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Evaluation of the effectiveness of the functional capacities of Community Animation Cells in improving the nutritional status of children under five in South Kivu, Democratic Republic of the Congo

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ABSTRACT: Child undernutrition remains a critical public health challenge in fragile and conflict-affected settings, where community-based delivery systems play a central role. This study assessed the effectiveness of the functional capacities of Community Animation Cells (CAC) in improving the nutritional status of children under five in South Kivu.

Methodology: A quasi-experimental study with a non-randomized control group was conducted in the Bunyakiri Health Zone, comparing intervention and control areas. A total of 280 households with children aged 0–59 months were surveyed at baseline and endline. Quantitative data were analyzed using Difference-in-Differences models with Poisson regression and generalized estimating equations to account for clustering, complemented by qualitative thematic analysis.

Results: Households exposed to strengthened CACs showed significantly higher odds of optimal infant and young child feeding practices, including continued breastfeeding up to 24 months (aOR = 1.044; p = 0.032) and adequate meal frequency (aOR = 0.689; p = 0.045). Hygiene practices such as handwashing at critical times were strongly associated with CAC activities (aOR = 1.193; p = 0.002). By April 2024, exclusive breastfeeding in the intervention zone reached 93.6% compared with 58.2% in the control zone, while children with MUAC > 125 mm increased to 95.5% versus 58.0%. Difference-in-Differences analyses confirmed a statistically significant net intervention effect on key nutrition indicators.

Conclusion: Strengthening CAC functional capacities significantly improved nutrition-related practices and nutritional outcomes among children under five. Scaling up CAC-based interventions with sustained supervision and reliable nutrition supply systems is recommended to enhance community-level nutrition impact.

KEYWORDS: community-based nutrition, child undernutrition, community animation cells.

1 INTRODUCTION

Child undernutrition remains one of the most persistent global public health challenges, despite sustained international commitments and the availability of evidence-based interventions. According to the *UNICEF–WHO–World Bank Joint Child Malnutrition Estimates,* between 2019 and 2024, an estimated 149–151 million children under five years of age were affected by stunting, while approximately 45 million suffered from wasting worldwide, reflecting both chronic and acute nutritional deprivation during a critical stage of growth and development [1]. Global analyses published in *The Lancet* demonstrate that child undernutrition is driven not only by inadequate dietary intake but also by structural determinants such as poverty, limited access to health services, poor water and sanitation, and weak community-level delivery systems [2]. These findings indicate a persistent gap between global nutrition strategies and their effective implementation at local levels.

The burden of child undernutrition is disproportionately concentrated in sub-Saharan Africa, where progress in reducing stunting has been slower than in other world regions. Meta-analyses of Demographic and Health Surveys indicate that stunting prevalence in sub-

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Saharan Africa has remained above 30 % for more than a decade, with only modest declines observed in several countries [3]. Structural factors such as food insecurity, low maternal education, limited health system coverage, and recurrent humanitarian crises continue to undermine nutritional gains. In contrast to regions where economic growth has translated into improved child nutrition, many sub-Saharan African countries face persistent barriers that constrain the effectiveness of nutrition-specific and nutrition-sensitive interventions.

Within Central Africa, child undernutrition is particularly severe, although regularly updated regional estimates remain limited. Scientific evidence from country-level studies highlights extreme vulnerability in fragile and conflict-affected settings. In countries such as the Central African Republic and the Democratic Republic of the Congo (DRC), chronic undernutrition among children under five consistently exceeds regional and global averages, driven by prolonged insecurity, displacement, and weakened food and health systems [4]. These conditions underscore the importance of community-based approaches capable of operating in contexts where formal health services are overstretched or intermittently functional.

The Democratic Republic of the Congo is among the countries most affected by child undernutrition globally. Peer-reviewed studies and national survey analyses indicate that chronic malnutrition affects approximately 40-45 % of children under five, while acute malnutrition remains recurrent in several provinces, particularly in eastern DRC [5], [4]. In response, national nutrition policies increasingly emphasize community-based platforms, including Community Animation Cells (CACs), to promote infant and young child feeding practices, hygiene behaviors, early detection of malnutrition, and community engagement. However, while CACs are widely implemented, their functional capacity and effectiveness in improving child nutritional outcomes remain insufficiently documented in the scientific literature.

In South Kivu Province, the nutrition situation is especially concerning due to prolonged conflict, population displacement, and limited market access. Community-based studies conducted in South Kivu report suboptimal infant and young child feeding practices, low dietary diversity, and a high prevalence of undernutrition among children under five [6]. In this context, CACs are expected to bridge gaps between households and the health system by supporting behavior change, community mobilization, and follow-up of vulnerable children. Nevertheless, empirical evidence linking CAC operational capacity to measurable improvements in child nutritional status remains scarce.

At the territorial level, particularly in Kalehe, data on child nutrition are fragmented, and evaluations of community-level mechanisms are rare. While nutrition interventions are frequently implemented by humanitarian and development actors, most assessments focus on service coverage rather than on the effectiveness of CAC functional capacities using comparative or quasi-experimental designs. This lack of localized evidence limits the ability of policymakers and practitioners to identify which components of community animation are most effective in improving child nutrition outcomes.

Against this backdrop, a clear research gap emerges between the documented magnitude of child undernutrition at global, regional, national, and provincial levels and the limited scientific evidence on the effectiveness of community-based nutrition governance mechanisms in fragile settings. This study therefore seeks to answer the following research question: *To what extent are the functional capacities of Community Animation Cells effective in improving the nutritional status of children under five in South Kivu, with a specific focus on Kalehe Territory?*

2 Materials And Methods

2.1 Study Setting

The study was conducted in the Bunyakiri Health Zone, located in the Kalehe territory of South Kivu province, Democratic Republic of Congo. Three health areas were selected: Bunyakiri and Tshigoma as intervention sites, and Bagana as a control site. This selection was based on documented contrasts in the performance of Community Animation Cells (CACs) and nutritional indicators among children under five years of age. The area is characterized by mountainous terrain, an economy primarily based on agriculture and livestock, and socio-cultural practices that influence health and nutrition behaviors.

2.2 Study Design

This was a quasi-experimental study with a non-randomized control group, structured in three successive phases: a baseline survey, a community-based intervention, and an endline survey. The design aimed to assess the effectiveness of CAC functional capacities in improving the nutritional status of children under five years of age.

2.3 STUDY POPULATION

The target population included: (i) households with at least one child aged 0–59 months, (ii) members of CACs in the selected villages, and (iii) key informants from health authorities and technical and financial partners involved in the nutrition and community health sectors.

2.4 ÉCHANTILLONNAGE ET TAILLE DE L'ÉCHANTILLON

To calculate the sample size, the sample size estimation formula will be as was applied by Charan and Biswas (Charan & Biswas, 2013):

$$n = \frac{2(Z_\alpha + Z_\beta)^2 P(1-P)}{(D)^2} * DE \text{ , } n = \frac{2(1.96+0.84)^2 0.48(1-0.48\ )}{(0.3)^2} * 2.45 = 107$$

Where:

n = Required sample size; $Z_{\alpha/2}$ = Standard normal deviate for α (1.96); Z_β = Standard normal deviate for β, 80% power = 0.84; P= Proportion of children with malnutrition in South Kivu; 48% (Nguyen *et al.,* 2023); D- Expected moderate effect size, assumption of 30%; DE= 1 + (m-1) rho where m is the cluster size of the clusters (30), rho is the intra cluster correlation coefficient, usually 0.05; DE= 1 + (30-1) 0.05 = 2.45.

An addition of 30% of the sample size will be added to cater for No-response in the study.

107 + (30% * 107) = 139.1 and we thought it useful to round up for convenience, so 140 participants per site. For reasons of convenience, this sample was increased to 140 per site, i.e.140 households in Bagana and 140 households in Tshigoma and Bunyakiri, making a total 280 households with children under the age of 5 interviewed during the study.

To select the members of the CACs to be interviewed, 60 members were randomly selected from the 12 villages involved in the study area, with 5 members selected from each of 12 villages.

2.5 INTERVENTION DESCRIPTION

The three-month intervention consisted of an integrated strengthening of the CACs in the intervention areas. It included structured training on nutrition, infant and young child feeding (IYCF), hygiene and sanitation (WASH), and essential family practices; provision of work tools and equipment; minimal logistical support for community activities; and regular technical supervision by the health zone teams. CAC members conducted home visits, nutrition screening and referral activities, and supported households through the promotion of community gardens and small-scale livestock for nutritional purposes. The control area continued routine activities without additional support.

2.6 DATA COLLECTION

Quantitative data were collected using semi-structured questionnaires administered on smartphones via the KOBO Collect application. Qualitative data were gathered through in-depth individual interviews, key informant interviews, and focus group discussions. Enumerators received prior training, and a rigorous system of supervision and quality control was implemented.

2.7 DATA ANALYSIS

Quantitative data were analyzed using SPSS (version 27) and ENA for SMART. Descriptive and bivariate analyses (Chi-square tests) were conducted, followed by multivariate models. The net effect of the intervention was estimated using a Difference-in-Differences approach with Poisson models and generalized estimating equations (GEE) to account for clustering by health area. Qualitative data were analyzed using a systematic thematic approach. Children's nutritional status was assessed using standardized anthropometric measurements.

2.8 ETHICAL CONSIDERATIONS

The study received approvals from the ethics committees of the Catholic University of Bukavu and the Great Lakes University of Kisumu, as well as the required administrative authorizations. Informed consent was obtained from all participants. Data confidentiality and anonymity were ensured, and participants could withdraw from the study at any time without consequences.

3 RESULTATS

3.1 FACTORS ASSOCIATED WITH HOUSEHOLD KNOWLEDGE, NUTRITION, HYGIENE PRACTICES, AND COMMUNITY ENGAGEMENT LINKED TO CAC ACTIVITIES: RESULTS FROM MULTIVARIATE ANALYSIS

Table 1. Household factors linked to the effective implementation of the functional capacities of the CACs in improving the nutritional status of children under 5 (logistic-base and endline regression for all zones)

Variables	Adjusted OR	95%	IC	p-value
Households' knowledge of how to continue breastfeeding after the introduction of solid foods until at least the age of 2, through the CACs	1,044	1,095	7,378	0,032
Household knowledge of the number of meals per day (at least 3) to give the child through the CAC activities	0,689	1,017	3,9	0,045
Household knowledge of a balanced diet being a variety of foods from all food groups in appropriate proportions through the CACs	1,021	0,154	0,845	0,019
Perceptions of manages that CACs are fulfilling their role and responsibilities as CAC members	1,046	0,131	0,944	0,038
Household practice of key handwashing times as a result of CAC activities	1,193	0,145	0,634	0,002
Feeding practices of children aged 6 to 24 months in the household at least 3 meals a day as a result of CAC activities	1,226	1,644	7,058	0,001
Children breastfeeding at least 8 times a day thanks to CAC activities	1,132	1,499	6,415	0,002
Possession of vegetable gardens by children's households through CAC activities in the villages	1,066	1,425	5,917	0,003
Consumption of drinking water in the household (fountains, springs and taps) as a result of CAC activities	0,928	1,282	4,988	0,007
Participation of manages in the elections of CAC members in your village	1,624	1,374	18,729	0,015

The results indicate that higher household knowledge, positive perceptions, and improved nutrition, hygiene, and caregiving practices promoted through CAC activities were significantly associated with increased odds of effective CAC functional capacity in improving the nutritional status of children under five. In addition, household participation in CAC governance and community-based livelihood activities, such as vegetable gardening and safe water use, showed a significant positive association with effective implementation outcomes.

3.2 PERFORMANCE OF KEY NUTRITION AND HEALTH INDICATORS BY INTERVENTION AND CONTROL ZONES, FEBRUARY–APRIL 2024

Table 2. Analysis of efficiency indicators for CAC (control and intervention zones) during the monitoring period of Intervention from February to April 2024

Indicators	Zone	Target/ Performance	Expected targets February 2024	Target Achieved February 2024	%	Expected targets March 2024	Target Achieved March 2024	%	Expected targets April 2024	Target Achieved April 2024	%
Children 0-6 months exclusively breastfed	Intervention zone	80%	42	20	47,6	41	36	87,8	47	44	93,6
	Control zone		162	131	80.7	167	141	84,4	141	82	58,2
Children aged 20-24 months who continue to breastfeed	Intervention zone	80%	45	13	28,9	45	39	86,7	46	43	93,5
	Control zone		82	43	35,26	80	38	47,5	80	40	50,0
Children aged 6-24 months consuming an adequate complementary food (at least 3 meals a day and 4-star ration)	Intervention zone	50%	84	35	41,7	80	44	55	81	54	68,1
	Control zone		112	59	52.7	112	63	56,3	116	59	50,9
Children aged 6 -59 months with PB > 125 mm	Intervention zone	80%	153	80	52,3	312	137	43,9	312	298	95,5
	Control zone		113	71	62,8	117	82	70,1	119	69	58,0
Pregnant and breastfeeding women who have received a 4-star diet (frequency and variety)	Intervention zone	80%	143	26	47,6	348	279	80,2	350	297	84,9
	Control zone		161	134	83.2	161	125	77,6	162	129	79,6
Children aged 0 -59 months attending CPS	Intervention zone	80%	370	35	9,5	417	372	89,2	428	396	92,5
	Intervention zone		312	64	20,5	317	111	35,0	315	121	38,4

The efficiency indicators show a marked and progressive improvement in the intervention zone across all monitored outcomes from February to April 2024, with most indicators reaching or exceeding expected targets by April. Exclusive breastfeeding (0–6 months) and

continued breastfeeding (20–24 months) in the intervention zone increased sharply over time, contrasting with consistently lower and relatively stable performance in the control zone. Complementary feeding adequacy and mid–upper arm circumference (PB >125 mm) also improved substantially in the intervention zone, particularly between March and April, while control zone results fluctuated and generally remained below targets. Coverage of adequate diets among pregnant and breastfeeding women rose rapidly in the intervention zone, surpassing performance observed in the control zone by the end of the monitoring period. Overall, attendance at child preventive services (CPS) and nutrition-related practices demonstrated stronger and more sustained gains in the intervention zone, indicating higher operational efficiency of CACs following the intervention.

3.3 Challenges, Stock-Out Constraints, And Community-Based Workarounds In The Management Of Child Malnutrition In Bunyakiri Health Zone

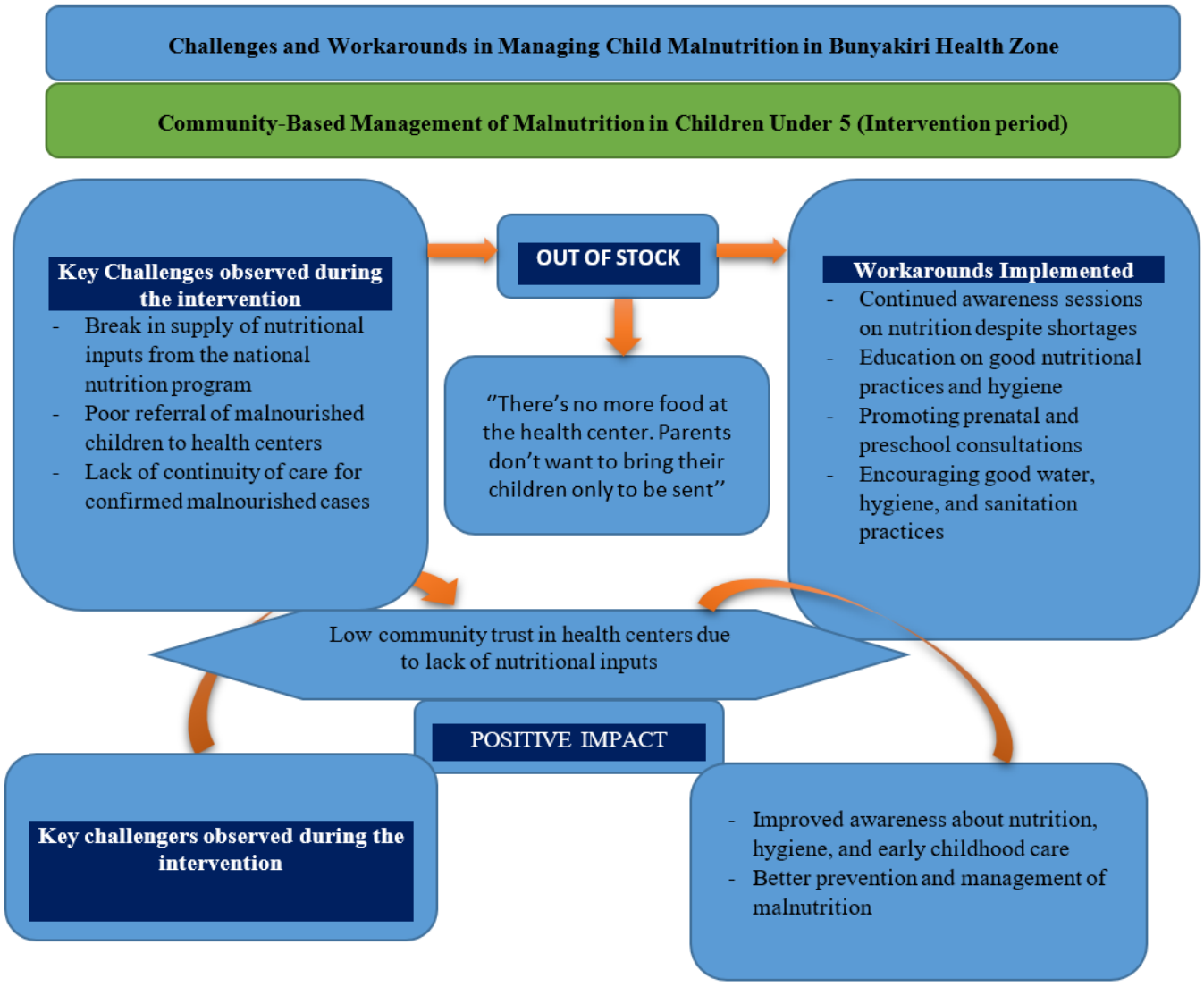

Fig. 1. Challenges observed during the intervention and workarounds implemented during the study

During the intervention in the Bunyakiri health zone, interruptions in nutritional supplies led to poor referrals, lack of continuity of care, and diminished community trust in health centers. In response, CAC members continued awareness campaigns, promoted good nutrition, hygiene, and prenatal care, and encouraged early childhood consultations. Despite supply challenges, these efforts improved community knowledge and contributed to better prevention and management of child malnutrition.

3.4 FACTORS IN THE FUNCTIONAL EFFECTIVENESS OF CAC MEMBERS IN IMPROVING THE NUTRITIONAL STATUS OF CHILDREN UNDER 5 IN THE BUNYAKIRI HEALTH ZONE, SOUTH KIVU, DRC (FEBRUARY TO APRIL 2024).

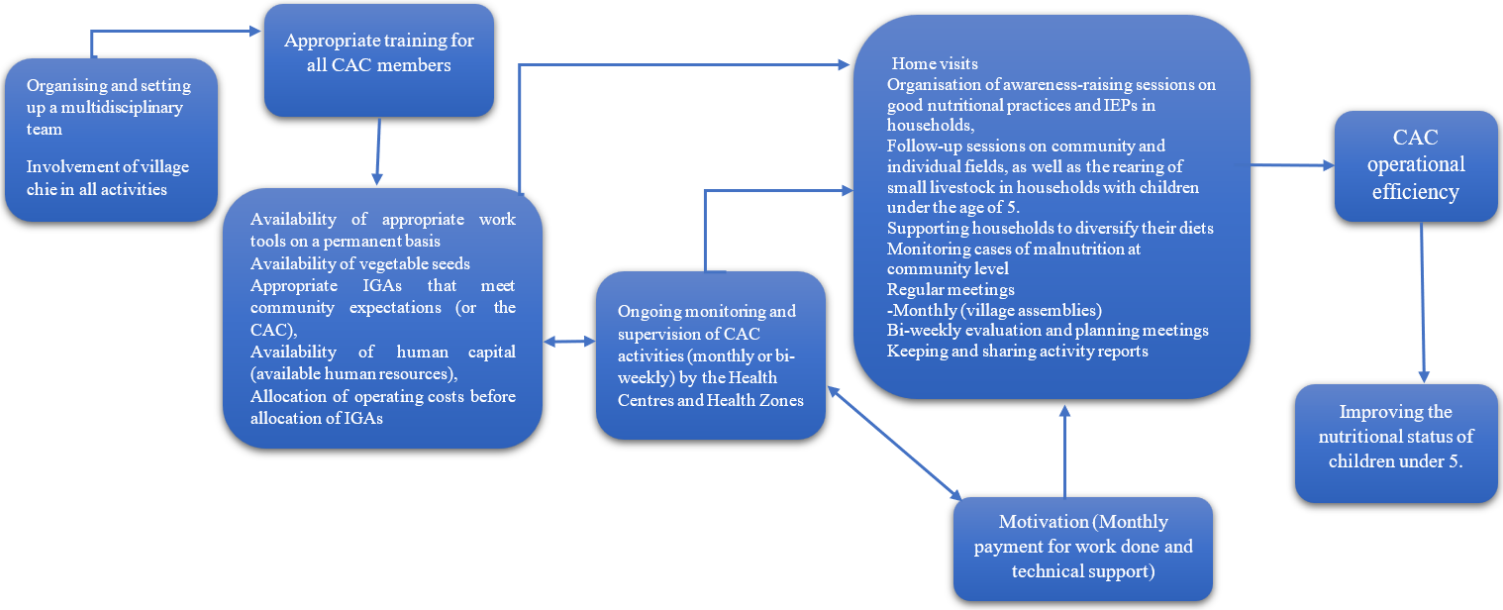

Fig. 2. Factors in the functional effectiveness of CACs in improving the nutritional status of children under 5 years of age from participant observation during the intervention

The figure illustrates that the functional effectiveness of Community Animation Cells (CACs) is driven by a coherent chain of enabling factors, beginning with appropriate training, inclusive community leadership, and the availability of essential resources and operating inputs. Continuous supervision, structured monitoring, and regular performance feedback by health facilities and health zones reinforce the consistent implementation of CAC activities at community level. Motivational mechanisms, including technical support and financial incentives, further sustain CAC engagement and operational continuity. Together, these interlinked factors enhance CAC operational efficiency, ultimately contributing to measurable improvements in the nutritional status of children under five in the Bunyakiri health zone.

4 DISCUSSION

This study provides compelling evidence that strengthening the functional capacities of Community Animation Cells (CACs) contributes meaningfully to improvements in child nutrition–related practices and selected nutritional outcomes in South Kivu, Democratic Republic of the Congo. The results confirm that community-based mechanisms, when operationally functional, can effectively address both immediate and underlying determinants of child undernutrition in fragile and conflict-affected settings.

The findings demonstrate that households exposed to well-functioning CACs showed significantly better knowledge and practices related to infant and young child feeding (IYCF), including continued breastfeeding, adequate meal frequency, and balanced diets. These results are consistent with previous studies indicating that interpersonal communication and sustained community engagement are critical drivers of behavioral change in nutrition [7]. CACs appear to have functioned as effective platforms for reinforcing nutrition messages through repeated sensitization sessions and household follow-up, thereby facilitating the translation of knowledge into practice.

In addition to feeding practices, the study highlights significant improvements in hygiene-related behaviors, particularly handwashing at critical moments and use of improved water sources. This finding supports evidence that integrated nutrition-WASH approaches are more effective than standalone nutrition interventions in reducing undernutrition, primarily by lowering infection-related nutrient losses [8], [9]. The results suggest that CACs successfully addressed multiple pathways of undernutrition by combining nutrition education with hygiene promotion at the community level. Community participation emerged as a key factor influencing CAC functionality. Households involved in the selection of CAC members were more likely to benefit from effective CAC operations, underscoring the importance of local legitimacy, trust, and accountability. This finding aligns with established community health system frameworks that emphasize participatory governance and social capital as prerequisites for sustained performance of community-based interventions [10], [11]. Locally elected CAC members may be better positioned to mobilize households and sustain engagement over time.

The association between household vegetable gardening and improved child nutrition indicators further underscores the relevance of nutrition-sensitive livelihood strategies embedded within CAC activities. Evidence from similar low-income and rural contexts indicates that homestead food production, when combined with nutrition education, enhances dietary diversity and micronutrient intake among young children [12], [13]. In South Kivu, where food availability is frequently constrained by insecurity and market instability, such integrated approaches appear particularly appropriate.

Monitoring data revealed a clear divergence between intervention and control areas, with consistent improvements observed in intervention zones across indicators such as exclusive breastfeeding, appropriate complementary feeding, and mid-upper arm circumference (MUAC). In contrast, control areas exhibited limited or inconsistent progress. These findings reinforce evidence from quasi-experimental studies showing that the effectiveness of community-based platforms depends on structured capacity strengthening rather than mere existence [11], [14]. The relatively rapid improvements observed suggest that targeted investments in CAC training, supervision, and coordination can yield meaningful short-term gains.

Despite these positive outcomes, qualitative findings indicate that CAC performance was constrained by systemic challenges, notably interruptions in nutrition commodity supply and declining trust in health facilities. Similar challenges have been documented in other fragile settings, where community-based platforms often maintain engagement despite disruptions in formal health services [15]. However, the findings underscore a critical limitation: community-level demand generation must be matched by reliable service availability. Without consistent supply-side support, gains in awareness and care-seeking may not fully translate into sustained nutritional improvements.

This study has several strengths, including its mixed-methods design, which enabled triangulation of quantitative and qualitative findings, and the inclusion of comparison areas to strengthen causal inference. Nonetheless, the non-randomized design may allow for residual confounding, and the relatively short follow-up period limits assessment of long-term sustainability. Future studies should examine whether observed gains persist over time and identify which CAC components, such as training intensity, supervision frequency, or incentive mechanisms—are most strongly associated with sustained impact.

From a policy and programmatic perspective, the findings provide strong support for prioritizing the functional strengthening of community-based nutrition structures. In fragile contexts such as South Kivu, CACs represent a contextually appropriate and potentially cost-effective platform for delivering integrated nutrition, hygiene, and livelihood interventions. Ensuring adequate supervision, community ownership, and alignment with supply-side systems will be essential to maximize their effectiveness and sustainability.

5 CONCLUSION

This study demonstrates that strengthening the functional capacities of Community Animation Cells (CACs) significantly improved nutrition-related knowledge, caregiving practices, and service utilization among households, leading to measurable gains in the nutritional status of children under five in South Kivu. Statistically significant associations were observed between CAC activities and optimal infant and young child feeding, hygiene practices, community engagement, and household-level food and water security.

Efficiency indicators showed faster and more sustained improvements in the intervention zones compared with control zones, particularly for breastfeeding practices, complementary feeding, MUAC outcomes, and maternal diets. Despite recurrent supply chain disruptions, CAC-led behavior change communication and community follow-up mitigated negative effects on prevention and early management of malnutrition. Overall, CACs proved to be an effective, resilient, and context-adapted platform for community-based nutrition improvement.

Scaling up CAC-based interventions should be prioritized, alongside reliable nutrition supply chains and sustained supervision, to consolidate community-driven gains in child nutrition and ensure long-term impact.

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