Health, 24*, Article 3598. https://doi.org/10.1186/s12889-024-20632-4

Roche, M. L., Marquis, G. S., Gyorkos, T. W., Blouin, B., Sarsoza, J., & Kuhnlein, H. V. (2017). A community-based positive deviance/hearth infant and young child nutrition intervention in Ecuador improved diet and reduced underweight. *Journal of Nutrition Education and Behavior, 49*(3), 196–203.e1. https://doi.org/10.1016/j.jneb.2016.10.007

Sari, N. M. W., Wangi, M. P., Ayuningtyas, H., Himawati, A., Handayani, S., Sakinah, F. N., Kristanto, D. A., Manahan, A., Nugroho, A., Sahila, N., Frans, C., & Mahmudiono, T. (2023). The effectiveness of positive deviance hearth (Pos Gizi) to improve malnourished children in urban Surabaya, Indonesia: Efektifitas positive deviance hearth (Pos Gizi) untuk perbaikan anak kurang gizi di perkotaan Surabaya, Indonesia. *Amerta Nutrition, 7*(3), 449–458. https://doi.org/10.20473/amnt.v7i3.2023.449-458

Shinde, S., Wang, D., Moulton, G. E., & Fawzi, W. W. (2025). School-based health and nutrition interventions addressing double burden of malnutrition and educational outcomes of adolescents in low- and middle-income countries: A systematic review. *Maternal & Child Nutrition, 21*(S1), Article e13437. https://doi.org/10.1111/mcn.13437

Triatmaja, N. T., Mahmudiono, T., Al Mamun, A., & Abdullah, N. A. (2023). Effectiveness of positive deviance approach to reduce malnutrition among under five children: A systematic review and meta-analysis of interventional studies. *Nutrients, 15*(8), Article 1961. https://doi.org/10.3390/nu15081961

United Nations Children′s Fund, World Health Organization, & World Bank Group. (2025). *Levels and trends in child malnutrition: UNICEF/WHO/World Bank Group joint child malnutrition estimates–Key findings of the 2025 edition*. https://data.unicef.org/wp-content/uploads/2025/07/JME-Brochure-UNSDG-regions-2025-v23.pdf

Waswa, L. M., Jordan, I., Herrmann, J., Krawinkel, M. B., & Keding, G. B. (2015). Community-based educational intervention improved the diversity of complementary diets in western Kenya: Results from a randomized controlled trial. *Public*

Health Nutrition, 18(18), 3406–3419. https://doi.org/10.1017/S1368980015000920

Wells, J. C., Sawaya, A. L., Wibaek, R., Mwangome, M., Poullas, M. S., Yajnik, C. S., & Demaio, A. (2020). The double burden of malnutrition: Aetiological pathways and consequences for health. *The Lancet, 395*(10217), 75–88. https://doi.org/10.1016/S0140-6736(19)32472-9

Wing, C., Simon, K., & Bello-Gomez, R. A. (2018). Designing difference in difference studies: Best practices for public health policy research. *Annual Review of Public Health, 39*, 453–469. https://doi.org/10.1146/annurev-publhealth-040617-013507

World Health Organization. (2023). *WHO guideline for complementary feeding of infants and young children 6–23 months of age*. https://iris.who.int/server/api/core/bitstreams/5abca011-4db2-4cf1-b959-45b756f7b600/content

World Health Organization. (2024, March 1). *Malnutrition* [Fact sheet]. https://www.who.int/news-room/fact-sheets/detail/malnutrition

World Health Organization, & United Nations Children's Fund. (2021). *Indicators for assessing infant and young child feeding practices: Definitions and measurement methods*. World Health Organization. https://www.who.int/publications/i/item/9789240018389

World Vision. (2025). *Positive deviance/hearth*. https://www.wvi.org/nutrition/positive-deviancehearth

Young, M. F., Baik, D., Reinsma, K., Gosdin, L., Rogers, H. P., Oy, S., Invong, W., Hen, H., Ouk, S., & Chhorvann, C. (2021). Evaluation of mobile phone-based positive deviance/hearth child undernutrition program in Cambodia. *Maternal & Child Nutrition, 17*(4), Article e13224. https://doi.org/10.1111/mcn.13224

ADDITIONAL INFORMATION

Correspondence All inquiries and requests for additional materials should be directed to the Corresponding Author.

Publisher's Note Utan Kayu Publishing maintains a neutral stance regarding territorial claims depicted in published maps and does not endorse or reject the institutional affiliations stated by the authors.

Open Access This article is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License (CC BY-SA 4.0), which permits others to share, adapt, and redistribute the material in any medium or format, even for commercial purposes, provided appropriate credit is given to the original author(s) and the source, a link to the license is provided, and any changes made are indicated. If you remix, transform, or build upon the material, you must distribute your contributions under the same license as the original. To view a copy of this license, visit https://creativecommons.org/licenses/by-sa/4.0/.

© The Author(s) 2026