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RESEARCH ARTICLE

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FACTORS PROMOTING THE IMPLEMENTATION OF THE FUNCTIONAL CAPACITIES OF COMMUNITY ANIMATION CELLS IN IMPROVING NUTRITIONAL STATUS OF CHILDREN UNDER FIVE IN BUNYAKIRI HEALTH ZONE, SOUTH KIVU PROVINCE, DRC

Doris Bengibabuya Hombanyi^{1,2}, Charles Wafula¹ and Careen Otieno¹

¹Faculty of Health Sciences, Department of Community Health and Development of Great Lakes University of Kisumu in Kenya; ²Community Health Department of the Higher Institute of Agroforestry and Environmental Management of Kahuzi Biega, ISAGE-KB, South Kivu, DRC

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*Corresponding Author:

Doris Bengibabuya Hombanyi

ABSTRACT

Introduction: While the effectiveness of treating severe and moderate acute malnutrition in children is well-documented, there is limited data on the long- and medium-term functional impact of Community Animation Cells (CACs) on improving the nutritional status of children under five through community-based management in Bunyakiri Health Zone. **Methodology:** This quasi-experimental study involved a baseline phase, intervention phase, and final phase. It included 140 households each in control and intervention zones and 60 CAC members (30 from each zone). Data was collected using surveys and interviews after a 3-month follow-up of CAC activities. **Results:** Factors promoting the implementation of the functional capacities of influencing CAC in improving nutritional status of children under five in Bunyakiri health zone included gender, education, economic stability, and age. Men were 18 times (OR= 18) more associated with the functional capacities of CACs compared to women, indicating a significant gender disparity. Education had a slight impact on the CAC's functional capacities, though not statistically significant ($p > 0.05$). Economic stability was crucial, with CAC members having income-generating jobs being significantly impact on the functional capacities of CAC ($p < 0.05$). Members over 30 in the Control zone were 1.41 times more likely to use effective nutrition strategies, but this was not statistically significant ($p > 0.05$). Training alone did not significantly promote the functional capacities of CAC in improving nutritional status of children under five ($p > 0.05$), highlighting the need for ongoing support. **Conclusion:** To enhance the implementation of the functional capacities CAC in improving child nutrition in Bunyakiri health zone, efforts should focus on promoting gender equity through targeted training, developing economic support for CAC members, providing tailored educational programs, and ensuring continuous training and supervision. Leveraging the experience of older members alongside the dynamism of younger members can further optimize program impact.

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INTRODUCTION

Malnutrition develops slowly, in a context of structural poverty where children do not have access to a well-balanced diet, and its consequences (stunted growth, weakened immune system, etc.) are largely irreversible, making it a major public health problem (Unicef, 2023). In South Kivu, a province located in the eastern part of the Democratic Republic of Congo (DRC), child malnutrition remains a pressing issue, exacerbated by factors such as poverty, inadequate healthcare, and limited access to nutritious food (Kandala et al., 2011). Addressing this challenge requires innovative approaches that leverage community-based strategies to enhance the nutritional status of vulnerable populations, particularly children under five (Story et al., 2017; Gajbhiye et al., 2024). Community Animation Cells (CACs) have emerged as a pivotal component in this effort, focusing

on improving nutritional outcomes through local engagement and empowerment. CACs are grassroots organizations in the DRC that mobilize community resources and facilitate the implementation of health and nutrition programmes at the local level (Kc et al., 2011). These cells play a crucial role in bridging the gap between health services and the community, promoting practices that contribute to better nutritional outcomes (World Health Organization, 2020). Research has shown that community-based interventions can significantly improve health outcomes by increasing awareness, enhancing access to resources, and fostering local ownership of health initiatives (Bhutta et al., 2013). Engaging communities in the design and implementation of nutrition programs ensures that interventions are tailored to local needs and conditions, which can enhance their acceptability and impact. Additionally, partnerships with local and international organizations can provide the necessary support and resources to sustain these initiatives (Sato et al., 2016). Inadequate community information on feeding practices and meal frequency,

coupled with insufficient dietary intake and limited dietary diversity, can be addressed by properly trained community health workers. These workers, if equipped with the capacity to engage community animation cells dedicated to advising on preventive infant and young child feeding (IYCF) practices, play a crucial role in enhancing the nutritional well-being of children under five years of age (Doocy et al., 2019). A proven approach called community-based management of acute malnutrition was introduced in 2001 to decentralise therapeutic care to communities (Bahwere et al., 2012). This approach has been utilized in both emergency and routine settings across various countries, and there is now extensive data showcasing the success of this model (Bahwere, 2014; Akparibo et al., 2017). However, the emergency situation resulting from the socio-political turmoil that has gripped the country since 1990, and in particular the province of South Kivu, has led to the introduction of humanitarian interventions, an approach that is essentially selective to health problems and more curative than preventive and promotional (Le Gargasson et al., 2013). In South Kivu, addressing the nutritional needs of children under five through CACs represents a promising strategy to combat malnutrition and improve overall health outcomes. Hence, the understanding of the factors that contribute to the success of these cells is essential for optimizing their effectiveness and ensuring sustainable improvements in child nutrition in this region.

MATERIEL AND METHODS

Context of the study area: The study was conducted in the Bunyakiri health zone, located in the Kalehe area of South Kivu province, Democratic Republic of Congo. This zone is bordered to the north by the Iteberro health zone; to the south and south-east by the Miti-Murhesa health zone; to the south-west by the Kalonge health zone; to the east by the Kalehe health zone, the Bushaku and Shicha Chandjofu peaks and the Minova health zone, separated by the Bulaisa mountain range; and to the west by the Mulungu health zone. The Tshigoma health area lies to the north of the Kachiri health area, to the south of the Mushunguti health area, to the east of the Ramba health area and to the west of the Makuta health area. Bunyakiri health zone is bordered by Bitobolo health area to the north, Muoma health area to the south, Chiriba health area to the east and Chisasa Hill to the west. The selection of these health areas was based on two factors. Firstly, the Bagana health area (control) was chosen due to its effective CAC members, who have successfully improved the nutritional status of children under five through community initiatives. In contrast, the Bunyakiri and Tshigoma health areas (intervention) were chosen due to the absence of functioning CACs in these villages has led to a decline in the nutritional status of children.

Study design: The study used a quasi-experimental design with three phases: baseline, intervention and end line. In the first phase, a cross-sectional baseline survey was conducted in three zones: the intervention zone, which included the Tshigoma health zone (Nyabikumba CAC) and Bunyakiri (CAC), and the control zone (Bagana). In the second phase, an experimental system was designed and implemented, focusing on CACs and households with children under 5 years of age. The aim was to assess factors promoting implementation of the functional capacities of CACs to improve the nutritional status of these children. Two groups of CAC members were identified for the trial. The intervention group received training on key nutrition issues, essential family practices (EFPs), hand washing and infant and young child feeding (IYCF). They were also provided with equipment, supplies and supervision. The control group did not receive any training, materials, equipment or supervision from the study, but continued with regular activities as defined by the government guidelines on his authority. A final cross-sectional survey was conducted three months after the intervention. Data from both groups were collected, analyzed and compared.

METHODS

Target population, sample size calculation and sampling technique: The study involved members of the Community Animation Cells

(CACs) in the health areas of Bagana (control zone) and Tshigoma and Bunyakiri (intervention zones) within the Bunyakiri health zone. The target population for the household surveys was households with children under the age of five. The population of Bunyakiri health zone, estimated at 292,280, is distributed by age group and pregnant women as follows 9,289 persons aged 0-11 months, 3,923 persons aged 12-59 months, 42,743 persons aged 0-59 months and 10,647 pregnant women.

The Sample size was determined using the following formula:

$$n = \frac{2(Z_{\alpha} + Z_{\beta})^2 P(1 - P)}{(D)^2} * DE = 107.$$

Where:

- n = required sample size
- $Z_{\alpha}/2$ = standard normal deviate for α (1.96)
- $Z_{\beta}/2$ = standard normal deviate for β (0.84 for 80% power)
- P = proportion of children with malnutrition in South Kivu (48%)
- D = expected moderate effect size (30%)
- DE = design effect, calculated as $1 + (m-1) \times ICC$ + $(m-1) \times \text{ICC}$, where m is the cluster size (30) and ICC is the intra-cluster correlation coefficient (0.05) (Nguyen et al., 2023)

An additional 30% was added to the sample size to account for non-response:

$$107 + (30\% \times 107) = 139.1107 + (30\% \times 107) = 139.1107 + (30\% \times 107) = 139.1. \text{ For convenience, the sample size was rounded up to 140 participants per site.}$$

For the interview of CAC members, 60 individuals were randomly selected from the 12 participating villages (4 villages in each health area) in the study area, with 5 members chosen from each village. Villages were selected during the initial phase of the study. Intervention areas, including Tshigoma and Bunyakiri health areas, were purposefully selected based on various reports (OCHA, 2023). Households within these selected villages were randomly chosen for the baseline study and were followed throughout the duration of the study. In each target village, whether control or intervention, members of the CACs and heads of households were included in the study.

Data collection: The data collection process involved several key steps: identifying study participants, obtaining informed consent, and gathering data through questionnaires/ semi-structured guides. Quantitative data were collected using semi-structured questionnaires preloaded onto smartphones with the KOBO Collect application. This digital approach enabled efficient data gathering through structured interviews and in-depth examination of responses. The inclusion criteria for selecting the households to be surveyed were: (1) be a family member in the household and aged 18 or over; (2) be present on the day of the survey; (3) be a family member with children under the age of five. The inclusion criteria as following: (1) be a member of a CAC in the villages targeted by the study, (2) be present on the day of the survey and agreed to participate, (3) be in charge (IT/ITA) of a health center responsible for treating cases of malnutrition and related illnesses were followed for the selection of CAC members to be interviewed. In contrast, Participants were excluded from the study if they either refused to participate or withdrew their consent during the study. Additionally, individuals who had been involved but were no longer active or unable to provide informed consent were also excluded. Data collected included the socio-demographic profiles of surveyed households, the socio-demographic characteristics of CAC members and the factors that promoting the implementation of functional capacities of CACs.

Data analysis: The quantitative data collected for this study underwent several processing and analysis stages. These included data entry, cleaning, and validation to ensure completeness,

consistency, and accuracy, as well as appropriate handling of missing values and outliers. Data processing and analysis were performed using R Studio 4.2.2 and SPSS V. 27. Confidentiality of the data was maintained throughout the process. Descriptive analysis was conducted to summarize the results, with frequencies and percentages calculated. Additionally, a chi-square test was used to examine the association between variables and the dependent variable. The Logistic regression analysis was used to identify factors associated with the implementation of the functional capacities of the Community Animation Cells in improving the nutritional status of children under five.

Conflict of interest: No conflict has been declared by authors.

RESULTS

1. Socio-demographic profile of CAC members favoring their functional capacities in improving the nutritional status of children under 5 years of age in Bunyakiri health Zone: The majority of CAC members interviewed were men in both the control (73.3%) and intervention (60%) zones. CAC members who were men were 18 times (OR= 18) more associated with the functional capacities of CACs compared to women [OR=1.83 (0.61-5.45), $p=0.41$]. CAC members with a high level of education (secondary and university) were 1.22 times more likely to promote the functional capacities of CAC activities to combat malnutrition than those with a primary level of education [OR1.22 (0.42-3.54), $p=0.79$]. CAC members who had at least one income-generating occupation or activity were 2.72 times more likely to promote CACs' activities to combat child malnutrition in the village [2.72 (0.01-0.92)] and this occupation was a significant factor in the promotion of CAC effectiveness in improving the nutritional status of children under 5 years of age ($p=0.02<0.05$) (Table 1).

CAC members over 30 in the control zone were somewhat more likely to know the composition of a balanced diet compared to younger members (OR=1.43, $p=0.999$), while in the intervention zone, older CAC members were more likely to know about balanced diets (OR=2.14, $p=0.417$). However, neither zone showed a significant relationship between age and the guidance CAC members provided on child feeding frequency (ORs for both zones were not significant). Additionally, no significant relationship was found between CAC members' age and their motivation to improve child and women's health. Overall, none of the variables examined had a significant impact on the effective implementation of CAC activities aimed at improving the nutritional status of children under 5 ($p>0.05$).

3. The impact of CAC members' marital status on factors that promote the implementation of functional capacities of CAC in improving the nutritional status of children under 5 in Bunyakiri health Zone: The results in the Table 3 show that in the control zone, married CAC members who received training in community strategies to combat child malnutrition were 2.9 times more likely to have effective functional capacities for improving children's nutritional status, though this result was not statistically significant (OR=2.90, $p=0.56$). In contrast, in the intervention zone, marital status had a significant negative association with the factors that promote the implementation of functional capacities of CAC members, regardless of the type of training received (OR=0.06, $p<0.001$). Knowledge of a balanced diet was not influenced by marital status in the control zone (OR=0.57, $p=0.999$), but in the intervention zone, married CAC members were likely to promote the functional capacities of CAC since they had knowledge on the balanced diet (OR=0.06, $p<0.001$). There was no significant relationship between CAC members' knowledge and practices on child feeding frequency and their marital status in the control zone, with ORs of 1.0 and 1.05, respectively.

Table 1. Socio-demographic profile of CAC members

Variable	Control	Intervention	Total	OR (95% IC)	Sig.
	Baseline n=30(%)	Baseline n=30(%)			
Gender					
Male	22 (73,3)	18 (60)	40 (66,7)	1.83 (0.61-5.45)	0.41
Female	8 (26,7)	12 (40)	20 (33,3)		
Marital Status					
Single	2 (6,7)	4 (13,3)	6 (10,0)	0.40 (0.06-2.43)	0.40
Married	27 (90,0)	22 (73,4)	49 (81,7)		
Widowed/Separated	1 (3,3)	3 (10,0)	4 (6,6)		
Separated	0 (0,0)	1(3,3)	1 (1,6)		
Level of education					
Primary	12 (40,0)	11 (36,7)	23 (38,3)	1.22 (0.42-3.54)	0.79
Secondary / High school	16 (53,3)	18 (60,0)	34 (56,7)		
Higher/university	2 (6,7)	1 (3,3)	3 (5,0)		
Occupation					
Self-employed (specify type of occupation)	24 (80,0)	25 (83,3)	49 (81,7)	2.72 (0.01-0.92)	0.02
Employed	1 (3,3)	2 (6,7)	3 (5,0)		
Agriculture	4 (13,4)	3 (10,0)	7 (11,6)		
First aid	1 (3,3)	0 (0,0)	1 (1,6)		
Ethnicity					
Mushi	1 (3,3)	1 (3,3)	2 (3,3)	1.0 (0.05-16.7)	1
Tembo	29 (96,7)	29 (96,7)	58 (96,7)		
Religion					
Christian	27 (90,0)	25 (83,3)	52 (86,6)	1.4 (0.29-7.0)	0.70
Muslim	0 (0,0)	1 (3,3)	1 (1,6)		
Other (please specify)	3 (10,0)	4(13,4)	7(11,6)		

2. The age distribution of CAC members and its association with the functional capacities of the CACs in improving the nutritional status of children under 5in Bunyakiri health Zone: The results presented in the Table 2 show that in the control zone, CAC members over 30 who received training on community strategies for combating malnutrition were slightly more likely to contribute effectively to the CAC's activities, though this finding was not statistically significant (OR=1.31, $p=0.999$). In the intervention zone, there was no significant relationship between the type of training received and the age of CAC members (OR=0.02, $p=0.087$).

Additionally, no significant association was found between CAC members' motivation to improve child nutrition and their marital status in either zone ($p>0.05$).

4. The impact of CAC members' gender on factors that promote the implementation of functional capacities of CAC in improving the nutritional status of children under 5 in the Bunyakiri Health Zone: In the control zone, male CAC members trained in community strategies were 1.3 times more likely than female members to promote functional capacities for improving children's nutritional status (OR=1.30, $p=0.999$).

Table 2. The age distribution of CAC members and its influence on the promotion of the implementation of functional capacities of CAC in improving the nutritional status of children under 5.

Variables	Control zone				intervention Zone				Control / intervention p-value (all)
	Age range				Age range				
	>30 years old n=15	≤30 years old n=15	OR(95% IC)	p-value	>30 years old n=19	≤30 years old n=11	OR(95% IC)	p-value	
Type of training									
Untrained in nutrition.	5(33.3)	7(46.7)	1.31(0.3-5.5)	0.999	8(42.1)	6(54.5)	0.02(0.1-3.0)	0.087	0.178
Community strategies	7(46.7)	6(40.0)			5(26.3)	4(36.4)			
Training on the signs of malnutrition	0(0.0)	1(6.66)			6(31.6)	1(9.1)			
Types of food, breastfeeding children	3(20.0)	1(6.66)			0(0.0)	0(0.0)			
Knowledge of a balanced diet									
A variety of foods from all food groups in appropriate proportions.	11(73.3)	12(80.0)	1.43(0.2-8.0)	0.999	15(78.9)	7(63.6)	2.14(0.4-11.1)	0.417	0.215
Food from a single food group.	0(0.0)	2(13.3)			1(5.7)	2(18.2)			
Any type of diet is considered balanced	4(26.7)	1(6.7)			3(15.8)	2(18.2)			
Number of times a day a child should eat									
Less than two meals	1(6.7)	2(13.3)	1.0(0.2-4.5)	0.999	1(5.3)	0(0.0)	0.51(0.1-2.5)	0.466	0.973
Two to three main meals.	5(33.3)	5(33.3)			11(57.9)	8(72.7)			
More than three times a day.	4(26.7)	6(60)			7(36.8)	3(27.3)			
According to the child's need and appetite.	2(13.7)	1(6.7)			0(0.0)	0(0.0)			
Three main meals and snacks between meals	3(20)	1(6.7)			0(0.0)	0(0.0)			
motivates as a volunteer, to carry out CAC activities									
No motivation	3(20.0)	3(20.0)	ND*	0.224	2(10.5)	1(9.1)	0.00(0.5-61.8)	0.157	0.586
Improving the health of children and women in my community	0(0.0)	2(13.3)			4(21.1)	1(9.1)			
Love for my own community	12(80.5)	10(66.7)			13(68.4)	9(81.8)			

*ND: Not Defined

Table 3. The impact of CAC members' marital status on factors that influence their effectiveness in enhancing the nutritional status of children under 5

Variables	Control zone				intervention Zone				Control / intervention p-value (all)
	Civil status				Civil status				
	Married n=27	not in a union (single, divorced, separated) n=3	OR(95% IC)	p-value	Married n=22	not in a union (single, divorced, separated) n=8	OR(95% IC)	p-value	
Type of training									
Untrained in nutrition.	12(44.4)	0(0.0)	2.90(9.2-30.1)	0.56	10(45.5)	4(50.6)	0.29(0.0-1.6)	0.195	0.592
Community strategies	11(40.7)	2(66.7)			5(22.7)	4(50.4)			
Training on the signs of malnutrition	1(3.7)	0(0.0)			7(31.8)	0(0.0)			
Types of food, breastfeeding children	3(11.1)	1(33.3)			0(0.0)	0(0.0)			
Knowledge of a balanced diet									
A variety of foods from all food groups in appropriate proportions.	21(77.8)	2(66.7)	0.57(0.0-7.4)	0.999	17(77.3)	5(62.5)	0.06(0.0-0.3)	<0.001	0.302
Foods from only one food group.	2(7.4)	0(0.0)			1(4.5)	2(25)			
Any type of diet is considered balanced	4(14.8)	1(33.3)			4(18.2)	1(12.5)			
Number of times a day a child should eat									
Less than two meals	3(11.1)	0(0.0)	1.0(0.0-12.5)	0.999	1(4.5)	0(0.0)	1.0(0.1-5)	0.999	0.999
Two to three main meals.	9(33.3)	1(33.3)			14(63.7)	5(62.5)			
More than three times a day.	9(33.3)	1(33.3)			7(31.8)	3(37.5)			
According to the child's need and appetite.	3(11.1)	0(0.0)			0(0.0)	0(0.0)			
Three main meals and snacks between meals	3(11.1)	1(33.3)			0(0.0)	0(0.0)			
Motivates as a volunteer, to carry out CAC activities?									
No motivation	5(18.5)	1(33.3)	0.00(ND)	0.999	2(9.1)	1(33.3)	2.11(0.2-15.7)	0.589	0.518
Improving the health of children and women in my community	2(7.4)	0(0.0)			3(13.6)	2(40)			
Love for my own community	20(74.1)	2(66.7)			17(77.3)	4(19.1)			

Table 4. The impact of CAC members' gender on factors that enhance their effectiveness in improving the nutritional status of children under 5 in the Bunyakiri Health Zone

Variables	Control zone		OR(95% IC)	p-value	intervention Zone		OR(95% IC)	p-value	Control / intervention p-value (all)
	Sex				Sex				
	Male n=22	Female n=8			Male n=18	Female n=12			
Type of training									
untrained in nutrition.	7(31,8)	5(62.5)	1,30(0,26-7,2)	0,999	7(38,9)	7(58,3)	0,76(0,1-3,7)	0,999	0,127
Community strategies	10(45,5)	3(37,5)			5(27,8)	4(33,3)			
Training on the signs of malnutrition	1(4,5)	0(0,0)			6(33,3)	1(8,4)			
Types of food, breastfeeding children	4(18,1)	0(0,0)			0(0,0)	0(0,0)			
Knowledge of a balanced diet									
A variety of foods from all food groups in appropriate proportions.	18(81,8)	5(62,5)	0,13(0,0-0,8)	0,013	14(77,8)	8(66,7)	ND	<001	0,331
Food from a single food group.	1(4,5)	1(12,5)			1(5,6)	2(16,66)			
Any type of diet is considered balanced	3(13,6)	2(25)			3(16,7)	2(16,66)			
Number of times a day a child should eat									
Less than two meals	2(9,1)	1(12,5)	0,58(0,0-3,0)	0,082	1(5,6)	0(0,0)	1,27(0,2-5,8)	0,999	0,952
Two to three main meals.	8(36,4)	2(25)			11(61,1)	8(66,7)			
More than three times a day.	8(36,4)	2(25)			6(33,3)	4(33,3)			
According to the child's need and appetite.	2(9,1)	1(12,5)			0(0,0)	0(0,0)			
Three main meals and snacks between meals	2(9,1)	2(25)			0(0,0)	0(0,0)			
Motivates as a volunteer, to carry out CAC activities?									
No motivation	4(18,2)	2(25)	7,0(0,3-144,0)	0,289	1(5,6)	2(16,7)	2,14(0,3-32,2)	0,622	0,884
Improving the health of children and women in my community	1(4,5)	1(12,5)			4(22,2)	1(8,3)			
Love for my own community	17(77,3)	5(62,5)			13(72,2)	9(75)			

Table 5. Link between the levels of education and the knowledge of the CAC members on the type of training, the number of times a day a child should eat, a balanced diet and motivation to work as volunteers in improving the nutritional status of children under five in Bunyakiri health zone

Variables	Control zone		OR(95% IC)	p-value	intervention Zone		OR(95% IC)	p-value	Control / intervention p-value (all)
	Level of education				Level of education				
	Primary n=12	High level (secondary and high school) n=18			Primary n=11	High level (secondary and high school) n=19			
Type of training									
Untrained in nutrition.	7(58,3)	5(27,8)	0,75(0,7-18,0)	0,141	6(54,5)	8(42,1)	0,81(0,1-4,1)	0,999	0,172
Community strategies	3(25)	10(55,6)			3(27,3)	6(31,6)			
Training on the signs of malnutrition	1(8,3)	0(0,0)			2(18,2)	5(26,3)			
Types of food, breastfeeding children	1(8,3)	3(16,6)			0(0,0)	0(0,0)			
Knowledge of a balanced diet									
A variety of foods from all food groups in appropriate proportions.	9(75)	14(77,8)	1,16(0,2(0,2-0,4)	0,999	7(63,6)	15(78,9)	0,46(0,0-2,4)	0,417	0,544
Food from a single food group.	1(8,3)	1(5,5)			2(18,2)	1(5,3)			
Any type of diet is considered balanced	2(16,7)	3(16,7)			2(18,2)	3(15,8)			
Number of times a day a child should eat									
Less than two meals	1(8,3)	2(11,1)	0,26(0,0-1,3)	0,139	0(0,0)	1(5,3)	1,93(0,3-9,6)	0,466	0,718
Two to three main meals.	6(50)	4(22,2)			8(72,7)	11(57,9)			
More than three times a day.	3(3,25)	7(38,9)			3(27,3)	7(36,4)			
According to the child's need and appetite.	1(8,3)	2(11,1)			0(0,0)	0(0,0)			
Three main meals and snacks between meals	1(8,3)	3(16,7)			0(0,0)	0(0,0)			
Motivates as a volunteer, to carry out CAC activities									
No motivation	2(16,66)	4(22,2)	0,0(ND)	0,151	1(9,1)	2(10,5)	1,18(0,1-8,4)	0,999	0,496
Improving the health of children and women in my community	2(16,66)	0(0,0)			2(18,2)	3(15,8)			
Love for my own community	8(66,66)	14(77,8)			8(72,7)	14(73,6)			

However, in the intervention zone, gender did not significantly influence the relationship between community strategy training and functional capacity (OR=0.76, p=0.9991). In both zones, knowledge of balanced diets was significantly better among male CAC members compared to females in terms of their ability to improve nutritional status (p<0.001). Additionally, in the control zone, men were seven times more motivated to volunteer for improving children's health compared to women, while in the intervention zone, men were 2.14 times more motivated. Despite these differences, no significant variation in functional abilities was found between genders in either zone (p>0.05) (Table 4).

in Table 5 indicate that individuals with a high level of education were 1.16 times more likely to have knowledge about balanced diets necessary promoting functional abilities of CAC in improving the nutritional status of children under 5 (OR=1.16, 0.2-0.4). However, no significant difference was observed among the variables studied (p>0.05).

6. Factors within the CACs that enhance the effective implementation of the functional capacities of community facilitation units: The results in Table 6 from a multivariate analysis revealed that although CAC members received training on community strategies to combat child malnutrition in both the control

Table 6. Factors within the CACs that promote the implementation of the functional capacities of community animation cells in improving nutritional status of children under five in Bunyakiri health zone

Variable	Baseline of Control zone n=30(%)	Baseline of Intervention zone n=30(%)	OR Adjusted (95% IC)	p-value
Type of training Received				
Untrained in nutrition.	13(43.3)	14(46.6)	0.96 (0.45-2.05)	0.928
Community Strategies	13(43.3)	9(30.0)		
Types of food, breast-feeding children	4(13.3)	5(16.7)		
Food production, essential family Practices	0(0.0)	2(6.7)		
Knowledge of a balanced diet				
A variety of foods from all the food groups in appropriate proportions.	23(76.7)	22(73.3)	1.23(0.58-2.59)	0.579
Foods from a single food group.	2(6.7)	3(10.0)		
Foods rich in sugar and fat	0(0.0)	0(0.0)		
All types of food are considered balanced	5(16.7)	5(16.7)		
knowing how many times a day the child should eat				
Less than two meals	3(10.0)	1(3.3)	0.44(0.21-0.92)	0.030
Two to three main meals.	10(33.3)	19(63.3)		
More than three times a day.	10(33.3)	10(33.3)		
According to the child's needs and appetite.	3(10.0)	0(0.0)		
Three main meals and snacks between meals	4(13.3)	0(0.0)		
Motivation of CAC members, as volunteers, to carry out activities.				
No motivation	6(20.0)	3(10.0)	1.57(0.71-3.45)	0.259
Improving the health of children and women in my community	2(6.7)	5(16.7)		
The love of my own community	22(73.3)	19(63.3)		
Participate in activities at CODESA level	0(0.0)	3(10.0)		

Table 7a. Household factors favouring the implementation of the functional capacities of the community outreach units

Variable		Baseline control zone	Baseline intervention zone	OR Adjusted (95% IC)	P value	
Distribution of appropriate portions at mealtimes						
Good functional capacity	Good nutritional status	I'm not sure about the portion size	17 (45.95)	07 (31.82)	0.79(0.5-8.4)	0.245
		Yes, I serve age appropriate portions	15 (40.54)	02 (9.09)		
		No, I provide my child with adult-sized portions.	05 (13.51)	13 (59.09)		
Poor functional capacity	Poor nutritional status	I'm not sure about the portion size	33 (32.04)	34 (28.81)	0.07(0.3-2.8)	0.904
		Yes, I serve age appropriate portions	57 (55.34)	13 (11.02)		
		No, I provide my child with adult-sized portions.	13 (12.62)	71 (60.17)		
Possession of vegetable gardens						
Good functional capacity	Good nutritional status	No	31 (83.78)	18 (81.82)	0.5(0.2-10.7)	0.593
		Yes	06 (16.22)	04 (18.18)		
Poor functional capacity	Poor nutritional status	No	81 (78.64)	61 (51.69)	1.17(0.9-11.1)	0.064
		Yes	22 (21.36)	57 (48.31)		
Practical advice on continuing to breastfeed children aged 20 to 24 months						
Good functional capacity	Good nutritional status	Always	03 (8.11)	08 (36.36)	2.04(1.2-48.8)	0.029
		Often	05 (13.51)	01 (4.55)		
		Very often	11 (29.73)	04 (18.8)		
		Not at all	18 (48.65)	09 (40.91)		
Poor functional capacity	Poor nutritional status	Always	19 (18.45)	37 (31.36)	1.90(0.02-0.9)	0.047
		Often	17 (16.50)	18 (15.25)		
		Very often	27 (26.21)	12 (10.17)		
		Not at all	40 (38.83)	51 (43.22)		

5. The influence of CAC members' education level on the knowledge of the CAC members on the type of training, the number of times a day a child should eat, a balanced diet and motivation to work as volunteers in improving the nutritional status of children under five in Bunyakiri health zone: The results

(43.3%) and intervention zones (30.0%) [OR=0.96, p=0.928], and had knowledge of balanced diets (76.7% in the control zone and 73.3% in the intervention zone) [OR=1.23, p=0.579], these factors were not significantly associated with the functional capacities of CAC in combating malnutrition.

Table 7b. Household factors favouring the implementation of the functional capacities of the community outreach units

Variable			Baseline control zone	Baseline intervention zone	OR Adjusted (95% IC)	P value
knowledge about feeding children from 0 to 6 months						
Good functional capacity	Good nutritional status	Breast milk only	11 (29.73)	11 (50.0)	0.2(0.2-5.1)	0.775
		Breast milk with other Food	26 (70.27)	11 (50.0)		
Poor functional capacity	Poor nutritional status	Breast milk only	60 (58.25)	88 (74.58)	1.15(0.8-11.8)	0.084
		Breast milk with other Food	43 (41.75)	30 (25.42)		
Number of meals the child must eat per day in this household						
Good functional capacity	Good nutritional status	At least 2 meals a day	20 (54.05)	10 (45.45)	1.34(0.5-27.9)	0.185
		2 to 3 meals per day	12 (32.43)	12 (54.55)		
		More than 3 meals per Day	05 (13.51)	0 (0.0)		
		As required	0 (0.0)	0 (0.0)		
		3 meals a day with rusty Causes	0 (0.0)	0 (0.0)		
Poor functional capacity	Poor nutritional status	At least 2 meals a day	35 (33.98)	35 (29.66)	0.54(0.5-5.8)	0.381
		2 to 3 meals per day	34 (33.01)	62 (52.54)		
		More than 3 meals per Day	27 (26.21)	19 (16.10)		
		As required	06 (5.83)	01 (0.85)		
		3 meals a day with rusty Causes	01 (0.97)	01 (0.85)		

CAC members who volunteered to improve community health were 1.57 times more likely to be effective in their activities [OR=1.57, p=0.259], but this was not statistically significant. The only significant factor identified was CAC members' knowledge that children should eat 2 to 3 times a day, which was associated with better functional capacities of CAC [OR=0.44, p=0.030]. Qualitative data emphasized the importance of targeted nutrition training for CAC members in enhancing the functional capacities of their CAC. Effective training helps CAC members acquire essential knowledge and skills for promoting good nutritional practices and detecting malnutrition. The trained CAC members work with families and community relays, who then refer malnourished cases to health facilities. Recommendations included ensuring the availability of Plumpy Nut in health centers for treating severe malnutrition. The findings highlight the need for comprehensive training to strengthen CAC members' abilities for the good functional of their CAC in improving nutrition status in children under five in Bunyakiri health zone

7. Household factors favouring the implementation of the functional capacities of the community outreach units: The results in Table 7a and Table 7b show that, after multivariate analysis of the factors studied in both the control and intervention zones, only household knowledge that they should continue to breastfeed children aged 20-24 months was significantly associated with the functional effectiveness of the CACs in improving the nutritional status of children under five (p<0.05).

DISCUSSION

The study reveals that men in Community Animation Cells (CACs) are more likely to be effective in community activities compared to women (OR = 18). Similarly, CAC members with income-generating occupations are notably more effective in their activities (p < 0.05), highlighting the importance of economic security for community involvement. Marital status influences effectiveness as well, with married members in the control zone being significantly more effective (OR = 2.90) compared to their unmarried counterparts. Furthermore, higher knowledge of balanced diets correlates with better child feeding practices (p < 0.05), and there is a notable impact of household knowledge on feeding children aged 20-24 months (p < 0.05). In addition to that, education also plays a role, with members having secondary or tertiary education being slightly more effective in addressing malnutrition, though this difference is not statistically significant (p > 0.05). Additionally, older CAC members (over 30 years old) in the control zone were somewhat more knowledgeable about balanced diets, although this difference was not statistically significant (p > 0.05). Previous studies have shown that men are often perceived as more effective in public roles due to their higher social status and dominant positions in decision-making (Li *et al.*, 2024).

This aligns with our findings on gender differences in effectiveness in CAC roles. However, research by Esplen and Brody (2007) highlights that women, despite these perceptions, have demonstrated significant effectiveness in nutrition programs due to their direct involvement in child care and household management. The finding that CAC members with income-generating occupations are more effective supports existing research by Haddad *et al.* (2003) and Pierre-Louis *et al.* (2007), which indicates that economic security enhances engagement in public health programs. The constraints faced by those without stable incomes, as mentioned by Debpuure *et al.* (2021) and Martin *et al.* (2021), corroborate our results. Education's role in improving public health practices is supported by studies such as Linnemayret *et al.* (2008), Burchiet *et al.* (2011), and Kemigishaet *et al.* (2016), which demonstrate that education enhances understanding and application of health practices. This is consistent with our findings, though the lack of statistical significance may suggest that other factors could also influence CAC effectiveness. The value of experience in managing community initiatives is reflected in our results, aligning with previous research by Saaka and Galaa (2011) and Kambleet *et al.* (2018), which emphasize the benefits of older members' experience in understanding community dynamics. Gillespie and Mason (1991), and Saaka and Galaa (2011) in their researches demonstrated that older CAC members often have more experience and authority, which can enhance their effectiveness in community roles. They can leverage their experience to mobilize resources and influence community behaviors. The association between marriage and increased effectiveness in community roles is consistent with Kehmet *et al.* (2015) and Pradhan *et al.* (2023), which suggest that marriage provides greater social and economic stability. The correlation between CAC members' knowledge and child feeding practices supports WHO recommendations and previous research by Dewey and Adu-Afarwuah (2008), which emphasizes the importance of meal frequency for child nutrition. Knowledge about prolonged breastfeeding is crucial for reducing malnutrition.

While men were found to be more effective, existing studies (Omumu and Ofil, 2010; Ersinoet *et al.*, 2018; Batticaca and Sinaga, 2023) offer mixed results on gender impacts, indicating that context-specific factors may influence these outcomes. Additionally, women's critical role in nutrition programs, despite lower perceived effectiveness, suggests that gendered perceptions may not fully capture their contributions. Esplen and Brody (2007) found women to be highly effective in nutrition programs due to their direct involvement in child care. This discrepancy may be attributed to differing social and cultural contexts impacting gender roles and perceptions of effectiveness. The lack of statistical significance (p > 0.05) regarding education's impact on CAC effectiveness may point to the need for more nuanced approaches to education and training. Variability in educational levels and contextual factors, such as local pedagogical methods, might affect outcomes, as indicated by the necessity for appropriate member education approaches. The

observed lack of significance ($p > 0.05$) in marital status in the intervention area contrasts with findings from the control zone. This discrepancy could be attributed to different training types or local social dynamics, suggesting that marital status's impact may be context-dependent, as we are in a humanitarian crisis context where women have so many roles to sustain the needs of the family when men are not busy. For example, it is likely that in some areas, unmarried members, who are often younger, are better educated or more motivated, allowing them to compensate for the lack of family support that married members receive. It is also important to note that marriage can often limit an individual's involvement in community activities, particularly for women (Minnotteet *et al.* 2008). In some societies, women's domestic and family responsibilities may limit their ability to participate actively in community organization (Evans *et al.*, 2022; Adongo *et al.*, 2023). Dwivedi (2014) and Zawairat *et al.* (2023) found that married women were often constrained by social expectations and domestic responsibilities, limiting their participation in community initiatives despite their potential to make a significant contribution.

The study found that training alone did not significantly impact CAC effectiveness in Bunyakiri health zone, supporting the idea from Kim *et al.* (2016) and Haldane *et al.* (2019) that training needs to be supplemented with ongoing support and monitoring. Socio-economic constraints, as highlighted by Bhutta *et al.* (2013) and Masset *et al.* (2012), also play a role in limiting the practical application of training. It has been declared by people in Bunyakiri health zone that they work with CACs to as we can see it in this declaration: "We work with the members of the CAC within the family, i.e. the mother and children, and at community level, it's the community relays who have to take the reports to the appropriate health structures". To make the CACs effective in their role in the community, supplement trainings with ongoing support and monitoring is required as it can be observed from this declaration: "An effective monitoring, support and evaluation system must be put in place for CACs by permanent government bodies, in particular the central office of the health zone and the health areas, in collaboration with other sectors, EPST, the health and safety office and the food industry.....".

Based on the discussion, several implications for policy development, practice, and further research emerge: (i) policies should address gender biases in community roles, recognizing and enhancing women's contributions to nutrition programs. Empowering women in leadership positions within CACs could balance perceived effectiveness and leverage their existing strengths. (ii) Integrating economic support strategies into community programs is crucial; providing financial resources or stability to CAC members can significantly enhance their effectiveness and participation. This aligns with Cohen and Garrett's (2010) recommendations for sustained engagement. (iii) Given the variable impact of education, there is a need for tailored educational strategies that account for local contexts. Implementing pair-learning approaches and mentoring can enhance the collective effectiveness of CACs. (iv) Recognizing that marital status impacts effectiveness in certain contexts, policies should consider local social dynamics and provide support structures that accommodate both married and unmarried members. (v) Ensuring that training programs are complemented by ongoing support and monitoring will help translate knowledge into effective practice. Addressing socio-economic constraints and providing logistical support are essential for improving community health outcomes. Future research should focus on exploring the nuanced roles of gender, education, and economic status in CAC effectiveness generally and in Bunyakiri health zone particularly, as well as evaluating the impact of various support mechanisms on CAC performance.

CONCLUSION

The study highlights that the effectiveness of CACs in improving child nutrition is influenced by a combination of educational, economic, and social factors. While certain factors like gender and

marital status impact CAC performance, the most significant improvements are achieved through a holistic approach that includes ongoing support, economic stability, and tailored educational strategies. Addressing these factors can enhance the overall effectiveness of community health programs in improving child nutrition.

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