SMART survey report in Aweil North county, Northern Bahr El Ghazal state, South Sudan

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List of acronyms

AFI:	Acute Food Insecurity
AMN:	Acute Malnutrition
CDC:	Centers for Disease Control and Prevention
CDR:	Crude Death Rate
CHD:	County Health Department
CM:	Centimeters
CMAM:	Community Management of Acute Malnutrition
CI:	Confidence interval
CMR:	Crude Mortality Rate
CWW:	Concern Worldwide
DDG:	Digital Data Gathering
DEFF:	Design Effect
ENA:	Emergency Nutrition Assessments
EIBF:	Early Initiation of Breastfeeding
ExBF:	Exclusive Breastfeeding
FCDO:	Foreign, Commonwealth and Development Office
FCS:	Food Consumption Score
FSL:	Food Security and Livelihoods
FSNMS:	Food Security and Nutrition Monitoring System
GAM:	Global Acute Malnutrition
GFD:	General Food Distribution
HFA:	Height for Age

HAZ:	Height for Age Z scores
HH:	Household
HHS:	Household Hunger Scale
IPC:	Integrated Phase Classification
IPC-AMN:	Integrated Phase Classification – Acute Malnutrition
IYCF:	Infant and Young Child Feeding
LCS:	Livelihood Coping Strategies
MAM:	Moderate Acute Malnutrition
MAD:	Minimum Acceptable Diet
MDD:	Minimum Dietary Diversity
MM:	Millimeter
MOH:	Ministry of Health
MUAC:	Mid Upper Arm Circumference
NBeG:	Northern Bahr el Ghazal State
NIWG:	Nutrition Information Working Group
OTP:	Out-Patient Therapeutic Programme
PLW:	Pregnant and Lactating Women
PPS:	Probability Proportional to Size
RC:	Reserve Cluster
RRC:	Relief and Rehabilitation Commission
SAM:	Severe Acute Malnutrition
SD:	Standard Deviation (measure of spread around the mean)
SMART:	Standardized Monitoring and Assessment of Relief and Transitions
SMOH:	State Ministry of Health Aweil North County
SSD:	South Sudan
TEM:	Technical Error of Measurement
TSFP:	Targeted Supplementary Feeding Programme
U5MR:	Under Five Mortality Rate
UNHCR:	United Nations High Commissioner for Refugees
UNICEF:	United Nations International Children's Emergency Fund
Vit A:	Vitamin A
WASH:	Water Sanitation and Hygiene
WFH:	Weight for Height
WHO:	World Health Organization
WHZ:	Weigh for Height Z Scores

Executive Summary

Between March 18 and22, 2024, a SMART survey was conducted across all five Payams in Aweil North County, Northern Bahr El Ghazal State, South Sudan. The survey employed a two-stage sample technique: first, villages were identified using the proportion to population size (PPS) method of cluster sampling, and second, houses were selected using simple random sampling.

Anthropometric data was collected from 312 households in 26 clustered villages in Aweil North County, and analyzed to determine the nutritional status of 389 children aged 6-59 months. There was no need to activate reserve clusters because the final sample size exceeded the intended sample size of 340 children.

Table 1: Executive summary table

Category	Indicator	n	N	(%) (95% CI)
Wasting	Prevalence of global malnutrition by WHZ (<-2 z-score and/or oedema)	100	385	26.0 % (21.7-30.8)
	Prevalence of severe malnutrition (<-3 z-score and/or oedema)	14	385	3.6 % (2.3-5.8)
	Prevalence of global malnutrition by MUAC (< 125 mm and/or oedema)	43	387	11.1 % (8.5-14.4)
	Prevalence of severe malnutrition (< 115 mm and/or oedema)	7	387	1.8 % (0.8-3.9)
	Prevalence of combined GAM (WHZ <-2 and/or MUAC < 125 mm and/or oedema)	115	387	29.7 % (25.3-34.5)
	Prevalence of combined SAM (WHZ < -3 and/or MUAC < 115 mm and/or oedema	18	387	4.7 % (2.9-7.4)
Stunting	Prevalence of stunting (<-2 z-score)	70	365	19.2 % (14.9-24.4)
	Prevalence of severe stunting (<-3 z-score)	17	365	4.7 % (2.9-7.5)
Underweight	Prevalence of underweight (<-2 z-score)	107	385	27.8 % (23.5-32.6)
	Prevalence of severe underweight (<-3 z-score)	32	385	8.3 % (5.7-12.0)
Mortality	Crude Death Rate (Deaths/10,000 people/day)	7	312	0.40 % (0.20-0.77)
	Under-5 Death Rate (Deaths/10,000 children U5/day)	0	312	0.0 %
Nutrition and Health Service Coverage	Measles card + mother confirmation	336	371	90.6 % (87.6-93.5)
	De-worming (children12-59 months)	276	338	81.7 % (76.9-85.8)
	Vitamin A Supplementation	354	394	89.8 % (86.5-92.6)

Introduction

South Sudan, the world's youngest country, has been embroiled in internal conflict since gaining independence from Sudan in 2011. This conflict has led to widespread displacements, disrupted livelihoods, and high levels of acute food insecurity and malnutrition across the country. Although a peace deal was signed in September 2018, challenges persist. According to UNHCR, as of July 2023, approximately 2.32 million South Sudanese refugees reside in neighboring countries[1].

As per the results of the latest Integrated Phase Classification (IPC) analysis, 46% of the total population, or 5.83 million people, are experiencing high levels of acute food insecurity, with 1.64 million in IPC Phase 4 (Emergency). Additionally, 35,000 people are classified in IPC Phase 5 (Catastrophe) in specific areas. Specifically in Aweil North, 45% of the population were classified in phase 3 and above with 10% in phase 4 during the analysis period. It is expected that this will increase to 50% with 15% in phase 4 in projection 1 (Oct 2023 – Mar 2024), and further to 55% with 20% in phase 4 in projection 2 (Apr – Jun 2024).

Aweil North County, located in Northern Bahr el-Ghazal State, is predominantly occupied by the Rek Dinka (Malual) people. It borders Aweil West County to the south, Aweil East County to the east, and Sudan to the north. The county's economy relies heavily on farming, with sorghum, groundnut, sesame, maize, and vegetables (such as okra and jews mellow) being the main crops.

The nutrition situation in Aweil North County has been a concern as per nutrition information working group (NIWG) priority counties, and the latest SMART survey conducted in April 2023 showed a Global Acute Malnutrition (GAM) rate of 24.7%, which is above the emergency threshold of 15%. There have been developments since then, including the influx of Sudanese refugees and South Sudanese returnees[2], which have created an information gap.

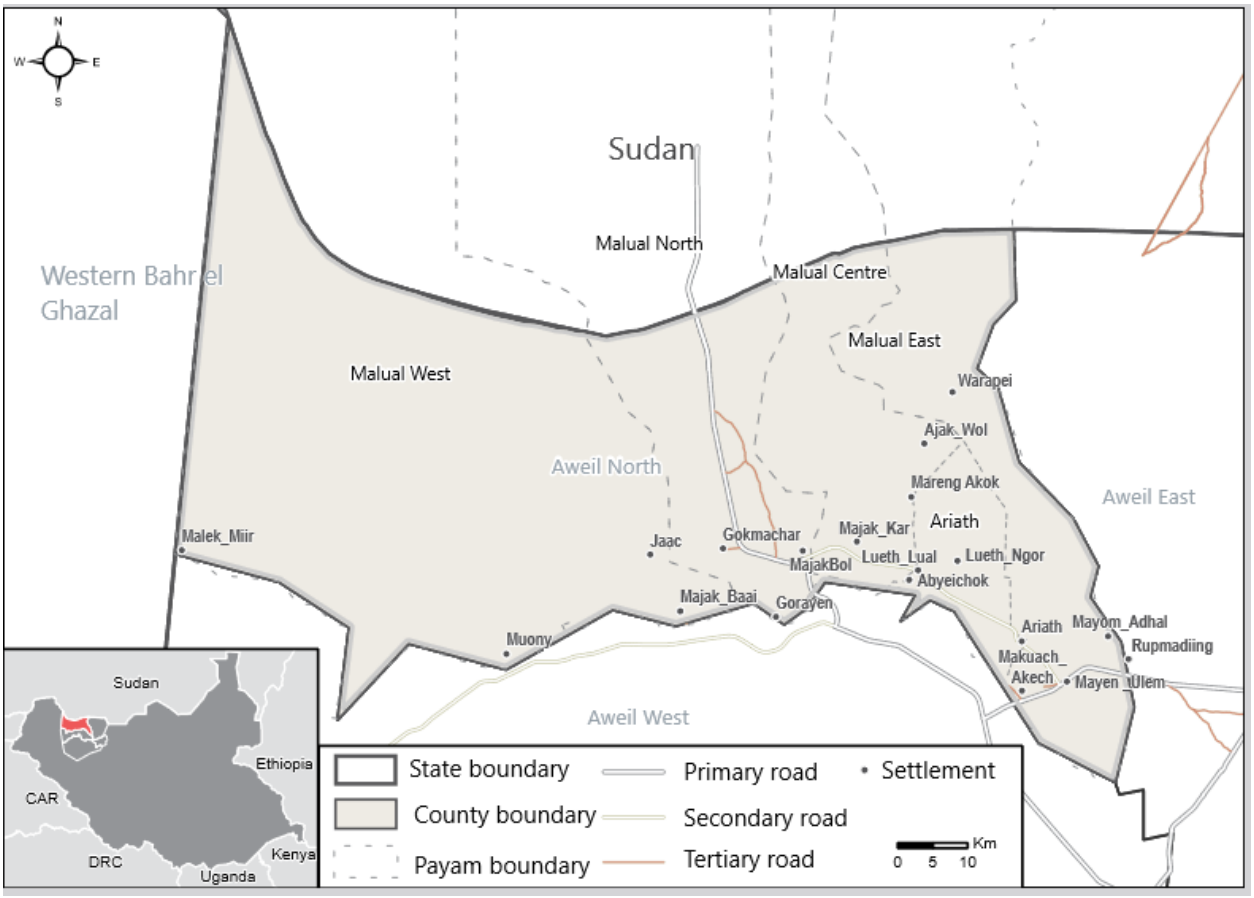
To address this gap, REACH Initiative, present in South Sudan since 2012, planned and conducted a SMART survey in Aweil North County from March 18th to 22nd, 2024. This survey aimed to collect anthropometric and mortality data, as well as key multi-sectoral indicators, to better understand the nutrition situation and its drivers in the county.

This report outlines the objectives and methodology of the SMART survey, including details on sampling procedures, team training, and data collection. Results will be presented across thematic sectors, with conclusions, recommendations, and priorities to inform stakeholders working in the context.

[1] South Sudan Refugee Crisis Explained, UNHCR, July 24, 2023

2 Sudanese Refugees and South Sudanese Returnees, NBeG RRC, Radio Tamazuj, May 2023

Figure 1: Aweil North county reference map



Survey Objectives

The general objective of this assessment was to assess the nutrition situation among children (boys and girls) aged 6-59 months and retrospective mortality rates amongst the population in Aweil North County. In addition, the assessment aimed to analyze the possible factors contributing to acute malnutrition for children 6-59 months in Aweil North, county, Northern Bahr el Ghazal (NBeG) state, South Sudan, to inform humanitarian actors and contribute to a more effective planning and implementation of nutrition services.

Specifically, the objectives of this assessment in Aweil North county break down into the following points:

- To estimate the prevalence of acute malnutrition, stunting and underweight among children (boys and girls) aged 6 – 59 months (about 5 years) in Aweil North County.
- To estimate retrospective (using a 98 days recall period) Crude Mortality Rate (CMR) and Under 5 Mortality Rate (U5MR) in Aweil North County.

- To estimate the proxy coverage of acutely malnourished children aged 6-59 months (about 5 years) in any nutrition program in Aweil North County.
- To estimate the coverage of various immunizations in Aweil North County including:
    - Vitamin A supplementation (for children aged 6-59 months)
    - Deworming (for children aged 12 to 59 months)
    - Measles vaccination coverage among children aged 9-59 months
- To assess childhood morbidity and health seeking behaviors among households with children aged 6-59 months (about 5 years) in Aweil North County.
- To assess the nutritional status of women of reproductive age (15-49) in Aweil North County.
- To assess IYCF Practices such as breastfeeding and complementary feeding among mothers (ever breastfed, exclusive breastfeeding, continued breastfeeding, minimum dietary diversity, minimum meal frequency and minimum acceptable diet) who have children under the age of two years in Aweil North County.
- To assess the WASH situation in Aweil North County (Main water source, distance/time to water source, water treatment status, access to soap, access to latrine).
- To assess the food security and livelihoods situation in Aweil North County [Food Consumption Scores (FCS), Household Hunger Scale (HHS), main livelihoods, and Livelihood Coping Strategies (LCS)].
- To formulate practical interventions and recommendations for both emergency and long-term programs of Nutrition actors in Aweil North County.

Methodology

This is a quantitative survey, that follows the SMART survey protocol, and is representative of the entire population of Aweil North county. The detailed sampling is presented below. All villages in Aweil North county were included and their respective population sizes were considered in order to provide each sampling unit with equal chances of being selected.

Sampling strategy

For this survey, a representative sampling was achieved following a two-stage cluster sampling strategy, which gives an equal chance for each village/cluster to be selected based on its population size, as per the SMART survey guidelines. This strategy consists of two steps: firstly, villages were randomly selected across all the villages in the geographical area of study, with a probability of selection proportional to population size (PPS). Secondly, households were randomly selected within each previously selected cluster. The final number of households to survey in each cluster was based on the calculation in table 4 below, which takes into account how many households per day one survey team can cover, considering different factors as detailed in the table.

Sampling strategy: selection of clusters

The smallest geographic unit used for the study is called a cluster, and in this instance, villages were the administrative level used as clusters. The list of all 431 villages, with populations ranging from as little as 48 individuals to as many as 1,750, was collected from the Aweil North County Health Department (CHD). As per the calculation (see table 5), 26 clusters needed to be selected out of this list in order to achieve the desired level of precision. Using the Emergency Nutrition Assessment (ENA) software, 26 clusters were randomly selected from the village list, along with 3 reserve clusters (RC), using the PPS method.

For clusters with more than 150 HHs, segmentation was used to select one portion of the cluster that will represent the cluster. Selection of segments were done using either PPS or simple random sampling depending on the population sizes of the specific segments[3]. In the selected segment, the process of HH selection was the same used for each cluster to select the 12 HHs to be surveyed within that particular segment/cluster.

The survey teams were able to visit all 26 selected villages and reached a total of 312 households (101% of the total 309 households planned) as well as 385 children under five (113% compared to the 340 needed to achieve representation), hence, there was no need to activate the reserve clusters as the minimum required sample for both clusters and number of children was achieved, as per the SMART guideline.

Sampling strategy: selection of households

Definition of household for the survey: A household was defined as a group of people living together, who cook and eat from the same cooking pot. Polygamous families were also defined based on the same principle: if each wife had her own pot, even if they were living in the same compound, they were treated as different households.

Household selection techniques: One of these two methods was used for household listing: (1) a verbal listing from one or more community leaders and, when not possible, or (2) a manual house-tohouse listing. Twelve households were then randomly selected from the complete list of HHs using a random number generator application.

In selected households, all eligible children (aged 6-59 months) were measured for anthropometric indices and the household questionnaire applied. Empty households and households with absent children were re-visited and information of the outcome recorded on the cluster control form. This form was also used to record information on empty and non-responding households.

[3] As per the SMART Guidelines, if the Segments will have almost equal population sizes, then, SRS will be used; but if the population sizes will be different, then PPS method will be used.

Table 2: Sample size (Anthropometric)

Parameter	Aweil North County	Justification
Estimated Prevalence (%)	20.8%	The lower confidence limit of a SMART survey in Aweil North County by CWW conducted in April 2023 was 24.7% (20.8 - 29.0, 95% CI). As per the projection for acute malnutrition for the first projection from December to March, the situation is likely improvement but within the same IPC Phase 4 for Acute Malnutrition.
Desired Precision	4.5	Based on the SMART survey Guide 2017
Design Effect	1	Based on the current situation in Aweil North County and the comments from the NIWG.
Children to be Included	**340**	
Average Household Size	6	From the 2023 SMART Survey Conducted by CWW
% Children Under-Five	21%	In the SMART survey conducted by CWW, the under % of children under 5 years old was 15%, which was very low compared to the national figure of 21%. For that reason the national proportion for <5 was chosen to be used.
% Non-Respondents	3%	Based on previous experience from Aweil North SMART 2023
Households to be Included	**309**	

Table 3: Sample size (Mortality)

Parameter	Aweil North County	Justification
Estimated death rate per 10,000/day	0.21	Aweil North SMART survey was conducted from April 17 to 29, 2023, by CWW: 0.21% (0.09 – 0.52, 95% CI). Point estimate taken as no special events happened since the last survey.
Desired Precision	0.3	This is taken as per the SMART guidance
Design Effect	1	Based on the current situation in Aweil North county and the comments from the NIWG.
Recall Period	8	Will be Updated When the SMART survey starts
Population to be Included	**1049**	
Average Household Size	6	Aweil North County SMART survey, 17 - 29, 2023 by CWW
% Non-Respondents	3%	From previous experience 2023
Households to be Included	**180**	

The maximum sample size was returned by the anthropometry sample size calculation, and this was considered the final sample size, in which 309 households were to be surveyed.

Table 4: Number of households team interviews per day

Activity	Estimated Time
Departure from Office	**7:30 AM**
a. Daily morning Briefings	*15min*
b. Travel to villages	*60 min*
c. Introduction and HH list development	*30 min*
d. Lunch break	*30 min*
e. Total Time from one HH to another	*5 min*
f. Travel back to base	*60 min*
Total time for HH listing, travelling and breaks (a + b + c + d + f)	195 min
Arrival back to Base	**5:30 PM**
Total Available time in a day	10:00hrs (600 minutes)
Available time for work	600 - 195 minutes= 405 minutes
Time taken to complete one questionnaire	*30 minutes*
Total time per household + e	*35 minutes*

Given the above, the number of households that a team can comfortably visit in a day is calculated as follows:

405 (min) / 35 (min) =11.6 **HHs/per day ~ 12 HHs**

Accordingly, the number of clusters is presented in the table 5 below:

Table 5: Number of clusters

	Aweil North
Total number of HHs based on sample size calculation	309
Total number of HHs to be assessed per day per team	12
Clusters Needed	25.75
Rounded UP	**26**

Survey teams, training, data collection and data management

Survey teams: Six teams of four members (1 Team Leader, 1 measurer, 1 assistant, 1 enumerator) were involved in the collection of the data. In each cluster, a local guide was employed to facilitate data collection at the household level. The survey teams were recruited by Concern Worldwide South Sudan (CWW) with the involvement of the local officials at Aweil North County. To the extent possible, the team members were a mix of both men and women and were recruited from the local communities. Supervisors consisted of a mix of Concern Worldwide, Relief and Rehabilitation Commission (RRC), State ministry of health (SMOH), County Health Department (CHD) and REACH staff.

Training: The survey teams were trained for five days between March 11th and 15 th, 2024. The training covered various components including: taking anthropometric measurements, sampling of households, data collection tools, digital data collection, data quality checks, and standardization exercise, pilot test, among other themes. The training of the enumerators was facilitated by SMART certified staff and staff with experience conducting SMART surveys.

Supervision: The overall management of the survey was done by REACH Initiative with support from Concern Worldwide (CWW) dedicated staff and State Ministry of Health (SMOH) representative. Maximum supervision of the survey teams was ensured to facilitate quality data.

Data entry and management: Data was collected through REACH tablets using Kobo. The data collection tools were programmed and uploaded to the tablets which were used by the survey teams. The teams were uploading the collected data to a central server on a daily basis to allow the survey manager to review the data collected each and every day and clean the data and give the feedback every morning to the teams.

Data quality

In order to ensure optimal and high data quality, a number of measures were put in place. The main ones included:

a) The survey was done in accordance with the submitted protocol, ensuring the following:
    a. That the training of survey teams was done using standardised material as recommended by SMART Methodology.
    b. That standardisation test was undertaken as part of the training; taking appropriate steps thereafter based on performance of the survey teams.
    c. That appropriate calibration of survey equipment, during the training and on every morning before proceeding to the field for data collection, was followed.
    d. That plausibility checks were conducted on a daily basis and informed the daily debriefing sessions which were conducted every day.

b) Data was collected through digital platform, and control checks and skip patterns were programmed to improve the data quality.

c) Anthropometry data was auto analysed using ENA software (January 2020) anthropometry section. The same software was also used to analyse the mortality data.

Questionnaire

The survey was conducted using structured data collection tools which have been developed by the Global SMART Team for both anthropometric and mortality surveys using KOBO. Other indicators were collected using the modules in line with current Food Security and Nutrition Monitoring System (FSNMS) questionnaires as much as possible.

Data collected

1. **Anthropometry**
    - **Age:** was determined using birth/health cards/records when available and local calendar of events which were jointly developed by local leaders and survey enumerators.
    - **Sex:** Male or female
    - **Weight:** Children's weights was taken without clothes using mother and child digital weighing scales (SECA scales with precision of 100gm).
    - **Height/length:** Children were measured using the wooden UNICEF measuring boards (precision of 0.1cm). Children less than 2 years of age were measured lying down, while those 2 years of age or older were measured standing up.
    - **Mid-upper arm circumference:** MUAC measurements were taken at the mid-point of the left upper arm using both the child and adult MUAC tapes (precision of 0.1cm) for children 6-59 months and for adult women 15-49 years of age.
    - **Bilateral pitting oedema:** Bilateral pitting oedemas were assessed by the application of normal thumb pressure on both feet for 3 seconds.

2. **Demographics and mortality:** Every current household member's age in years, their sex, place of birth, and the date they joined the household were all variables gathered throughout the recall period. The age in years, the sex, and whether the household member was born into the family during the recall period were all gathered for those household members who departed during the recall period of 98 days. Age in years, sex, whether the deceased was born or joined the household during the recall period, estimated cause of death, and place of death were all variables recorded for those who passed away during the recall period.

3. **Health interventions data:** Vitamin A supplementation, Deworming, and Measles immunization data were collected through health cards or recall of 6 months prior to data collection.

4. **Morbidity**: Two-week retrospective morbidity data was collected from mothers/caregivers of all children (of 6-59 months old) included in the anthropometric survey.

5. **Food Security Indicators**:
    a. **Food Consumption Scores (FCS):** An indicator of the general quantity and quality of foods being consumed in a household, based on how many days any household

member has consumed 9 distinct food groups within a 7-day recall period. Households were categorized into categories of severity based on their responses. FCS is often used as a proxy for quality of food consumed. Standard FCS thresholds are <21 for 'poor', 21-<=35 for 'borderline' and 35+ for 'acceptable'.

b. **Household Hunger Scale (HHS):** Measures the perceived hunger by asking the frequency a household has experienced three common experiences associated with hunger in the past 30 days (no food in the house, slept hungry, gone whole day and night without food). HHS is often used as a proxy for quantity of food consumed. Thresholds and categories used for analysis are those used for IPC Acute Food Insecurity (AFI) in South Sudan.
c. **Livelihood Coping Strategies (LCS):** Measures behaviours or actions households are taking to cope with not having enough food or resources to get food. Ten coping strategies were probed for and then categorized as Emergency, Crisis, or Stress strategies.

6. **WASH** – indicators on main drinking water source, access to latrines, distance/time to water source, and water treatment were asked.

Referral: During the collection of these anthropometric data, all children whose measurements indicated they were acutely malnourished, and who were not already enrolled in nutrition treatment programs, were referred to the relevant partners using referral forms to existing Targeted Supplementary Feeding Programme (TSFP) and Outpatient Therapeutic Programme (OTP) programs in the area.

Classifying malnutrition

Individual classification of nutritional status

Individual classifications for nutritional status by different anthropometric measurements are summarized in table 6 below for wasting, stunting, and underweight.

Table 6: Individual malnutrition classifications by WHO

Type of Malnutrition	Grade of Malnutrition	Anthropometric Indicators and Cutoffs
Wasting	Global Acute Malnutrition (GAM) Moderate & severe wasting	<-2 z-scores weight-for-height (WFH) and/or oedema
		<125mm mid-upper arm circumference and/or oedema
		Presence of bilateral pitting oedema
	Severe Acute Malnutrition (SAM) Severe wasting	<-3 z-scores weight-for-height (WFH) and/or oedema
		<115mm mid-upper arm circumference and/or oedema
		Presence of bilateral pitting oedema

Stunting	Global Chronic Malnutrition Global Stunting	<-2 z-scores height-for-age (HFA)
	Severe Chronic Malnutrition Severe Stunting	<-3 z-scores height-for-age (HFA)
Underweight	Global Underweight	<-2 z-scores weight-for-age (HFA)
	Severe Underweight	<-3 z-scores weight-for-age (HFA)

Population cut-offs for malnutrition

Table 7 below defines the population cut-offs for determining the severity of malnutrition when the prevalence of acute and chronic malnutrition is known. These levels are internationally agreed upon and provide an objective basis for developing responses to increased levels of acute and chronic malnutrition[4]. To interpret proportions at a population level with meaning, absolute numbers are also necessary.

Table 7: WHO/UNICEF Classification for Severity of Malnutrition by Prevalence among Children 6-59 months[5]

LEVELS	PREVALENCE OF THRESHOLDS %		
	WASTING	OVERWEIGHT	STUNTING
Very low	<2.5	<2.5	<2.5
Low	2.5- <5	2.5- <5	2.5- <10
Medium	5- <10	5- <10	10- <20
High	10- <15	10- <15	20- <30
Very high	>=15	>=15	>=30

Table 8: IPC AMN classifications for severity of malnutrition prevalence among children 6-59 months[6]

IPC AMN Phase Classification	PREVALENCE OF THRESHOLDS %		
	WASTING by GAM by Weight for Height z-score	WASTING by GAM by Mid-Upper Arm Circumference[7]	Priority Response Objective
Acceptable	<5	<5%	Maintain the low prevalence of acute malnutrition
Alert	5- <10		

[4] *Physical Status: The use and interpretation of Anthropometry. Report of a WHO expert committee, 1995. Chapter 5, p208 & 212*
[5] *Threshold classification according to WHO 2018*
[6] *Threshold classification according to IPC Acute Malnutrition reference tables*
[7] IPC AMN classification by MUAC should only be done in the absence of GAM by WHZ data. Whether a higher or lower IPC AMN Phase is classified depends on the historical relationship between WHZ and MUAC in the unit of analysis. See IPC AMN Guidance for more details.

		5 - <10%	Strengthen existing response capacity and resilience. Address contributing factors to acute malnutrition. Monitor conditions and plan response as required.
Serious	10- <15	10 - <15%	Urgently reduce acute malnutrition levels through scaling up of treatment and prevention of affected populations
Critical	15- <30	>= 15%	Urgently reduce acute malnutrition levels through significant scale up and intensification of treatment and protection activities to reach additional population reached.
Extremely Critical	>=30		Urgently reduce acute malnutrition levels through addressing widespread acute malnutrition and disease epidemics by all means

1.1.1 Data cleaning and analysis

The anthropometric and mortality data was analysed using ENA for SMART (January 2020 version). The other additional data (immunization, maternal nutrition, morbidity etc.) were analysed using R. Various statistics have been computed on the data, including percentages, means, and median among others. The analysed data is presented in both tabular and graphical form. The preliminary datasets were made available within 7 days after the last day of data collection, and the preliminary report within 14 days. The preliminary report has gone through REACH validation processes, and was also submitted to the Nutrition Information Working Group (NIWG) for validation.

During the data collection exercise, daily quality checks were performed to ensure the process was running smoothly and that enumerators were well trained on the procedures to be performed. Moreover, specific checks on the anthropometric and mortality results were carried out, specifically the following:

- **Check SMART Flagged children –** Input the anthropometric data into ENA and run the plausibility report. This should identify children without z-scores and if a flagged child cannot be corrected this way, we keep the child in the dataset as it contributes to our quality score.
- **Cleaning extreme MUAC values –** MUAC values <5cm or >20cm or likely errors and will be removed for children 6-59 months.
- **Cleaning reported deaths –** If date of death is available, removing reported deaths that occurred outside of the recall period of interest which is 98 days.

Results

A total of 312 households consisting of 1897 individuals were included in the survey. The average household size was 6.1 individuals. Out of the surveyed households, 97% had children under five years old, bringing the total number of children included in the survey to 389. The proportion of head of households showed a slight inclination towards women, with 54% of the total households being female headed and the remaining 46% male headed households. As the survey achieved the minimum number of children, as per SMART guidelines, there was no need to activate reserve villages.

Table 9: Survey sample and non-response

	Target	Achieved		Absent		Refused	
	N	N	% of Target	N	% of Target	N	% of Target
Children	340	389	114	3	0.88	1	0.29
Households	309	312	101	2	0.65	5	1.62
Villages	26	26	100	N/A	N/A	N/A	N/A

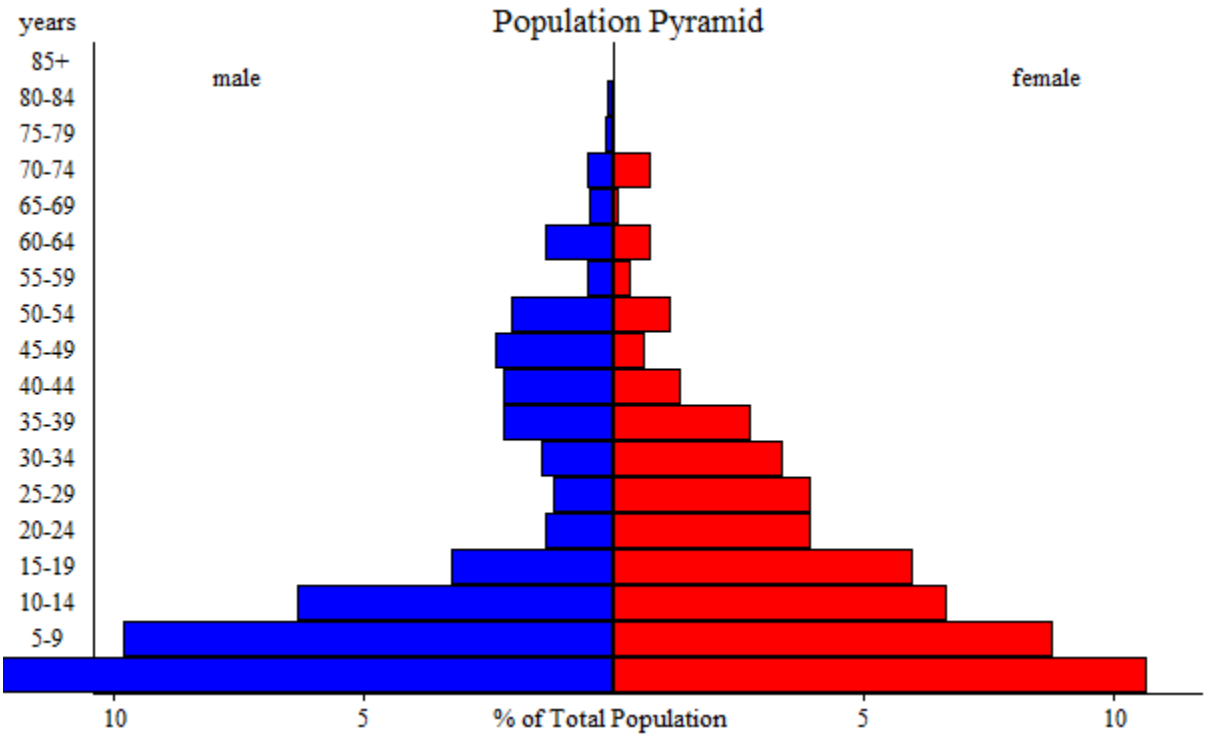
Anthropometric Results

Of the 26 villages surveyed in Aweil North County, a total of 389 children aged 6-59 months (217 boys and 172 girls) were measured to assess acute malnutrition status. In this survey, all planned 26 clusters were surveyed with 312 (101%) of all initially planned households and 389 (114%) of all initially planned children measured for anthropometry. To study the presence of outliers, the data was checked with +/-3 from the observed mean and those values identified as outliers were flagged by SMART software as not being plausible either for height, weight, or age. These SMART flags were excluded from the analysis but not from the data. **In total, 4 data points were flagged for the weight-for-height z-score, hence, 385 children were analyzed. Similarly, 385 (4 excluded) children were analyzed for weight-for-age, and 365 (24 excluded) for heigh-for-age.** This analysis was conducted using WHO 2006 standards.

Table 10: Distribution of age and sex of sample

	Boys		Girls		Total		Ratio
AGE (mo)	**no.**	**%**	**no.**	**%**	**no.**	**%**	**Boy:girl**
6-17	52	53.1	46	46.9	98	25.2	1.1
18-29	54	54.5	45	45.5	99	25.4	1.2
30-41	51	56.7	39	43.3	90	23.1	1.3
42-53	44	57.1	33	42.9	77	19.8	1.3
54-59	16	64.0	9	36.0	25	6.4	1.8
Total	217	55.8	172	44.2	389	100.0	1.3

Figure 2: Population pyramid for age and sex



GAM by WHZ

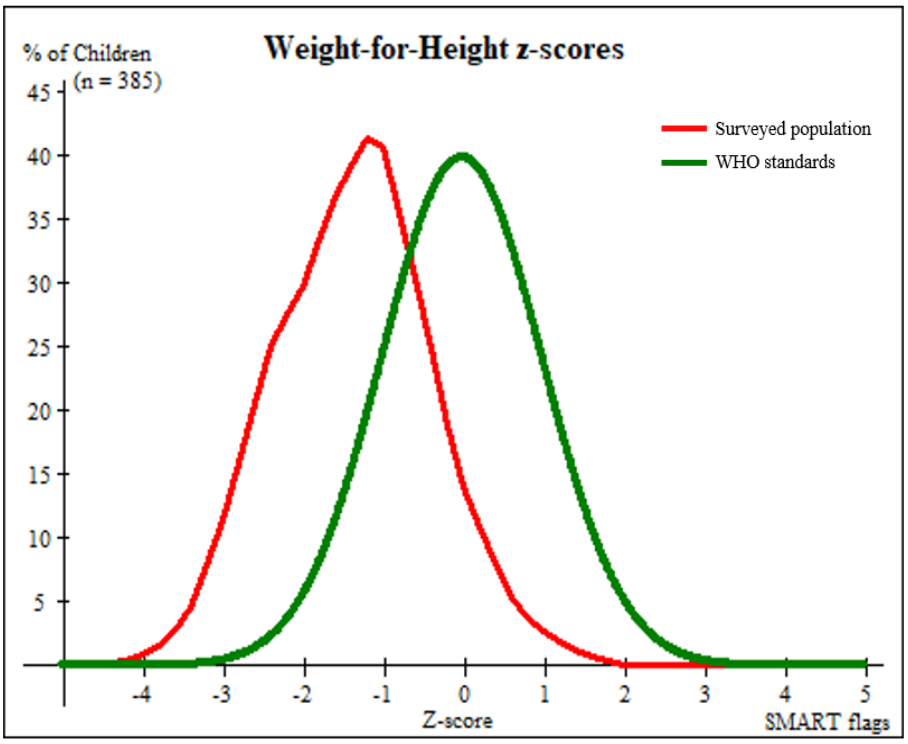
The prevalence of GAM defined as WHZ (WHZ<-2 and/or oedema) among children 6-59 months old was estimated at 26.0% (21.7 – 30.8, 95%CI) (see table 11 below), which categorizes as "Critical" level as per IPC AMN classification[8]. Correspondingly, a GAM rate falling in the Critical phase requires significant scale-up and intensification of treatment and protection activities to reach additional population affected[9]. In addition, the prevalence of SAM per WHZ among children 6-59 months old was 3.6% (2.3 – 5.8, 95%CI). No nutritional bilateral oedema case was observed during the assessment.

The latest SMART survey conducted in April 2023 by Concern Worldwide had an estimated GAM rate of 24.7% (20.8 – 29.0, 95%CI), in comparison with a current GAM rate of 26.0% (21.7 – 30.8, 95%CI) estimated through this survey. In order to compare the GAM rates from both surveys, it is necessary to understand if the change is statistically significant. Because the confidence intervals of the GAM rates of both surveys overlapped, this can indicate that the change in the overall GAM rate might not be significant. However, statistical tests were necessary to prove whether this difference is statistically significant or not. Analyzing the results with the CDC statistical calculator showed that the difference between the GAM rates was, in fact, statistically insignificant (p-value of 0.7082). Therefore, when comparing the GAM rates from both surveys,

[8] Integrated Phase Classification (IPC) Technical Manual Version 3.1
[9] ibid

we cannot draw the conclusion that the current nutritional status of the under-five population in Aweil North County has deteriorated (compared to the results obtained in April 2023).

Figure 3: Gaussian curve for Weight-for-Height z-scores



The Weight-for-Height Z-score mean and standard deviation were -1.36 and 0.96, respectively, indicating a higher prevalence of malnourished children compared to the WHO reference population. Measurement quality fell within the recommended range of 0.8 – 1.2 standard deviation, as outlined in the SMART guidelines. The surveyed community demonstrated homogeneity, with a Design Effect (DEFF) of 1, consistent with the planning stage. Skewness and kurtosis values of 0.08 and -0.05, respectively, suggesting normal distribution and data authenticity.

Table 11: Prevalence of acute malnutrition based on weight-for-height z-scores (and/or oedema) and by sex

	All n = 385	**Boys** n = 214	**Girls** n = 171
Prevalence of global malnutrition (<-2 z-score and/or oedema)	(100) 26.0 % (21.7 - 30.8 95% C.I.)	(56) 26.2 % (20.8 - 32.4 95% C.I.)	(44) 25.7 % (20.1 - 32.4 95% C.I.)
Prevalence of moderate malnutrition	(86) 22.3 %	(48) 22.4 %	(38) 22.2 %

(<-2 z-score and >=-3 z-score, no oedema)	(18.8 - 26.4 95% C.I.)	(17.9 - 27.7 95% C.I.)	(17.3 - 28.1 95% C.I.)
Prevalence of severe malnutrition (<-3 z-score and/or oedema)	(14) 3.6 % (2.3 - 5.8 95% C.I.)	(8) 3.7 % (2.0 - 7.0 95% C.I.)	(6) 3.5 % (1.4 - 8.3 95% C.I.)

The prevalence of oedema is 0.0 %

The general rate of Global Acute Malnutrition (GAM) stood at 26.0% (with a 95% confidence interval of 21.7% to 30.8%). Notably, the prevalence of both Severe Acute Malnutrition (SAM) and Moderate Acute Malnutrition (MAM) appeared slightly higher among boys compared to girls, potentially contributing to the observed imbalance in gender distribution – the overall sex ratio showing a significant difference (with a p-value of 0.023). These findings surpass the WHO's designated threshold of 15% for classifying the situation as "critical," falling within the range of 15% to 29.9%, which aligns with an Integrated Food Security Phase Classification (IPC) of Phase 4.

Table 12: Prevalence of acute malnutrition by age, based on weight-for-height z-scores and/or oedema

		Severe wasting (<-3 z-score)		Moderate wasting (>= -3 and <-2 z-score)		Normal (> = -2 z score)		Oedema	
Age (mo)	**Total no.**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
6-17	95	4	4.2	26	27.4	65	68.4	0	0.0
18-29	99	2	2.0	23	23.2	74	74.7	0	0.0
30-41	89	2	2.2	19	21.3	68	76.4	0	0.0
42-53	77	4	5.2	12	15.6	61	79.2	0	0.0
54-59	25	2	8.0	6	24.0	17	68.0	0	0.0
Total	**385**	**14**	**3.6**	**86**	**22.3**	**285**	**74.0**	**0**	**0.0**

When looking at the results per age categories, these show that children between the age of 6-17 months old were the most affected by both severe and moderate wasting. This outcome might imply poor complementary feeding practices, as children of this age need additional calories apart from breastfeeding.

GAM by MUAC

Table 13: Distribution of acute malnutrition and oedema based on weight-for-height z-scores

	<-3 z-score	**>=-3 z-score**
Oedema present	Marasmic kwashiorkor. 0 (0.0 %)	Kwashiorkor. 0 (0.0 %)
Oedema absent	Marasmic No. 15 (3.9 %)	Not severely malnourished. 374 (96.1 %)

The prevalence of Global Acute Malnutrition (GAM) by Mid-Upper Arm Circumference (MUAC) was determined to be 11.1% (with a 95% confidence interval of 8.5% to 14.4%), while the rate of Severe Acute Malnutrition (SAM) was recorded at 1.8% (with a 95% confidence interval of 0.8% to 3.9%). Notably, both SAM and Moderate Acute Malnutrition (MAM) rates by MUAC were most prominent among children aged 6-17 months. However, it's essential to note that MUAC measurement has demonstrated a bias towards detecting malnutrition in younger children.

Table 14: Prevalence of acute malnutrition based on MUAC cut off's (and/or oedema) and by sex

	All n = 387	**Boys** n = 216	**Girls** n = 171
Prevalence of global malnutrition (< 125 mm and/or oedema)	(43) 11.1 % (8.5 - 14.4 95% C.I.)	(17) 7.9 % (4.5 - 13.3 95% C.I.)	(26) 15.2 % (11.1 - 20.5 95% C.I.)
Prevalence of moderate malnutrition (< 125 mm and >= 115 mm, no oedema)	(36) 9.3 % (6.8 - 12.5 95% C.I.)	(16) 7.4 % (4.2 - 12.6 95% C.I.)	(20) 11.7 % (8.0 - 16.8 95% C.I.)
Prevalence of severe malnutrition (< 115 mm and/or oedema)	(7) 1.8 % (0.8 - 3.9 95% C.I.)	(1) 0.5 % (0.1 - 3.6 95% C.I.)	(6) 3.5 % (1.4 - 8.3 95% C.I.)

Table 15: Prevalence of acute malnutrition by age, based on MUAC cut off's and/or oedema

	Severe wasting (< 115 mm)	**Moderate wasting (>= 115 mm and < 125 mm)**	**Normal (> = 125 mm)**	**Oedema**

Age (mo)	Total no.	No.	%	No.	%	No.	%	No.	%
6-17	96	4	4.2	22	22.9	70	72.9	0	0.0
18-29	99	3	3.0	9	9.1	87	87.9	0	0.0
30-41	90	0	0.0	5	5.6	85	94.4	0	0.0
42-53	77	0	0.0	0	0.0	77	100.0	0	0.0
54-59	25	0	0.0	0	0.0	25	100.0	0	0.0
Total	387	7	1.8	36	9.3	344	88.9	0	0.0

According to the all-district pooled analysis, it was estimated that overall 63.5% of GAM and 65.4% of SAM cases were identified by WHZ only; 15.1% of GAM and 19.3% of SAM cases were identified by MUAC only and 21.4% of GAM and 15.3% of SAM cases were identified by both WHZ and MUAC[10]. This survey also illustrates that (as can be seen in Tables 14 and 15 above) c a higher number of children with acute malnutrition (wasting) were identified through weight-for-height measurements (WHZ) compared to Mid-Upper Arm Circumference (MUAC) measurements. The prevalence of malnutrition detected via MUAC was consistently lower than through weight-for-height measurements. In fact, as demonstrated in Table 17 below, only 7.2% (28 cases) of acute malnutrition instances were identified by both methods. Furthermore, the results illustrate that WHZ measurements proved more effective in identifying acute malnutrition cases, capturing 72 cases, compared to MUAC measurement, which only identified 15 cases.

Table 16: Prevalence of combined GAM and SAM based on WHZ and MUAC cut off's (and/or oedema) and by sex*

	All n = 387	**Boys** n = 216	**Girls** n = 171
Prevalence of combined GAM (WHZ <-2 and/or MUAC < 125 mm and/or oedema)	(115) 29.7 % (25.3 - 34.5 95% C.I.)	(61) 28.2 % (22.5 - 34.8 95% C.I.)	(54) 31.6 % (25.4 - 38.4 95% C.I.)
Prevalence of combined SAM (WHZ < -3 and/or MUAC < 115 mm and/or oedema	(18) 4.7 % (2.9 - 7.4 95% C.I.)	(12) 3.6 % (2.0 - 6.4 95% C.I.)	(13) 3.7 % (2.0 - 6.9 95% C.I.)

*With SMART or WHO flags a missing MUAC/WHZ or not plausible WHZ value is considered as normal when the other value is available

[10] Concordance between WHZ and MUAC for the detection of wasting, ENN 2020

Table 17: Detailed numbers for combined GAM and SAM

	GAM		SAM	
	no.	%	no.	%
MUAC	15	3.9	4	1.0
WHZ	72	18.6	11	2.8
Both	28	7.2	3	0.8
Oedema	0	0.0	0	0.0
Total	115	29.7	18	4.7

*Total Population: 387

GAM by WAZ

Underweight, as a nutritional indicator, assesses a child's weight relative to their age. According to the WHO 2006 growth standards, which formed the basis of our analysis, a weight-for-age Z-score falling between -2 SD and above -3 SD is classified as moderate underweight, while a Z-score below -3 SD is considered severe underweight. Our findings revealed an overall underweight prevalence of 27.8% (95% CI: 23.5 - 32.6), with detailed age and sex breakdowns presented in Tables 18 and 19 respectively. According to WHO standards, the reported prevalence of underweight, at 27.8% (95% CI: 23.5 - 32.6), falls within the high classification range (20% to <30%).

Figure 4: Gaussian curve for Weight-for-Age z-scores

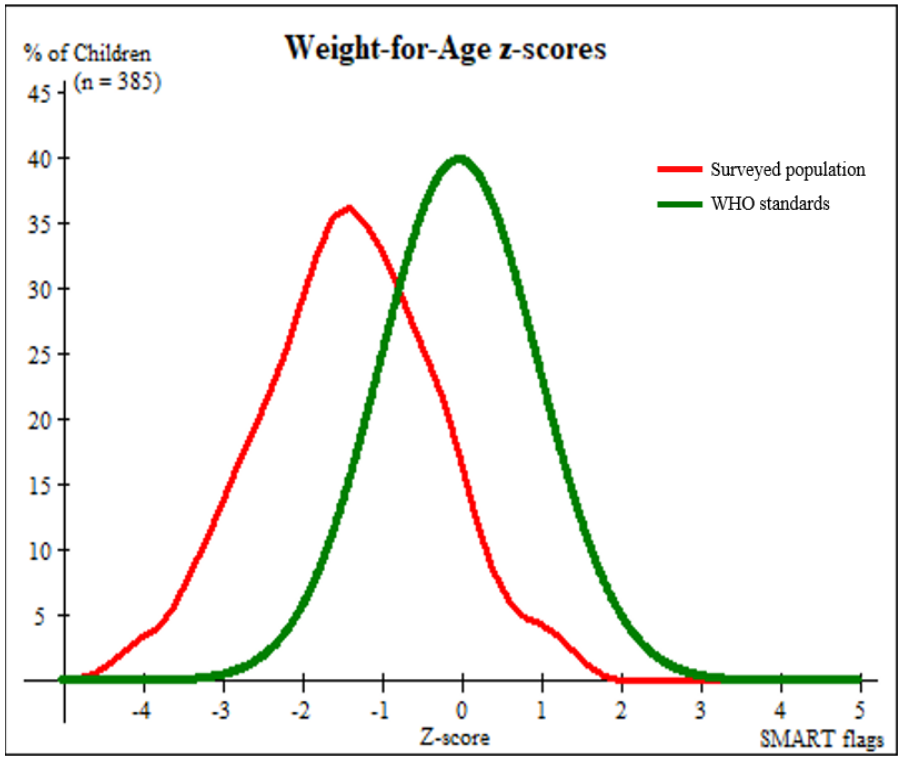


Table 18: Prevalence of underweight based on weight-for-age z-scores by sex

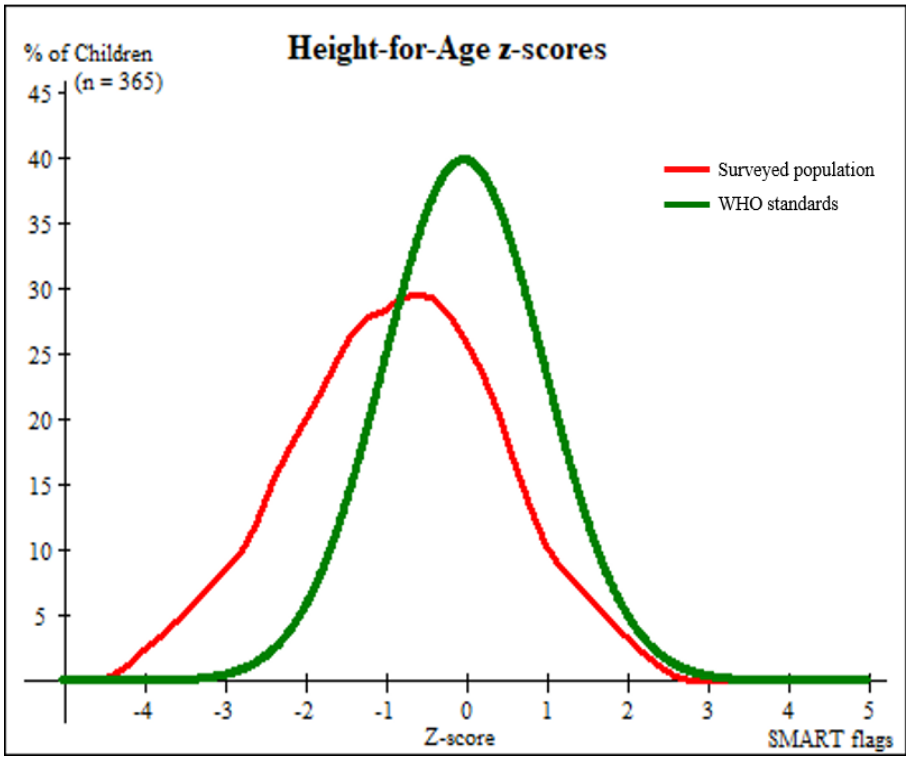
	All n = 385	**Boys** n = 216	**Girls** n = 169
Prevalence of underweight (<-2 z-score)	(107) 27.8 % (23.5 - 32.6 95% C.I.)	(63) 29.2 % (23.5 - 35.6 95% C.I.)	(44) 26.0 % (19.8 - 33.4 95% C.I.)
Prevalence of moderate underweight (<-2 z-score and >=-3 z-score)	(75) 19.5 % (14.8 - 25.2 95% C.I.)	(44) 20.4 % (14.5 - 27.8 95% C.I.)	(31) 18.3 % (12.8 - 25.6 95% C.I.)
Prevalence of severe underweight (<-3 z-score)	(32) 8.3 % (5.7 - 12.0 95% C.I.)	(19) 8.8 % (5.6 - 13.7 95% C.I.)	(13) 7.7 % (4.1 - 13.9 95% C.I.)

Table 19: Prevalence of underweight by age, based on weight-for-age z-scores

		Severe underweight (<-3 z-score)		Moderate underweight (>= -3 and <-2 z-score)		Normal (> = -2 z score)		Oedema	
Age (mo)	**Total no.**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
6-17	96	6	6.3	15	15.6	75	78.1	0	0.0
18-29	98	13	13.3	22	22.4	63	64.3	0	0.0
30-41	89	7	7.9	18	20.2	64	71.9	0	0.0
42-53	77	5	6.5	14	18.2	58	75.3	0	0.0
54-59	25	1	4.0	6	24.0	18	72.0	0	0.0
Total	385	32	8.3	75	19.5	278	72.2	0	0.0

The results regarding underweight prevalence indicate a more severe impact on younger children (aged 6-29 months), who account for about half (50%) of the cases compared to their older counterparts (aged 30-59 months).

Figure 5: Gaussian curve for height-for-age z-scores



Stunting refers to the condition wherein children exhibit impaired growth and development, typically stemming from chronic or recurrent malnutrition. This condition is characterized by a child's height-for-age falling more than two standard deviations below the median outlined by WHO child growth standards. Stunting typically underscores the enduring and cumulative impacts of inadequate nutrition, often compounded by intergenerational challenges. Such challenges arise from prolonged periods of insufficient nutrition and are further exacerbated by recurring and chronic illnesses. Additionally, stunting serves as a reflection of the broader socio-economic status of a community, extending beyond nutritional considerations.

The general prevalence of stunting was determined to be 19.2% (95% Confidence Interval: 14.9 - 24.4) for the analysed population of 6-59 months. Notably, stunting rates are elevated among boys and are most pronounced within the 18-29 months age bracket. Analysis of the height-for-age Z-scores distribution (refer to Figure 5) revealed a leftward shift compared to the reference population, with a mean of –0.85 (±1.26 standard deviation) and a comparatively shorter curve. This discrepancy with the WHO standards' curve suggests a heightened prevalence of stunting within the surveyed population in comparison to the reference group.

Table 20: Prevalence of stunting based on height-for-age z-scores and by sex

	All n = 365	**Boys** n = 204	**Girls** n = 161
Prevalence of stunting (<-2 z-score)	(70) 19.2 % (14.9 - 24.4 95% C.I.)	(41) 20.1 % (14.2 - 27.7 95% C.I.)	(29) 18.0 % (12.7 - 24.9 95% C.I.)
Prevalence of moderate stunting (<-2 z-score and >=-3 z-score)	(53) 14.5 % (10.5 - 19.7 95% C.I.)	(31) 15.2 % (10.9 - 20.8 95% C.I.)	(22) 13.7 % (8.4 - 21.4 95% C.I.)
Prevalence of severe stunting (<-3 z-score)	(17) 4.7 % (2.9 - 7.5 95% C.I.)	(10) 4.9 % (2.3 - 10.0 95% C.I.)	(7) 4.3 % (2.0 - 9.4 95% C.I.)

****** *Calculated Prevalence of stunting with an SD of 1 is 12.6%*

Table 21: Prevalence of stunting by age based on height-for-age z-scores

		Severe stunting (<-3 z-score)		Moderate stunting (>= -3 and <-2 z-score)		Normal (> = -2 z score)	
Age (mo)	**Total no.**	**No.**	**%**	**No.**	**%**	**No.**	**%**
6-17	94	3	3.2	7	7.4	84	89.4
18-29	87	5	5.7	17	19.5	65	74.7
30-41	84	2	2.4	13	15.5	69	82.1
42-53	75	6	8.0	12	16.0	57	76.0
54-59	25	1	4.0	4	16.0	20	80.0
Total	365	17	4.7	53	14.5	295	80.8

The following table (Table 22) presents an analysis of anthropometric data for each indicator, including the design effect, means, standard deviation, and scores outside the expected range. The survey successfully attained the anticipated standard deviation (0.8 – 1.2) for weight-for-height and weight-for-age z-scores.

Table 22: Mean z-scores, Design Effects and excluded subjects

Indicator	n	Mean z-scores ± SD	Design Effect (z-score < -2)	z-scores not available*	z-scores out of range
Weight-for-Height	385	-1.36±0.96	1.00	0	4
Weight-for-Age	385	-1.41±1.10	1.00	0	4
Height-for-Age	365	-0.85±1.26	1.26	0	24

* contains for WHZ and WAZ the children with Oedema.

Mortality results

The survey, which included a total of 1,897 individuals across all surveyed households, specifically gathered information related to mortality. For all respondents, a recall period of 98 days was used during the interview. To report on the survey's results, the 98-day period from 4 until 20 March 2024 (until the mid-time of the data collection period) was applied. With this parameter set, participants were asked to retrospectively recall any deaths that had occurred within their household during the established recall period.

Table 23: Mortality rates

CMR (total deaths/10,000 people / day): 0.40 (0.20-0.77, 95% CI)
U5MR (deaths in children under five/10,000 children under five / day): 0.00 (0.00-0.00, 95% CI)

During the established recall period, participants reported a total of 7 deaths, with no deaths recorded among children under five. This resulted in a Crude Death Rate (CDR) of 0.40 (95% CI: 0.20 - 0.77), while the under-five mortality rate was 0%. When comparing these rates with the official emergency thresholds of 1.14 for the total population and 2.3 for children under five (equivalent to 1.14/10,000 deaths per day for the total population and 2.3/10,000 deaths per day for children under five), the results significantly fall below these thresholds. This suggests that the overall health status of the population in Aweil North county can be considered stable.

Table 24: General demographic information on mortality sample

Indicator	Results
Average Household Size	6.1
Mid-Interval Population	1897
% of children Under-5 years	24.4
Birth Rate	1.08
In-Migration Rate (Joined)	0.28
Out-Migration Rate (Left)	1.64
Design Effect for CDR	1

Table 25: Broad Causes of Death

Cause of death	%
Illness	71.4
Trauma/Injury	28.6

Table 26: Location of death

Location of reported deaths	%
Place of Current Residence	57.1
During Migration	0
Place of Last Residence	42.9
Other	0

Approximately 57.1% of reported deaths took place in the respondent's current place of residence. The majority (71.4%) of reported causes of death were reportedly attributed to illness, while the remaining (28.6%) were linked to trauma or injury.

Child Morbidity and Access to Health Care

To gauge the prevalence of common diseases among children aged 6-59 months, we collected retrospective morbidity data based on information from caregivers' responses. This data was collected over a two-week recall period. The survey revealed that the majority of children (85.3%, 95% C.I. 79.5 – 90.4) had experienced at least one episode of illness in the two weeks preceding data collection. Suspected cases of malaria and diarrhea were the most frequently reported illnesses, accounting for 85.3% and 19.9% of cases, respectively, among children in this age group who had experienced illnesses within the two-week period. Respondents identified malaria as the most common disease affecting children in the area.

Table 27: Prevalence of reported illness in children in the two weeks prior to interview (n=156)

	6-59 months
Prevalence of reported illness	85.3% (79.5 – 90.4, 95% C.I.)

Table 28: Symptom breakdown among children for whom illness was reported in the two weeks prior to interview (n=156)

	6-59 months
Diarrhoea	19.9% (14.1 – 26.3, 95% C.I.)
Cough	15.4% (9.6 – 21.2, 95% C.I.)
Suspected Malaria	85.3% (80.1 – 90.4, 95% C.I.)
Measles	0%
Other	5.8% (2.6 – 9.6, 95% C.I.)

Table 29: Health care seeking behavior reported by caretakers of sick children 6-59 months of age (n=156)

	6-59 months
No treatment sought	10.3% (5.8 – 15.4, 95% C.I.)
Primary Health Care Centre	84.0% (78.2 – 89.7, 95% C.I.)
Hospital	0% (0.0 – 0.0, 95% C.I.)
Other	5.8% (2.6 – 9.6, 95% C.I.)

Children 6-59 months who had been sick in the two weeks prior to data collection were more likely to be malnourished than their counterparts who had not been ill. Generally, ill children are more at risk of malnutrition than healthy children[11].

The majority of children (89.1%, n=139) aged 6-59 months, who had been ill in the two weeks preceding data collection, were reportedly taken to any type of health facility by their caretakers for treatment. The choice of facility varied based on distance and accessibility. The most common response in case of illness was to visit a primary health center (84.0%). Among the children who had been ill, only 10.9% were not brought to health facilities by their caretakers for treatment.

Nutrition and Health Program Coverage

Table 30: Measles vaccination coverage for children 9-59 months

	Measles (with card) = 38.3%	**Measles (with card or confirmation from mother) = 90.6%**
YES	(No. 142) 38.3% (33.2 – 43.1, 95% C.I.)	(No. 336) 90.6% (87.6 – 93.5, 95% C.I.)

Table 31: Vitamin A (children 6-59 months) and deworming treatment (children 12-59 months) coverage

	Vitamin A Supplementation last 6 months n= 89.8 %	**Deworming Treatment last 6 months n= 81.7 %**
YES	(No. 354) 89.8% (86.5 – 92.6, 95% C.I.)	(No. 276) 81.7% (76.9 – 85.8, 95% C.I.)

To gather information, the survey team asked caregivers whether their children had received vitamin A capsules or deworming tablets in the six months prior to the assessment. As shown in Table 31 above, 89.8% of children aged 6-59 months (n=354, 95% C.I. 86.5 – 92.6) had reportedly received vitamin A supplementation. Furthermore, approximately 81.7% of children aged 12-59 months (n=276, 95% C.I. 76.9 – 85.8) received deworming capsules in the six months preceding data collection. The high level of coverage may be associated with the recent campaign CHD in the county[12], which served as the starting point for the recall period in the survey.

[11] National Library of Medicine
[12] Republic of South Sudan Measles outbreak and response weekly situation update, WHO, April 2024

Infant and Young Child Feeding Practice (IYCF)

Proper feeding of infants and young children can increase their chances of survival and promote optimal growth and development, especially in the critical window from birth to 2 years of age[13].

Information on child feeding practices was gathered for all children aged 0-23 months and analyzed as described below. The sample sizes obtained in this type of survey for Infant and Young Child Feeding (IYCF) practices were small, so the results should only be interpreted as an indication. They should not be taken as representative of the population's knowledge and practices.

In this survey, mothers/caretakers of 95 children aged 0-23 months were interviewed. The mothers/caretakers were interviewed about the IYCF practices of their children between the ages of 0-23 months in line with the revised indicators for assessing IYCF practices by WHO & UNICEF (2021).[14] The findings of the survey are presented in the following tables, graphs, and discussions.

Ever Breastfed

When mothers were asked whether their children were ever breastfed, 92.6% (n=88, 87.4 – 97.9, 95% CI) reported that they had breastfed their children aged 0-23 months at some point in their lifetime. Among those children who were ever breastfed, 95.5% (n=84, 90.9 – 98.9, 95% CI) had reportedly been initiated to breastfeeding immediately within one hour of birth, as per WHO recommendation.

Table 32: IYCF child ever breastfed and early initiation of breastfeeding

IYCF (Ever Breastfed & Early Initiation)				
Indicator Name	Age group	n	%	95% CI
Child ever breastfed	0-23 months	88	92.6	87.4 – 97.9
Breastfeeding initiation	0-23 months	84	95.5	90.9 – 98.9

Exclusive breastfeeding (EBF)

The WHO Global Strategy for Infant and Young Child Feeding (IYCF) recommends exclusive breastfeeding for infants until they reach six months of age. Exclusive breastfeeding provides infants with a food source uniquely suited to their needs, ensuring safety, cleanliness, health, and accessibility. Evidence suggests that infants in low and middle-income countries who receive mixed feeding (both breast milk and other foods or liquids) before six months are nearly

[13] Breastfeeding in the 21st century: epidemiology, mechanisms, and lifelong effect. Victora, Cesar G et al. The Lancet , Volume 387 , Issue 10017 , 475 – 490.

[14] Indicators for assessing infant and young child feeding practices (WHO 2021)

three times more likely to die than those who are exclusively breastfed.[15] Exclusive breastfeeding protects against diarrhea, lower respiratory infections, acute otitis media and childhood overweight and obesity.[16] In Aweil North, 65.9% (n=58, 55.7 – 76.1, 95% CI) of children aged 0-5 months had reportedly been exclusively breastfed. This value fell below the minimum standard set by UNHCR, which states that in emergency contexts, the proportion of exclusively breastfed infants (0-5 months) should be at least seventy percent.

Continued breastfeeding

Children should continue being breastfed for two years or beyond as per the global WHO IYCF recommendations.[17] Children who are still breastfed after one year of age can meet a substantial portion of their energy needs with breast milk in their diet. Continued breastfeeding is also vital during illness: while sick children often have little appetite for solid food, continued breastfeeding can help prevent dehydration while also providing the nutrients required for recovery[18].

Accordingly, children aged 12-23 months were assessed based on the recall period of the previous 24 hours and results showed that only 11.7% (n=94, 5.3 – 18.1, 95% CI) of children had received continued breastfeeding.

Minimum Dietary Diversity

WHO guiding principles recommend that children aged 6-23 months are fed a variety of foods to ensure that nutrient needs are met.[19] Food group diversity is associated with improved linear growth in young children. A diet lacking in diversity can increase the risk of micronutrient deficiencies, which may have a damaging effect on children's physical and cognitive development.

In this regard, the survey findings showed that 42.1% of surveyed children received food from at least 5 of the 8 food groups (including breast milk) during the indicated recall period of 24 hours, as per the Infant and Young Child Feeding (IYCF) guideline recommendation. These findings suggest that meals were likely not adequately diverse for most of the children aged 6-23 months, indicating limited nutrient diversity.

Minimum Acceptable Diet

Among both breastfed and non-breastfed children, "meat, poultry, fish, or eggs should be eaten daily, or as often as possible" as per WHO guiding principles.[20] There is evidence that children

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[15] Guidelines on optimal feeding of low birth-weight infants in low- and middle-income countries (who.int)

[16] ibid.

17 WHO & UNICEF (2003). Global Strategy for Infant and Young Child Feeding

[18] ibid

[19] WHO (2005): Guiding principles for feeding non-breastfed children 6-24 months of age

[20] WHO & UNICEF (2021). Indicators for assessing infant and young child feeding practices: definitions and measurement methods

who consume eggs and flesh foods have higher intakes of various nutrients important for optimal linear growth. Consuming eggs is associated with increased intakes of energy, protein, essential fatty acids, vitamin B_{12}, vitamin D, phosphorus, and selenium, and with higher recumbent length. Introduction of meat as an early complementary food for breastfed infants is also associated with improved protein and zinc intake[21].

According to the survey results in Aweil North, about 38.3% (n=36, 28.7 – 47.9, 95% CI) of surveyed children aged 6-23 months had received a minimum acceptable diet with minimum meal frequency of 67% (n=61, 58.2 – 76.9, 95% CI) in the 24 hours prior to data collection. Given the small sample size for this calculation and the presence of high population movements (affecting displaced people's and returnees' livelihoods) and a higher Global Acute Malnutrition (GAM) rate, these results should be interpreted with caution.

Women's Nutritional Status by MUAC

A total of 166 pregnant and lactating women (PLW) were measured using MUAC to identify PLW nutritional status. PLW's nutritional status is important, because malnourished PLW cannot provide the required nutritional intake for infants, especially for those under 6 months. From the total PLW, about 54.7% were lactating, 42.2% were pregnant and the remaining 3.1% were pregnant and breastfeeding women. As can be seen in table 34 below, 20 women (31.3%) showed a proxy GAM below the 230mm MUAC measurement threshold, indicating their nutritional status was critical, while the remaining 68.7% of PLW showed a normal nutritional status.

Table 33: MUAC status among PLW

	MUAC for PLWs	N (sample size)	Proportion (%)
Severe Acute Malnutrition	<21.0cm	3	4.7 %
Moderate Acute Malnutrition	<23.0cm	17	26.6 %
Normal	>23.0cm	44	68.7 %

Contributing Factors

Water, Sanitation, and Hygiene (WASH)

Source of Drinking Water

Consumption and use of unsafe water can cause diarrhea, which can prevent children from getting the nutrients they need to survive, ultimately leading to malnutrition. Malnourished children are also more vulnerable to waterborne diseases like Cholera. Inadequate access to

[21] Guiding principles for feeding non-breastfed children 6-24 months of age.pdf

minimum water, hygiene, and sanitation is estimated to account for around 50 percent of global malnutrition.[22]

During the assessment, respondents were asked a series of systematically organized closed-ended questions. These questions were designed to determine whether the water sources mentioned were improved or unimproved, and the responses were then automatically coded accordingly in the database. In Aweil North county, only a small number of households reported fetching water from unimproved sources, accounting for 4.8% (n=15, 2.6 – 7.7, 95% CI). The primary water source mentioned by the majority of respondents was boreholes, accounting for 93.3% of the responses.

Time to collect water

Another important indicator considered regarding the source of drinking water is the time it takes for households to collect water. It is important to note that queuing time and variations between villages in terms of distance were not included or considered during the analysis.

Nearly half of the respondents (48.1%) reported being able to access their main household water source between 30 minutes to 1 hour. This was followed by 40.7% of households reporting that they could access their water source in less than 30 minutes. However, 10.6% of households reported traveling for more than an hour to half a day to fetch water from their main source.

Water treatment used

Unsafe drinking water is among the main sources of life-threatening, waterborne diseases. This indicator therefore assesses the prevalence of households using effective methods for treating drinking water, which is particularly relevant as one of the main child morbidity issues in the assessed area was incidence of diarrheal disease, amongst other factors. The prevalence of diarrhea can be minimized by improving access to safe water, promotion of water treatment, improving sanitation and hygiene promotion as well as focusing on the home management of childhood illness.

The vast majority of households interviewed, comprising 88.1% (n=275, 84.6 – 91.3, 95% CI), reported doing nothing to the water collected before consumption, regardless of whether it came from improved or unimproved sources. Only a small percentage of households reported using treatment methods: 7.4% use boiling, 2.9% use cloth filtering, and 1.6% use chlorine as a water treatment method.

Hygiene and sanitation

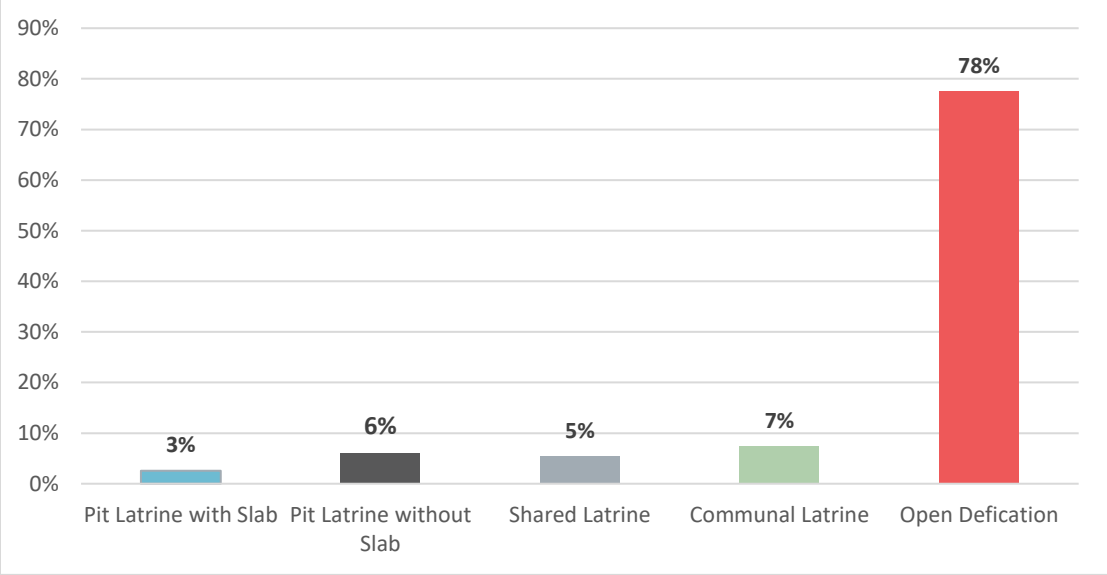
This composite indicator evaluates the population's access to a satisfactory number of appropriately located latrines with operational handwashing facilities, which is vital for ensuring

[22] 4 things you need to know about water and famine (UNICEF 2022)

sanitation and disease prevention. The lack of access to safe latrines within households is identified as a significant factor contributing to higher rates of malnutrition and mortality. When households were asked about their access to latrines, the majority (77.6%, n=242, 95% CI: 72.8 – 82.1) reported not having access to such sanitation facilities and instead practiced open defecation. A small percentage of households (7.4%, n=23, 95% CI: 4.8 – 10.3) had access to communal latrines, followed by pit latrines without slabs (6.1%, n=19, 95% CI: 3.5 – 8.7), shared latrines (5.4%, n=17, 95% CI: 2.9 – 8.0), and pit latrines with slabs (2.6%, n=8, 95% CI: 1.0 – 4.5) see figure 6.

A complementary indicator to the above is access to soap for handwashing, as this can break the vicious cycle of diarrhea and undernutrition[23]. Children are especially susceptible to infection by bacteria and viruses, found in fecal matter, that cause diarrhea. When children get diarrhea, they often eat less food, and have a reduced ability to absorb and benefit from nutrients in the food they do eat. The indicator evaluates the proportion of households with soap available for their use. According to the survey findings, over a third (38.5%, n=120, 95% CI: 33.3 – 44.6) of households reported having access to soap, as confirmed by enumerators. Another 18.3% (n=57, 95% CI: 13.8 – 22.8) reported having access to soap, but this was not confirmed by enumerators. The remaining households (42.9%, n=134, 95% CI: 37.5 – 48.1) reported not having access to soap.

Figure 6: Percentage of households per type of latrine they reported having access to



[23] Why Handwashing. Global Handwashing Partnership

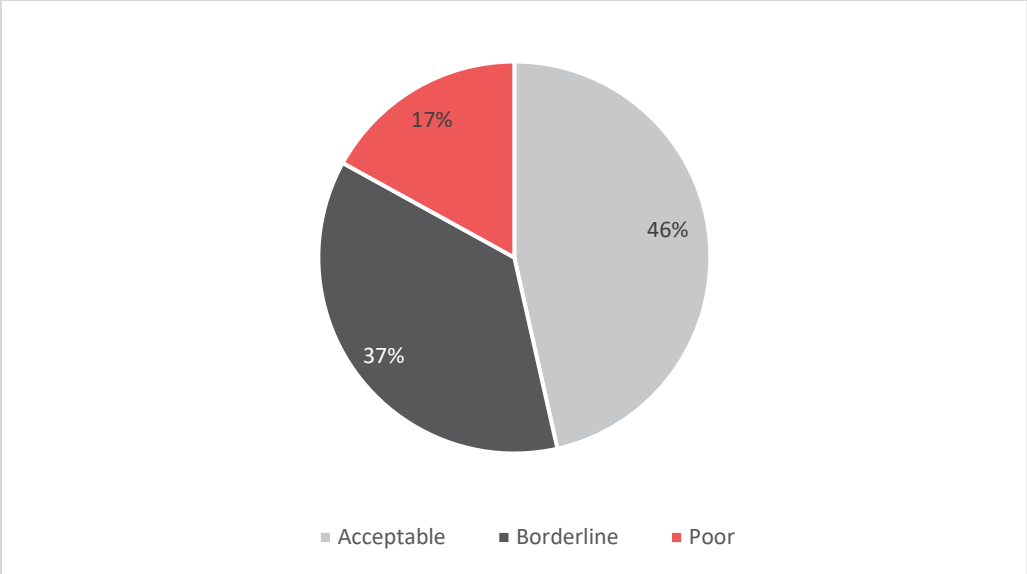
Food Security and Livelihoods (FSL)

Food Consumption Score

The Food Consumption Score (FCS) is regarded as a proxy indicator of current food security status. It is a composite score derived from the types of food consumed, how often they are eaten, and the nutritional significance of different food groups. This indicator is calculated based on the number of food groups a household has consumed over a recall period of the past 7 days, and is categorized into three groups: poor consumption (FCS = 0 to 21), borderline consumption (FCS = 21.5 to 35), and acceptable consumption (FCS > 35.0).

According to the survey results, nearly half of the respondents (46.5%, n=145) had an acceptable food consumption score. This was followed by 36.5% (n=114) with a borderline food consumption score, and 17% (n=53) with a poor food consumption score.

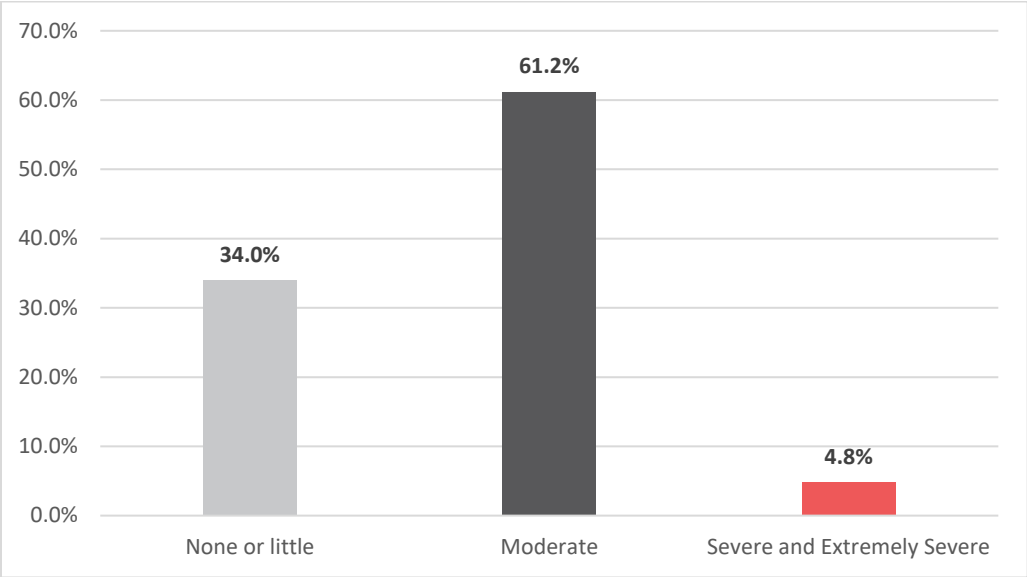
Figure 7: Percentage of households per FCS category



Household Hunger Scale (HHS)

The Household Hunger Scale is a proxy indicator for food access, designed around three questions concerning households' perceptions of varying degrees of hunger and the frequency of experiencing hunger in the past 4 weeks/30 days. The Household Hunger Scale measures whether households fall into moderate or severe categories of hunger, or whether they experienced little to no hunger. Using this composite indicator, respondents can score between zero and six depending on their answers. Scores are categorized as none or light hunger (HHS = 0-1), moderate hunger (HHS = 2-3), and severe hunger (HHS = 4-6). Results for this indicator can be seen in figure 8 below. Notably, close to 5% of households reported experiencing severe or extremely severe hunger in the 30 days prior to the survey.

Figure 8: Percentage of households per HHS category



Household Income Source

The primary activities that households reported engaging in over the last 3 months to earn income were mostly related to selling agricultural products, which accounted for about half (49%, n=153) of the responses. This was followed by receiving a salary, with 18.3% (n=57) of responses, and selling collected firewood, which accounted for 11.9% (n=37) of responses.

Over one third (38.1%) of the sampled households reported that their households were affected by some type of shock in the 6 months prior to the survey. Among these, almost half were associated with high food prices, with 43.7% (n=52) of households reporting this, followed by a reduction in household income (27.7%, n=33), and loss of employment (18.5%, n=22) of responses.

Discussion

Nutritional status

During the data collection period, 312 households from 26 clusters were visited to gather information on mortality, child and maternal nutrition, and other contextual factors (FSL and WASH). A total of 389 children aged 6-59 months were assessed through anthropometric surveys, of which 385 had their information analyzed for weight-for-height. Four children were excluded from the analysis due to the presence of SMART flags indicating they had out-of-range values, and were therefore classified as outliers.

The prevalence of Global Acute Malnutrition (GAM) among the sampled children was estimated at 26.0% (95% C.I.: 21.7 – 30.8), and Severe Acute Malnutrition (SAM) prevalence was 3.6% (95% C.I.: 2.3 – 5.8), based on Weight-for-Height and the presence of bilateral edema. Notably, no children were identified with bilateral edema during the survey. As per IPC AMN technical guideline classification thresholds, the current nutrition status of Aweil North county is classified as "Critical."

The current malnutrition status of the county, when compared to the results of the previous most recent survey conducted in April 2023 (with a GAM rate of 24.7% - n=107, 20.8 – 29.0, 95% CI), seems to indicate a deterioration. However, this could not be confirmed by statistical tests (using the CDC calculator), showing a p-value of 0.7082. Hence, we cannot make a conclusion that the nutritional situation of children aged 6-59 months in Aweil North has been deteriorating since last year, as the statistical test revealed that there was no significant change.

Mortality

During the recall period of 98 days, a total of 7 deaths among all households assessed were reported, and there were no recorded under-five mortalities. The Crude Mortality Rate (CMR) was calculated at 0.40 (95% CI: 0.20 - 0.77), indicating that it falls below the emergency threshold for the crude mortality rate of the Aweil North county population.

Causes of malnutrition

Malnutrition poses a greater risk to sick children than to healthy ones. In line with this, the majority (85.3%) of children aged 6-59 months were reported sick during the two-week recall period. Among them, the incidence of diarrhea episodes was 19.9%, with suspected malaria (85.3%) and cough (15.4%) being the most common reported symptoms. Since illness is an immediate cause of malnutrition in children, and the identified sicknesses are considered major risk factors according to the IPC reference table, the situation is very serious in the surveyed area, consistent with the high prevalence of malnutrition.

In terms of program coverage, it is encouraging that the majority (90.6%) of children aged 9 to 59 months had received measles vaccination, assessed by using both vaccination cards and

maternal recall. Similarly, 89.8% had reportedly received a vitamin A vaccination, while 81.7% of children received deworming treatment. The relatively high coverage compared to last year's SMART survey findings may be attributed to the recent vaccination campaign conducted in the county, which served as the starting point for the recall period.

When it comes to Infant and Young Child Feeding (IYCF) practices, the results show that child feeding practices are often insufficient. Only 42.1% of children aged 6-23 months were reported to have met the minimum dietary diversity requirement, and just 38.3% of these children had reportedly received the minimum acceptable diet, which includes both dietary diversity and meal frequency. Children who do not meet these minimum nutrition requirements are at high risk of malnutrition.

Additionally, 88.1% of households do not treat their drinking water before use. On the other hand, only a small percentage (4.8%) of households reported to get their domestic water from unimproved sources. Despite the majority of households (93.3%) accessing water from improved sources, the fact that most of them do not treat the collected water before consumption puts the community at large at risk of water-borne illnesses like diarrhea, particularly for children under five and pregnant or nursing women. Additionally, low sanitation practices, as evidenced by 78% of households reportedly using open defecation, and poor children's health (considering that 85.3% surveyed children were reported to experience at least one episode of illness), this increase the vulnerability to malnutrition in the community.

When we examine Food Security and Livelihoods (FSL) indicators, around a fifth (17%) of households were found to have a poor food consumption score, while approximately 61% of households experience moderate hunger, and about 5% have faced severe hunger. Considering that these households are already struggling to meet their calorie requirements, coupled with the influx of refugees and returnees, the situation may further deteriorate in the coming months.

Conclusions

The survey results indicate that the Global Acute Malnutrition (GAM) rate is 20.6% (21.7 – 30.8. 95% CI), placing it in the "critical" category according to IPC-AMN guidelines. The Severe Acute Malnutrition (SAM) rate is 3.6% (2.3 – 5.8, 95% CI) based on Weight-for-Height Z-score (WHZ).

According to the Integrated Food Security Phase Classification (IPC), the current nutritional status of Aweil North county is classified as Phase 4 "Critical", falling within the thresholds of 15 – 29.9% established by the IPC and WHO. These results reaffirm the South Sudan IPC analysis projection for the same period (Oct 2023 – Mar 2024), estimating Aweil North County to remain in IPC phase 4. While the projection anticipated improvement within the same phase, the reality according to this assessment is that it has deteriorated within the same phase.

The high GAM rate could be associated with the presence of major diseases such as suspected malaria and diarrhoea, exacerbated by poor water utilization and extremely low levels of

sanitation facilities usage, along with macro-level shocks such as high food prices. The situation could become even more dire in the coming months due to the high influx of refugees and returnees in the area.

Recommendations and priorities

Nutrition

In this assessment, the Global Acute Malnutrition (GAM) rate was measured at 26.0%, indicating that the current nutritional status of Aweil North County was classified as "Critical" according to the IPC classification. Moreover, there are indications that the situation could progressively deteriorate given the reasons stated above. In such a scenario, it would be difficult to revert the situation easily, as the current GAM rate is around the limit that could lead to an extremely critical level.

Accordingly, the following recommendations are drawn:

- ⇨ Continuing the implementation of the ongoing Community Management of Acute Malnutrition (CMAM) program is crucial, and if possible, scaling it up is recommended, especially considering indications of further deterioration. CMAM programs are essential for identifying and treating malnourished children in the community, providing therapeutic feeding, and offering nutrition education and support to caregivers. Scaling up CMAM services can help to reach more children in need and prevent the situation from worsening. Additionally, it is important to strengthen collaboration with local health facilities and community health workers to ensure early detection and treatment of malnutrition cases. Increasing awareness among caregivers about the importance of early detection and seeking timely treatment for malnutrition is also essential.
- ⇨ Strengthening the community outreach efforts of early detection of acute malnutrition cases, referral and treatment through community-based screening, as there is witnessed in some areas that there are more SAM cases while nutrition facilities are not open all week anymore due to budgetary constraints and activity scaling down.
- ⇨ Advocating for and implementing a Blanket Supplementary Feeding Program (BSFP) during the lean period is crucial to reduce malnutrition rates. BSFP involves providing supplementary food rations to vulnerable groups, including children under five, pregnant and lactating women, and the elderly, to prevent malnutrition during periods of food scarcity. Implementing BSFP ensures that vulnerable populations have access to nutritious food, even when food availability is low. This can help preventing acute malnutrition and its associated health risks. Additionally, BSFP can provide a safety net for households experiencing food insecurity, helping to alleviate the burden of food shortages. Advocating for BSFP involves working with local authorities, NGOs, and international agencies to raise awareness of the importance of supplementary feeding programs during lean periods. It also involves securing funding and resources to implement these programs effectively. By implementing BSFP during the lean period, we can reduce malnutrition rates, improve health outcomes, and ensure the well-being of vulnerable populations in Aweil North County.

Most IYCF indicators showed poor child feeding practice (EIBF = 80.0%, ExBF = 45%, CBF = 73.9%, MDD = 49.6%, MAD = 17.5%). However, most of them werebelow the emergency thresholds. Consequently, the following recommendations are made:

- ⇨ Improving community awareness on the importance of optimal complementary feeding through various mechanisms, such as: Cooking Demonstrations, Health Education Sessions, Home Visits, Use of Local Media, Community workshops and Distribution of Educational Materials. By implementing these mechanisms, we can improve community awareness and knowledge about optimal complementary feeding practices, ultimately leading to better nutrition outcomes for under-five children and Pregnant and Lactating Women (PLWs).
- ⇨ Improving the community's understanding of breastfeeding practices, such as Exclusive Breastfeeding (ExBF) and Continued Breastfeeding (CBF), and their importance for child development and health through various means.

Health programme coverage

All vaccination coverages (Vitamin A = 89.8%, Measles = 90.6%, Deworming = 81.7%) fall below the Sphere standards of >95%. However, when compared with previous coverage and with similar areas, the coverage has increased, which may be associated with the recent vaccination campaign conducted in the county. Therefore, it is advisable to continue such campaigns more regularly, with a focus on pocket areas of the county such as Ariath and Malual East Payams. These areas have relatively higher rates of unvaccinated children compared to other payams, based on the data. In future campaigns, increasing awareness among caretakers about the importance of these childhood vaccines is essential.

For the vast majority of children (85.3%), experiencing illness was reported during the two-week recall period, and most of them (89.1%) reportedly had caretakers who sought treatment for them. This indicates that health-seeking behavior is already good, and needs to be strengthened for further improvement.

Contributing Factors

WASH:

Most of the households (95.2%) source their water from improved sources. However, a large majority of them (88.1%) do not use any water treatment mechanisms for drinking water. Additionally, the majority of households (77.6%) practice open defecation. Hence, there is a need to:

- ⇨ Promoting community sensitization and enhance campaigns on appropriate water, sanitation, and hygiene (WASH) practices.
- ⇨ Creating better hygiene at the household and community level to prevent diarrhoea, since it is crucial to improve access to and knowledge of safe fecal disposal. This can be achieved through health education and support in latrine construction among target communities.

FSL:

As we observed FSL indicators, around one fifth (17%) of households were found to have a poor food consumption score, while 61% of households have experienced moderate hunger, and about 5% severe hunger. Considering that these households are already struggling to meet their calorie requirements, coupled with the influx of refugees and returnees, the situation may further deteriorate in the coming months. Based on these results, recommendations include:

- ⇨ Strengthening social protection programs designed for food availability, food transfers, and cash support.
- ⇨ Advocating for and/or implementing General Food Distribution (GFD) during the lean period to support struggling households' food security and ability to cope with continued inflation, providing adequate household food rations.

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Our gratitude also goes to the entire Aweil North community, including randomly selected individuals and village chiefs who participated in the survey. We appreciate the community members who escorted our teams from house to house, as well as the mothers and caregivers who dedicated their time to responding to the questionnaire and allowing their children to be measured by the survey team despite their household responsibilities.

Finally, we extend sincere thanks to all survey participants, including supervisors, team leaders, enumerators, and drivers, for their endurance and dedication during the survey. Their commitment enabled us to obtain quality data, even from hard-to-reach areas that required hours of travel on foot.

Appendices

Appendix 1 - Plausibility Report

Plausibility check for: SSD2401_REACH_SSD_AWEIL_NORTH_SMART_SURVEY.as

Standard/Reference used for z-score calculation: WHO standards 2006

(If it is not mentioned, flagged data is included in the evaluation. Some parts of this plausibility report are more for advanced users and can be skipped for a standard evaluation)

Overall data quality

Criteria	Flags*	Unit	Excel.	Good	Accept	Problematic	**Score**
Flagged data	Incl	%	0-2.5	>2.5-5.0	>5.0-7.5	>7.5	
(% of out of range subjects)			0	5	10	20	**0** (1.0 %)
Overall Sex ratio	Incl	p	>0.1	>0.05	>0.001	<=0.001	
(Significant chi square)			0	2	4	10	**4** (p=0.023)
Age ratio(6-29 vs 30-59)	Incl	p	>0.1	>0.05	>0.001	<=0.001	
(Significant chi square)			0	2	4	10	**2** (p=0.063)
Dig pref score - weight	Incl	#	0-7	8-12	13-20	> 20	
			0	2	4	10	**0** (5)
Dig pref score - height	Incl	#	0-7	8-12	13-20	> 20	
			0	2	4	10	**2** (11)
Dig pref score - MUAC	Incl	#	0-7	8-12	13-20	> 20	
			0	2	4	10	**2** (8)
Standard Dev WHZ	Excl	SD	<1.1	<1.15	<1.20	>=1.20	
.			and	and	and	or	
.	Excl	SD	>0.9	>0.85	>0.80	<=0.80	
			0	5	10	20	**0** (0.96)
Skewness WHZ	Excl	#	<±0.2	<±0.4	<±0.6	>=±0.6	
			0	1	3	5	**0** (0.08)
Kurtosis WHZ	Excl	#	<±0.2	<±0.4	<±0.6	>=±0.6	
			0	1	3	5	**0** (-0.05)
Poisson dist WHZ-2	Excl	p	>0.05	>0.01	>0.001	<=0.001	
			0	1	3	5	**0** (p=0.503)
OVERALL SCORE WHZ =			0-9	10-14	15-24	>25	**10** %

The overall score of this survey is 10 %, which is good.

Appendix 2 - Assignment of Clusters

Payam	Village	Estimated Population size	Clusters
Malual East	Mabior Reeh	480	1
Malual East	Majok Lual Angok	928	2
Malual East	Riangbar	314	3
Malual East	Maluo	628	4
Malual East	Mayen Ulem	1460	5
Malual East	Makuach Nyieth	723	6
Malual East	Makuach Akech	1056	7
Malual East	Riech Thieech	314	8
Malual East	Majak Lual	350	9
Malual East	Mabior Akoon Kuot	700	10
Malual North	Marol Tiit	960	11
Malual North	warchum	382	12
Malual North	Mayom Adhal	968	13
Malual North	Mariik	890	14
Malual North	Roldit	789	RC
Malual North	Rolngut Centre	1200	15
Malual Centre	Maper Wieu	987	16
Malual Centre	Abyei	381	17
Ariath	Riang Ajiiwak	748	18
Ariath	Lanager	1344	19
Ariath	Yith Agany	912	20
Ariath	Riang Awach	1500	21
Ariath	Marol Ameel	882	22
Malual West	Kuol Kon	724	23
Malual West	Malual Dok	548	RC
Malual West	Warthou	1178	24
Malual West	Kongdai	134	25
Malual West	Nyin jier	201	26
Malual West	Mangok piok	714	RC

Appendix 3 – Standardization Test Results

Standardisation test results					Precision				Accuracy		OUTCOME			
Weight		subjects	mean	SD	max	Technic-	TEM/me	Coef of	Bias fro	Bias from median			From	From
		#	kg	kg	kg	TEM (kg	TEM (%	R (%)	Bias (kg	Bias (kg)			Supervis	Median
	Supervis	10	10.8	3.1	0.5	0.17	1.6	99.7	0	0.04	TEM po	R value :	Bias goc	Bias acceptable
	Enumera	10	10.8	3.1	1.2	0.3	2.8	99.1	0.1	0.11	TEM rej	R value :	Bias acc	Bias poor
	Enumera	10	10.9	3.1	0.6	0.21	1.9	99.5	0.1	0.11	TEM rej	R value :	Bias acc	Bias poor
	Enumera	10	10.8	3.1	0.3	0.13	1.2	99.8	0.06	0.09	TEM po	R value :	Bias acc	Bias acceptable
	Enumera	10	10.8	3.1	0.7	0.22	2.1	99.5	0.07	0.09	TEM rej	R value :	Bias acc	Bias acceptable
	Enumera	10	10.8	3.1	0.5	0.16	1.5	99.7	0.04	0.06	TEM po	R value :	Bias acc	Bias acceptable
	Enumera	10	10.9	3.1	0.5	0.18	1.7	99.6	0.07	0.09	TEM po	R value :	Bias acc	Bias acceptable
	Enumera	10	11.3	3.6	10.1	2.26	20	60.6	0.6	0.61	TEM rej	R value I	Bias reje	Bias reject
	Enumera	10	10.8	3.1	0.4	0.14	1.3	99.8	0.1	0.11	TEM po	R value :	Bias poc	Bias poor
	Enumera	10	10.9	3.1	0.6	0.2	1.9	99.6	0.07	0.07	TEM po	R value :	Bias acc	Bias acceptable
	Enumera	10	10.8	3.1	0.7	0.22	2	99.5	0.05	0.06	TEM rej	R value :	Bias acc	Bias acceptable
	Enumera	10	10.7	3.2	1.5	0.46	4.3	97.9	0.18	0.21	TEM rej	R value .	Bias poc	Bias reject
	enum int	11x10	10.8	3	-	0.17	1.6	99.7	-	-	TEM ac	R value	good	
	enum int	11x10	11	3.2	-	0.97	8.8	90.7	-	-	TEM rej	R value	poor	
	inter enu	12x10	10.9	3.1	-	0.54	5	95.6	-	-	TEM rej	R value	acceptable	
	TOTAL i	11x10	-	-	-	1	9.2	89.3	-	-	TEM rej	R value	reject	
	TOTAL+	12x10	-	-	-	0.96	8.8	90.1	-	-	TEM rej	R value	poor	
Height		subjects	mean	SD	max	Technic-	TEM/me	Coef of	Bias fro	Bias from median			From	From
		#	cm	cm	cm	TEM (cr	TEM (%	R (%)	Bias (cr	Bias (cm)			Supervis	Median
	Supervis	10	85.3	12.2	1.2	0.47	0.5	99.9	0	0.45	TEM ac	R value :	Bias goc	Bias acceptable
	Enumera	10	85.1	11.9	1.7	0.59	0.7	99.8	0.56	0.29	TEM ac	R value :	Bias acc	Bias good
	Enumera	10	84.8	11.8	10	2.26	2.7	96.4	0.77	0.83	TEM rej	R value :	Bias acc	Bias poor
	Enumera	10	85.3	11.7	2.3	0.72	0.8	99.6	0.87	0.47	TEM po	R value :	Bias poc	Bias acceptable
	Enumera	10	85.2	12	1.3	0.47	0.6	99.8	0.64	0.34	TEM ac	R value :	Bias acc	Bias good
	Enumera	10	86	11.7	6.9	1.59	1.9	98.2	0.98	0.86	TEM rej	R value :	Bias poc	Bias poor
	Enumera	10	85.4	11.7	3	0.75	0.9	99.6	0.89	0.48	TEM po	R value :	Bias poc	Bias acceptable
	Enumera	10	85.8	11.6	10.1	2.31	2.7	96	0.99	0.75	TEM rej	R value :	Bias poc	Bias acceptable
	Enumera	10	85.2	11.9	1.6	0.51	0.6	99.8	0.47	0.2	TEM ac	R value :	Bias acc	Bias good
	Enumera	10	85.2	11.9	1.2	0.43	0.5	99.9	0.55	0.3	TEM ac	R value :	Bias acc	Bias good
	Enumera	10	85.3	12.1	1.2	0.45	0.5	99.9	0.41	0.33	TEM ac	R value :	Bias acc	Bias good
	Enumera	10	85.5	11.7	0.8	0.29	0.3	99.9	0.69	0.35	TEM go	R value :	Bias acc	Bias good
	enum int	11x10	85.5	11.7	-	0.96	1.1	99.3	-	-	TEM ac	R value	good	
	enum int	11x10	85.2	11.5	-	1.41	1.7	98.5	-	-	TEM po	R value	acceptable	
	inter enu	12x10	85.3	11.6	-	1.15	1.3	99	-	-	TEM po	R value	acceptable	
	TOTAL i	11x10	-	-	-	1.69	2	97.9	-	-	TEM rej	R value	acceptable	
	TOTAL+	12x10	-	-	-	1.63	1.9	98	-	-	TEM rej	R value	acceptable	
MUAC		subjects	mean	SD	max	Technic-	TEM/me	Coef of	Bias fro	Bias from median			From	From
		#	mm	mm	mm	TEM (m	TEM (%	R (%)	Bias (mr	Bias (mm)			Supervis	Median
	Supervis	10	142.1	10.1	4	1.99	1.4	96.1	0	0.95	TEM go	R value .	Bias goc	Bias good
	Enumera	10	141.1	9.8	4	1.4	1	98	1.3	1.54	TEM go	R value .	Bias acc	Bias acceptable
	Enumera	10	141.3	9.7	3	1.5	1.1	97.6	1.33	1.2	TEM go	R value .	Bias acc	Bias acceptable
	Enumera	10	141.6	10.6	3	1.28	0.9	98.5	1.83	1.17	TEM go	R value .	Bias acc	Bias acceptable
	Enumera	10	142.9	10.2	5	2.04	1.4	96	1.88	1.37	TEM ac	R value .	Bias acc	Bias acceptable
	Enumera	10	142.7	9.9	5	1.9	1.3	96.3	1.34	1.54	TEM go	R value .	Bias acc	Bias acceptable
	Enumera	10	142.1	10.1	5	1.72	1.2	97.1	1.43	1.4	TEM go	R value .	Bias acc	Bias acceptable
	Enumera	10	142.4	10.6	5	2.35	1.6	95.1	1.69	1.44	TEM ac	R value .	Bias acc	Bias acceptable
	Enumera	10	142.9	9.8	5	1.97	1.4	96	1.72	1.54	TEM go	R value .	Bias acc	Bias acceptable
	Enumera	10	140.8	10.4	5	1.53	1.1	97.8	1.97	1.2	TEM go	R value .	Bias acc	Bias acceptable
	Enumera	10	141.4	10	5	1.77	1.3	96.9	1.5	1.27	TEM go	R value .	Bias acc	Bias acceptable
	Enumera	10	142	10	4	1.76	1.2	96.9	1.7	1.33	TEM go	R value .	Bias acc	Bias acceptable
	enum int	11x10	142.2	10	-	1.96	1.4	96.1	-	-	TEM go	R value	acceptable	
	enum int	11x10	141.7	9.9	-	1.98	1.4	96	-	-	TEM go	R value	acceptable	
	inter enu	12x10	141.9	9.9	-	1.95	1.4	96.2	-	-	TEM go	R value	acceptable	
	TOTAL i	11x10	-	-	-	2.65	1.9	92.8	-	-	TEM ac	R value	poor	
	TOTAL+	12x10	-	-	-	2.65	1.9	92.9	-	-	TEM ac	R value	poor	

MUAC		subjects	mean	SD	max	Technic-	TEM/me	Coef of	Bias fro	Bias from median			From	From
		#	mm	mm	mm	TEM (m	TEM (%	R (%)	Bias (mr	Bias (mm)			Supervis	Median
	Supervis	10	142.1	10.1	4	1.99	1.4	96.1	0	0.95	TEM go	R value .	Bias goc	Bias good
	Enumera	10	141.1	9.8	4	1.4	1	98	1.3	1.54	TEM go	R value .	Bias acc	Bias acceptable
	Enumera	10	141.3	9.7	3	1.5	1.1	97.6	1.33	1.2	TEM go	R value .	Bias acc	Bias acceptable
	Enumera	10	141.6	10.6	3	1.28	0.9	98.5	1.83	1.17	TEM go	R value .	Bias acc	Bias acceptable
	Enumera	10	142.9	10.2	5	2.04	1.4	96	1.88	1.37	TEM ac	R value .	Bias acc	Bias acceptable
	Enumera	10	142.7	9.9	5	1.9	1.3	96.3	1.34	1.54	TEM go	R value .	Bias acc	Bias acceptable
	Enumera	10	142.1	10.1	5	1.72	1.2	97.1	1.43	1.4	TEM go	R value .	Bias acc	Bias acceptable
	Enumera	10	142.4	10.6	5	2.35	1.6	95.1	1.69	1.44	TEM ac	R value .	Bias acc	Bias acceptable
	Enumera	10	142.9	9.8	5	1.97	1.4	96	1.72	1.54	TEM go	R value .	Bias acc	Bias acceptable
	Enumera	10	140.8	10.4	5	1.53	1.1	97.8	1.97	1.2	TEM go	R value .	Bias acc	Bias acceptable
	Enumera	10	141.4	10	5	1.77	1.3	96.9	1.5	1.27	TEM go	R value .	Bias acc	Bias acceptable
	Enumera	10	142	10	4	1.76	1.2	96.9	1.7	1.33	TEM go	R value .	Bias acc	Bias acceptable
	enum int	11x10	142.2	10	-	1.96	1.4	96.1	-	-	TEM go	R value	acceptable	
	enum int	11x10	141.7	9.9	-	1.98	1.4	96	-	-	TEM go	R value	acceptable	
	inter enu	12x10	141.9	9.9	-	1.95	1.4	96.2	-	-	TEM go	R value	acceptable	
	TOTAL i	11x10	-	-	-	2.65	1.9	92.8	-	-	TEM ac	R value	poor	
	TOTAL+	12x10	-	-	-	2.65	1.9	92.9	-	-	TEM ac	R value	poor	

Suggested cut-off points for acceptability of measurements				
Parameter		MUAC r	Weight K	Height cm
individua	good	<2.0	<0.04	<0.4
TEM	acceptal	<2.7	<0.10	<0.6
(intra)	poor	<3.3	<0.21	<1.0
	reject	>3.3	>0.21	>1.0
Team TE	good	<2.0	<0.10	<0.5
(intra+int	acceptal	<2.7	<0.21	<1.0
and Tota	poor	<3.3	<0.24	<1.5
	reject	>3.3	>0.24	>1.5
R value	good	>99	>99	>99
	acceptal	>95	>95	>95
	poor	>90	>90	>90
	reject	<90	<90	<90
Bias	good	<1	<0.04	<0.4
	acceptal	<2	<0.10	<0.8
	poor	<3	<0.21	<1.4
	reject	>3	>0.21	>1.4

Appendix 4 – Local Event Calendar

Month of Year	2019		2020		2021		2022		2023		2024	
Jan			*New year*	**50**	*New year*	**38**	*New year*	**26**	*New year*	**14**	*New year*	**2**
Feb			*Fishing in Kirkou*	**49**	*Fishing in Kirkou*	**37**	*Fishing in Kirkou*	**25**	*Fishing in Kirkou*	**13**	*Fishing in Kirkou*	**1**
Mar			*Coming resigad cattle keepers*	**48**	*Coming resigad cattle keepers*	**36**	*Coming resigad cattle keepers*	**24**	*Coming resigad cattle keepers*	**12**	*Coming resigad cattle keepers*	**0**
April	*Easter*	**59**	*Easter*	**47**	*Easter*	**35**	*Easter*	**23**	*Easter*	**11**		
May	*SPLA Day Start of Rainy season*	**58**	*SPLA Day Start of Rainy season*	**46**	*SPLA Day Start of Rainy season*	**34**	*SPLA Day Start of Rainy season*	**22**	*SPLA Day Start of Rainy season*	**10**		
June	*Planting season*	**57**	*Planting season*	**45**	*Planting season*	**33**	*Planting season*	**21**	*Planting season*	**9**		
July	*South Sudan Independe Day*	**56**	*South Sudan Independence Day, Martyr Day*	**44**	*S South Sudan Independence Day, Martyr Day*	**32**	*South Sudan Independence Day, Martyr Day*	**20**	*South Sudan Independence Day, Martyr Day*	**8**		
Aug	*Ascension day, Hunger month*	**55**	*Ascension day, Hunger month*	**43**	*Ascension day, Hunger month*	**31**	*Ascension day, Hunger month, Heavy flood*	**19**	*Ascension day, Hunger month*	**7**		
Sept	*Start of harvest*	**54**	*Start of harvest*	**42**	*Start of harvest*	**30**	*Heavy floods, Start of harvest*	**18**	*Start of harvest*	**6**		
Oct	*Comboni Day*	**53**	*Comboni Day*	**41**	*Comboni Day*	**29**	*Comboni day*	**17**	*Comboni day, Eboli*	**5**		
Nov	*Start of dry season, transfer of cattle to river banks*	**52**	*Start of dry season, transfer of cattle to river banks*	**40**	*Start of dry season, transfer of cattle to river banks*	**28**	*Start of dry season, transfer of cattle to river banks*	**16**	*Start of dry season, transfer of cattle to river banks*	**4**		
Dec	*Christmas Celebrati*	**51**	*Christmas Celebration*	**39**	*Christmas Celebration*	**27**	*Christmas Celebration*	**15**	*Christmas Celebration*	**3**		