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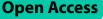
Uptake of preventive nutrition interventions among caretakers of children under 5 years in a pastoral setting of South Sudan

Walter Nehemiah Baluku[1,2*], Barbara Eva Kirunda Tabusibwa[2], Ronald Wasswa[3], Shishay Tsadik[5], Stella Guwoly Henry[6], Geoffrey Babughirana[7] and Rornald Muhumuza Kananura[3,4]

Abstract

Background Preventive nutrition interventions (PNI) are usually implemented without understanding how multilevel factors affect uptake. Undernutrition is defined as inadequate intake of nutritious foods. Pastoral populations in conflict settings are seen to have low uptake. The study assessed the level and multiple factors influencing the uptake of PNI in caregivers of under 5 in Kapoeta South County of South Sudan.

Methods A quantitative approach was employed with an element of a qualitative in a socio-ecological framework. A total of 405 caretakers of CU5 were selected to respond to quantitative household interviews, while qualitative data was collected using KIIs. Primary data were collected through structured questionnaires, which were used to attain quantitative data. The data collected through the method of KII were of qualitative type. Using deductive thematic analysis approach, the quantitative data were coded into personal, interpersonal, and community-level factors, and the analysis was done using STATA software version 16. A technique for constructing the uptake level as low, medium, or high was factor analysis. With the result of the binary logistic regression to determine association. Furthermore, semi-structured KIIs were conducted and the qualitative information analyzed thematically to elaborate on the quantitative results.

Result The uptake level of the Preventive Nutrition Interventions (PNIs) was low at 51. 4%. In the socioecological system, facilitators and barriers related to this uptake differed across the benchmarks of that model. At the community level however, lack of a health facility within the community (OR = 1. 63, C. I. = 1. 02–2. 59) and the time taken before one can access a health facility (OR = 1. 70, C. I = 1. 30–2. 23) showed that accessibility could encourage uptake of PNIs. In the interpersonal dimension, joint decision makers at the family level (OR = 0. 31, C. I = 0. 19–0. 50) had higher uptake. Three factors at the individual level revealed that low uptake was inversely related to caregivers' knowledge of PNIs (OR = 0. 16, C. I. = 0. 10–0. 25), but positively related to having an undernourished child (OR = 2. 59, C. I. = 1. 73–3. 89), as well as number of children in the household (OR = 0. 40, C. I. = 0. 26). KIIs validate that undernutrition and practical issues were the main determinant of PNI uptake.

Conclusion This study found that caretakers of children under 5 years reported low knowledge of and uptake to preventive nutrition interventions (PNIs) among the pastoral population in South Sudan. Based on the proposed socioecological model, we recommend that PNI approaches need to target multiple levels. At the community level, the focus is on improving access to health facilities and reducing the travel time to these facilities. Another way

*Correspondence:
Walter Nehemiah Baluku
walterbalukun@gmail.com
Full list of author information is available at the end of the article

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to increase intervention uptake is to improve spousal-supported joint decisions at the interpersonal level. Enhancing the awareness of the target audience and providing them with relevant information can impact the utilization rates of PNIs at the individual level. Therefore, nutrition stakeholders should employ an approach that targets community, interpersonal, and individual levels with the purpose of increasing PNI uptake.

Keywords Under-5, Nutrition uptake, Social ecological model, South Sudan, Pastoral communities

Background

In many low-resource and conflict-affected countries, childhood undernutrition remains a public health problem [1]. Undernutrition, defined as the lack of essential nutrients to meet an individual's needs to maintain good health [2], is among the leading public health problems affecting children aged 6–59 months [3, 4]. Despite remarkable global progress in scaling up preventive nutrition interventions [5], low uptake typically leads to poor nutrition outcomes, thereby perpetuating the problem. In 2018, global statistics on childhood undernutrition indicators estimated that stunting and waste affected 22.2% and 7.5% of children under 5 years of age, respectively [6]. Undernutrition ranks among the risk factors for illness [7], contributes to 45% of child deaths annually [8], and incurs significant human and economic costs [9]. The worst effects of undernutrition occur during the first 1000 days of life, from pregnancy to two years of early childhood [10].

In South Sudan, undernutrition among children under 5 years is a serious public health problem, with surveys indicating varying and persistent global acute malnutrition (GAM) rates above the World Health Organisation's (WHO) 15% emergency threshold [11]. At the onset of the lean season, the Food Security and Nutrition Monitoring System (FSNMS) Round 24 revealed the prevalence of wasting at 16.2%, stunting at 17.9%, and severe stunting at 5.2% among CU5 [11].

Given the diverse causes of undernutrition, prevention would require a multi-sectoral package of interventions implemented. Preventive nutrition interventions, which are a life course, are indicated at different stages of life to prevent undernutrition. During the first 1,000 days of life, various interventions such as nutrition education and counselling [12], breastfeeding practices, growth monitoring, deworming, vaccinations, vitamin A supplements, antenatal and postnatal care services, dietary diversity, and access to water and hygiene services are crucial in preventing undernutrition among children under 5. People often overlook the importance of addressing the uptake of preventive nutrition interventions [13].

Despite the relatively well-documented prevalence of child undernutrition in some South Sudanese communities, the factors associated with the under-5 uptake of preventive nutrition interventions in pastoral communities remain elusive. Importantly, uptake of preventive nutrition interventions could be context-dependent. For example, countries with stable socio-political environments are better suited to implement preventive nutrition interventions with minimal uptake challenges compared to countries in emergency settings that experience conflicts and natural disasters [14].

In addition, differences in communal settlements, with some of them being purely pastoral in nature and others being agro-pastoralists, contribute to the level of adoption of preventive nutrition interventions. Other challenges include the fact that pastoral communities are typically mobile and frequently affected by cyclic droughts, making it difficult to reach them for any interventions [11]. Restricted connections to service provision, such as potable water, sanitation, and hygiene (WASH), exacerbate these difficulties; the primary concern is the high prevalence of malnutrition among under-five-year-old children in these regions. Studies in the same settings from different countries [13] have reported how malnutrition, as could be the case for uptake of preventive nutrition interventions, is influenced by individual factors (carer's knowledge, socioeconomic status), interpersonal dynamics (family support, social networks), and community-level factors (access to services, cultural norms) [15]. With this in mind, this study aimed to use the social-ecological model to assess the multilevel factors influencing the uptake of preventive nutrition interventions among caretakers of CU5 in Kapoeta South County.

Methods and data

Study area

The study was carried out in Kapoeta South County, one of the three counties that make up the greater Kapoeta region in the Eastern Equatorial State of South Sudan [16]. The county lies in the eastern semi-arid livelihood zone and is predominantly inhabited by the Toposa tribe, who practice pure pastoralism as their livelihood activity with some subsistence farming, especially the growing of cereal crops such as sorghum [17]. Estimates place the population of Kapoeta South County at 94,489, including 17,953 children under the age of five [18]. The county is further subdivided into five payams, namely, Machi I, Machi II, Longeleya, Pwata, and Kapoeta town. It borders

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Kapoeta East County to the east, Kapoeta North to the north, Lafon County to the west, Budi County, and Karamoja of Uganda to the south. Kapoeta South County is approximately 900 km away from Juba Capital City. It's situated at coordinates: 04°46′30″N 33°35′24″E [19] (Appendix 3).

Study design

The study used a community-based cross-sectional design, using quantitative and qualitative data collection methods. This study was conducted between April and May 2022.

Study population

The study population consisted of children under 5 years and their caretakers, who provided information on the individual level, interpersonal, and community factors associated with the uptake of preventive nutrition interventions. The source population for this study included all children under 5 years (CU5) and their carers residing in Kapoeta South County, South Sudan.

Inclusion criteria

The study included children under 5 years from pastoralist communities. The study also included the children's caretakers because they are at the center of intervention uptake for the under 5 children. Nutrition partners implementing preventive nutrition interventions who have been in this area for more than seven years.

Exclusion criteria

Children under 5 years and their caretakers who passed away during the study period are excluded. Furthermore, children under 5 years diagnosed with severe acute malnutrition (SAM) along with medical complications were excluded. Moreover, individuals who have been in the study area for not more than 90 days.

Sample size

Kish [20] expressed a single population proportion formula with a 95% confidence level and a 5% margin of error (desired precision d) to determine the sample size. The sampling parameters include the estimated prevalence of the outcome (P), the desired precision (d), and the 95% CI. For Kapoeta South County, we estimated a desired precision (d) of 5%, a Z-value of 1.96 at the 95% confidence interval (CI), and P, the proportion of the desired outcome (low uptake of preventive nutritional interventions), at 50% due to the absence of available information. We also substituted a 10% non-response rate in the formula.

$$n = \left(\frac{Za}{2}\right)^2 P(1-P)/d^2$$

Where n = sample size, P = proportion of the desired outcome (uptake), d = margin of error/desired precision.

Therefore, $n = (1.96)^2 \times 0.5(1-0.5)/(0.05)^2$=384.16 , Approx. **384.**

Adjustment for a 10% non-response rate equates to $n = (384 + 38) = \mathbf{422}$.

The final sample size for this study was 422 children under the age of 5.

During the study, 96.7% (N=408) of the 422 sampled respondents responded to the questionnaire, with 96% (N=405) of them responding to the outcome variable. This study thus included 405 households. The initial sample size calculated before accounting for non-response was 384. Therefore, the final sample size was statistically sufficient. The study only achieved a sample size of 408 (96.7%), compared to the planned 422 (100%) because it was discovered that 14 households had migrated to the Kakuma refugee camp in Kenya due to severe hunger in the Kapoeta region.

Sampling procedure

The study was done with a three-stage sampling procedure. The first stage involved the selection of Kapoeta South County and its 5 payams purposefully due to the high (15.7%) prevalence of undernutrition. The second stage involved single-stage cluster sampling, where clusters were selected using SMART methodology by an inbuilt formula in the ENA for SMART software when all the clusters/villages and their population size estimates (obtained from the county department of population and demography) were entered. In the third stage, we selected households from which to draw respondents. This was done by simple random sampling using a table of random numbers.

Variables

Variables of uptake

The level of preventive nutrition interventions (PNIs) that carers of children under five years old had taken in the study population was the dependent variable in this study. The uptake was operationally defined and categorised based on the carer's reported level of engagement with PNIs into three levels: low level uptake, medium level uptake, and high level uptake [21]. This categorisation was done based on factor analysis of answers to questionnaires using factors such as attendance to the nutrition sessions, compliance with nutrition recommendations, and use of the nutrition facilities. Using a cut-off medium score of 24%, which is the first quartile of the frequency and has been used as the cut-off in

other studies [22], all respondents below were considered to have low uptake of preventive nutrition intervention. Tables 1 and 2 provide details on the study measures and their measurements.

Data collection tools and procedures

The principal investigator designed structured questionnaires to obtain socio-ecological and individual-level quantitative and qualitative data concerning the use of preventive nutrition interventions. To ensure validity, the questionnaire underwent the following validation processes: In terms of content validity, the calculated CVR was 0.85 and the obtained CVI was 0.90, suggesting that most items were relevant to the measured construct and should be easily comprehensible. Cronbach's alpha internal consistency coefficient measure of reliability was found to be 0.78; this shows that the information the students got was highly reliable. Research assistants developed and proved the reliability of this tool, using it to collect data from the carers of the CU5 in Kapoeta South County, South Sudan, regarding intake levels and related factors.

Then, Key Informant Interviews (KIIs) were conducted to collect responses from 4 nutrition partners represented by nutrition programmers, specialists/managers, the County Health Department (CHD), and 5 Payam administrators to triangulate data already collected from the quantitative survey. A team of fifteen research assistants was recruited and trained in data collection management and finally organised into three groups, each managed by a team leader. Fluent in the local Toposa language, these assistants easily followed up with study participants in the cattle camps to ensure interviews with all sampled respondents. Data collection tools were pre-tested in the neighbouring Kapoeta North (not covered by this research to avoid bias during the study) to ensure that interviewers understood the questions and followed correct protocols.

Each day's collected data was checked and discussed with the teams to ensure questionnaires were filled and to ensure the accuracy of the data. Therefore, we checked the data for completeness and consistency before collecting subsequent data. Each collected qualitative data was transcribed verbatim before the next data was collected, which enabled the capture of emerging insights into the semi-structured guide. The principal investigator believed this could help enhance credibility and comprehensiveness in the themes. Peer debriefing was

Table 1 Variables of uptake

Category	Variables	Measurement	Sources of data
Uptake	Blanket supplementary feeding (BSFP)	Categoric: (1) Yes and (2) No	Interviews, HH survey
	Growth monitoring	Categoric: (1) Yes and (2) No	Interviews, HH survey
	Training on Kitchen gardens	Categoric: (1) Yes and (2) No	Interviews, HH survey
	Cooking demonstrations	Categoric: (1) Yes and (2) No	Interviews, HH survey
	CVT	Categoric: (1) Yes and (2) No	Interviews, HH survey
	ECDE	Categoric: (1) Yes and (2) No	Interviews, HH survey
	Child protection services	Categoric: (1) Yes and (2) No	Interviews, HH survey
	Counseling on initiation of BF	Categoric: (1) Yes and (2) No	Interviews, HH survey
	Exclusive breastfeeding (BF)	Categoric: (1) Yes and (2) No	Interviews, HH survey
	Counseling on Dietary diversity	Categoric: (1) Yes and (2) No	Interviews, HH survey
	Nutrition education	Categoric: (1) Yes and (2) No	Interviews, HH survey
	Vitamin A and Zn supplements	Categoric: (1) Yes and (2) No	Interviews, HH survey
	Family MUA	Categoric: (1) Yes and (2) No	Interviews, HH survey
	Timely complementary feeding	Categoric: (1) Yes and (2) No	Interviews, HH survey
	Health education on WASH	Categoric: (1) Yes and (2) No	Interviews, HH survey
	Deworming	Categoric: (1) Yes and (2) No	Interviews, HH survey
	Antenatal and Post-natal care	Categoric: (1) Yes and (2) No	Interviews, HH survey
	BCG, Penta3, Measles, Rota vaccination	Categoric: (1) Yes and (2) No	Interviews, HH survey
	Insecticide-treated nets	Categoric: (1) Yes and (2) No	Interviews, HH survey
	Family Planning services	Categoric: (1) Yes and (2) No	Interviews, HH survey
	Folic acid and iron supplements	Categoric: (1) Yes and (2) No	Interviews, HH survey
		Categoric: (1) Yes and (2) No	Interviews, HH survey
		Categoric: (1) Yes and (2) No	Interviews, HH survey
		Categoric: (1) Yes and (2) No	Interviews, HH survey

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Table 2 Variables of individual, interpersonal and community factors

Category	Variables	Measurement	Sources of data
Community Factors	Coordination and mobilization,	Nominal	In-depth Interview, HH survey
	Integration of interventions,	Nominal	In-depth Interview, HH survey
	Availability of communication channels	Nominal	In-depth Interview, HH survey
	Road network and Transport means,	Nominal	In-depth Interview, HH survey
	Static Health facilities	Nominal	In-depth Interview, HH survey
	Cattle Raiding,	Nominal	In-depth Interview, HH survey
	Men's participation in child care	Nominal	In-depth Interview, HH survey
	Access to beneficiaries	Nominal	In-depth Interview, HH survey
	High women roles/Gender roles	Nominal	In-depth Interview, HH survey
	Availability of protected water sources	Nominal	In-depth Interview, HH survey
	Distance to health facilities	Nominal	In-depth Interview, HH survey
	COVID-19 factor	Nominal	In-depth Interview, HH survey
			In-depth Interview, HH survey
			In-depth Interview, HH survey
Interpersonal Factors	Husband support	Binary: (1) Yes and (2) No	In-depth Interview, HH survey
	Decisions making	Binary: (1) Yes and (2) No	In-depth Interview, HH survey
	Family linkages	Binary: (1) Yes and (2) No	In-depth Interview, HH survey
Individual Factors	Knowledge,	Binary (1) Yes and (2) No	In-depth Interview, HH survey
	Practices	Continuous:	In-depth Interview, HH survey
	Alcoholism	Binary: (1) Yes and (2) No	In-depth Interview, HH survey
	Individual characteristics	Continuous:	In-depth Interview, HH survey
	-Age,	Continuous	In-depth Interview, HH survey
	-marital status,	Continuous:	In-depth Interview, HH survey
	-education,	Continuous:	In-depth Interview, HH survey
	-Occupation,	Continuous:	In-depth Interview, HH survey
	-ethnicity,	Categoric: (1) Yes and (2) No	In-depth Interview, HH survey
	-disability,	Continuous:	In-depth Interview, HH survey
	-HH head,	Continuous:	In-depth Interview, HH survey
	-Income		In-depth Interview, HH survey

undertaken during the data collection and coding daily as a means of improving the trustworthiness of the data. Moreover, triangulation data generated from in-depth interviews (KIIs) were applied.

Data analysis
Quantitative data analysis was done by using STATA version 16.0 (Stata Corp., College Station, Texas, USA). A descriptive summary of all variables was done with frequencies 405 and percentages 0–100. The Kaiser–Meyer–Olkin test was conducted as a measure of sampling adequacy [23], indicating 87.0% suitability for factor analysis. All indicators with eigenvalues greater than or equal to 1 were retained. Using all the indicators identified from factor analysis, an index for the overall level of uptake of preventive nutrition intervention was generated. From this, the medium score was computed to generate a categorical variable showing the levels of uptake: low, medium, and high. Using a cut-off medium score

of 24%, all respondents below were considered to have low uptake. From 25%–50%, these were categorised as medium, and 50%+were considered to have high uptake of preventive nutrition intervention (PNI).

The three generated categories of PNI were used to run two models: Model 1 (using the multinomial regression) and Model 2 (using the ordinal logistic). Another variable of PNI was generated by merging medium and high categories together to formulate a binary variable. This variable was coded 1 if the respondent's level of uptake was low and 0 if otherwise (high/medium). With this, a binary logistic regression (Model 3) was run. Model diagnostic tests were performed using the log-likelihood test, the Akaike Information Criterion (AIC), and the Bayesian Information Criterion (BIC). A model with a lower AIC/BIC was selected and considered to fit the data well. From the three models performed, the logistic regression fits the data better because of its low value of AIC/BIC and the high value from the log-likelihood test (Table 3).

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Table 3 Factors associated with low uptake of PNI using a multinomial regression (Model 1)

Variable	Medium vs Low AOR [95%CI]	High vs Low AOR [95%CI]
Woman's age (Year)		
< 20	1.00	1.00
20–29	1.21[0.32,4.53]	3.19[0.51,20.11]
30–39	0.97[0.22,4.35]	1.53[0.21,11.31]
>40	1.06[0.15,7.64]	2.87[0.22,38.24]
Education status		
None	1.00	1.00
Educated	0.53[0.19,1.54]	1.60[0.50,5.13]
Tribe		
Non-Toposa	1.00	1.00
Toposa	0.78[0.13,4.56]	0.40[0.07,2.21]
Disability		
No	1.00	1.00
Yes	0.34[0.12,0.99]**	0.66[0.24,1.83]
Ever heard about PNI		
No	1.00	1.00
Yes	3.46[1.73,6.94]***	5.79[2.58,13.01]***
Access to information on PNI		
No	1.00	1.00
Yes	1.19[0.49,2.89]	0.79[0.29,2.14]
Child's age (Months)		
<12	1.00	1.00
6–59	1.47[0.30,1.85]	2.11[0.32,2.24]
Child's gender		
Female	1.00	1.00
Male	0.72[0.39,1.31]	0.55[0.28,1.07]
Child's Nutritional status by MUAC		
Well-nourished	1.00	1.00
Undernourished	0.39[0.21,0.75]***	0.55[0.27,1.11]
Age of the household head (Year)		
<25	1.00	1.00
25–34	1.34[0.56,3.20]	0.90[0.39,2.11]
35–44	3.77[1.10,13.01]**	1.06[0.27,4.15]
45+	4.29[0.90,20.42]	0.19[0.02,1.61]
Household wealth index		
Richest	1.00	1.00
Richer	0.69[0.23,2.08]	0.84[0.28,2.54]
Middle	0.99[0.34,2.94]	0.42[0.13,1.37]
Poorer	2.26[0.60,8.50]	1.58[0.35,7.12]
Poorest	1.35[0.46,4.02]	1.01[0.32,3.18]
Household head		
Father	1.00	1.00
Mother	3.18[1.00,10.13]**	1.24[0.35,4.36]
Education status of household head		
None	1.00	1.00
Educated	3.33[1.05,10.54]**	1.16[0.32,4.27]
Decision maker in a household		
Respondent	1.00	1.00
Husband/partner jointly	2.46[1.18,5.12]**	4.57[1.81,11.51]***

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Table 3 (continued)

Variable	Medium vs Low AOR [95%CI]	High vs Low AOR [95%CI]
Number of children under 5 in a household		
1	1.00	1.00
2	2.11[1.04,4.30][**]	2.30[1.12,4.73][**]
3–4	1.59[0.58,4.38]	0.63[0.17,2.34]
Time to the health facility	0.48[0.25,0.95][**]	0.56[0.28,1.11]
Community coordination and mobilization	1.15[0.34,3.86]	4.37[0.84,22.76]
Community integration of interventions	1.59[0.59,4.25]	1.59[0.47,5.39]
Good road network and transport means	1.52[0.58,4.00]	2.32[0.72,7.44]
Absence of government health facility	0.16[0.06,0.42][***]	0.09[0.03,0.27][***]
Men participate in child care	0.35[0.16,0.80][**]	1.36[0.55,3.36]

AOR is the adjusted odds ratio all at 95% confidence intervals; [**] $p < 0.05$, [***] $p < 0.01$; results based on multinomial logistic regression

Table 4 Model diagnostic test

Models	Log-likelihood	AIC	BIC
Model 1 (Multinomial regression)	−284	693	939
Model 2 (Ordinal logistic)	−316	696	823
Model 3 (Logistic regression)	−182	426	545

Unadjusted and adjusted results for the model were provided and presented using *p*-value < 0.05 at 95% confidence interval as the level of significance. Only variables whose *p*-values were less than 0.2 at bivariate were considered at multivariate. Given the complexity of the study which included many variables, stepwise regression [13] using forward and backward elimination was done during logistic regression analysis to identify predictor variables that best explain data. Backward elimination was conducted given the effects of many correlated independent variables in the model to improve out-of-sample accuracy and enhance the generalizability of results. A stepwise selection yielded a simple and easily interpretable model to allow variables to be tested and qualify for inclusion into the final model that combined individual, interpersonal, and community factors which in nature act together to influence an outcome. In our analysis, we employed different statistical models to assess the uptake of Preventive Nutrition Interventions (PNIs). The diagnostic tests for these models are summarized in Table 4.

Focus group discussions comprised 10 key informants in different levels of nutrition health care. The focus group discussions were guided by 13 questions. Each response to each question was recorded with the respective key informant. These 13 questions were grouped into themes based on the objectives of the study, namely level of preventive nutrition interventions and individual, interpersonal, and community-level factors. According to the research objectives and literature, a deductive thematic analysis approach was embraced in which themes were developed beforehand. Responses from each question were used to explain the patterns observed from the quantitative analysis. Table 5 summarizes the questions and themes they were categorized into.

Reflexivity

This study places great emphasis on reflexivity, conscious of the fact that most researchers are not originally from South Sudan. We accepted the cultural, academic, and social variances inside the community while recognizing that they could shape perceptions and interpretations of the local situation, especially related to nutrition practices of caregivers of CU5 in Kapoeta South County. In order to reduce potential biases, it was important to us to position the perspectives of the participants at the center of our research approach by involving local translators and community representatives to boost our insight and lessen probable errors.

While undertaking this research, we deliberately strove to be reflexive, being aware of how subjectivity might affect our results. We took an approach that included actively working with local stakeholders and applying contextualized knowledge to make sure the data we collected was analyzed accurately regarding the challenges caregivers face. This provided us the opportunity to assess the cultural and contextual sensitivity of our study context critically, enhancing our knowledge of its complexities while validating our interpretations via checks with local residents.

The engagement of our team members greatly affected the design of our research tools as well as our methodology. Working with international NGOs on nutrition projects in South Sudan gave me important understanding of the local situation. Barbara had previously undertaken

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Table 5 Factors associated with low uptake of PNI by ordinal logistic regression (Model 2)

Variable	OR [95%CI]	Model 2 AOR [95%CI]
Woman's age (Year)		
< 20	1.00	1.00
20–29	2.49[1.11,5.57]**	1.99 [0.67,5.91]
30–39	1.99[0.85,4.66]	1.12 [0.33,3.78]
>40	2.93[1.11,7.75]**	1.62 [0.37,7.08]
Education status		
None	1.00	1.00
Educated	1.51[0.94,2.43]	1.26 [0.61,2.58]
Tribe		
Non-Toposa	1.00	1.00
Toposa	0.50[0.18,1.33]	0.53 [0.16,1.79]
Disability		
No	1.00	1.00
Yes	0.51[0.28,0.94]**	0.60 [0.28,1.26]
Ever heard about PNI		
No	1.00	1.00
Yes	5.81[3.76,8.99]***	4.37 [2.54,7.51]***
Access to information on PNI		
No	1.00	1.00
Yes	3.16[1.97,5.06]***	0.91 [0.46,1.82]
Child's age (Months)		
< 6	1.00	1.00
6–59	1.78[0.33,0.97]**	2.31 [0.47,1.82]
Child's gender		
Female	1.00	1.00
Male	0.67[0.47,0.98]**	0.64 [0.41,1.00]
Child's Nutritional status by MUAC		
Well-nourished	1.00	1.00
Undernourished	0.41[0.28,0.60]***	0.48 [0.30,0.78]***
Age of the household head (Year)		
< 25	1.00	1.00
25–34	0.88[0.53,1.44]	1.01 [0.53,1.86]
35–44	0.53[0.31,0.92]**	1.06 [0.43,2.62]
45 +	0.48[0.24,0.99]**	0.62 [0.20,1.91]
Household wealth index		
Richest	1.00	1.00
Richer	0.85[0.47,1.52]	1.09 [0.50,2.39]
Middle	0.46[0.25,0.85]**	0.64 [0.28,1.45]
Poorer	0.72[0.38,1.37]	1.58 [0.60,4.17]
Poorest	0.63[0.37,1.07]	1.13 [0.51,2.53]
Household head		
Father	1.00	1.00
Mother	3.26[2.10,5.04]***	1.31 [0.57,3.04]
Education status of household head		
None	1.00	1.00
Educated	2.07[1.25,3.41]***	1.21 [0.54,2.72]
Decision maker in a household		
Respondent	1.00	1.00
Husband/partner jointly	3.29[2.05,5.26]***	2.59 [1.47,4.57]***

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Table 5 (continued)

Variable	OR [95%CI]	Model 2 AOR [95%CI]
Number of children under 5 in a household		
1	1.00	1.00
2	2.37[1.57,3.58]***	1.51 [0.91,2.50]
3–4	1.30[0.74,2.30]	0.81 [0.39,1.71]
Time to health facility	0.59[0.46,0.77]***	0.68 [0.42,1.09]
Community coordination and mobilization	4.11[2.34,7.22]***	1.78 [0.67,4.68]
Community integration of interventions	3.26[1.93,5.53]***	1.33 [0.62,2.85]
Good road network and transport means	3.17[1.96,5.14]***	1.53 [0.72,3.25]
Absence of government health facility	0.68[0.44,1.04]	0.22 [0.11,0.41]***
Men participate in child care	1.74[1.19,2.54]***	1.28 [0.72,2.29]

AOR is the adjusted odds ratio all at 95% confidence intervals; **$p < 0.05$, ***$p < 0.01$; Model 2 is based on ordinal logistic regression

several studies on IYCF in South Sudan, Babu is currently directing similar projects in Sudan and previously done similar work Somalia, Karamoja and thus brought a more expansive view of best practices in humanitarian contexts. As a health researcher familiar with these contexts, Kananura contributed to our understanding of the details involved. Our united expertise improved the structure of the study and confirmed that our findings were relevant to the community we aimed to help.

Results

Demographic characteristics of children under five and their caregivers

The study indicated that 96% of the respondents participated in this study. More than half, 60.2%, of the caregivers ranged between ages 20 to 29 years. The majority were married (91.6%), uneducated (82.2%), from the Toposa tribe (96.3%), and without disabilities (86.9%). More than half, 69.4% of the participants were pastoralists or farmers. Almost half of them had never heard about preventive nutrition interventions (40.7%), and about a quarter did not have access to information about PNIs (26.4%).

Focusing on the children, the majority were between 12 to 36 months of age (74.8%). And almost half, 43.2% of the children were undernourished.

Intrapersonal factors included the age of the household head where almost half, 40.4% were between 25 and 34 years of age. Households were distributed in the wealth index, but a larger proportion were in the poorest category (28.9%). More than two-thirds of the households were headed by a mother (68.4%). The majority of household heads were not educated (85.4%), and the husband was mostly the household decision-maker (73.8%). More than half of the households had one child each (55.3%).

Community factors included time taken to reach the health facility where more than half spent an hour or less

to the health facility (53.1%). The majority (81%) of the participants responded that there was community coordination and mobilization, 79.7% reported that there were community integration interventions, and 65.7% said that the community had communication channels. The majority of the participants (75.8%) reported that there was a good road network and transport means, 76.5% reported the absence of a government health facility, and 60.5% reported that men participated in child care.

The details of sample demographic characteristics of the respondents and their children under five years of age are presented in Table 6.

Factor analysis to assess the dependent variable – low uptake of preventive nutrition interventions

Factor analysis was employed to identify and categorize the various factors influencing the uptake of preventive nutrition interventions (PNIs). The analysis revealed several key dimensions:

Preventive nutrition sensitivity

The Results of factor analysis revealed that preventive nutrition sensitivity was mainly measured by growth monitoring (93%), BSFP (89%), cooking demonstrations (85%), and cash and voucher assistance (81%) as shown in Table 7. Other measurements of preventive nutrition-sensitive interventions were child protection services (78%), and early childhood development (75%).

Preventive nutrition-specific interventions

Preventive nutrition-specific interventions were measured by health education on proper sanitation, water and hygiene (93%), nutrition education (90%), training on family MUAC, and complementary feeding with each contributing 90%. Counselling on dietary diversity (78%),

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Table 6 Demographic characteristics of the respondents and children under five in Kapoeta South

Variable	Frequency (*N* = 405)	Percentage
Individual characteristics		
Woman's age (Year)		
< 20	29	7.2
20–29	244	60.2
30–39	100	24.7
> 40	79	7.9
Marital status		
Never lived as a couple	24	5.9
Married	371	91.6
Separated/divorced	10	2.5
Education status		
None	333	82.2
Educated	72	17.8
Tribe		
Non-Toposa	15	3.7
Toposa	390	96.3
Disability		
No	352	86.9
Yes	53	13.1
Occupation		
Business	91	22.5
Pastoralist/farmer	281	69.4
Civil servant/NGO	33	8.1
Ever heard about PNI		
No	165	40.7
Yes	240	59.3
Access to information on PNI		
No	107	26.4
Yes	298	73.6
Child's age		
< 6 Months	31	7.7
6–59 Months	374	92.3
Child's sex		
Female	190	46.9
Male	215	53.1
Child's Nutritional Status by MUAC		
Well-nourished	230	56.8
Undernourished	175	43.2
Intrapersonal factors		
Age of the household head (Year)		
< 25	89	22.9
25–34	157	40.4
35–44	104	26.7
45 +	39	10.0
Household wealth index		
Richest	80	19.7
Richer	82	20.3
Middle	75	18.5

Table 6 (continued)

Variable	Frequency (*N* = 405)	Percentage
Poorer	51	12.6
Poorest	117	28.9
Household head		
Father	128	31.6
Mother	277	68.4
Education status of household head		
None	346	85.4
Educated	59	14.6
Decision maker in a household		
Respondent	106	26.2
Husband/partner jointly	299	73.8
Number of children under 5 in a household		
1	224	55.3
2	132	32.6
3–4	49	12.1
Community factors		
Time to the health facility		
< 1 h	215	53.1
1–2 h	122	30.1
> 2 h	68	16.8
Community coordination and mobilization	328	81.0
Community integration of interventions	323	79.7
Community communication channels	266	65.7
Good road network and transport means	307	75.8
Absence of government health facility	310	76.5
Men participate in childcare	245	60.5

Table showing the frequency in number and percentage frequency of caregivers and children based on different demographic characteristics

Counseling on early initiation of breastfeeding (77%), and Counseling on Exclusive breastfeeding (61%) were other measurements of preventive nutrition-specific. Results in Table 7 also indicated several indicators that defined health-related interventions.

Health-related interventions

From the results, folic and iron supplements (90%), health education on water, hygiene and sanitation (88%), deworming (87%), and family planning services (80%) were the main measures of health-related interventions. In addition, antenatal and postnatal care services (78%), vaccinations like Rotavirus (78%), BCG (73%), measles (69%), penta-3 (67%), as well as sleeping under insecticide-treated mosquito nets (63%) significantly contributed to the interventions.

These findings highlight that a broad range of factors, from direct nutrition interventions to broader health and sanitation education, impact the overall uptake of PNIs.

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Table 7 Factor analysis of the measures of uptake of preventive nutrition interventions

Indicator	Preventive Nutrition Sensitive	Preventive Nutrition specific	Health related interventions
BSFP	0.887		
Growth monitoring	0.925		
Kitchen Gardening	0.810		
Cooking demonstrations	0.848		
Cash and Voucher assistance	0.812		
Early Childhood development (ECD)	0.754		
Child Protection Services	0.781		
Counseling on Early initiation of breastfeeding		0.775	
Counseling on Exclusive breastfeeding		0.609	
Counseling on Dietary Diversity		0.780	
Nutrition Education		0.904	
Vitamin A and Zinc Supplements		0.886	
Health education on proper sanitation, water and hygiene		0.927	
Training on Family MUAC		0.899	
Complementary Feeding		0.897	
Health education on water, hygiene and sanitation			0.884
Deworming interventions			0.869
Antenatal and Postnatal care services			0.780
BCG			0.734
Penta-3-Vaccination			0.669
Measles Vaccination			0.690
Rota Virus			0.783
Insecticide treated mosquito nets			0.627
Family Planning services			0.801
Folic and Iron Supplements			0.901

Table 8 Level of uptake of preventive nutrition intervention

Level	Frequency (n)	Percentage (%)
Low	208	51.4
Medium	110	27.1
High	87	21.5
Total	405	100.0

Table showing the frequency and percentage of participants in different uptake levels of PNIs

The factor analysis helped in understanding how these variables interrelate and influence the likelihood of low, medium, and high uptake levels of preventive nutrition interventions.

Level of uptake of preventive nutrition interventions by children under 5 years in Kapoeta South County

The majority (51.4%) of the respondents were categorized in the low uptake. The analysis of the level of uptake of Preventive Nutrition Interventions (PNIs) among participants revealed varying degrees of engagement. The results are presented in Table 8, which shows the frequency and percentage of participants in different uptake levels.

The qualitative data collected from Key Informant Interviews (KIIs) revealed several themes related to the intake of Preventive Nutrition Interventions (PNIs) and factors influencing their accessibility. Table 9 summarizes these themes alongside the relevant questions addressed during the interviews.

To explain the distribution of participants into low, medium, and high uptake of PNIs, results from the KIIs were analyzed to assess the attitudes of the people of Kapoeta South towards undernutrition. Results from KIs revealed that participants from eight out of ten KIIs believe that undernutrition is a normal phenomenon in their community.

> "...*Our people in this community take undernutrition as a normal disease locally known as "egizenyi"which is caused by lack of food because it has been here ever since from a long time ago before we were borne".*

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Table 9 Qualitative data from KIIs and respective themes

Themes	Questions
Preventive Nutrition Interventions (PNI) intake	Community perceptions
Personal and interpersonal factors	Men's involvement
Community factors	Factors affecting community from accessing interventions
	Availability of nutritional partners
	Availability of health systems, support
	Mobilization and coordination
	Covid 19
	Views of factors limiting access to under 5s
	Views on availability of competent staff
	Views on ability to maintain core pipelines
	Views on modality of delivery of PNIs
	Views on number of nutrition sites

Table 10 Frequency of individual preventive nutrition intervention uptake

Intervention	Frequency (Total $N = 405$)	% Frequency
BSFP	188	46.42
Growth monitoring	158	39.01
Kitchen gardens	154	38.02
Cooking demos	126	31.11
CVT	26	6.42
ECDE	32	7.90
Child protection services	89	21.98
Initiation of BF	195	48.15
Exclusive BF	187	46.17
Dietary diversity	107	26.42
Nutrition education	205	50.62
Vitamin A	184	45.43
Family MUAC	106	26.17
Folic and iron	165	40.74
Timely CF	148	36.54
Health Education on WASH	196	48.40
Deworming	195	48.15
ANC and PNC visits	207	51.11
Immunization	218	53.83
Insecticide-treated nets	189	46.67
Family planning services	29	7.16

Table showing frequency and percentage of participants' uptake of different PNIs

The study also assessed the level of uptake of each individual preventive nutritional intervention which was classified into three groups. Of the preventive nutrition-sensitive classification, Initiation of breastfeeding was the most frequently practiced at 48.2% ($N = 195$), followed by Blanket Supplementary Feeding, growth monitoring, kitchen gardens, and cooking demos (46.4%, 39%, 38% and 31.1% respectively). In the preventive nutrition-specific class, nutrition education was the most practiced preventive intervention at 50.6% ($N = 205$). All the other interventions were practiced by more than 100 participants. Lastly, in the health-related interventions class, immunization was mostly practiced at 53.8% followed by ANC and PNC visits (51.1%). Health education on WASH, deworming, and insecticide-treated nets followed in frequency (48.4%, 48.2%, and 46.7% respectively). The least used interventions were Cash and Voucher Transfers (CVT) and Early Childhood Development Education (ECDE) at 6.42% and 7.9% respectively. Below is a summary of the responses per intervention used to describe uptake based on the three classifications of the variables (Table 7-Appendix 5).

Association of individual, interpersonal and community factors with low uptake of preventive nutritional interventions

Table 10 shows the unadjusted and adjusted results of the factors associated with the uptake of preventive nutrition intervention (PNI). At the bivariate level, women aged 40 and above, having heard about PNI, having access to information, female-headed households, having an educated household head as well and having joint decision-making within a household were less likely to have low levels of PNI. In addition, households with more than one child under five, community coordination and mobilization, community integration of interventions and having good road network and transport means were associated with reduced odds of low levels of PNI. On the other hand, living with a disability, being undernourished, longer distances to health facilities, and the absence of government health facilities in a community increased the risk of having a low-level uptake of PNI.

After controlling for all possible confounders, the multivariate results revealed that having heard about PNI, and nutritional status were associated with the level of uptake of PNI. From the results, caretakers who ever heard about PNI were less likely to have a low uptake level of PNI (AOR = 0.22; 95% CI = 0.12, 0.40) as compared to their counterparts who had never. Findings also revealed that undernourished (AOR = 2.26; 95% CI = 1.30, 3.93) children were significantly associated with increased odds of lower levels of PNI as compared and well-nourished children Table 11.

Compared to women who could make independent decisions, joint decision-making in a household was associated with reduced odds of low uptake to PNI (AOR = 0.34; 95% CI = 0.18, 0.65). Similarly, households

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Table 11 Association of individual, interpersonal, and community factors with low uptake of preventive nutritional interventions

Variable	OR [95%CI]	AOR [95%CI]
Woman's age (Year)		
< 20[a]	1.00	1.00
20–29	0.47[0.20,1.06]	0.56[0.16,1.92]
30–39	0.51[0.21,1.22]	0.86[0.21,3.45]
> 40	0.24[0.08,0.69] ***	0.59[0.09,3.76]
Marital status		
Never lived as a couple[a]	1.00	
Married	0.67[0.28,1.59]	-
Separated/divorced	0.43[0.09,1.95]	-
Education status		
None[a]	1.00	1.00
Educated	0.67[0.40,1.11]	1.21[0.48,3.01]
Tribe		
Non-Toposa[a]	1.00	
Toposa	1.61[0.56,4.61]	-
Disability		
No[a]	1.00	1.00
Yes	2.22[1.20,4.09]**	2.11[0.95,4.69]
Occupation		
Business[a]	1.00	
Pastoralist/farmer	0.84[0.52,1.35]	-
Civil servant/NGO	1.32[0.59,2.97]	-
Ever heard about PNI		
No[a]	1.00	1.00
Yes	0.16[0.10,0.25]***	0.22[0.12,0.40]***
Access to information on PNI		
No[a]	1.00	1.00
Yes	0.31[0.19,0.49]***	0.99[0.47,2.13]
Child's age (Months)		
< 6	1.00	1.00
6–59	2.74[0.99,3.22]	2.31[0.59,3.02]
Child's gender		
Female[a]	1.00	1.00
Male	1.46[0.99,2.17]	1.55[0.91,2.65]
Child's Nutritional status by MUAC		
Well-nourished[a]	1.00	1.00
Undernourished	2.59[1.73,3.89]***	2.26[1.30,3.93]***
Interpersonal		
Age of the household head (Years)		
< 25[a]	1.00	1.00
25–34	1.02[0.61,1.72]	0.92[0.45,1.92]
35–44	1.47[0.83,2.59]	0.50[0.17,1.46]
45 +	1.45[0.68,3.09]	0.66[0.16,2.75]
Household wealth index		
Richest[a]	1.00	1.00
Richer	1.35[0.73,2.51]	1.25[0.50,3.11]
Middle	2.15[1.13,4.08]**	1.48[0.58,3.79]
Poorer	1.20[0.59,2.44]	0.47[0.15,1.51]
Poorest	1.58[0.89,2.80]	0.83[0.33,2.12]

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Table 11 (continued)

Variable	OR [95%CI]	AOR [95%CI]
Household head		
Father[a]	1.00	1.00
Mother	0.31[0.20,0.49]***	0.53[0.20,1.38]
Education status of household head		
None[a]	1.00	1.00
Educated	0.39[0.22,0.71]***	0.44[0.15,1.24]
Decision maker in a household		
Respondent[a]	1.00	1.00
Husband/partner jointly	0.31[0.19,0.50]***	0.34[0.18,0.65]***
Number of children under 5 in a household		
1[a]	1.00	1.00
2	0.40[0.26,0.63]***	0.47[0.25,0.86]**
3–4	0.58[0.31,1.09]	0.84[0.33,2.14]
Community factors		
Time to health facility	1.70[1.30,2.23]***	1.84[1.05,3.23]**
Community coordination and mobilization	0.25[0.14,0.45]***	0.58[0.19,1.75]
Community integration of interventions	0.31[0.18,0.53]***	0.62[0.26,1.49]
Community communication channels	1.06[0.71,1.60]	-
Good road network and transport means	0.33[0.20,0.53]***	0.56[0.24,1.30]
Absence of government health facility	1.63[1.02,2.59]**	7.82[3.22,18.99]***
Men participate in child care	0.69[0.46,1.03]	1.44[0.70,2.94]

AOR is the adjusted odds ratio all at 95% confidence intervals; [a]indicates baseline category; (-) indicates that a variable was dropped; **$p < 0.05$, ***$p < 0.01$; this model is based on based on binary logistic regression

with two children under 5 were less likely to have low levels of uptake to PNI as compared to those with only one child (AOR = 0.47; 95% CI = 0.25, 0.86). Regarding community factors, results show that taking longer time to the facility (AOR = 1.84; 95% CI = 1.05, 3.23), and communities without a government facility were more likely to have low uptake levels of PNI (AOR = 7.82; 95% CI = 3.22, 18.99).

Joint decision-making with the spouses was highlighted as a significant influencing factor from the results of KIIs. This means that the role of men's involvement in matters of child healthcare made a big difference in this community. From the results, Sevene (7) out of ten (10) KIIs highlighted that men's involvement is considered shameful and a sign of weakness in their households.

> *"…Previously in Toposa culture, it's the responsibility of a mother or a woman to take care of the child or a baby. If men see a fellow man doing this role, it's an insult to them and women will think you are a weak man while other men will isolate you in this community".*

However, this trend changed in recent years when young men were seen to be more involved in their children's child care. This finding explains the importance of men's involvement in child healthcare.

> *"…because times are changing, some men have been involved in some activities of NGOs and they are changing completely in behavior. Some men who are working with the government or NGOs have some motorbikes and they carry their women and children for medical services. The young men also inform other fellow young men with much information. But we fear that our culture is being affected. Mostly young men are embracing this culture".*

From the quantitative data results above (Table 2, appendix 4), the time taken to go to the health facility and the absence of a government health facility are the two community factors that significantly influence the uptake of PNIs. Results from the KIIs revealed the biggest community contributor to the uptake of PNIs was access to the interventions. Access can be affected by distance, time, and insecurity. Nine out of ten KIIs revealed that health facilities were not sufficient within the community, thereby supporting the finding that the lack of a government health facility in the community influenced uptake significantly.

> *"…We lack adequate government health facilities in this area for our people to get preventive nutrition services. Whenever we take these issues to the county and legislative assembly meetings at the county, they*

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say the government has no finance resources and that it is in plan. It is also difficult to access preventive services because we are purely pastoralists and keep moving very far into cattle camps, so we have to walk 3 to 4 hours to access musesifa-health facility".

Discussion

The findings showed that the participants were almost split into low, medium, and high uptake, whereby low uptake had slightly more representation than its counterparts at 51. 4%. Hence the low implementation of Preventive Nutrition Interventions (PNIs) can be attributed majorly to the attitudes and perceptions of the pastoralist communities where under nutrition is considered normal. Perhaps the reason for this perception, could be one of the reasons why caregivers in Kapoeta South County may not opt to attend preventive nutrition related services from health facilities thereby making the uptake low. These low levels of PNI assessment are not unique to the study setting as comparable trends have been described in other low-resource health facilities. For example, in a survey that was done in Burkina Faso on a preventive nutrition package implemented and offered alongside a community-based screening for acute malnutrition revealed that the uptake of the intervention was also low and people's attitude within the community greatly influenced the levels of participation towards the intervention [9]. Also, a study done in Kenya among the pastoralist community, cultural barriers/ and mobility affect the use of health care services for nutrition. These findings indicate that low uptake of PNIs is not exclusive to Kapoeta South but are a common feature with other pastoralist communities in sub-Saharan Africa. Thus, it is important to take into account these socio-cultural factors as the barriers for them to apply an adequate community education and engagement plans.

As for the study's strengths, prior knowledge about preventive nutritional interventions enhanced the likelihood of their uptake. The study also postulated that there is increased likelihood of the caregivers seeking these interventions since they realized their importance for the physical well-being of children under the age of five. This goes with other observations as positive nutrition outcomes in the continent have over the last decade been associated with nutrition education [24]. Another work done in Ethiopia also revealed a positive correlation between knowledge of nutrition interventions namely Essential Nutrition Actions (ENAs) and utilization of the interventions [25].

Households where decisions were made by the husband or jointly with the partner had higher chances of utilizing PNIs. Joint decision-making translates to more informed decisions, owing to information both mother and father have gathered regarding nutrition from different sources. This finding agrees with a case study in Indonesia that assessed the use of maternal health services and found that making joint decisions increased the probability of using antenatal healthcare services [26]. Key informants mentioned that men of a younger age were more open to involvement in child care. Men's inclusion in mother-to-mother support groups as modelled by nutrition partners could yield a positive impact to gain and share knowledge and jointly make decisions with their spouses [15] on ways to improve the nutrition status of CU5 and thus key to facilitate increase in uptake of PNIs.

The lack of a government health facility and the long time taken to reach the health facilities in the community reduced the probability of utilizing preventive nutrition interventions. Key informants mentioned not having enough health facilities, and the population being too big for those that are available. Without a government health facility in the village, it implies caregivers travel long distances for many hours to get PNIs which discourages uptake. Time to reach health facilities, long distances and bad roads were highlighted by KIs as factors affecting uptake and thus correlated to low uptake of PNIs as discovered in this study. Poor physical access to health facilities was identified as a key contributor to reduced uptake of preventive health services [27]. The current finding on time to health facility doesn't conform to a study done in China which found no correlation between travel time, utilization and uptake among rural residents in Shaanxi Province [28] owed to different contexts of pastoral context in the current study. Very few studies have been conducted in pastoral settings and perhaps limited data to support these results but this confirms the need for future investigations using other multilevel approaches [29].

This primary study implemented in the contextual environment of South Sudan established that the enlisting of Preventive Nutrition Interventions (PNIs) is significantly low. Regarding the strengths of this study, we included a host of variables to determine the outcome variable through factor analysis and its association with independent factors determined. This was a unique and new approach in the nutritional sciences research within the South Sudan context filling an important data gap, as most nutrition programs do not address uptake factors. However, in order to be able to increase the adequacy of the sample, as well as the statistical power, a 10 percent non-response rate was provided, yet, all the respondent questionnaires were completed. To deal with covariates and correlations for having close-to-serendipitial results while examining associations, Factor analysis was used. Non-response rate was managed in the study by ensuring the study attained a 95% response rate of the calculated

sample size in order to retain the statistical power of the analyses. More importantly, there was no attrition among the respondents which would have affected the study in terms of sample size requisite for the study.

Study limitations

However, there are several limitations that have been considered essential to address and state in this particular study. First, the data collection instrument depended mostly on participants' own answers, which can be subjective. While care was taken to ensure that all the selected instruments were validated for reliability and validity in order to reduce the number of errors, the configuration of the data in terms of PNIs may reduce the dependability of the results. This is equally a limitation because self-administered questionnaires may result in recall bias or social desirability, thereby over- or underestimating the level of intervention uptake.

Secondly, the study was among the Toposa tribe mainly from pastoralist zone of South Sudan where cattle theft and cyclical movement is rife. These socio cultural factors are likely to present some challenges in our sampling technique in an effort to arrive at an acceptable sample point where we are able to effectively and consistently sample some of the respondents.

Nonetheless, the study achieved the intended sample size to the last participant and the high response rate given that PNI is a new concept and still not widely embraced among the target users therefore respondents were very receptive. To the questions posed to them and it was evident that the responses given were an accurate cross section of the current levels of uptake of PNI among the sampled population. However, it is important to inform the results with these considerations because of the following guidelines: Further study could also gain from assessing the actual quantity of PNI employed as well as investigating such interventions in other settings or societies for confirmation and extension of such findings.

Conclusions

Using the socioecological model framework, we identified factors that influence the uptake of preventive nutrition interventions (PNIs) at various levels. They include community, interpersonal, and individual levels. Constraints such as mobility and accessibility to health facilities, exacerbated by drought and lack of transport, influenced the intervention at the community level. At the interpersonal level, shared household decision-making and communication concerning the PNIs were considered important in ensuring support and compliance with the interventions. Studies at the individual level revealed that awareness of the preventive nutrition interventions had a direct impact on uptake of the interventions, where higher awareness of the interventions improved uptake rates. Thus, the interaction between these variables put into perspective the necessity of multilevel approaches that would tackle barriers to the uptake of PNI adequately.

This study demonstrates that a variety of social factors contribute to the low use of PNIs, particularly in the southern region of South Sudan. The reason for this is that the majority of the population relies on traditional health facilities, with no government health facility located more than 45 min away from our catchment area. Intensification of PNI use therefore requires integration of PNIs in outreach programs with enlightenment campaigns for pastoral caregivers. Other considerations include improving decision-making by all household members as well as incorporating the PNIs into existing health systems. Future studies should compare these culturally appropriate educational interventions and outreach methods to determine their effectiveness. Further, it will be important to expand the knowledge regarding better coordination of PNIs and changes in joint decision-making on uptake and outcome. Through cross-sectional approaches, we can better describe the routines and determinants of PNI uptake, and we can investigate how improved health services and increased community awareness influence the modification of PNI practices.

Abbreviations

CBT	Cash-Based Transfers
CHD	County Health Department
CU5	Children Under 5 years
CVA	Cash and Voucher Assistance
ECD	Early childhood Development Programmes
ENA	Emergency Nutrition Assessment
GAM	Global Acute Malnutrition
IYCF-E	Infant and Young Child Feeding in Emergency
MaKCHS	Makerere University College of Health Sciences
MIYCN	Maternal Infant and Young Child Nutrition
MUAC	Mid Upper Arm Circumference
MoH	Ministry of Health
NIDs	National Immunization Days
NIWG	Nutrition Information Working Group
OTP	Outpatient Therapeutic Program
PNI	Preventive Nutrition Interventions
RSS	Republic of South Sudan
RUSF	Ready to Use Supplementary Food
RUTF	Ready to Use Therapeutic Food
SC	Stabilization Centre
SCI	Save the Children International
SMART	Standardized Monitoring and Assessment for Relief and Transitions
SMOH	State Ministry of Health
UNICEF	United Nations Children's Fund
VAS	Vitamin A Supplements
WASH	Water Hygiene and Sanitation
WFP	World Food Programme
WHO	World Health Organization
WVI	World Vision International

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Supplementary Information

> Supplementary Material 1.

Data availability
The Zip Folder contatining various data sets collected during the researshc stusyd has been attached as related data files to be reviewed by the reviewers along side the main manuscript.

Declarations

Ethics approval and consent to participate
Approval was obtained from the Institutional Review Board (IRB) of Makerere University School of Public Health (Reference number: ERC 1113/2017) and permission was granted by the Directorate of Planning, Budgeting and Research at the Ministry of Health in South Sudan, as well as the UNICEF Nutrition Information Working Group (NIWG). This research was performed in accordance with the Declaration of Helsinki. A detailed informed consent form was provided to the caretakers/mothers before carrying out assessments.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

Author details
[1]Child Relief and Support Fund, Juba, South Sudan. [2]Department of Epidemiology and Biostatistics, Makerere University School of Public Health, Kampala, Uganda. [3]Department of Health Policy, Planning and Management, Makerere University School of Public Health, Kampala, Uganda. [4]African Population and Health Research Center, Nairobi, Kenya. [5]World Food Programme, Juba, South Sudan. [6]Action Against Hunger, Juba, South Sudan. [7]World Vision International, Khartoum, Sudan.

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