NUTRITION AND MORTALITY SMART SURVEY

FINAL REPORT

GHADEER LOCALITY, SOUTH KORDOFAN STATE, SUDAN

Funded by:

Global Affairs Canada

May 2022

Acknowledgements

This nutrition SMART survey would not have been possible without the financial support from Global Affairs Canada.

Appreciation goes to the Federal Ministry of Health of the republic of Sudan, as well as the State Ministry of Health in South Kordofan, and all their representatives in Ghadeer for their generous support during implementation of the survey. Further, the consultant is grateful to the local administration, including the office of the State Governor and the Commissioner's office in Ghadeer, for authorizing the survey, as well as the community leaders (Sheikhs) in all the visited villages who zealously assisted the survey teams during data collection.

Sincere gratitude goes to Action Against Hunger Sudan team in charge of survey implementation particularly Sanjida Tawhid (Country Director), Yonas Mesele (Health and Nutrition Head of Department), Ezeldin Youssif (Health and Nutrition Manager), Leena Khalid (M&E Officer) and Osama Alsindi (Field Office Manager, South Kordofan), for supporting survey planning, training, logistics, and data collection.

A profound thank you goes to the field supervisors including Mohammed Alsadig from UNICEF, Eissa Hassan from GOAL, and Osama from the Federal Ministry of Health. Special thanks are expressed to the survey teams for their dedication and hard work.

Gratitude is extended to mothers and caregivers for providing information during the interviews and allowing their children to be measured.
The participation of the SMART global team at Action Against Hunger Canada, and the contributions of the Sudan Nutrition Information Technical Working Group are highly acknowledged.

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Acronyms

AAH	Action Against Hunger
CMAM	Community Management of Acute Malnutrition
CMR	Crude Mortality Rate
ENA	Emergency Nutrition Assessments
GAM	Global Acute Malnutrition
HAZ	Height for Age Z scores
HH	Household
IPC	Integrated Food Security Phase Classification
MAM	Moderate Acute Malnutrition
MUAC	Mid Upper Arm Circumference
NIS TWG	Nutrition Information Technical Working Group
OTP	Out-Patient Therapeutic Programme
WRA	Women of Reproductive Age
PPS	Probability Proportional to Size
S3M	Simple Spartial Survey Method
SAM	Severe Acute Malnutrition
SD	Standard Deviation (measure of spread around the mean)
SMART	Standardized Monitoring and Assessment for Relief and Transitions
TSFP	Targeted Supplementary Feeding Program
U5MR	Under 5 Mortality Rate
UNICEF	United Nation Children's Fund
WAZ	Weight for Age Z scores
WFP	World Food Program
WHO	World Health Organisation
WHZ	Weight for Height Z scores

Executive summary

Action Against Hunger Spain in collaboration with the Federal Ministry of Health of the republic of Sudan, and with financial support from Global Affairs Canada (GAC) conducted a SMART nutrition and mortality survey in Ghadeer locality in South Kordofan State, Sudan. The main objective of the survey was to assess the current prevalence of acute malnutrition and the crude and under-five retrospective death rates, as well as to analyze possible factors contributing to malnutrition.

The Standardized Monitoring and Assessment for Relief and Transitions (SMART) which applies the two-stage cluster sampling and random sampling techniques was used. In the sampled households, anthropometric measurements were taken from eligible children aged 6-59 months while mortality interviews targeting all household members were conducted. In addition, mothers or caregivers were interviewed to gather information on the health status of children, as well as the infant and young child feeding practices. A total of 682 children aged 6-59 months from 533 households in 39 clusters were sampled for anthropometric measurements. The mortality assessment was conducted concurrently in all the 533 households.

The prevalence of global acute malnutrition (GAM) based on Weight-for-Height <-2 Z scores and/or oedema for Ghadeer locality was 18.0% (14.8-21.6 95% C.I.), and the severe acute malnutrition (SAM) prevalence based on Weight-for-Height <-3 Z scores and/or oedema was 2.4% (1.5 -3.7 95% C.I.). The GAM prevalence indicated a critical nutrition situation according to the WHO classification. The prevalence of SAM is considered high based on routine acute malnutrition screening data regularly conducted by health and nutrition agencies. One case of oedema was identified during the assessment. The prevalence of GAM based on MUAC < 125 mm was 4.1% (2.7-6.3 95% C.I) while SAM based on MUAC<115 was 0.4% (0.1-1.4 95% C.I.).

The crude mortality rate (CMR) and the under-five mortality rate (U5MR) were 0.85 (0.55-1.32) and 1.53 (0.67-3.46) respectively. Both the CMR and the U5MR were classified as alert, but were below the WHO emergency thresholds of 1/10,000/day and 2/10,000/day respectively. Most deaths were due to illness (82.4%), and the majority of these deaths (82.5) occurred in the deceased members current location, which were the households surveyed.

Measles immunization coverage both by card and recall was commendable at 89.3%, exceeding the World Health Organization (WHO) recommended standard of ≥80%.

The percentage of children who had reportedly suffered from one or more illnesses in the two weeks preceding the survey was 43.3%. The proportions of the three most common childhood illnesses were as follows: fever (29.7%), cough (21.9%) and diarrhea (18.0%). Notably, nearly one-third (30.4%) of the children surveyed were suffering from other illnesses such as, malaria, vomiting, eye infection, and ear infection. About half of the caregivers (52.2%) sought conventional health care when their children were sick, 21.4% bought medicine from pharmacies, 10.8% sought alternative treatment and 15.6% did not seek treatment. Of those who sought treatment from health facilities, 49.5% reportedly visited public health facilities.

Infant and young child feeding indicators were assessed using the final sample size calculated for the survey. IYCF results should be interpreted cautiously due to the small sample size. Except for one indicator (children born in the last 24 months who were ever breastfed), IYCF practices in Ghadeer were poor, with rates falling below the WHO recommendation of ≥80%. The proportion of children 0-23 months who had ever breastfed was high at 97.1%. Timely initiation of breastfeeding within the first hour of birth among children 0-23 months was 64.4%, with less than half (47.6%) of children 0-5 months being exclusively breastfed up to 6 months. The introduction of solid, semi-solid or soft foods at the age of six months 73.3%. The number of children 6-23 months who met the recommended minimum dietary diversity was low at 33.8%. Similarly, only 37.3% of the breastfed and non-breastfed children met the recommended minimum meal frequency. The percentage of children who consumed the minimum acceptable diet was very low at 14.0%.

The majority (68.1%) of the assessed women of reproductive age had a normal nutrition status (MUAC≥23), but almost one-quarter (23.8%) of the women were at risk of malnutrition (MUAC>21-<23) with another 8.1% being malnourished (MUAC<21).

The results of key indicators are summarized in table 1 below.

Table 1: Summary of survey results

Anthropometry - Children 6-59 months based on WHO 2006 standards				
Index	Indicator	N	n	Percent (95% C.I)
WHZ- scores	Prevalence of global acute malnutrition (<-2 z-score and/or oedema)	674	121	18.0% (14.8 - 21.6)
	Prevalence of moderate malnutrition (<-2 z-score and >=-3 z-score, no oedema)	674	105	15.6% (12.5 - 19.12
	Prevalence of severe malnutrition (<-3 z-score and/or oedema)	674	16	2.4% (1.5 - 3.7)
MUAC children	Prevalence of global acute malnutrition (< 125 mm and/or oedema)	682	28	4.1 % (2.7 - 6.3)
	Prevalence of moderate acute malnutrition (< 125 mm and >= 110 mm, no oedema)	682	25	3.7 % (2.4 - 5.6)
	Prevalence of severe acute malnutrition (< 115 mm and/or oedema)	682	3	0.4 % (0.1 - 1.4)
WAZ- scores	Prevalence of underweight (<-2 z-score)	676	191	28.3% (23.8 – 33.2)
	Prevalence of moderate underweight (<-2 z-score and >=-3 z-score)	676	157	23.2% (19.3 - 27.7)
	Prevalence of severe underweight (<-3 z-score)	676	34	5.0% (3.5 – 7.2)

HAZ-scores	Prevalence of stunting (<-2 z-score)	664	184	27.7% (23.8 – 32.0)
	Prevalence of moderate stunting (<-2 z-score and >=-3 z-score)	664	148	22.3 % (19.4 – 25.5)
	Prevalence of severe stunting (<-3 z-score)	664	36	5.4% (3.7 - 7.8)
Retrospective Mortality - 109 days recall period				
Mortality	CMR Deaths/10,000 people/day	3662	34	0.85 (0.55 - 1.32)
	U5 MR Deaths/10,000 children U5/day	721.5	12	1.53 (0.67 - 3.46)
Other child variables				
Measles vaccination	Measles immunization based on card	652	198	30.4% (26.7 - 34.0)
	Measles immunization based on recall	652	384	58.9% (54.9 - 62.9)
Morbidity				
	Prevalence of reported illness	682	295	43.3 (39.4 - 47.1)
Type of illness	Fever	438	130	29.7 (25.6 - 34.0)
	Cough		96	21.9 (18.0 - 26.0)
	Diarrhoea		79	18.0 (14.6 - 21.7)
	Other		133	30.4 (26.3 - 34.7)
Health seeking behavior				
Treatment sought	None	295	46	15.6 (11.9 - 19.7)
	Visited public health facility		146	49.5 (43.7 - 55.2)
	Visited private health facility		8	2.7 (1.0 - 4.7)
	Bought medicine from the pharmacy		63	21.4 (17.0 - 25.8)
	Other		32	10.8 (7.8 - 14.6)
Infant and young child feeding practices				
IYCF	Children ever breastfed (0-23.9 months)	312	303	97.1 (95.2-98.7)
	Early initiation of breastfeeding (0-23.9 months)	312	201	64.4 (59.3-70.2)
	Exclusive breastfeeding (0-5.9 months)	84	40	47.6 (36.9-58.3)
	Introduction of solid, semi-solid or soft foods (6-8.9 months)	30	22	73.3 (56.7-86.7)
	Minimum dietary diversity (6-23.9 months)	228	78	33.8 (27.6-40.4)
	Minimum meal frequency for both breastfed and non-breastfed (6-23.9 months)	228	85	37.3 (30.7-43.9)
	Minimum acceptable diet (6-23.9)	228	32	14.0 (9.2-18.4)
Maternal nutrition status				
MUAC women	MUAC <21cm	479	39	8.1 (5.8-10.6)
	MUAC >21 - <23cm		114	23.8 (20.3-27.8)
	MUAC ≥23cm		326	68.1 (63.9-72.2)

Specific recommendations are outlined below:

1. Survey results show that the prevalence of acute malnutrition exceeds the WHO emergency threshold. At the time of the survey, there were four health and nutrition partners working in Ghadeer, namely Action Against Hunger, CARE, CONCERN Worldwide and CAFA, and they only covered a few areas within the locality. The current nutrition interventions implemented by the four partners should be continued and scaled up to improve coverage. The partners should consider intensifying their nutrition activities by increasing mobile treatment centres to reach many of the areas where health and nutrition services are not available.
2. Given that a considerable number of malnourished children were referred to available health facilities and nutrition centers for treatment, there is a need to strengthen routine community screening of under-fives, as well as active case finding, to ensure that malnourished children are enrolled in treatment programs. In addition, defaulter tracing should be carried out to re-admit children who have defaulted, as a number of malnourished children identified in the survey were said to have stopped attending nutrition treatment centres.
3. In line with the recommendation to expand nutrition program coverage in Ghadeer, timely procurement and distribution of essential nutrition commodities is required, particularly during the dry season when roads are passable. Officials from the State Ministry of Health in Ghadeer, as well as the respondents, complained about frequent pipeline breakdowns and a severe lack of nutrition commodities in the few nutrition treatment centres that were operating.
4. According to survey findings, about two-fifths (43.3%) of children in Ghadeer suffered from a variety of childhood illnesses in the two weeks that preceded the survey. There is a need to upscale the current integrated management of childhood illnesses program to not only treat existing cases but also to prevent the spread of these illnesses.
5. The health seeking behavior of mothers and caregivers was less than satisfactory, with approximately one-third (32.2%) buying medicine from pharmacies or using alternative treatment options. There is a need to strengthen health education at community and health facilities levels about the importance of health seeking in order to encourage community members to use the available community health services.
6. Sub-optimal infant and young child feeding practices were noted by the survey. It's recommended that a comprehensive Social Behaviour Change Communication (SBCC) program meant to sensitize the community on appropriate IYCF practices using community change agents such as, health facility staff, community nutrition volunteers, mother support groups among others should be continuously implemented and strengthened.
7. Survey results show that both underweight and stunting are a major concern in Ghadeer. Provision of health education to mothers and caregivers on optimal child care and feeding practices should be intensified. In addition, mothers and caregivers should be sensitized on the value of seeking health services, and proper sanitation and hygiene practices as these measures go a long way in reducing the incidence of both acute and chronic malnutrition.

8. Findings revealed that a significant number of women of reproductive age (23.8%) were at risk of malnutrition, with 8.1% already malnourished. It is critical to improve maternal nutrition by implementing diverse strategies including strengthening maternal nutrition education through the use of mother support groups, continuous screening of women of child bearing age for acute malnutrition, especially among pregnant and lactating mothers, and providing treatment and linking them to programs that provide livelihood support, such as the cash transfer and food security program currently being implemented by AAH in Ghadeer.
9. Conduct regular SMART surveys to monitor the nutrition situation. The current survey is the first successful nutrition assessment that was conducted in the area to establish a baseline for future reference.

1 Introduction

1.1 Background

Ghadeer locality is one of the seventeen localities that make up the South Kordofan State in the republic of Sudan. Ghadeer borders Abu Jubeiha locality to the West, Heiban locality to the Northeast, Talodi locality to the East, Alleri locality to the Southeast and shares an international border with Upper Nile State in South Sudan to the South.

According to the Sudan Humanitarian Needs Overview report of 2022, Ghadeer locality has an estimated population of 55,824. The County is inhabited by diverse Arab ethnic groups including the Hawazma, Kenana, Kawahla and the African Nuba Logan tribes. The main livelihood activities in Ghadeer include pastoralism, small scale agriculture, trading in livestock and farm products sourced locally such as maize, sesame and peanuts, as well as imported goods sourced from Khartoum. Recently, illegal gold mining has become an important source of income in this area as reported by local government officials who were interviewed during debriefing meetings after the survey.

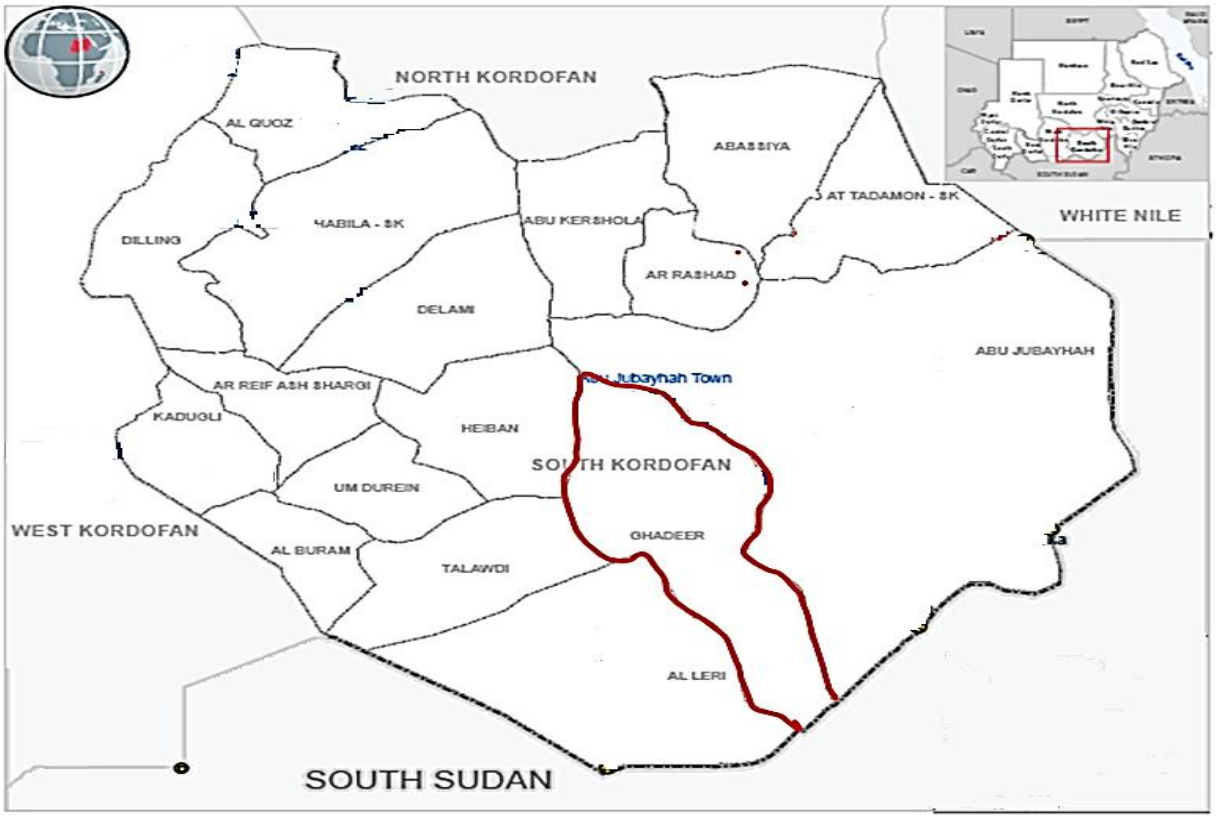

Figure 1: Map of South Kordofan State showing the location of Ghadeer.

Ghadeer locality is partially accessible and faces multiple challenges caused by natural disasters such as drought during the dry season, flooding during the rainy season, widespread insecurity and protracted conflict between local communities. Localized conflict between the nomads and farmers has been on the rise and continues to displace people and disrupt livelihoods. Ghadeer was extensively affected by a major communal conflict that started in October 2020. The conflict began in Ghadeer locality and was occasioned by land disputes between the Hawazma tribe against a coalition of the Kenana, Kawahla and Nuba Logan tribes. The conflict resulted in the displacement of nearly 40,000 persons, majority of whom were women and children who moved

from the affected areas to Abu Jubeiha, Rashad, and Abu Kershola localities[1]. In 2021, tribal conflict increased in the eastern corridor localities of Abu Jubeiha, Ghadeer and Talodi, leading to the displacement of over 13,000 people[2].

Ghadeer remains volatile, and overall access to basic health and nutrition services is low. According to the State Ministry of Health officials, there is one main hospital and 13 health units spread across the area, but most of these health facilities lack health workers and essential medical and nutrition supplies are inadequate.

Numerous cases of insecurity have continued to be reported in Ghadeer according to residents and the local authorities. Incidents of carjacking, hijacking of individuals including humanitarian workers are common, and there is an increase in cases of armed robberies along the main routes.

The food security situation in Ghadeer is alarming. According to the IPC Sudan food security outlook update in May 2021, Ghadeer was classified at IPC phase 3 (crisis level). Further, IPC classification projections for the period between October 2021 and February 2022 indicated that most parts of South Kordofan including Ghadeer would remain in IPC phase 3 despite the expected improvement in food availability following the harvest season, owing to intercommunal conflicts that were expected to persist during the harvest and post-harvest seasons.

Based on this context, the main drivers of malnutrition in Ghadeer include the cyclical intercommunal conflicts, widespread insecurity and limited access, a severe lack of basic health and nutrition services, and food insecurity.

To determine the trend of malnutrition prevalence in Ghadeer locality, Action Against Hunger Spain conducted a post-harvest SMART survey to assess the nutritional status of children aged 6-59 months in the month of April 2022.

1.2 Humanitarian assistance

There are a number of agencies currently working in Ghadeer including WFP, UNICEF, Action Against Hunger, CARE, CONCERN Worldwide, and CAFA. These organizations support and implement various programs as outlined in table 2 below.

Table 2: Humanitarian agencies present in Ghadeer

Organization	Sector
WFP	TSFP (RUSF distribution)
UNICEF	OTP (RUTF distribution)
Action Against Hunger	Food security and livelihoods program
CARE International	Programs in health and nutrition, and WASH
CONCERN	Programs in health and nutrition
CAFA	Programs in health, education, and protection

[1] Inter-Agency assessment report: Abu Kershola, Rashad & Abu jubeiha, January 2022
[2] UNOCHA South Kordofan State profile March 2022.

1.3 Survey Justification

The survey was necessary to determine the level of acute malnutrition among children aged 6-59 months in Ghadeer locality. Results from the last S3M survey conducted in South Kordofan in 2018 are outdated and are not reliable as a source of information that can be used for planning and decision making. There had never been a SMART survey conducted in Ghadeer, and this justified the need for a locality specific survey. In addition, there was a need to understand the current nutrition situation in the area in order to assist the government and other stakeholders in responding to the needs of the population by designing programs based on the survey findings.

1.4 Main objective of the survey

The overall objective of this survey was to determine the nutrition status of children aged 6-59 months as well as the mortality situation in Ghadeer locality. The survey also assessed the probable factors contributing to malnutrition. The findings were used to propose recommendations to inform the humanitarian response in the area.

1.4.1 Specific Objectives

1. To determine the prevalence of acute malnutrition, stunting and underweight among children aged 6-59 months.
2. To determine the retrospective crude mortality rate and the under-five mortality rate.
3. To assess the two-week retrospective childhood morbidity rate among children aged 6-59 months.
4. To understand the health seeking behaviors of the caretakers of children aged 6-59 months.
5. To assess the coverage of measles vaccination in children 9-59 months
6. To assess the nutritional status of women aged 15-49 years by MUAC measurement.
7. To assess the core infant and young child feeding practices among children aged 0-23 months.

1.5 Timing of the survey

The SMART Survey was conducted from April 17 to April 23, 2022 after the main harvest season as shown in the seasonal calendar below.

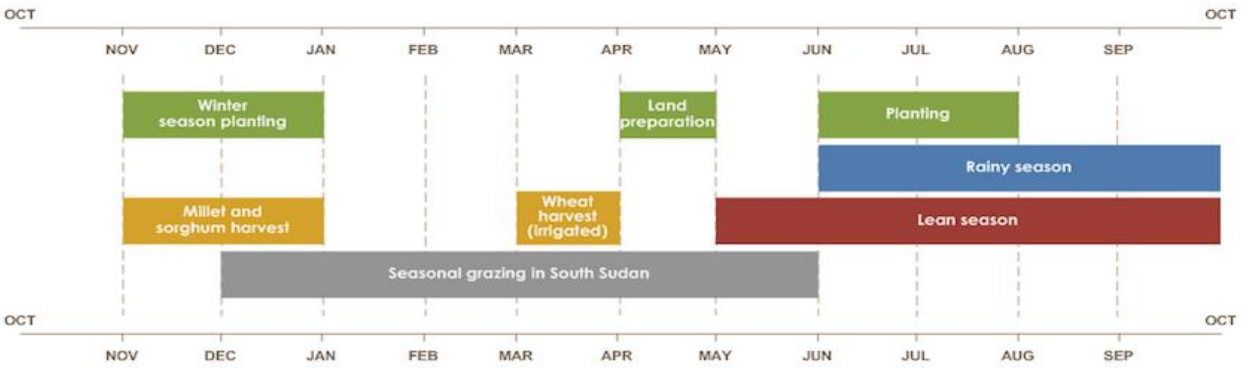

Figure 2: Sudan seasonal calendar

2 Methodology

2.1 Study design

The SMART survey employed a cross-sectional household survey design using the two-stage cluster sampling based on the SMART methodology. Clusters were selected using probability proportional to population size (PPS). Stage one sampling involved the sampling of clusters to be included in the survey while the second stage sampling involved the selection of households from the sampled clusters.

2.2 Study population

The target population for the anthropometric survey was children aged 6-59 months while all households were targeted for retrospective mortality assessment. Mothers or caregivers were interviewed to obtain information on childhood morbidity, health seeking behaviours, measles vaccination for children over the age of 9 months, and infant and young child feeding practices.

2.3 Sample size determination

The sample size was calculated using ENA for SMART software (January 11th, 2020 version). This was a combined survey that included both the anthropometry and mortality modules. Sample size calculation for anthropometry and mortality yielded two different household samples. The mortality sample was higher (534 households) than the anthropometry sample (464 households) and therefore the survey used the larger of the two samples (534) as the final sample size for the survey as recommended by the SMART survey guidelines[3]. The sample size of 534 households was subsequently adjusted slightly based on the calculation of the number of clusters which yielded 39 clusters and 14 HHs per cluster, which resulted in a total sample size of 546 HHs for the whole survey. However, after identifying the recall event, the recall period in days increased from the initial 93 days used for planning to 109 days. This led to a decrease of the mortality sample size from 546 HHs to 456 HHs.

For anthropometry, a total of 431 children in 464 households was calculated and for mortality, a total of 3248 persons was calculated.

The final sample size calculated for this survey was also used to assess infant and young child feeding practices. Information on infant and young child feeding practices (IYCF) was collected in all the 546 households with children 0-23 months in order to provide a snapshot of IYCF practices in the area. The results of the IYCF survey should however be interpreted and utilized cautiously due to small sample sizes.

The calculation of sample sizes is shown in the tables below:

[3] SMART Methodology. *Updated SMART Manual Version 2.0 published in 2017.*

Table 3: Anthropometry sample size determination

Parameter	Values used	Rationale
Estimated prevalence %	20.1	Based on the CWW 2021 SMART Survey report in South Kordofan. A conservative estimate of 20.1% was used. Although the survey was conducted after the harvest season, this locality was largely unstable, with a population that is prone to food insecurity and service delivery is limited.
±desired precision %	4.5	According to the SMART methodology guideline.
Design effect	1.3	Based on the CWW SMART survey report 2021. A more conservative DEFF was considered due to the anticipated variability.
Average household size	6.4	As per the CWW SMART survey report 2021.
% of children under-five	17	Based on national EPI estimate.
% of non-response households	5	Anticipated non response rate.
Children to be included	**431**	Determined by ENA for SMART software using the above given parameters.
Households to be included	**464**	Determined by ENA for SMART software based on the above given parameters.

Table 4: Mortality sample size determination

Parameter	Values used	Rationale
Estimated death rate per 10000/day	0.5	As per the SMART methodology recommendation. There was no reliable information on CMR in the survey area.
±desired precision per 10000/day	0.3	Based on the SMART methodology guidelines.
Design effect	1.3	According to the SMART methodology guideline. A more conservative DEFF was used to cater for any variations.
Recall period in days	93	Default value used. This was adjusted during training.
Average household size	6.4	Based on the CWW SMART survey report of 2021.
% of non-response households	5	Anticipated non response rate.
Population to be included	**3248**	Determined by ENA for SMART software based on the above given parameters.
Households to be included	**534**	Determined by ENA for SMART software based on the above given parameters.

Achievement of the sample size was good, with the survey reaching 97.6% of planned households while the number of children included in the survey was exceeded and stood at 158.2%. The overachievement in the number of children indicates that that the percentage of children under the age of five was underestimated, but this is consistent with the SMART methodology guidelines of choosing a lower estimate to avoid not getting enough children during the survey. The survey nonresponse rate was 2.4%.

Achievement of sample size is shown in the table below:

Table 5: Percent of households and children 6-59 months included in the survey

Number of HHs planned	Number of HHs surveyed	% surveyed /planned	Number of children 6-59 months planned	Number of children 6-59 months surveyed	% surveyed /planned
546	533	97.6%	431	682	158.2%

2.4 Sampling methodology

The survey applied a two-stage cluster sampling based on the SMART methodology with clusters being selected using probability proportional to population size (PPS).

2.4.1 First stage sampling

The first stage entailed assigning the smallest sampling unit called clusters, which in this case were villages. A sampling frame for clusters (villages) with their respective population sizes and the indication of their accessibility in terms of security was prepared with the assistance of Ghadeer health officials as well as the locality administrators. All secure villages along with their respective populations were entered into the ENA for SMART software planning screen, which was used to select clusters randomly based on PPS, from the total number of villages considered secure within Ghadeer locality.

A total of 39 clusters were selected from the sampling frame generated from the list of all villages in the entire Ghadeer locality excluding villages that were unsafe for the teams to visit.

2.4.2 Second stage sampling

Simple random sampling was used to select 14 households per cluster to be surveyed. The household heads in the villages were listed with the support of the village Sheikhs. Once a complete list of household heads was obtained, enumerators used the random numbers tables to select the required number of households from the household list which comprised the sampling frame in the second stage of sampling at the household level.

2.4.3 Number of households per cluster

The number of households to be completed per day was determined according to the time the team could spend in the field excluding transportation, other procedures and break times.

The details below are taken into consideration when performing this calculation based on the given context:

1. Departure from office at 7:30 am and back at 5:30 pm.

2. Average travel time to reach each cluster (to and from the field): 2 hrs.
3. Duration for initial introduction and selection of households: 1 hour.
4. Break: one lunch break of 1 hour.

The above gave an average of 6 hours of working time in each cluster. It was determined that on average teams could spend 20 minutes in each household and 5 minutes moving from one HH to another, therefore, each team could comfortably reach 14 HHs per day. The total number of households in the sample was then divided by the number of households to be completed in one day so as to determine the number of clusters to be included in the survey. Based on this calculation, 39 clusters (534 HH/14 HH per day = 38.1 rounded up to 39) were selected to be included in the survey.

Out of 118 villages, 39 villages, corresponding to 39 clusters were included in the survey. Fifteen villages considered to be too insecure for the teams to visit were excluded from the sampling frame of all villages in Ghadeer locality.

2.5 Survey implementation

2.5.1 Survey management and coordination

The survey protocol was developed and discussed with Action Against Hunger staff in charge of survey implementation before being presented to the Nutrition Information Technical Working Group (NIS TWG) for validation. The survey was managed by a consultant from Action Against Hunger Canada. The consultant also led the fieldwork and was overall responsible for survey implementation at field level.

Relevant information on security and access was obtained before the survey from the South Kordofan State government and the Ghadeer locality administration. Meetings were held with local leaders on arrival in order to brief them on the survey objectives, methodology and procedures to be followed during the survey. In addition, updated information on security, access, and village level population was requested from the local authorities in Ghadeer.

2.5.2 Training, data collection, supervision, and data quality

2.5.2.1 Survey teams training and data collection

The survey teams were trained on the SMART methodology for five days from 1st to 5th April 2022. In order to manage the logistical and financial resources available to the implementing agency, a joint training of two separate survey teams for Ghadeer and Tadamon localities was conducted in Abu Jubeiha locality. The survey manager delivered the training in English, but the content was translated by Action Against Hunger M&E Officer with assistance from four survey supervisors from the Federal Ministry of Health, UNICEF, WHO, and Muslim Aid agency. The training focused on the survey objectives, sampling methodology and field procedures, anthropometric measurements, use of the event calendar, administration of the survey questionnaire in a digital format, and interviewing techniques.

On the third day of training, two standardization tests were carried out simultaneously in a large compound within the main health facility in Abu Jubeiha locality that also housed the training

hall. The two standardization tests were used to evaluate the accuracy and precision of the team members in taking anthropometric measurements. Both teams for Ghadeer and Tadamon performed well in the test. The standardization test results for Ghadeer are shown in annex 3 of this survey report. The survey questionnaire was pre-tested as part of the training of enumerators in two separate villages of Abu Jubeiha locality.

Data collection in Ghadeer was set for April 17, 2022, which was a 12-day break after the enumerator's training and following completion of data collection in Tadamon locality. As a result, the Ghadeer teams required a one-day refresher training and another field pretest in order to test the questionnaire and help the teams to familiarize with it, refresh team members knowledge on sampling methods and field procedures, check the time it took to interview, gauge how well teams worked together and their understanding of roles. The refresher training was conducted on April 15, 2022, followed by the second pretest on April 16, 2022. Data was collected from April 17 to April 23, 2022. There were 6 teams in Ghadeer. Each team consisted of three members (1 team leader and 2 enumerators).

Data was collected offline using the KoBo Toolbox application because the telephone network in Ghadeer was limited and unreliable, making it impossible to upload data to a configured server. As a result, anthropometric data was also recorded on paper forms to allow for daily plausibility check of the data to determine its quality and give feedback to the teams every morning before going to the field.

All the 39 randomly chosen clusters were surveyed. Data collection in clusters 33 and 34 began on April 19 but could not be completed due to their remote location and the need for the team to return to base earlier owing to the increased security incidents reported along the routes leading to the selected village. The remaining households were completed on April 23, 2022 which was the last day of data collection in Ghadeer.

2.5.2.2 Survey teams' supervision

At field level, close supportive supervision by the consultant, the AAH M&E Officer and three dedicated supervisors from the Federal Ministry of Health, UNICEF, and GOAL organization ensured that the data collected was of high quality. Any mistakes that were noted during data collection were corrected and teams given prompt feedback.

2.5.2.3 Data quality assurance

A number of measures were employed to ensure quality data including:

- Use of the KoBo Toolbox application for digital data collection to minimize possibility of errors when recording data.
- A five-day comprehensive training together with standardization test and field pretest.
- Field supervision of the survey teams during data collection.
- Calibration and standardization of survey equipment.

- Use of the cluster control forms to track the assessment outcome for every household.
- Daily plausibility checks and sharing of feedback with the teams for continuous improvement as data collection progressed.
- A refresher training and a second field pretest were conducted to refresh the teams on the key aspects of the survey including field sampling and field procedures, anthropometric measurements, familiarity with the questionnaire and how to fill it as well as interview techniques.

2.5.3 Data collection tools

Structured questionnaires were used to collect quantitative data. Data was collected using the KoBo Toolbox digital application. Data collection tools included: Mortality questionnaire (targeting all households), anthropometric questionnaire (targeting children 6-59 months) and infant and young child feeding questionnaire (targeting mothers/caregivers).

All questionnaires used were the standard SMART survey data collection tools recommended by the SMART global team at Action Against Hunger Canada as well as the NIS TWG (Appendix 4).

2.6 Data collected

In all selected households, all children 6-59 months were included in the anthropometric survey. The age of the children was determined using birth certificates where available and a local calendar of events for children without birth certificates. If there were no children 6-59 months in the household, the household was still interviewed for mortality. All survey data were collected by recall.

The following case definitions were used in the assessment:

2.6.1 Mortality

Retrospective mortality data were collected in all the visited households, including those with no children aged 6-59 months. A recall period of 109 days was used.

Individual mortality questionnaire was used to collect the following data:

- Total number of people in the household
- Number of children under five years
- Number of people who left the household within the recall period (total and children under five years)
- Number of people who joined the household within the recall period (total and children under five years)
- Number of births in the household within the recall period
- Number of deaths in the household within the recall period (total and children under five years)
- Cause of deaths

2.6.2 Individual information per survey child - Anthropometry

Age: The primary source for this information was the child's birth certificate or birth notification. In the absence of these documents, a local calendar of events was used to estimate the age (Appendix 5).

Gender/Sex: This was recorded as either 'f' for female or 'm' for male.

Weight: A digital weighing scale (SECA) was used to measure children's weight. Children were weighed with minimal or no clothing and weight recorded to the nearest 0.1kg.

The teams on daily basis calibrated the electronic scales using a standard weight to ensure accuracy.

Height/Length: This was measured using a standard UNICEF height/length board – taking a standing height for children 24-59 months (or >87 cm) and recumbent length for children 6-23 months (or <87 cm). Both height and length were measured to the nearest 0.1 cm. Measurement was done by a measurer and recorded with assistance from the child's mother/caretaker.

MUAC: Mid Upper Arm Circumference was measured on the left arm at the middle point between the tip of the elbow and the tip of the shoulder bone while the arm was at right-angle. MUAC was measured to the nearest mm. In the event of a disability on the left arm or a left-handed child, the right arm was used.

Bilateral Oedema: This was assessed by the application of moderate thumb pressure for at least 3 seconds on both feet. If a depression formed upon pressure application, the presence of bilateral oedema was confirmed.

2.6.3 Individual information per survey child – Child health

Measles immunization: Assessed by checking for measles vaccination on EPI cards or by recall and was only done for eligible children (≥ 9 months)

Child morbidity and health seeking: Two-week retrospective morbidity data was collected from mothers or caregivers of all children (6-59 months) included in the anthropometric survey. The mother or caregiver was asked if the child had been ill in the past two weeks and if so, they were then asked the type of illness and treatment sought.

2.6.4 Individual information per survey child – Infant and Young Child Feeding practices

Infant and young child feeding practices were assessed based on the standard WHO recommendations (WHO, 2010) as follows:

Ever breastfed: Proportion of children born in the last 24 months who were ever breastfed.

$$\frac{\textit{Children born in the last 24 months who were ever breastfed}}{\textit{Children born in the last 24 months}}$$

Early initiation of breastfeeding: Proportion of children born in the last 23 months who are put to the breast within one hour of birth.

$$\frac{\textit{Children 0-23 months who were put to the breast within one hour of birth}}{\textit{Children 0-23 months}}$$

Exclusive breastfeeding under 6 months: Proportion of infants 0–5 months of age who are fed exclusively with breast milk a day before the survey date.

$$\frac{\textit{Infants 0–5 months of age who received only breast milk during the previous day}}{\textit{Infants 0–5 months of age}}$$

Introduction of solid, semi-solid or soft foods: Proportion of infants 6–8 months of age who received solid, semi-solid or soft foods.

$$\frac{\textit{Infants 6-8 months of age who received solid, semi-solid or soft foods during the previous day}}{\textit{Infants 6–8 months of age}}$$

Minimum dietary diversity: Proportion of children 6–23 months of age who received foods from ≥ 4 food groups during the previous day.

$$\frac{\textit{Children 6–23 months of age who received foods from ≥ 4 food groups during the previous day}}{\textit{Children 6–23 months of age}}$$

Minimum meal frequency: Proportion of breastfed and non-breastfed children 6–23 months of age who receive solid, semi-solid, or soft foods (but also including milk feeds for non-breastfed children) the minimum number of times or more.

$$\frac{\textit{Breastfed and non-breastfed children 6–23 months of age who received solid, semi-solid, or soft foods (but also including milk feeds for non-breastfed children) the minimum number of times or more during the previous day}}{\textit{Children 6-23 months of age}}$$

Minimum acceptable diet: Proportion of children 6–23 months of age who receive a minimum acceptable diet (apart from breast milk).

Breastfed children 6–23 months of age who had at least the minimum dietary diversity and the minimum meal frequency during the previous day

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Breastfed children 6-23 months of age

and

Non-breastfed children 6–23 months of age who received at least 2 milk feedings and had at least the minimum dietary diversity not including milk feeds and the minimum meal frequency during the previous day

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Non-breastfed children 6-23 months of age

2.6.5 Maternal nutritional status

The nutritional status of women of reproductive age was assessed by measuring the mid-upper arm circumference.

2.7 Data entry, analysis, and report writing

After completing data collection in Ghadeer, data was uploaded to a configured server where it was retrieved and analyzed. Anthropometric data were analyzed using ENA for SMART software January 11th, 2020 version. Additional survey data were analyzed using SPSS version 26 and Excel.

2.8 Classifying malnutrition

2.8.1 Weight for height (WFH) and MUAC – Wasting among children

The prevalence of wasting is presented as global acute malnutrition (GAM) and severe acute malnutrition (SAM) using weight-for-height (WFH) Z- scores and MUAC indices described below:

- Children whose WFH Z-scores fell below -2 standard deviations from the median of the WHO growth standards or had bilateral oedema were classified as wasted (to reflect GAM).
- Children whose WFH Z-scores fell below -3 standard deviations from the median of the WHO growth standards or had bilateral oedema were classified as severely wasted (to reflect SAM).
- A cut-off point of <125mm MUAC was used to denote GAM among the under-fives.

2.8.2 Weight for age (WFA) – Underweight

The prevalence of underweight is presented as weight for age (WFA) Z scores defined below:

- Children whose WFA Z-scores fell below -2 standard deviations from the median of the WHO growth standards were classified as underweight.
- Children whose WFA Z-scores fell below -3 standard deviations from the median of the WHO growth standards were classified as severely underweight.

2.8.3 Height for age (HFA) – Stunting

The prevalence of stunting is presented as height-for-age (HFA) Z scores defined below:

- Children whose HFA Z-scores fell below -2 standard deviations from the median of the WHO growth standards were classified as stunted.
- Children whose HFA Z-scores fell below -3 standard deviations from the median of the WHO growth standards were classified as severely stunted.

2.9 Results dissemination

The consultant prepared and shared a final draft report in MS Word accompanied by ENA and Excel data sets. Final survey documents and reports were submitted to Action Against Hunger Spain after incorporating feedback given and for circulation.

2.10 Possible bias and assumptions

The survey excluded a significant number of villages which were considered insecure and difficult to survey. This meant that the coverage area for this survey had to be restricted to areas that were considered safe and accessible for data collection. It is worth noting that the excluded villages could be areas presenting poorer health and nutrition situation since they are more difficult to access and often miss out on essential services provided by humanitarian agencies. Although some villages were excluded, the survey still covered the entire County.

Recall bias, as well as the intentional exclusion of some children, could have occurred. 89% of the children did not have records indicating birth dates.

Anthropometric measurements are prone to measurement errors. To minimize errors, survey teams were adequately trained on measurement techniques and standardization test carried out in order to improve the accuracy and precision of measurements.

Causes of death should also be interpreted with caution because they were reported by family members based on observation, with no verification of the clinical cause of death.

To further mitigate against potential biases, questions were translated into local language and tools were refined through pretesting.

Nearly all the participants did not speak or understand English. During training and fieldwork, the survey manager relied heavily on the translator to present information. This may have led to information distortion and an inability to understand the technical content presented in the training. In addition, some surveyors were unable to follow instructions during data collection, potentially affecting survey results.

2.11 Ethical considerations

Participation in the survey was voluntary. Verbal consent was sought from all respondents (mothers and caregivers of children) before starting the interview.

Children were weighed naked if the mother or caregiver gave the authorization, if not weighing was done with the minimum possible clothing.

Mothers and/or caregivers of moderately and severely acutely malnourished children (assessed with Weight-for-Height or with MUAC) were informed of their condition and a referral slip to the nearest nutrition site was provided.

3 Survey results

3.1 Anthropometric results (based on WHO standards 2006)

3.1.1 Distribution by age and sex

Anthropometric measurements were taken on a total of 682 children (360 boys and 322 girls) aged 6-59 months to assess acute malnutrition. The distribution of the assessed children by age and sex shows that boys and girls were equally represented with a ratio of 1.1.

The age ratio of 6-29 months to 30-59 months was 0.99 (The value should be around 0.85). This was found to be statistically significant (p-value = 0.041). The representation of the older age category (54-59 months) was lower compared to younger children. The under-representation of children in the 54-59 months age group was mainly due to the absence of these children in the households at the time of the survey as many were reportedly attending Madrasa (religious school) or participating in family livelihood activities such as farming, herding, fetching water among other activities.

Distribution of age and sex is shown in Table 6 below.

Table 6: Distribution of age and sex of sample

	Boys		Girls		Total		Ratio
AGE (mo)	**no.**	**%**	**no.**	**%**	**no.**	**%**	**Boy:girl**
6-17	86	55.8	68	44.2	154	22.6	1.3
18-29	96	51.6	90	48.4	186	27.3	1.1
30-41	71	47.7	78	52.3	149	21.8	0.9
42-53	67	54.0	57	46.0	124	18.2	1.2
54-59	40	58.0	29	42.0	69	10.1	1.4
Total	360	52.8	322	47.2	682	100.0	1.1

3.1.2 Prevalence of acute malnutrition based on Weight for Height and by sex

The prevalence of Global Acute Malnutrition (GAM) in Ghadeer locality was 18.0**%** (14.8 – 21.6 95% C.I.), and the severe acute malnutrition (SAM) rate was 2.4% (1.5 – 3.7 95% C.I.). GAM prevalence indicates a critical nutrition situation according to the WHO classification of acute malnutrition. Similarly, the rate of SAM is considered high based on routine acute malnutrition screening data by agencies that implement nutrition programs but there are no defined prevalence thresholds for SAM.

There was no statistically significant difference in the prevalence of acute malnutrition between boys and girls as estimated by Weight for Height Z-score (p value = 0.3716).

Table 7: Prevalence of acute malnutrition based on weight-for-height Z-scores and/or oedema by sex

	All n = 674	Boys n = 356	Girls n = 318
Prevalence of global malnutrition (<-2 z-score and/or oedema)	(121) 18.0 % (14.8 - 21.6 95% C.I.)	(69) 19.4 % (15.7 - 23.7 95% C.I.)	(52) 16.4 % (11.9 - 22.0 95% C.I.)
Prevalence of moderate malnutrition (<-2 z-score and >=-3 z-score, no oedema)	(105) 15.6 % (12.5 - 19.2 95% C.I.)	(57) 16.0 % (12.4 - 20.4 95% C.I.)	(48) 15.1 % (11.0 - 20.3 95% C.I.)
Prevalence of severe malnutrition (<-3 z-score and/or oedema)	(16) 2.4 % (1.5 - 3.7 95% C.I.)	(12) 3.4 % (2.0 - 5.7 95% C.I.)	(4) 1.3 % (0.5 - 3.2 95% C.I.)

The survey found one case of oedema.

Graphical presentation of the distribution of weight-for-height Z-scores of the survey data shows that the curve had deviated to the left, with a mean of -1.13 and SD of ±0.94. This indicates that the nutrition status of the surveyed population is poor compared to the WHO reference population. The standard deviation of ±0.94 is within the acceptable range of 0.8 to 1.2. The design effect (DEFF) determined was 1.28 which shows there were no major inter-cluster differences.

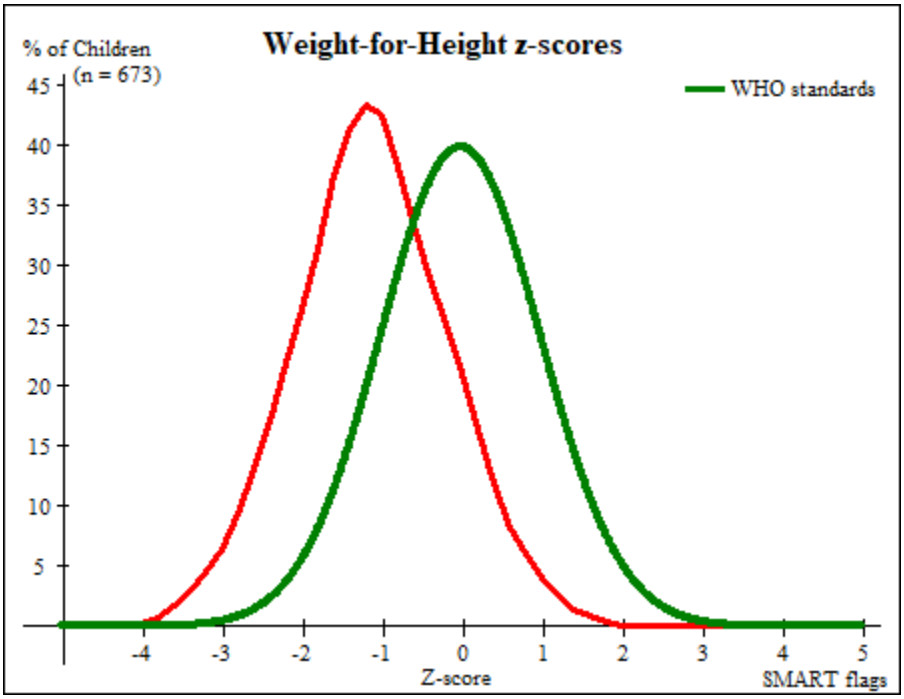

Figure 3: Frequency Distribution of WFH Z-scores for children 6-59 months

3.1.3 Prevalence of acute malnutrition by age based on Weight for Height

The prevalence of acute malnutrition (WHZ<-2 and/or oedema) by age shows that older children in the age categories 42-53 and 54-59 months were more likely to be affected by severe acute malnutrition, while younger children 6-17 and 18-29 months were more prone to moderate acute malnutrition.

Table 8: 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	152	2	1.3	29	19.1	120	78.9	1	0.7
18-29	183	4	2.2	26	14.2	153	83.6	0	0.0
30-41	147	1	0.7	15	10.2	131	89.1	0	0.0
42-53	124	4	3.2	16	12.9	104	83.9	0	0.0
54-59	68	4	5.9	19	27.9	45	66.2	0	0.0
Total	674	15	2.2	105	15.6	553	82.0	1	0.1

3.1.4 Distribution of acute malnutrition and oedema based on WFH Z-scores

During the survey, one case of oedema was identified. There were also additional 20 marasmic cases with no oedema as shown in Table 9 below.

Table 9: Distribution of acute malnutrition and oedema based on WFH Z-scores

	<-3 z-score	>=-3 z-score
Oedema present	Marasmic kwashiorkor. 1 (0.1 %)	Kwashiorkor. 0 (0.0 %)
Oedema absent	Marasmic No. 20 (2.9 %)	Not severely malnourished. 661 (96.9 %)

3.1.5 Prevalence of acute malnutrition based on MUAC cut off's and/or oedema by sex

Table 10 below shows the prevalence of global acute malnutrition based on MUAC (<125 mm) and/or oedema which was 4.1 % (2.7 – 6.3 95% C.I.) and of severe acute malnutrition (MUAC<115 mm and/or oedema) was 0.4 % (0.1 – 1.4 95% C.I.).

The prevalence of acute malnutrition using MUAC is significantly lower compared to using Weight for Height Z-scores. Research studies on the concordance between estimates of wasting measured by weight-for-height and by MUAC generally indicate great variation between these two measurements mainly because of variations in the body shape, age and gender among

various surveyed populations. It is therefore recommended that both criteria are used in anthropometric surveys[4].

Table 10: Prevalence of acute malnutrition based on MUAC cut off's and/or oedema by sex

	All n = 682	Boys n = 360	Girls n = 322
Prevalence of global malnutrition (< 125 mm and/or oedema)	(28) 4.1 % (2.7 - 6.3 95% C.I.)	(12) 3.3 % (1.8 - 6.2 95% C.I.)	(16) 5.0 % (2.9 - 8.4 95% C.I.)
Prevalence of moderate malnutrition (< 125 mm and >= 115 mm, no oedema)	(25) 3.7 % (2.4 - 5.6 95% C.I.)	(10) 2.8 % (1.3 - 5.7 95% C.I.)	(15) 4.7 % (2.7 - 8.0 95% C.I.)
Prevalence of severe malnutrition (< 115 mm and/or oedema)	(3) 0.4 % (0.1 - 1.4 95% C.I.)	(2) 0.6 % (0.1 - 2.3 95% C.I.)	(1) 0.3 % (0.0 - 2.3 95% C.I.)

3.1.6 Prevalence of acute malnutrition based on MUAC cut off's and/or oedema by age

Generally, younger children aged 6-17 and 18-29 months were more affected by both moderate acute malnutrition based on MUAC (cut off >115 mm and < 125 mm). This may be attributed to inadequate feeding practices among these children.

Table 11: Prevalence of acute malnutrition based on MUAC cut off's and/or oedema by age

		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	154	0	0.0	12	7.8	142	92.2	1	0.6
18-29	186	1	0.5	9	4.8	176	94.6	0	0.0
30-41	149	0	0.0	4	2.7	145	97.3	0	0.0
42-53	124	0	0.0	0	0.0	124	100.0	0	0.0
54-59	69	1	1.4	0	0.0	68	98.6	0	0.0
Total	682	2	0.3	25	3.7	655	96.0	1	0.1

[4] Weight-for-height and mid-upper-arm circumference should be used independently to diagnose acute malnutrition: policy implications. Grellety and Golden BMC Nutrition (2016).

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

The prevalence of combined GAM among children 6-59 months in Ghadeer was 19.5% (16.5-22.9 95% CI) as shown in Table 23 below. Although there is no globally accepted threshold for combined GAM and SAM, the observed prevalence of combined GAM was higher than the prevalence of WHZ or and MUAC on their own, implying that the combined GAM and MUAC indicator identified more acutely malnourished children.

Table 12: Prevalence of combined GAM and SAM based on WHZ and MUAC cut off's (and/or oedema) and by sex*

	All n = 682	Boys n = 360	Girls n = 322
Prevalence of combined GAM (WHZ <-2 and/or MUAC < 125 mm and/or oedema)	(133) 19.5 % (16.5 - 22.9 95% C.I.)	(74) 20.6 % (16.8 - 25.0 95% C.I.)	(59) 18.3 % (13.9 - 23.7 95% C.I.)
Prevalence of combined SAM (WHZ < -3 and/or MUAC < 115 mm and/or oedema	(16) 2.3 % (1.5 - 3.7 95% C.I.)	(12) 3.3 % (2.0 - 5.6 95% C.I.)	(4) 1.2 % (0.5 - 3.2 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

3.1.8 Prevalence of underweight based on weight for age Z scores by sex

The prevalence of underweight among children was 28.3% (23.8 – 33.2 95% C.I.) with 5.0 % (3.5 – 7.2 95% C.I.) being severely underweight. The underweight prevalence is considered high according to the WHO classification[5].

The rate of underweight among boys was 29.5% (24.4-35.2 95% C.I.) and was slightly higher than the underweight prevalence among girls which was 26.9% (21.0-33.7 95% C.I.). However, this difference in underweight between boys and girls was not statistically significant (p value = 0.5752).

Table 13: Prevalence of underweight based on weight-for-age Z-scores by sex

	All n = 676	Boys n = 356	Girls n = 320
Prevalence of underweight (<-2 z-score)	(191) 28.3 % (23.8 - 33.2 95% C.I.)	(105) 29.5 % (24.4 - 35.2 95% C.I.)	(86) 26.9 % (21.0 - 33.7 95% C.I.)
Prevalence of moderate underweight (<-2 z-score and >=-3 z-score)	(157) 23.2 % (19.3 - 27.7 95% C.I.)	(87) 24.4 % (19.9 - 29.6 95% C.I.)	(70) 21.9 % (16.3 - 28.7 95% C.I.)
Prevalence of severe underweight (<-3 z-score)	(34) 5.0 % (3.5 - 7.2 95% C.I.)	(18) 5.1 % (3.2 - 7.8 95% C.I.)	(16) 5.0 % (2.9 - 8.5 95% C.I.)

[5] Nutrition Landscape Information System (NLiS) country profile indicators 2019

3.1.9 Prevalence of underweight based on weight for age Z scores by age

Prevalence of underweight by age shows children in the age group 18-29 months were most affected by both severe and moderate underweight. Generally, younger children aged 6-17 and 18-29 months were more susceptible to both severe and moderate underweight.

Table 14: Prevalence of underweight based on weight-for-age Z-scores by age

		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	152	7	4.6	39	25.7	106	69.7	1	0.7
18-29	183	16	8.7	48	26.2	119	65.0	0	0.0
30-41	149	4	2.7	33	22.1	112	75.2	0	0.0
42-53	124	3	2.4	24	19.4	97	78.2	0	0.0
54-59	68	4	5.9	13	19.1	51	75.0	0	0.0
Total	676	34	5.0	157	23.2	485	71.7	1	0.1

3.1.10 Prevalence of stunting based on height for age Z scores

The rate of stunting in Ghadeer was 27.7% (23.8-32.0 95% C.I.) and severe stunting was 5.4% (3.7-7.8 95% C.I.). This result is classified as high according to the WHO classification[6]. Boys had a higher stunting rate 29.7% (24.5-35.6 95% C.I.) than girls 25.5% (21.1-30.5) but the difference in stunting by gender was not statistically significant (p value= 0.3003).

Table 15: Prevalence of stunting based on height-for-age z-scores and by sex

	All n = 664	**Boys** n = 350	**Girls** n = 314
Prevalence of stunting (<-2 z-score)	(184) 27.7 % (23.8 - 32.0 95% C.I.)	(104) 29.7 % (24.5 - 35.6 95% C.I.)	(80) 25.5 % (21.1 - 30.5 95% C.I.)
Prevalence of moderate stunting (<-2 z-score and >=-3 z-score)	(148) 22.3 % (19.4 - 25.5 95% C.I.)	(78) 22.3 % (18.4 - 26.7 95% C.I.)	(70) 22.3 % (18.1 - 27.1 95% C.I.)
Prevalence of severe stunting (<-3 z-score)	(36) 5.4 % (3.7 - 7.8 95% C.I.)	(26) 7.4 % (4.9 - 11.2 95% C.I.)	(10) 3.2 % (1.7 - 5.8 95% C.I.)

[6] Nutrition Landscape Information System (NLiS) country profile indicators 2019

Stunting prevalence by age indicates that children in the age category 18-29 months were more affected by both severe and moderate stunting followed by children in the age group 30-41. This finding is consistent with previous research which indicates that the risk of stunting gradually increases with age as child feeding and other care practices become poorer as children get older[7].

Table 16: 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	150	5	3.3	29	19.3	116	77.3
18-29	179	17	9.5	58	32.4	104	58.1
30-41	147	10	6.8	31	21.1	106	72.1
42-53	120	4	3.3	22	18.3	94	78.3
54-59	68	0	0.0	8	11.8	60	88.2
Total	664	36	5.4	148	22.3	480	72.3

3.1.11 Mean Z-scores, design effects and excluded subjects

The mean Z scores for wasting (WHZ), underweight (WAZ) and stunting (HAZ) were; -1.13±0.94, -1.42±0.97 and -1.23±1.14 respectively, all indicating a poorer nutrition situation compared to WHO reference population. The standard deviations for all the three nutrition indicators including WHZ, WAZ, and HAZ were within the acceptable range of 0.8-1.2 which indicates that the survey data was of high quality. The sample design effect values of 1.28 for WHZ and 1.35 for HAZ showed only little inter-cluster variability. However, the DEFF value of 1.78 for WAZ indicated high inter-cluster variability.

Table 17: 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	673	-1.13±0.94	1.28	1	8
Weight-for-Age	676	-1.42±0.97	1.78	1	5
Height-for-Age	664	-1.23±1.14	1.35	0	18

* contains for WHZ and WAZ the children with oedema.

[7] Reducing stunting in children - UNICEF 2015

3.2 Demography and mortality results (retrospective over 109 days prior to interview)

3.2.1 Age and sex pyramid

Overall, male to female sex ratio was 0.87. There are differences between age groups with male to female sex ratio found to be lower in the 18-49 (0.74) age group. Individuals between the ages of 18-49 years made up one third (33.3%) of the surveyed population. Notable were the indents in the population pyramid among males in the age groups 20-24 and 30-34 and among females in the age group 30-34. One probable contributing factor could be the higher rate of out-migration noted in the survey. A higher proportion of the population is female (53.5%) than male (46.5%). The percentage of children under five was 19.7%.

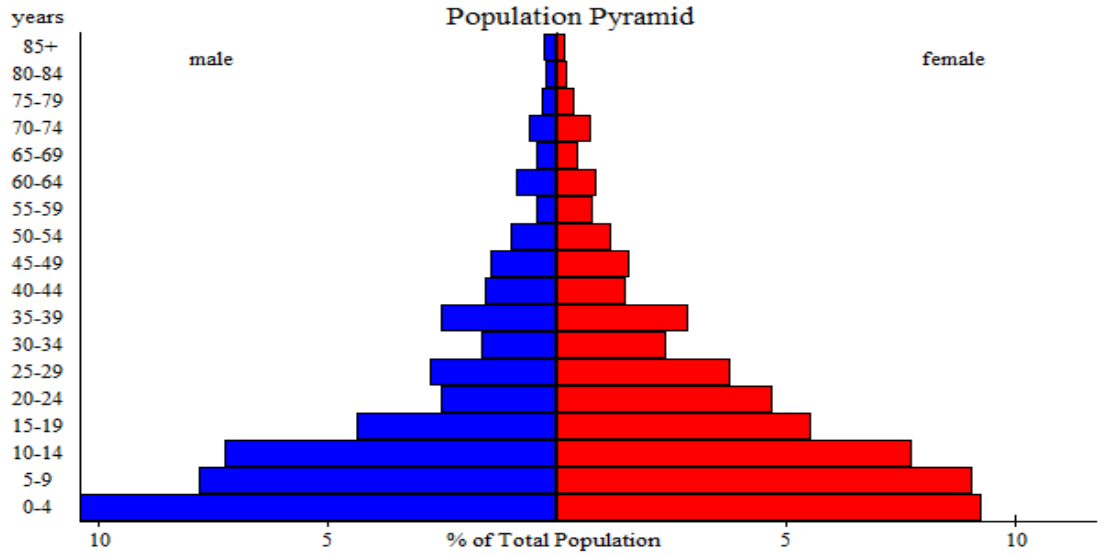

Figure 4: Population Pyramid of Ghadeer locality, South Kordofan State, Sudan

Mortality data was collected using the mortality individual questionnaire. The survey revealed a death rate of 0.85 (0.55-1.32) per day among the adult population, while the under-five mortality rate was 1.53 (0.67-3.46) as reported in the previous 109 days. Both the CMR and the U5MR were below the WHO emergency thresholds of 1/10,000/day and 2/10,000/day respectively.

Most deaths were as a result of illness (82.4%) while injuries contributed 14.7% of deaths. 2.9 percent of the reported deaths were due to unknown causes. 82.5% of deaths occurred in the current location, 11.8% occurred during migration and another 5.9% of deaths occurred in the other unspecified places.

Mortality results are presented in table 18 below.

Table 18: Demographic profile of the respondents in Ghadeer

Parameters for Mortality		Results (C.I 95%)	
CMR (deaths per 10 000/day		0.85 (0.55-1.32 95% CI)	
U5MR (deaths in children <5/10 000/day		1.53 (0.67-3.46 95%)	
Persons recorded within the recall period		3662	
Current residents <5 years old		721.5	
Total deaths during the recall period		34	
Total deaths during the recall period <5 years old		12	
Recall Period (days)		109	
Population to be included		3248	
Average HH Size		6.9	
Percentage of children under 5		21.4	
Households to be included		534	
Birth rate		0.95	
In-migration rate (Joined)		12.15	
Out-migration rate (Left)		12.35	
Cause of death	**%**	**Location of death**	**%**
1. Unknown	2.9	1] In current location	82.4
2. Injury/traumatic	14.7	2] During migration	11.8
3. Illness	82.4	3] In the place where person migrated	0.0
		4] Other	5.9

4 Other results

4.1 Measles immunization, vitamin A supplementation and deworming

The survey evaluated the coverage of measles vaccine among children 9-59 months. Measles vaccination coverage confirmed by checking the EPI card was 30.4% while coverage based on recall was 58.9%. The overall measles vaccine coverage by both card and recall was 89.3% which met the WHO target coverage of ≥80%.

Table 19: Measles vaccine coverage

Indicator	N	n	Proportion (95% C.I)
Children 9-59 months immunized against measles, based on card	652	198	30.4 (26.7-34.0)
Children 9-59 months immunized against measles, based on recall	652	384	58.9 (54.9-62.9)

4.2 Morbidity status

Morbidity in children was determined by asking mothers or caregivers of the surveyed children if their children had been sick in the 2-weeks preceding the survey. More than two-fifths (43.3%) of the children were reported to have been sick two weeks prior to the survey. The proportions of the three most common childhood illnesses were as follows: fever (29.7%), Cough (21.9%), and diarrhea (18.0%). Notably children in this community suffered from other illnesses that were mentioned by their caregivers such as malaria, vomiting, eye infection, ear infection among other illnesses.

Table 20: Morbidity among children two weeks prior to the survey

Indicator	N	n	Proportion (95% C.I)
Prevalence of reported illness	682	295	43.3 (39.4-47.1)
Fever	438	130	29.7 (25.6-34.0)
Cough		96	21.9 (18.0-26.0)
Diarrhea		79	18.0 (14.6-21.7)
Other		133	30.4 (26.3-34.7)

4.2.1 Health seeking behaviour

Health seeking behavior among caregivers was explored. Results showed that among mothers or caregivers with sick children, 15.6% of them did not seek treatment. Majority (49.5%) reportedly visited public health facilities, while only 2.7% visited private health facilities. It is important to take note of the nearly one-quarter (21.4%) of caregivers who bought medicine from the pharmacy. About 10.8% of mothers or caregivers sought other forms of treatment such as visiting

traditional healers, drinking hibiscus tea, or using honey. Health seeking behaviors of the mothers are indicated in the chart below:

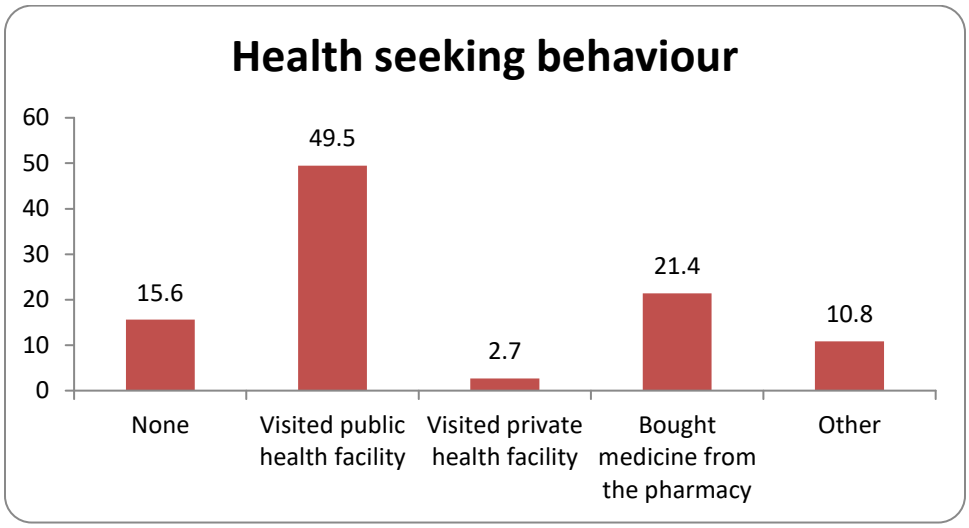

Figure 5: Health seeking practices among mothers in Ghadeer

4.3 Infant and young child feeding practices

Information on IYCF was collected based on a 24-hour recall, in line with the WHO guidelines. The number of children between 0-23 months considered for IYCF in Ghadeer locality was 312. The total sample size as well as sample sizes for the the specific indicators is not sufficient to achieve the desired level of precision, therfore IYCF results be interpreted with caution.

The proportion of infants ever breastfed was 97.1%. The proportion of infants reportedly put to the breast within the first hour of birth was 64.4%. Information collected on exclusive breastfeeding for children aged 0-5.9 months showed less than half (47.6%) of the children were exclusively breastfed. Introduction of solid, semi-solid or soft foods at the age of six months was 73.3%. Only 33.8% of the surveyed children fulfilled the minimum dietary diversity while 37.3% of breastfed and non-breastfed children met the minimum meal frequency. A paltry 14% of children aged 6-23 months were consuming the minimum acceptable diet.

Table 21: Summary of key IYCF indicators

Indicator	N	n	Proportion (95% C.I)
Children ever breastfed (0-23.9 months)	312	303	97.1 (95.2-98.7)
Early initiation of breastfeeding (0-23.9 months)	312	201	64.4 (59.3-70.2)
Exclusive breastfeeding (0-5.9 months)	84	40	47.6 (36.9-58.3)

Introduction of solid, semi-solid or soft foods (6-8.9 months)	30	22	73.3 (56.7-86.7)
Minimum dietary diversity (6-23.9 months)	228	78	33.8 (27.6-40.4)
Minimum meal frequency for both breastfed and non-breastfed (6-23.9 months)	228	85	37.3 (30.7-43.9)
Minimum acceptable diet (6-23.9)	228	32	14.0 (9.2-18.4)

4.4 Maternal nutrition

Maternal nutrition was assessed by measuring the MUAC of women of reproductive age who were present at the time of interview and agreed to be measured. An estimated 68.1% of the women had a normal nutrition status (MUAC≥23), with nearly one-quarter (23.8%) of the PLW's being at risk of acute malnutrition (MUAC>21-<23). About 8.1% of the women aged 15-49 months were found to be malnourished (MUAC<21).

Table 22: Maternal nutrition among women of reproductive age

Indicator	Frequency	Proportion (95% C.I)
MUAC <21cm	39	8.1 (5.8-10.6)
MUAC >21 - <23cm	114	23.8 (20.3-27.8)
MUAC ≥23cm	326	68.1 (63.9-72.2)
Total	479	

5 Discussion

5.1 Nutrition status

5.1.1 Acute malnutrition

According to the survey findings, the prevalence of GAM in Ghadeer was 18.0**%** (14.8-21.6 95% C.I.) which indicates a critical nutrition situation as per the WHO acute malnutrition thresholds. Similarly, the prevalence of SAM was 2.4% (1.5-3.7 95% C.I.) and is considered high based on routine acute malnutrition screening data by agencies that implement nutrition programs because there are no defined prevalence thresholds for SAM.

Based on these findings, the high prevalence of GAM and SAM may be attributed to the high morbidity rate that was observed, limited health and nutrition services provided by both the government and humanitarian agencies, and the sub-optimal infant and young child feeding practices identified in this study. To further compound the situation, there is limited access in several areas of the locality due to persistent intercommunal conflict and rampant insecurity that makes it difficult for the local communities to access markets, trade or carry out other livelihood activities.

5.1.2 Underweight

The prevalence of underweight among the children in Ghadeer was 28.4% (24.0-33.2 95% C.I.), with 5.0% (3.5-7.2 95% C.I.) being severely underweight. This is classified as high according to WHO classification. Underweight was higher among boys (29.7%) than in girls (26.9%) but this could be a result of the survey including more boys than girls. This indicates that underweight is a burden to the population living in Ghadeer locality.

5.1.3 Chronic malnutrition

The rate of chronic malnutrition in Ghadeer is worrying. The results show a level of stunting considered high at 27.7% (23.8-32.0 95% C.I.). This finding suggests that children are suffering from long term nutritional deprivation, and highlights the need to prioritize stunting prevention interventions in Ghadeer.

5.2 Mortality

The crude mortality rate was 0.85 (0.55 - 1.32 95% C.I.) and the under-five mortality rate was 1.53 (0.67-3.46). Both the CMR and the U5MR were below the WHO emergency thresholds of 1/10,000/day and 2/10,000/day respectively. Although the mortality rates were below the emergency thresholds, the current levels are classified as alert, and given the high levels of acute malnutrition and the high morbidity rate noted by the survey, the mortality rate may potentially increase, especially among children.

5.3 Morbidity

More than two-fifths (43.3%) of children in Ghadeer were reportedly sick in the 2 weeks that preceded the survey. This points to a significant morbidity burden in this area which calls for interventions to treat and prevent common childhood illnesses including the other illnesses

identified by the survey. Current health programs should be strengthened and maintained while continuously conducting health education and awareness raising on the importance of seeking health services when children fall sick.

5.4 Infant and young child feeding practices

Although this survey assessed IYCF practices, results should be interpreted with caution as the sample sizes per indicator as well as the overall sample size are small to draw meaningful conclusions. These findings only give a general idea of the status of infant and young child feeding practices.

The vast majority of the children under 2 years in the survey area were breastfed at some point (97.1%). This is an indication that breastfeeding is widely practiced; however, findings show that that the other core IYCF indicators including initiation to breastfeeding within the first hour of birth (64.4%), exclusive breastfeeding up to 6 months (47.6%), introduction of solid, semi-solid, or soft foods at the age of six months (73.3%), minimum dietary diversity (33.8%.), minimum meal frequency of the breastfed and non-breastfed children (37.3%), and minimum acceptable diet (14.0%) had rates that were lower than the WHO recommendation of ≥80%. This demonstrates that IYCF practices in Ghadeer were poor, and this may partly explain the high prevalence of malnutrition in the survey area.

5.5 Maternal nutrition

Most of the assessed women aged 15-49 years had a normal nutrition status (MUAC≥23). However, of concern is the 23.8% of these women found to be at risk of malnutrition (MUAC>21-<23) and the 8.1% of the women found to be already malnourished (MUAC<21). This outcome suggests that a considerable number of women of reproductive age were either at risk of malnutrition or were already malnourished. As a result, it is critical to implement measures to protect the nutritional status of these vulnerable groups.

6 Conclusion

The goal of this SMART survey was to assess the nutrition and mortality situation in Ghadeer locality. The survey will provide useful information for planning and execution of effective interventions to improve the nutritional and health status of children in the assessed area.

The prevalence of global acute malnutrition exceeded the WHO acute malnutrition threshold of 15% which indicates a critical nutrition situation. Thus, there is a need to scale up malnutrition treatment programs (SC, OTP & TSFP) in order to reduce the high rate of acute malnutrition.

According to the survey findings, underweight and stunting are a major concern. Both underweight and stunting rates in Ghadeer were classified as high as per the WHO thresholds. It is crucial that measures are put in place urgently in order to tackle the high underweight and stunting rates. In this regard, activities should increasingly focus on underweight and stunting reduction and prevention alongside interventions that are implemented to reduce acute malnutrition.

From a health perspective, morbidity is a concern with more than two-fifths (43.3%) of the children reportedly suffering from various illness in the two weeks preceding the survey. Morbidity is a major contributing factor for both acute and chronic malnutrition. Health interventions should be implemented swiftly to treat and prevent childhood morbidity. In addition, the survey found that the health seeking behavior of mothers and caregivers when their children are sick were unsatisfactory. Health education and awareness raising are needed in order to encourage mothers and caregivers to use the available health services.

Infant and young child feeding practices in the survey area are below accepted standards, thus putting under five children at an increased risk of morbidity and malnutrition. This calls for the promotion of infant and young child feeding behaviors as well as expanding and strengthening existing IYCF programs.

Although most women of child bearing age had a normal nutrition status, a considerable number of them (23.8%) were at risk of malnutrition, with another 8.1% already malnourished. The nutritional status of a mother is linked to the nutritional status of her child and this calls for efforts to protect the nutritional status of women of reproductive age in order to break the cycle of malnutrition which is passed down from the mother to her child.

7 Recommendations

1. Survey results show that the prevalence of acute malnutrition exceeds the WHO emergency threshold. At the time of the survey, there were four health and nutrition partners working in Ghadeer, namely Action Against Hunger, CARE, CONCERN Worldwide, and CAFA, and they only covered a few areas within the locality. The current nutrition interventions implemented by the three partners should be continued and scaled up to improve coverage. The partners should consider intensifying their nutrition activities by increasing mobile treatment centres to reach many of the areas where health and nutrition services are not available.
2. Given that a considerable number of malnourished children were referred to available health facilities and nutrition centers for treatment, there is a need to strengthen routine community screening of under-fives, as well as active case finding, to ensure that malnourished children are enrolled in treatment programs. In addition, defaulter tracing should be carried out to re-admit children who have defaulted, as a number of malnourished children identified in the survey were said to have stopped attending nutrition treatment centres.
3. In line with the recommendation to expand nutrition program coverage in Ghadeer, timely procurement and distribution of essential nutrition commodities is required, particularly during the dry season when roads are passable. Officials from the State Ministry of Health in Ghadeer, as well as the respondents, complained about frequent pipeline breakdowns and a severe lack of nutrition commodities in the few nutrition treatment centres that were operating.
4. According to survey findings, about two-fifths (43.3%) of children in Ghadeer suffered from a variety of childhood illnesses in the two weeks that preceded the survey. There is a need to upscale the current integrated management of childhood illnesses program to not only treat existing cases but also to prevent the spread of these illnesses.
5. The health seeking behavior of mothers and caregivers was less than satisfactory, with approximately one-third (32.2%) buying medicine from pharmacies or using alternative treatment options. There is a need to strengthen health education at community and health facilities levels about the importance of health seeking in order to encourage community members to use the available community health services.
6. Sub-optimal infant and young child feeding practices were noted by the survey. It's recommended that a comprehensive Social Behaviour Change Communication (SBCC) program meant to sensitize the community on appropriate IYCF practices using community change agents such as, health facility staff, community nutrition volunteers, mother support groups among others should be continuously implemented and strengthened.
7. Survey results show that both underweight and stunting are a major concern in Ghadeer. Provision of health education to mothers and caregivers on optimal child care and feeding practices should be intensified. In addition, mothers and caregivers should be sensitized on

the value of seeking health services, and proper sanitation and hygiene practices as these measures go a long way in reducing the incidence of both acute and chronic malnutrition.

8. Findings revealed that a significant number of women of reproductive age (23.8%) were at risk of malnutrition, with 8.1% already malnourished. It is critical to improve maternal nutrition by implementing diverse strategies including strengthening maternal nutrition education through the use of mother support groups, continuous screening of women of child bearing age for acute malnutrition, especially among pregnant and lactating mothers, and providing treatment and linking them to programs that provide livelihood support, such as the cash transfer and food security program currently being implemented by AAH in Ghadeer.
9. Conduct regular SMART surveys to monitor the nutrition situation. The current survey is the first successful assessment that was conducted in the area to establish a baseline for future reference.

8 Appendices

Appendix 1: Plausibility report

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** (1.2 %)
Overall Sex ratio	Incl	p	>0.1	>0.05	>0.001	<=0.001	
(Significant chi square)			0	2	4	10	**0** (p=0.146)
Age ratio(6-29 vs 30-59)	Incl	p	>0.1	>0.05	>0.001	<=0.001	
(Significant chi square)			0	2	4	10	**4** (p=0.041)
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** (12)
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** (0.94)
Skewness WHZ	Excl	#	<±0.2	<±0.4	<±0.6	>=±0.6	
			0	1	3	5	**0** (0.04)
Kurtosis WHZ	Excl	#	<±0.2	<±0.4	<±0.6	>=±0.6	
			0	1	3	5	**0** (-0.11)
Poisson dist WHZ-2	Excl	p	>0.05	>0.01	>0.001	<=0.001	
			0	1	3	5	**0** (p=0.109)
OVERALL SCORE WHZ =			0-9	10-14	15-24	>25	**8** %

The overall score of this survey is 8 %, this is excellent.

Appendix 2: List of selected clusters

Geographical unit	Population size	Cluster
Alwehda	1200	1,2
Gabrona	2400	3,4,5
Mogta Alkhor	600	6
Hugna	900	7
Alsouq	900	8,9
Almagad	1500	10,RC
Alengaz	720	11
Ahilla Aljadeeda	480	
Gabal Alahmer	1200	12,13
Gancy	355	
Tikal area	180	14
Alnodaif	450	
Tosi	1200	15,RC
morong	1500	16,17
Rigaba	423	18
Gadeer	3000	19,20,21,22
Agaibish	362	
Um elshaikh	328	23
Eltania	238	
Koro Nomad	376	RC
Um dihalib	1560	24,25
Dakka	1500	26,27
Elgaw	162	
Um zarzor	312	
Rigala	180	28
Gabal tair nomad	116	
Dabdob	210	
Abu taba	288	29
Karbara	234	
Alhafira UmSul	214	
Um Jamki	120	
Zaafaiya	845	30,31
Traida	422	
Hagar gangi	216	
Higair Logan	600	32
tafarga	110	
Hegair Aldoum	1320	33,34

Um Kado	600	35
Algabana	616	36
Habob	276	
Humaid/Madakhat	102	
Falata Nomad	782	RC,37
Rasairssa nomad	300	
Rasairssa	1140	38
Alsawani	350	39
Helt Kawaga	270	

Appendix 3: Standardization test results

Standardisation test results					Precision				Accuracy		OUTCOME			
Weight		subjects	mean	SD	max	Technical error	TEM /mean	Coef of reliability	Bias from superv	Bias from median			From	From
		#	kg	kg	kg	TEM (kg)	TEM (%)	R (%)	Bias (kg)	Bias (kg)			Supervisor	Median
	Supervisor	10	12	2.4	0.3	0.09	0.8	99.9	0	0.04	TEM acceptable	R value good	Bias good	Bias acceptable
	Enumerator 1	10	12	2.4	0.4	0.13	1.1	99.7	0.06	0.05	TEM poor	R value good	Bias acceptable	Bias acceptable
	Enumerator 2	10	12	2.4	0.2	0.08	0.7	99.9	0.08	0.05	TEM acceptable	R value good	Bias acceptable	Bias acceptable
	Enumerator 3	10	12	2.4	0.4	0.13	1.1	99.7	0.08	0.03	TEM poor	R value good	Bias acceptable	Bias good
	Enumerator 4	10	12	2.4	0.3	0.09	0.8	99.8	0.07	0.04	TEM acceptable	R value good	Bias acceptable	Bias acceptable
	Enumerator 5	10	12	2.5	0.4	0.15	1.2	99.6	0.07	0.09	TEM poor	R value good	Bias acceptable	Bias acceptable
	Enumerator 6	10	12	2.4	0.2	0.08	0.7	99.9	0.07	0.06	TEM acceptable	R value good	Bias acceptable	Bias acceptable
	Enumerator 7	10	12	2.4	0.2	0.07	0.6	99.9	0.06	0.05	TEM acceptable	R value good	Bias acceptable	Bias acceptable
	Enumerator 8	10	12	2.5	0.3	0.09	0.7	99.9	0.09	0.07	TEM acceptable	R value good	Bias acceptable	Bias acceptable

	Enumerator 9	10	12	2.4	0.2	0.09	0.8	99.9	0.07	0.05	TEM acceptable	R value good	Bias acceptable	Bias acceptable
	enum inter 1st	9x10	12	2.4	-	0.11	0.9	99.8	-	-	TEM acceptable	R value good		
	enum inter 2nd	9x10	12	2.4	-	0.08	0.7	99.9	-	-	TEM good	R value good		
	inter enum + sup	10x10	12	2.4	-	0.09	0.7	99.9	-	-	TEM good	R value good		
	TOTAL intra+inter	9x10	-	-	-	0.14	1.2	99.6	-	-	TEM acceptable	R value good		
	TOTAL+ sup	10x10	-	-	-	0.14	1.2	99.7	-	-	TEM acceptable	R value good		
Height		subjects	mean	SD	max	Technical error	TEM /mean	Coef of reliability	Bias from superv	Bias from median			From	From
		#	cm	cm	cm	TEM (cm)	TEM (%)	R (%)	Bias (cm)	Bias (cm)			Supervisor	Median
	Supervisor	10	88.7	11.5	1.7	0.65	0.7	99.7	0	0.38	TEM poor	R value good	Bias good	Bias good
	Enumerator 1	10	88.7	11.6	1.8	0.65	0.7	99.7	0.49	0.47	TEM poor	R value good	Bias acceptable	Bias acceptable

	Enumerator 2	10	88.7	11.4	2.2	0.77	0.9	99.5	0.44	0.34	TEM poor	R value good	Bias acceptable	Bias good
	Enumerator 3	10	88.2	11.3	1.5	0.46	0.5	99.8	0.57	0.45	TEM acceptable	R value good	Bias acceptable	Bias acceptable
	Enumerator 4	10	88.6	11.7	1.7	0.5	0.6	99.8	0.3	0.43	TEM acceptable	R value good	Bias good	Bias acceptable
	Enumerator 5	10	88.1	11.5	1.4	0.53	0.6	99.8	0.74	0.54	TEM acceptable	R value good	Bias acceptable	Bias acceptable
	Enumerator 6	10	88.5	11.4	1.6	0.76	0.9	99.6	0.59	0.37	TEM poor	R value good	Bias acceptable	Bias good
	Enumerator 7	10	88.6	11.8	2.5	0.93	1	99.4	0.6	0.47	TEM poor	R value good	Bias acceptable	Bias acceptable
	Enumerator 8	10	88.5	11.7	1.1	0.36	0.4	99.9	0.57	0.42	TEM good	R value good	Bias acceptable	Bias acceptable
	Enumerator 9	10	88.4	11.2	2.2	0.88	1	99.4	0.65	0.49	TEM poor	R value good	Bias acceptable	Bias acceptable
	enum inter 1st	9x10	88.7	11.4	-	0.73	0.8	99.6	-	-	TEM acceptable	R value good		
	enum inter 2nd	9x10	88.3	11.2	-	0.62	0.7	99.7	-	-	TEM acceptable	R value good		
	inter enum + sup	10x10	88.5	11.3	-	0.67	0.8	99.6	-	-	TEM acceptable	R value good		

	TOTAL intra+inter	9x10	-	-	-	0.96	1.1	99.3	-	-	TEM acceptable	R value good		
	TOTAL+ sup	10x10	-	-	-	0.95	1.1	99.3	-	-	TEM acceptable	R value good		
MUAC		subjects	mean	SD	max	Technical error	TEM /mean	Coef of reliability	Bias from superv	Bias from median			From	From
		#	mm	mm	mm	TEM (mm)	TEM (%)	R (%)	Bias (mm)	Bias (mm)			Supervisor	Median
	Supervisor	10	15	1	1.1	0.35	2.4	88.3	0	0.24	TEM good	R value reject	Bias good	Bias good
	Enumerator 1	10	14.8	1.1	2.2	0.59	4	68.7	0.43	0.28	TEM good	R value reject	Bias good	Bias good
	Enumerator 2	10	15.1	0.9	1.6	0.51	3.4	65.4	0.38	0.33	TEM good	R value reject	Bias good	Bias good
	Enumerator 3	10	14.9	1	0.7	0.29	2	91.5	0.36	0.23	TEM good	R value poor	Bias good	Bias good
	Enumerator 4	10	14.6	1	0.5	0.2	1.4	95.8	0.47	0.26	TEM good	R value acceptable	Bias good	Bias good
	Enumerator 5	10	14.6	0.9	0.8	0.39	2.7	80.2	0.52	0.33	TEM good	R value reject	Bias good	Bias good

	Enumerator 6	10	14.9	1	0.7	0.3	2	90.5	0.41	0.25	TEM good	R value poor	Bias good	Bias good
	Enumerator 7	10	14.9	1	0.6	0.22	1.5	95.1	0.33	0.2	TEM good	R value accep table	Bias good	Bias good
	Enumerator 8	10	14.9	1	1.2	0.42	2.8	83.7	0.3	0.26	TEM good	R value reject	Bias good	Bias good
	Enumerator 9	10	15	0.9	1.2	0.37	2.5	83.2	0.31	0.26	TEM good	R value reject	Bias good	Bias good
	enum inter 1st	9x10	14.8	1	-	0.44	3	81.1	-	-	TEM good	R value reject		
	enum inter 2nd	9x10	14.9	0.9	-	0.39	2.6	81.1	-	-	TEM good	R value reject		
	inter enum + sup	10x10	14.9	1	-	0.42	2.8	81.3	-	-	TEM good	R value reject		
	TOTAL intra+inter	9x10	-	-	-	0.57	3.8	64.9	-	-	TEM good	R value reject		
	TOTAL+ sup	10x10	-	-	-	0.57	3.8	65.7	-	-	TEM good	R value reject		
Suggested cut-off points for														

acceptability of measurements														
Parameter		MUAC mm	Weight Kg	Height cm										
individual	good	<2.0	<0.04	<0.4										
TEM	acceptable	<2.7	<0.10	<0.6										
(intra)	poor	<3.3	<0.21	<1.0										
	reject	>3.3	>0.21	>1.0										
Team TEM	good	<2.0	<0.10	<0.5										
(intra+inter)	acceptable	<2.7	<0.21	<1.0										
and Total	poor	<3.3	<0.24	<1.5										
	reject	>3.3	>0.24	>1.5										
R value	good	>99	>99	>99										
	acceptable	>95	>95	>95										
	poor	>90	>90	>90										
	reject	<90	<90	<90										
Bias	good	<1	<0.04	<0.4										
	acceptable	<2	<0.10	<0.8										
	poor	<3	<0.21	<1.4										
	reject	>3	>0.21	>1.4										

Appendix 4: Data collection tools

DEMOGRAPHY & MORTALITY QUESTIONNAIRE

DATE OF INTERVIEW: [D][D]/[M][M]/ [Y][Y]

01	02	03	04	05	06	07	08	09	10
No.	Name	Sex (M/F)	Age (years)	Joined on or after: [ ][ ] (Start date of the recall period - ex. Jan. 1, 1900) WRITE 'Y' for YES. Leave BLANK if NO.	Left on or after: HOUSEHOLD[8] NO.	Born on or after:	Died on or after:	Cause of death 1= illness 2=injury 66=unknown	Location of death 1=current location 2=during migration 3=in place of last residence 4=other
a) List all the people that slept in this household last night.									
1									
2									
3									
4									
5									
6									
7									
8									
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11									
12									
13									
14									
15									
16									
17									
18									
b) List all the people that slept in this household on the **first night of the recall period (FILL IN DATE/EVENT)** but did **NOT sleep** in the **household last night**.									
1					Y				
2					Y				
3					Y				
4					Y				
5					Y				
6					Y				
7					Y				
c) List all the people that slept in this household on the **first night of the recall period but have since died**									
1							Y		
2							Y		
3							Y		
4							Y		
5							Y		
Was anyone in the household pregnant at the start of the recall period? No [ ] Yes [ ] If yes, how many? _____									

[8] HH definition: Group of people living under same roof & sharing food from the same pot for a period of at least 6 months. In home with multiple wives, those living and eating in different houses are considered as separate HHs. Wives living in different houses and eating from same pot are considered as one HH.

ANTHROPOMETRIC & HEALTH QUESTIONNAIRE

استمارة القياسات الجسمانية و الصحة

(To be conducted in EVERY SELECTED HH with children 6-59 months and PLWs)

علي ان يتم ملأها في كل منزل تم اختياره مع الأطفال من عمر 6 الي 59 شهر و الحوامل و المرضعات

Date (DD/MM/YY): …./……/…..... Cluster No:…… Team No…..… State:…….. District……..…….. Division:…….
Location……..…….. Village:……...……

1	2	3	4	5	6	7	8	9	10	12	13	14	15	17
Child No.	HH NO	Child Name	Sex **m** = Male **f** = Female	Date of Birth (DD/MMYY)	Age in months	Weght in Kg (eg 12.4)	Height in cm (eg 78.1)	Oedema No =0 **1** =Yes	MUAC in cm (eg 11.3)	Measles Vaccineat 9 month **0** = No **1** =Yes with EPI card **2** =Yes mother recall **3** = Child <9m	Illness in past 14 days? **0** = No **1** =Yes If no, go to 16	Type of Illness **1** = Fever **2** = Cough **3** = Diarrhoea 99 = Other (specify)	Treatment Sought: **0** = None **1** =Hospital **2** =PHCC/U **3** = Mobile /outreach clinic 4=Private clinic 5=Traditional practitioner 6= Pharmacy/chemist **99**=Other (Specify)	Pregnant and Lactating Women (PLW) MUAC _____cm
رقم الطفل	رقم المنزل	اسم الطفل	النوع/الجنس	تاريخ الميلاد (يوم يوم/شهر شهر/سنة)	العمر بالشهور	الوزن بالكيلو جرام(مثلا 12.4 كجم)	الطول/الارتفاع بالسنتمتر (مثلا 78.1cm)	ورم لا=0 نعم= 1	مقياس محيط منتصف العضد بالسنمتر (مثلا11.3c m)	التطعيم ضد الحصبة في الشهر التاسع لا= 0 نعم مع وجود كرت تطعيم=1 نعم الام تذكرت =2 الطفل اصغر من 9 شهور=3	الامراض خلال 14 يوم لا=0 نعم=1 اذا كانت الإجابة لا تخطي الي 16	نوع المرض 1 = حمي 2 = كحة 3 = اسهال اخري = 99 (حدد)	طلب العلاج: لم يتم = 0 مستشفي = 1 وحدة/مركز صحي = 2 عيادة جوالة= 3 عيادة خاصة = 4 معالج تقليدي = 5 صيدلي = 6 اخري = 99 (حدد)	قياس منتصف محيط العضد للحوامل و المرضعات : قراءة المواك (بالسنمتر)
1														
2														
3														
4														

5													
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INFANT AND YOUNG CHILD FEEDING CHILD FEEDING QUESTIONNAIRE

Date (D/M/Y): ……./……./….. Cluster No:……… Team No…..… State:……………….. locality……..…….. Village:………...														Date (D/M/Y): ……./……./…..... Cluster No:……… Team No…..… State:……………….. locality……..…….. Village:………...……												
Identification					**INFANT AND YOUNG CHILD FEEDING (0 TO 23 MONTHS) PART A**									**INFANT AND YOUNG CHILD FEEDING (0 TO 23 MONTHS) PART B**												
11	11.1	11.2	11.3	11.4	11.5	11.6	11.7	**11.8 Yesterday, during the day or at night, did [NAME] receive any of the following liquids?**						**11.8….Yesterday, during the day or at night, did [NAME] receive any of the following liquids?**			**11.9 Describe what did *(NAME)* eat yesterday** during the day or night, whether at home or outside the home since (NAME) woke up yesterday until NAME went to sleep?							11.10 How many times did [child's name] eat solid or semi-solid food other than liquids yesterday during the day or at night? (number of times)	11.11 Yesterday during the day/night, did [child's name] consume any food given by a health centre for the treatment of malnutrition (Plumpy'Nut, Plumpy'sup, Plumpy'Nut dose, sprinkles/sachet etc) OR fortified food (porridge consisting of several	11.12
HH No.	Child No.	Child Name	Sex M= Male F= Female	Age in months (0-23 months)	Has [NAME] ever been breastfed? (EverBF) 1= Yes 0 = No 8 = Don't know	How long after birth did you first put [NAME] to the breast? 1 = Less than one hour 2 = Between 1 and 23 hours 3 =More than 24 hours 8 =	Is (Name) still breastfeeding now? 1= Yes 0 = No 8 = Don't know	Plain water **1= Yes 0 = No 8 = Don't know**	Infant formula ____ times	Milk such as tinned, powdered, or fresh animal milk ____ times	Sour milk or Yoghurt ____ times	Juice or juice drinks 1= Yes 0 = No 8 = Don't know	HH No.	clear Broth 1= Yes 0 = No 8 = Don't know	Thin Porridge 1= Yes 0 = No 8 = Don't know	Other water base liquids 1= Yes 0 = No 8 = Don't know	Cereals, flours, grains, roots and tubers (Maize, Sorghum, potatoes, cassava) 1= Yes 0 = No 8 = Don't know	legumes and nuts (Beans, Peas, Lentils, Nuts and Seeds) 1= Yes 0 = No 8 = Don't know	dairy products (milk, yogurt, cheese) 1= Yes 0 = No 8 = Don't know	flesh foods (meat, fish, poultry and liver/organ meats) 1= Yes 0 = No 8 = Don't know	eggs 1= Yes 0 = No 8 = Don't know	vitamin-A rich fruits and vegetables (carrot, red pepper, pumpkin, Ripe Mangoes, papaya) 1= Yes 0 = No 8 = Don't know	other fruits and vegetables (Avocado, Banana, Apple, Grapes, Guava, Lemon, Pinapeale, Cabbage, onions, tomatoes, etc 1= Yes 0 =			Pregnant and Lactating Women (PLW) MUAC ______cm

						Don't know																	No 8 = Don't know		meal mixed, CSB) OR any food with added a micronutrient powder (MNP)? 1= Yes 0 = No 8 = Don't know	

Appendix 5: Local calendar of events

SMART

Ghadeer Event Calendar

	Seasons	2017		2018		2019		2020		2021		2022	
Jan	Cold Season	New Year's Day/Independence Day		New Year's Day/Independence Day	51	New Year's Day/Independence Day	39	New Year's Day/Independence Day	27	New Year's Day/Independence Day	15	New Year's Day/Independence Day	3
Feb	Cold Season				50		38		26		14		2
Mar	Dry season	Month of Gasayer (before Ramadan)		Month of Gasayer (before Ramadan)	49	Month of Gasayer (before Ramadan)	37	Month of Gasayer (before Ramadan)	25	Attack on Alshabaka area/ Month of Gasayer (before Ramadan)	13	Dikka looting/ Month of Gasayer (before Ramadan)	1
April	Dry season				48	Bashir overthrown	36	Ramadan	24	Ramadan	12	Ramadan	0
May	Beginning of the rainy season	Beginning of autumn (first fall)	59	Ramadan/ Beginning of autumn (first fall)	47	Ramadan/ Beginning of autumn (first fall)	35	Eid Al-Fitr / Beginning of autumn (first fall)	23	Eid al-Fitr / Beginning of autumn (first fall)	11		
June	Main rainy season	Ramadan	58	Eid Al-fitr	46	Eid Al-fitr	34		22	Bagara conflict	10		
July	Main rainy season	Eid Al-fitr	57		45		33	Eid al-Adha	21	Eid al-Adha / attack on leaders in Rigila	9		
Aug	Main rainy season	Severe diarrhea outbreak	56	Eid AL-Adha	44	Eid AL-Adha	32		20		8		
Sept	End of rainy season	Eid AL-Adha	55		43	The sit-in for use of cyanide, fire in locality centre	31		19		7		
Oct	Harvesting season	Harvesting season (sorghum)	54	Harvesting season	42	Harvesting season	30	Harvesting season	18	Harvesting season	6		
Nov	Harvesting season		53		41		29		17		5		
Dec	Beginning of the cold season	Christmas	52	Christmas	40	Christmas	28	Christmas	16	Christmas	4		