

Cross-sectional retrospective mortality, nutrition
and measles vaccination coverage surveys among
Sudanese refugees and Chadian returnees in
Toumtouma, Ourang and Arkoum camps, Ouaddaï
province, Chad

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Survey design	Retrospective surveys with recall period
Survey period	August - September 2023
Survey sites	Toumtouma, Ourang and Arkoum camps, Ouaddaï province, Chad
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CONTENTS

LIST OF ABBREVIATIONS	5
SUMMARY	6
1 INTRODUCTION	8
1.1 Context	8
1.2 MSF presence in the country	10
1.3 Justification for surveys.....	11
2 OBJECTIVES	11
2.1 Main objective.....	11
2.2 Secondary objectives.....	11
3 METHODS.....	11
3.1 Survey design	11
3.2 Survey sites and periods.....	12
3.3 Survey population	12
3.4 Definitions	12
3.4.1 Household definition.....	12
3.4.2 Definition of head of household	12
3.4.3 Definition of household member.....	12
3.4.4 Shelter	12
3.4.5 Severe acute malnutrition.....	13
3.4.6 Moderate acute malnutrition	13
3.4.7 Measles vaccination coverage	13
3.4.8 Violence.....	13
3.5 Recall period.....	13
3.6 Inclusion and exclusion criteria	13
3.7 Sampling.....	14
3.7.1 Sample size	14
3.7.2 Sampling procedures.....	14
3.8 Procedures	15
3.8.1 Presentation of the survey to the community.....	15
3.8.2 Introduction to the household survey	15
3.8.3 Interviews with household members	16
3.9 Data collection and management	16

3.10	Data analysis.....	17
4	ETHICAL CONSIDERATIONS	17
4.1	Ethical references.....	17
4.2	Ethical approval.....	17
4.3	Administrative approval.....	18
4.4	Verbal consent	18
4.5	Risks and benefits for participants and contingency plans.....	18
4.6	Confidentiality.....	19
5	COLLABORATION AND DISSEMINATION OF RESULTS	19
6	IMPLEMENTATION IN THE FIELD	20
6.1	Human resources, training and supervision	20
6.2	Logistics and transport resources	21
7	RESULTS	21
7.1	Description of the sample and demographic information.....	21
7.2	Mortality Retrospective	23
7.3	Frequency and main causes of violence	26
7.4	Prevalence of acute malnutrition.....	27
7.5	Measles vaccination	27
8	DISCUSSION.....	28
8.1	Origin and demography	28
8.2	Retrospective mortality and violence	29
8.3	Prevalence of acute malnutrition.....	30
8.4	Measles vaccination	30
8.5	Limitations.....	30
9	CONCLUSION	31
10	REFERENCES	31
11	APPENDIX.....	32
	Appendix 1: Questionnaire	32
	Appendix 2: Approval of Chad's National Bioethics Committee.....	35
	Appendix 3: Causes and places of death by age group, sex and phase.....	36

LIST OF ABBREVIATIONS

CMR	Crude mortality rate
GAM	Global acute malnutrition
GPS	Global Positioning System
MAM	Moderate acute malnutrition
MSF	Médecins sans Frontières
MSF ERB	Médecins sans Frontières Ethics Review Board
MSF-OCB	Médecins sans Frontières - Operational Centre Brussels
MSF-OCP	Médecins sans Frontières - Operational Centre Paris
MSF-WaCA	Médecins sans Frontières - West and Central Africa
MSPP	Ministry of Public Health and Prevention
MUAC	Mid-Upper Arm Circumference
OTP	Outpatient therapeutic program
SAM	Severe acute malnutrition
U5MR	Mortality rate for children under 5 years of age
UNHCR	Office of the United Nations High Commissioner for Refugees
WHO	World Health Organisation
95% CI	95% confidence interval

SUMMARY

Introduction

Since April 15, 2023, fighting erupted in Sudan between the army led by General Abdel Fattah al-Burhan and the paramilitary Rapid Support Forces (RSF) under the command of General Mohamed Hamdan Dogolo, known as Hemeti. This war has caused a major humanitarian crisis in Sudan, with violent fighting spreading throughout the country, particularly in Darfur, and aggravating pre-existing inter-community tensions.

By the end of March, almost 30,000 civilians had fled to Chad in search of safety. By September 2023, according to data from the United Nations High Commissioner for Refugees (UNHCR), clashes between military and paramilitary forces had driven more than 420,000 people to flee to Chad in successive waves, of whom around 327,000 had settled in the Ouaddaï province. Chadian refugees and returnees live in very precarious conditions, with limited access to primary healthcare, water and food. Little recent data is available on the mortality, nutritional status, and vaccination coverage of refugee populations in camps in eastern Chad, particularly in Toumtouma, Ourang and Arkoum camps. The results of these surveys are essential for Médecins Sans Frontières (MSF) to better plan its humanitarian interventions, coordinate effectively with other actors, and communicate about the refugee crisis in eastern Chad.

Methodology

Three cross-sectional surveys were carried out, the first with systematic random sampling in Toumtouma camp from August 7 to 13, and the next two with cluster random geospatial sampling in Ourang camp from August 17 to 22 and Arkoum camp from August 30 to September 4, 2023. Each survey covered retrospective mortality, frequency and type of violent events experienced, nutritional status of children aged 6 to 59 months, and measles vaccination coverage among children aged 6 months to 14 years. The recall period ran from January 1 to the day of the survey, i.e., a minimum of 210, 228 and 241 days respectively. Two phases were considered: 1) the pre-crisis phase (Toumtouma: January 1 - March 14, 2023 / Ourang and Arkoum: January 1 - April 14, 2023) and 2) the crisis phase (Toumtouma: March 15 - day of survey / Ourang and Arkoum: April 15 - day of survey). In Toumtouma camp, the crisis phase started earlier due to inter-community tensions that erupted end of March in West Darfur and drove important population displacements towards Chad.

Results

Retrospective mortality

In Toumtouma camp, of the 1,032 households included (i.e., 6,372 people), 59.7% were refugees, 35.9% returnees and 4.4% displaced persons. The crude mortality rate (CMR) was significantly higher in phase 2 (CMR: 0.58 deaths/10,000 people/day [95% CI: 0.43 - 0.74]) than in phase 1 (CMR: 0.20 deaths/10,000 people/day [95% CI: 0.07 - 0.33]). Eighty-nine percent of those who died were men. Violence (77%; n=48) was the main cause of death reported, followed by diarrhea (6%; n=4) and respiratory infection (5%; n=3). Among the deaths, 68% occurred in their town or village of origin, 21% during displacement and 11% in an unknown location. Most people who died came from El Geneina (40%), Tandulti (35%) and Umm Dam (16%) in Darfur.

In Ourang camp, of the 1032 households included (i.e., 6302 people), 99.0% were refugees and 1.0% returnees. The CMR was significantly higher in phase 2 (CMR: 2.25 deaths/10,000 people/day [95% CI: 1.77 - 2.74]) than in phase 1 (CMR: 0.11 deaths/10,000 people/day [95% CI: 0.02 - 0.20]). Eighty-three percent of those who died were men (3.88 deaths/10,000

people/day [95% CI: 3.01 - 4.76] in phase 2). Violence (82%; n=147) was the main cause of death reported, followed by measles (5%; n=9). Among the deaths, 69% occurred in their town or village of origin, 25% during displacement and 6% in Adre, Chad. Most people who died came from El Geneina (96%) in Darfur.

In Arkoum camp, of the 1029 households included (i.e., 5324 people), 98.4% were refugees, 1.3% displaced and 0.4% returnees. The CMR was significantly higher in phase 2 (CMR: 0.67 deaths/10,000 people/day [95% CI: 0.46 - 0.89]) than in phase 1 (CMR: 0.15 deaths/10,000 people/day [95% CI: 0.03 - 0.26]). Seventy-seven percent of those who died were men; the mortality rate among men was 1.14 [95% CI: 0.72 - 1.55] in the second phase. Violence (50%; n=28) was the main cause of death reported, followed by diarrhea (16%; n=9). Among the deaths, 52% occurred in their town or village of origin, 27% during displacement, 5% after their arrival in Chad and 16% in an unknown location. Most people who died came from Mistre (54%) and Kongu (29%) in Darfur.

Frequency and main causes of violence

Among households in Toumtouma, Ourang and Arkoum camps, the overall frequency of violence was 3.3%, 11.7% and 4.4% respectively. The main types of violence were beatings (71.0% in Toumtouma, 71.1% in Ourang, and 79.7% in Arkoum), and shootings (27.1% in Toumtouma, 34.7% in Ourang, and 15.1% in Arkoum).

Prevalence of acute malnutrition

Among children aged 6-59 months, the prevalence of global acute malnutrition (GAM) according to MUAC and/or bilateral oedema was 5.5% [95% CI: 4.1 - 7.5] in Toumtouma, 11.3% [95% CI: 9.2 - 13.8] in Ourang, and 11.6% [95% CI: 9.5 - 14.5] in Arkoum camp. Rates of severe acute malnutrition (SAM) were 2.3% [95% CI: 1.4 - 3.6] in Toumtouma, 4.8% [95% CI: 3.6 - 6.4] in Ourang, and 4.6% [95% CI: 3.4 - 6.3] in Arkoum.

Measles vaccination

Measles vaccination coverage among children aged 6 months to 14 years was estimated at 58.6% [95% CI: 56.9 - 60.3] in Toumtouma, 75.9% [95% CI: 71.3 - 79.9] in Ourang, and 63.6% [95% CI: 58.2 - 68.7] in Arkoum.

Conclusions

In the three camps investigated, excess mortality was observed among households during the crisis phase (phase 2), with a significant difference in CMR due to deaths from violence among men. Among households living in Toumtouma camp, the CMR more than doubled and among households in Arkoum camp, it more than tripled. The population in Ourang camp seems to have been particularly affected by the violence, with CMR 20 times higher than in the pre-crisis period and mortality rates exceeding the standard emergency threshold (1 death/10,000 people/day). The vast majority of deaths occurred on the sites of origin or during displacement towards Chad (89% in Toumtouma, 94% in Ourang and 79% in Arkoum). GAM and SAM prevalences among 6-59-month-olds were high in Ourang and Arkoum camps, with an alarming SAM prevalence of over 4%. In addition, the measles vaccination coverage, which ranged from 59% to 76% across the camps surveyed, was insufficient to prevent outbreaks.

1 INTRODUCTION

1.1 Context

Since 15 April 2023, the war between the army of General Abdel Fattah al-Burhan and the paramilitary Rapid Support Forces (RSF) of General Mohamed Hamdan Dogolo, known as Hemeti, has created a major crisis in Sudan. Violent fighting broke out all over the country, including Darfur, considerably exacerbating already existing inter-community tensions. By the end of March, according to the United Nations Office for Humanitarian Affairs (OCHA), inter-community violence had broken out in the town of Tandulti in West Darfur, resulting in the deaths of at least 6 people, and almost 30,000 civilians had crossed the border into Chad.

According to the Office of the United Nations High Commissioner for Refugees (UNHCR September 2023), violent fighting between the military and paramilitaries has caused successive waves of over 420,000 people to flee to Chad, including almost 327,000 in Ouaddaï province. The political situation in Sudan is still very unstable, and fighting was still ongoing in Khartoum at the beginning of August. The Chadian government predicts that by the end of 2023, no fewer than 600,000 Sudanese refugees may arrive in Chad (1).

Sudanese refugees and Chadian returnees (the number of returnees is estimated at over 62,000) live in very precarious conditions with limited access to primary healthcare, water and food. Of the households registered, 85% are made up of women and young children (1). A measles epidemic began at the beginning of March, and the nutritional situation of children under 5 is worrying. The massive influx of people is also having a major impact on the host populations and local resources. According to the UNHCR, the town of Adré is currently hosting more than 230,000 refugees and returnees, 4 times its usual population.

In mid-May, the volatile security situation at the border prompted the local authorities to prohibit the formation of camps within 40 kilometers of the border in order to prevent any flare-ups. The refugee camps in Ouaddaï province are overcrowded and struggling to cope with the various health challenges, despite ongoing expansion. The UNHCR has opened two new camps, Ourang in the Adré district and Arkoum in the Hadjer Haddid district, to which people from the spontaneous camps in Adré, Borota and Goungour have been relocated. By mid-August, more than 44,000 people from Adré had been settled in Ourang and nearly 26,000 people from the Borota and Goungour camps in Arkoum.

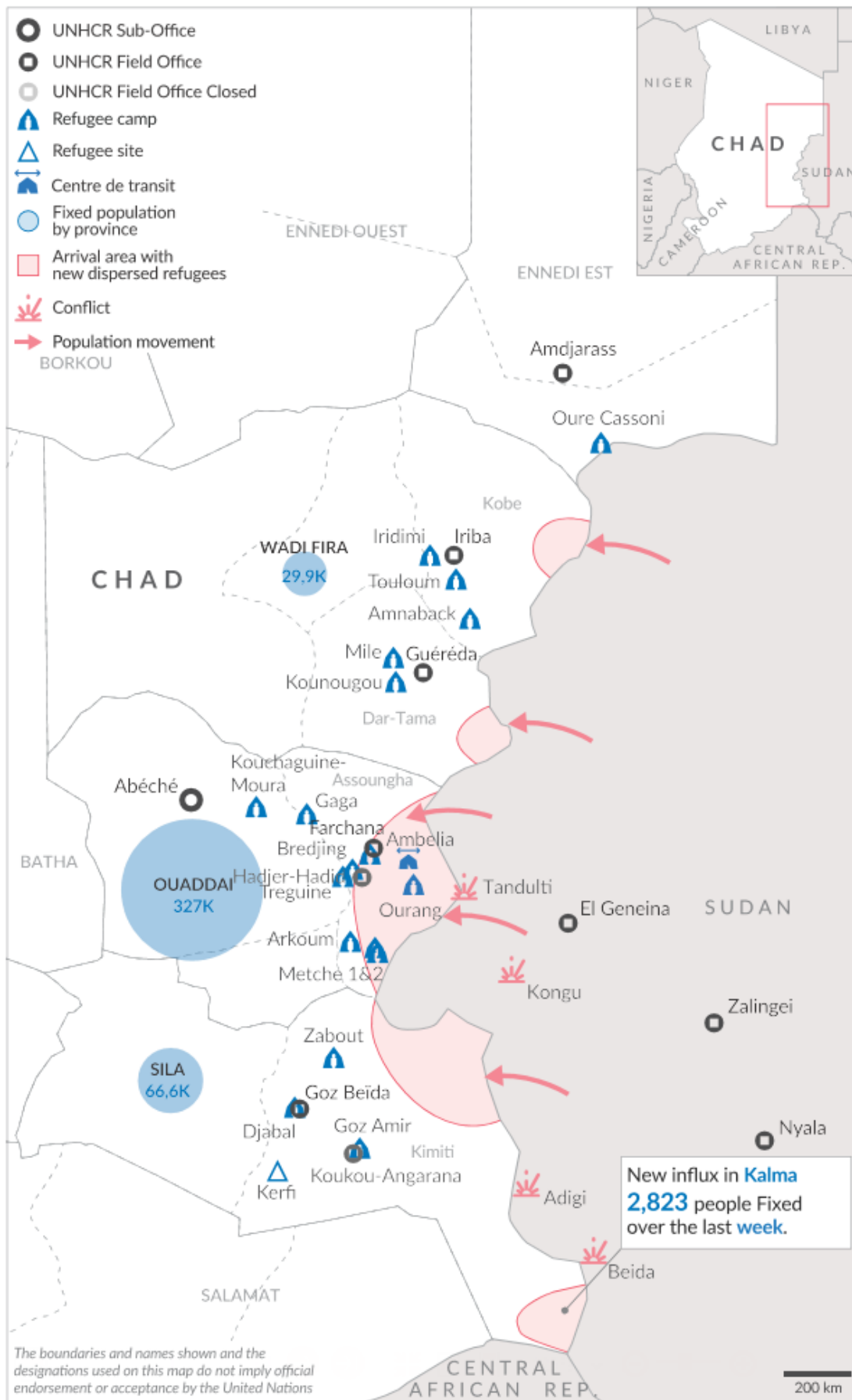


Figure 1. Influx of Sudanese refugees and Chadian returnees from Darfur, September 2023, UNHCR

1.2 MSF presence in the country

Médecins Sans Frontières (MSF) has been present in Chad for 40 years, carrying out activities to support vulnerable populations, responding to the various crises involving Sudanese or Central African refugees and programs to combat infectious diseases and child malnutrition:

- In Moissala, in the south of the country, MSF is currently running a malaria program and a maternal and child health programme focused on the continuum of care.
- In N'Djamena, MSF opened a nutrition programme in 2021, which was transferred to MSF-WaCA at the end of 2022. MSF also supported the Ministry of Public Health and Prevention in its response to measles outbreaks by providing support for reactive vaccination in the 9th arrondissements in 2022 and the implementation of another reactive vaccination campaign in south district in early 2023.
- In Adré, MSF has opened a paediatric care project and set up a contingency plan in the event of an influx of refugees and/or wounded and is supporting the Ministry of Public Health and Prevention (MSPP) in epidemiological surveillance and epidemic response.

To respond to the crisis of Sudanese refugees and Chadian returnees, MSF-OCP is working in Ouaddaï province, in Adré and in Arkoum camp (hospital and outpatient activities) and in Hilouta, Mahamata and Goungour camps (vaccination activities and support for health centres). Over the last 12 months, MSF has admitted 2,830 cases of severe acute malnutrition (SAM) to the outpatient therapeutic program (OTP) and 14,170 children to the paediatric emergency department. Since the start of the conflict in Sudan and the arrival of refugees, MSF has integrated adult emergencies, surgery, and maternity into its activities.

In addition, MSF-OCP has supported the MSPP in conducting several measles vaccination campaigns targeting children aged between 6 months and 14 years at refugee reception sites. A total of 20,201 children were vaccinated at the Borota site between April and May 2023, and 3,238 children in the same age group at the Hilouta site in week 23 (5 to 11 June 2023). In the Adré camp, where part of the population has been relocated to Ourang, a total of 40,667 children were vaccinated in July and 139 suspected cases of measles were identified and treated at the district hospital.

- Since week 15 of this year, corresponding to the start of the crisis in Sudan, to week 37 (11 to 17 September 2023), a total of 2,213 patients presented to the emergency department at Adré hospital, including 1,723 from Sudan who had suffered intentional injuries linked to the war in Sudan.
- The hospital currently has 120 in-patients for trauma care and 150 patients in paediatric wards.
- Adults have largely been admitted with intentional injuries, including open wounds and fractures, while children have been mostly admitted with non-traumatic injuries, including lower respiratory tract infections, malaria and non-bloody diarrhoea.

1.3 Justification for surveys

Little recent data is available on mortality, nutritional status and vaccination coverage of refugee populations in camps in eastern Chad. The results of these surveys are needed to address this lack of information and to facilitate better planning of MSF's humanitarian interventions, better coordination with other actors and advocacy and communication purposes in relation to the refugee crisis in Eastern Chad.

2 OBJECTIVES

2.1 Main objective

To assess retrospective mortality, nutritional status and measles vaccination coverage among Sudanese refugees and Chadian returnees in Toumtouma, Ourang and Arkoum camps in Ouaddaï province, Chad

2.2 Secondary objectives

- Describe the distribution of the population by age, origin and gender
- To estimate the prevalence of global and severe acute malnutrition in children aged between 6 and 59 months (assessed on the basis of mid-upper arm circumference (MUAC) and the presence or absence of nutritional oedema)
- To determine the proportion of children aged between 6 months and 14 years vaccinated against measles
- Estimate the crude mortality rate (CMR) and the specific mortality rate in children under 5 (U5MR) during the recall period
- Determine the main causes of death during the recall period (violence, illness, obstetric death, etc.) and their distribution by age and sex
- Assess the frequency and type of violent events experienced by household members during the recall period

3 METHODS

3.1 Survey design

Three cross-sectional retrospective mortality, nutritional and measles vaccination coverage surveys, representative of the target population in each camp.

The population was sampled using the method best suited to the context, i.e., systematic random sampling in Toumtouma camp and spatial sampling in Ourang and Arkoum camps (see chapter 3.7.2).

3.2 Survey sites and periods

The surveys were carried out in Toumtouma camp from 7 to 13 August, Ourang camp from 17 to 22 August and Arkoum camp from 30 August to 4 September.

3.3 Survey population

The population for each survey consisted of all people living, or who had lived, in the camp during the recall period. The population also included household members who had never stayed in the camp but who were members of the household during the recall period prior to their arrival in the camp.

Although the exact size of the population in each camp is unknown and dynamic, the estimated population in each site at the time of the survey was 6,000 returnees in Toumtouma, 44,265 refugees in Ourang and 25,885 refugees in Arkoum.

3.4 Definitions

3.4.1 Household definition

A household was defined as a group of people who are under the responsibility of one person or head of household, sleeping under the same roof or shelter and sharing at least 1 meal a day during the recall period.

3.4.2 Definition of head of household

The head of household was defined as follows:

- an adult member of the household (aged 18 or over) who identifies himself/herself as the head of the household and is identified as such by the other members, *and*
- can provide accurate information on all demographic and mortality issues in their household (can describe with reasonable accuracy the events that occurred during the recall period), or can authorise another household member to provide the information, *and*
- lived in the household throughout the recall period, *and*
- was present at the time of the survey

A household was excluded from the survey if none of its members met all these criteria.

3.4.3 Definition of household member

A household member was defined as a person who is or was part of the household according to the household definition during the recall period. This includes household members who have died or moved, but who were part of the household at some point during the recall period.

3.4.4 Shelter

A shelter was defined as a single-roofed structure where a group of people slept the previous night.

3.4.5 Severe acute malnutrition

Severe acute malnutrition (SAM) was defined for children aged 6 to 59 months by a MUAC <115mm and/or the presence of nutritional oedema (bilateral oedema identified when thumb pressure, applied to the tops of both feet for three seconds, leaves an indentation in the foot after the thumb is lifted).

3.4.6 Moderate acute malnutrition

Moderate acute malnutrition (MAM) was defined for children aged 6 to 59 months by a MUAC between 115 mm and <125 mm, with no oedema.

3.4.7 Measles vaccination coverage

To correspond to the age range vaccinated by the MSF and MSPP teams during the campaigns, the assessment of vaccination status was carried out in children aged between 6 months and 14 years inclusive. This was carried out using the following definitions:

- Vaccinated against measles with card: child for whom the parents or legal guardian stated that he or she had been vaccinated against measles and presented his or her vaccination card or record
- Vaccinated against measles by verbal declaration: child for whom the parents or legal guardian stated that he/she had been vaccinated against measles without presenting a vaccination card or booklet
- Not vaccinated against measles: child for whom the parents or legal guardian state that he or she has not been vaccinated and who does not have a vaccination card or record.

3.4.8 Violence

Violence was defined as the intentional use of physical force, threats against others or oneself, against a group or community, resulting in or with a high likelihood of resulting in trauma, psychological harm, developmental problems, or death, such as physical violence, sexual violence, psychological violence and deprivation.

3.5 Recall period

The recall period was from 1 January 2023 to the day of each survey, corresponding to a minimum of 210, 228 and 241 days respectively in Toumtouma, Ourang and Arkoum camps. A calendar of events was drawn up according to the events and the local context to precisely determine the dates on which deaths and other key dates occurred.

3.6 Inclusion and exclusion criteria

A person was included in each survey if they met the following criteria:

- is or was a member of the selected household during the recall period, *and*
- informed consent was given by the head of the family (see Chapter 4.4 for more details on the informed consent process) and by the interviewee

A person was excluded from each survey if they met one of the following criteria:

- refusal to take part in the survey, *or*
- inability to locate the participant after two search attempts, if no one in the household was authorised to respond on their behalf

3.7 Sampling

3.7.1 Sample size

The sample size was calculated using "ENA for SMART 2020" software (2).

The criteria listed in table 1 were considered when calculating the sample size.

Table 1. Sample size calculation criteria

Criteria	1 st period: Pre-crisis 1 January to 14 April 2023*		2 nd period: Crisis phase 15 April 2023 - day of survey*.	
	CMR	U5MR	CMR	U5MR
Expected mortality per 10,000 people/day	1	2	1	2
Accuracy of mortality per 10,000 people/day	0.3	0.7	0.3	0.7
Recall period in days	104	104	106	106
Estimated household size**	5	5	5	5
Average percentage of non-respondents	20	20	20	20
Total population to be sampled	4104	1508	4027	1479
Total households to be sampled	1026	942	1007	925

* As the crisis phase had already begun for the Toumtouma camp population, the following periods were considered in the analysis: 1^{er} January - 14 March 2023 (pre-crisis) and 15 March - the day of the survey (crisis phase).

** Estimating 2 children under 5 years old per household.

On the basis of an expected CMR of 1/10,000 persons/day, a precision around the estimate of ± 0.3 with a 95% confidence interval (95% CI; alpha error = 0.05), a recall period of 104 and 106 days, an average of 5 members per household and an expected percentage of 20% non-respondents, a minimum of 1026 households was sampled in each camp.

3.7.2 Sampling procedures

The households to be surveyed were selected according to the sampling methods described below, taking into account the local context, the availability of up-to-date demographic data and recent satellite images.

(i) Systematic random sampling for Toumtouma camp

Once the total number of shelters had been counted, a sample size was calculated based on the total number of households to be surveyed. A random number table was used to select the first household, then the other households were selected based on a sampling interval.

(ii) Random geospatial cluster sampling for camps in Ourang and Arkoum

The sampling procedure involved a preparatory stage to define the area of interest for each camp with a georeferenced polygon. One hundred and three random coordinates were generated within the polygon, regardless of their distance from a household/shelter. The selected coordinates were found using a GPS device or the OsMand application. The interviewers then selected the 10 nearest households/shelters within 20 metres of the coordinates.

3.8 Procedures

3.8.1 Presentation of the survey to the community

During preparation, the survey coordinator informed and discussed with key authorities and community leaders/groups to ensure mutual understanding and a smooth and respectful implementation of the survey. He also informed the administrative authorities and community leaders/representatives of the survey team's visit to the selected camp one or two days in advance.

The purpose of the survey was explained to the administrative authorities using an information leaflet and oral permission was obtained before the interviews began. Administrative authorities and community leaders/representatives were informed that they could freely refuse to participate in the survey without any consequences or penalties.

3.8.2 Introduction to the household survey

In each household selected, the survey teams explained the purpose of the survey to the head of household in the language he/she spoke, and verbal consent was obtained to conduct the interviews (the consent process is described in chapter 4.4).

If the head of household refused to participate, the survey team recorded this information, thanked the head of household and moved on to the next selected household.

If the head of household agreed to take part, the survey team identified together with the head a place where the interview could be conducted confidentially. The head of the household could suggest that another member of the household answer questions on behalf of all the members of the household. The survey team encouraged the head of household to discuss with the other adult members whether they agreed to him/her giving consent on their behalf, and whether anyone wished to answer the questions themselves. In all cases, a parent/caregiver would respond on behalf of the children. The survey team then explained what information was being collected for each member of the household.

3.8.3 Interviews with household members

If a member of the household was not present at the time of the survey, and the head of the household did not want to answer the questions on his or her behalf and did not delegate another member of the household to do so, the interviewers returned later in the day to interview him or her.

If a selected household was not available after two attempts to visit (morning and afternoon), or if it did not wish to respond, the household was not replaced.

The interview was based on a standardised questionnaire which included the following sections:

- age and sex of household members who arrived, left, were born or died during the survey recall period
- nutritional status of children aged 6 to 59 months
- vaccination status of children aged 6 months to 14 years
- cause and date of death of all household members who died during the recall period
- frequency and type of violent events experienced by household members during the recall period

An example of the questionnaire is provided in Appendix 1.

Special training was given to the survey teams to familiarise themselves with the questions, how to ask them and how to record answers using the electronic questionnaire form.

No personally identifiable data (name, telephone number) was collected during the survey, which reduced the risk that participants could be identified after the survey was completed. The address and/or geographical coordinates that were used to sample the household were kept and managed separately from the survey questionnaire (further details available in chapter 4.6).

3.9 Data collection and management

The data was digitally recorded directly onto tablet computers by the survey team. An electronic data capture mask using Kobo Collect (<https://www.kobotoolbox.org>) was prepared and tested during the pilot phase of the survey. The data stored in the electronic device was encrypted and transferred directly to a dedicated server located at MSF-OCB in Brussels, Belgium. The server in place is configured to protect electronic documents. The electronic database will be kept at MSF headquarters for 5 years.

Access to the electronic database is limited to the survey co-investigators and the medical coordinator.

In addition to the principal investigator and partners, the country's Ministry of Public Health and Prevention may also have access to the de-identified data set. Other local research partners may have access after approval by the principal and partner institutions.

3.10 Data analysis

Prior to any analysis, the data was checked for inconsistencies in data entry and responses.

Data analysis was carried out using STATA (StataCorp, College Station, TX, USA, <https://www.stata.com>).

Indicators of categorical variables were presented as proportions with 95% confidence intervals (95% CI). Continuous variables were presented as means with associated standard deviations, if they were normally distributed, or as medians with associated interquartile ranges (IQR) of 25th and 75th, if they were not normally distributed. Some continuous variables were summarised into categories (i.e. age groups) and presented accordingly.

Mortality rates during the recall period were calculated using the following formula:

$$\text{Mortality Rate} = \frac{\text{Total number of deaths during the recall period}}{\text{total number of person – time during the defined period}} * k$$

For the CMR, the total number of deaths and person-time in the entire population was used. For the U5MR, only the deaths and person-time in this specific age group were used in the formula. The 95% confidence intervals were calculated. For the Ourang and Arkoum analyses, the design effect was estimated and incorporated into the confidence interval calculations. Two-sided exact tests were used to assess differences between the two periods, and p-values (*p*) were also presented.

Person-time was expressed as person-days and was calculated by adding together the exact number of time units that each household member spent during the recall period.

For members who were present at the beginning and still present at the end of the recall period, the total time units for the recall period were counted.

For members who were present neither at the beginning nor at the end of the recall period (i.e., newborns, new arrivals, deaths, and departures), a precise calculation of the units of time spent in the household was made (for example, the person-time of a newborn was the number of days calculated as the survey date minus the date of birth).

4 ETHICAL CONSIDERATIONS

4.1 Ethical references

Each survey was conducted in accordance with the Declaration of Helsinki (3), the International Ethical Guidelines for Epidemiological Studies (4) and the International Ethical Guidelines for Health Research Involving Human Subjects. (5).

The lead investigator was responsible for the ethical compliance of each survey.

4.2 Ethical approval

The investigation protocol was approved by MSF's Ethical Review Board and by Chad's National Bioethics Committee (CNBT) (see approval in appendix 2).

4.3 Administrative approval

The protocol was approved by the local administrative authorities. The communities (community chiefs, religious leaders, opinion leaders, etc.) in the survey area were informed of the objectives of the study, an information sheet was provided to them, and their verbal agreement was sought at a community meeting to present the survey.

4.4 Verbal consent

An information sheet translated into the local language was read and verbal consent was sought from each head of the selected households.

The head of household may have chosen to delegate the task of answering the questionnaire to another member of the household if that person was more familiar with the questions asked.

The survey was explained to all participants in a language with which they were familiar. Everyone had the opportunity to refuse to take part at any time without penalty and no incentives or encouragement were given to respondents. Anyone approached was entirely free to participate or not.

Information about children and adolescents who were unable to answer the questions was obtained from their parent/guardian or head of household.

For nutritional screening and vaccination, a child was excluded if the parent/guardian refused to give consent for participation or was unable to be located.

A copy of the information sheet was left with the household after the interviews had been carried out.

Verbal consent was documented in the electronic questionnaire by a statement from the interviewer indicating that verbal consent had been obtained by the head of household.

4.5 Risks and benefits for participants and contingency plans

The retrospective mortality survey did not cause physical harm to participants. Nevertheless, asking for details of recent deaths in the household may be upsetting and/or intrusive, particularly in this context. Investigators therefore received psychological first aid training from a member of the medical team, including referral pathways for severe cases.

In addition, community members may have believed that questions about violence were being asked as part of an investigation into the parties involved, putting participants and the research team at risk. Measures to mitigate this risk included informing the investigators of MSF's principles of independence, neutrality, and impartiality, which were clearly explained in the information sheets (for community leaders and household heads of household) and during meetings with community leaders. Furthermore, it was stressed during the interviews that the purpose of these questions was to document the violence suffered by these communities, to help our advocacy work on this humanitarian crisis and not to identify the groups involved. The risk assessment was updated daily based on feedback from interviewees.

There were no direct benefits for the participants. However, during each survey, emergency cases identified during the interviews were referred to the nearest health facility, and the costs were paid by MSF.

The community may also benefit from the results of the surveys as:

- better understanding of the rates and causes of death in the region will facilitate the development of more appropriate programmes and more effective use of resources
- specific data on mortality and estimates of the causes of death are crucial for advocacy at national and international level

No financial or in-kind compensation was provided in exchange for participation in each survey.

4.6 Confidentiality

Participant privacy was respected during the interview process. Staff were trained to determine the appropriate conditions for maintaining confidentiality during the interview process, including the choice of the best location (e.g., a one-room flat) when the context made it challenging to respect privacy.

Participants' names were not recorded on the questionnaire, and individual records were only linked to a household number throughout the data entry and analysis process.

The confidentiality of the data collected from participants was ensured during and after each survey. Individual responses were not associated with a household number during data entry or analysis. The electronic database was password-protected. Any data that could be combined with other data sources to make the responses of individuals potentially identifiable were not distributed outside the sites of each survey and will not appear in any report or publication.

The shelter was identified by geographical coordinates, but the names of the participating households were not recorded in the questionnaire. All geographical coordinates were used for sampling purposes only. They were then disassociated once the data had been collected, the database created, and the analysis completed. This reduced the risk of participants being identified once each survey had been completed.

5 COLLABORATION AND DISSEMINATION OF RESULTS

The surveys were carried out in collaboration with Epicentre, MSF-OCP and the Ministry of Public Health and Prevention, represented by the Ouaddaï Provincial Health Delegation and the Adré and Hadjer Hadid health districts.

Epicentre was the implementing partner in collaboration with MSF-OCP. Epicentre was also responsible for supervising field activities, analysing data and drafting the report.

MSF-OCP was the sponsor of each survey and was responsible for funding. Permission for publication must be obtained from Epicentre, MSF-OCP and the Ministry of Public Health and Prevention.

The results of the study are the property of MSF-OCP and the Ministry of Public Health and Prevention.

The final report will be shared with all partners (Ministry of Public Health and Prevention, MSF and Epicentre). It will also be shared with other actors involved in humanitarian aid in Chad.

6 IMPLEMENTATION IN THE FIELD

6.1 Human resources, training and supervision

The data was collected by 7 teams of 2 interviewers supervised by 2 supervisors for Toumtouma camp and by 9 teams of two interviewers and 2 supervisors for Ourang and Arkoum. Given the context, it was difficult to have all the interviewers fluent in French and the local language. The teams were therefore put together in such a way as to ensure that each team had at least one person who spoke and read French fluently and another who spoke the local language fluently (Arabic for Toumtouma camp and Massalit for Ourang and Arkoum camps).

Before the start of each survey, the teams received 4 days' training, including 3 days of theory with role-playing and one day for the pilot phase.

The training covered:

- survey protocol and procedures
- methodology for household selection
- data to be collected and filling of questionnaires
- ethical rules and obtaining verbal consent
- interview techniques to ensure confidentiality and deal with sensitive issues
- measurement of the mid-upper arm circumference (validated by a standardisation test) and the search for nutritional oedema
- procedures to be followed for referring severe, SAM and MAM cases
- use of tablets for community surveys

The training also covered the use of a GPS device to search and locate selected GPS points, and psychological first aid training provided by a member of the medical team. This was followed by a practical exercise in the field (pilot). The questionnaires were field-tested in households in the camp not selected for each survey, during a pilot day. Verbal consent was sought from pilot participants in the same way as for the survey. The data collected during the pilot phase was not used for the survey data and was destroyed immediately after the test day. The survey documents (particularly the questionnaire) were revised at the end of the pilot. The teams worked under the close supervision of an epidemiologist. He was responsible for obtaining all the necessary authorisations, training the interviewers, organising and

supervising the fieldwork, ensuring compliance with ethical rules, ensuring the quality of the data collected, entering and analysing the data and drafting the final report.

6.2 Logistics and transport resources

The MSF team provided administrative and logistical support, including presentation and validation of the protocol with the competent authorities, the contracts and payment of interviewers and supervisors, the translation of information leaflets, the purchase of survey equipment, the printing/photocopying of documents, the management of vehicles, communication, and security.

7 RESULTS

7.1 Description of the sample and demographic information

The surveys took place from 7 to 13 August in Toumtouma camp, from 17 to 22 August in Ourang camp and from 30 August to 4 September in Arkoum camp. Excluding members who died, left or disappeared during the recall period, a total of 1032 households (6126 people) took part in the survey in Toumtouma camp, 1032 households (6122 people) in Ourang camp and 1029 households (5085 people) in Arkoum camp. The average household size was 5.9 in Toumtouma and Ourang and 4.9 in Arkoum, with an average sex ratio of 0.85 across the camps. Refugees accounted for 60%, 99% and 98% of households respectively (Table 2).

Table 2. Household status and distribution by age group and sex of members present during the surveys in Toumtouma, Ourang and Arkoum camps

	Toumtouma			Ourang			Arkoum		
	Number	%	M/F ratio	Number	%	M/F ratio	Number	%	M/F ratio
Household status									
Refugees	3657	59.7	0.82	6058	99.0	0.93	5002	98.4	0.82
Returned	2199	35.9	0.77	64	1.0	1.13	18	0.4	1.57
Displaced persons	270	4.4	0.82	0	0.0	-	65	1.3	0.91
Age range									
0-1 year	300	4.9	1.07	345	5.6	1.01	269	5.3	0.92
2-4 years	755	12.3	1.04	646	10.6	1.18	692	13.6	0.82
5-14 years	2171	35.4	0.95	1945	31.8	1.08	1702	33.5	1.00
15-29 years	1360	22.2	0.64	1668	27.2	0.72	1169	23.0	0.60
30-44 years	667	10.9	0.43	865	14.1	0.88	695	13.7	0.73
45-59 years	314	5.1	0.67	340	5.6	0.92	316	6.2	1.16
≥ 60 years	559	9.1	0.93	313	5.1	0.92	242	4.8	0.69
Total	6126	100	0.80	6122	100	0.93	5085	100	0.82

Children under the age of 5 accounted for around 17% of the population and those under 15 for almost 55%. The median age was 13 (IQR: 6 - 30) in Toumtouma, 15 (IQR: 7 - 29) in Ourang and 13 (IQR: 6 - 29) in Arkoum. Table 2 and Figure 1 show an under-representation of men in

the 15-29 age group, with a sex ratio of 0.6 - 0.7 on average for each camp and 0.4 and 0.7 for the 30-44 age group in Toumtouma and Arkoum camps.

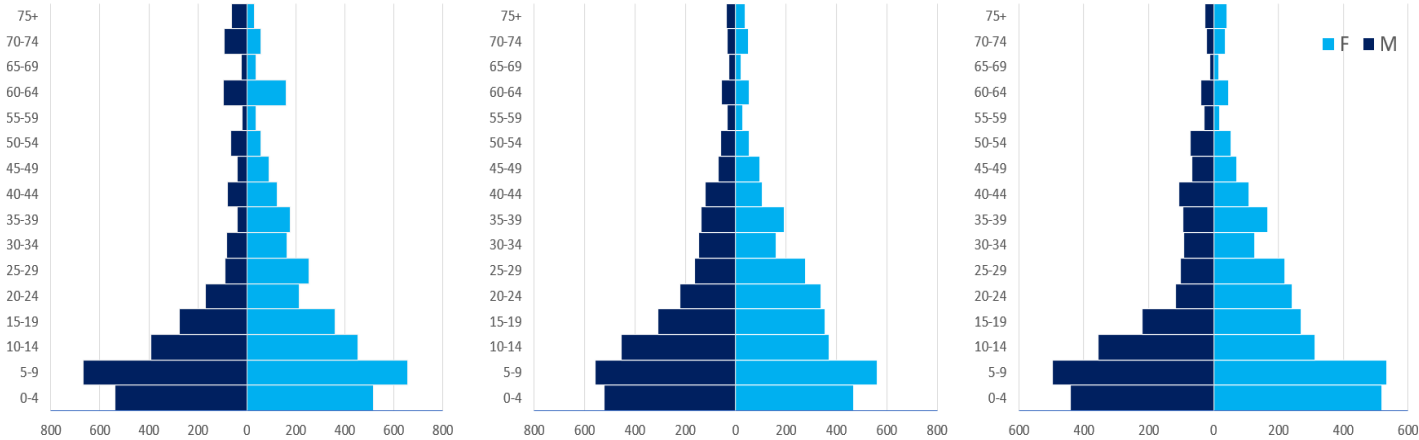


Figure 2. Age pyramid by sex of the populations present during the surveys in Toumtouma, Ourang and Arkoum camps

Almost all households were from West Darfur. In Toumtouma camp, the majority came from Umm Dam (48%), Tandulti (26%) and El Geneina (13%). In Ourang camp, 91% of households were from the town of El Geneina, while in Arkoum camp 47% and 33% were from Kongu and Mistre, respectively (Figure 3).

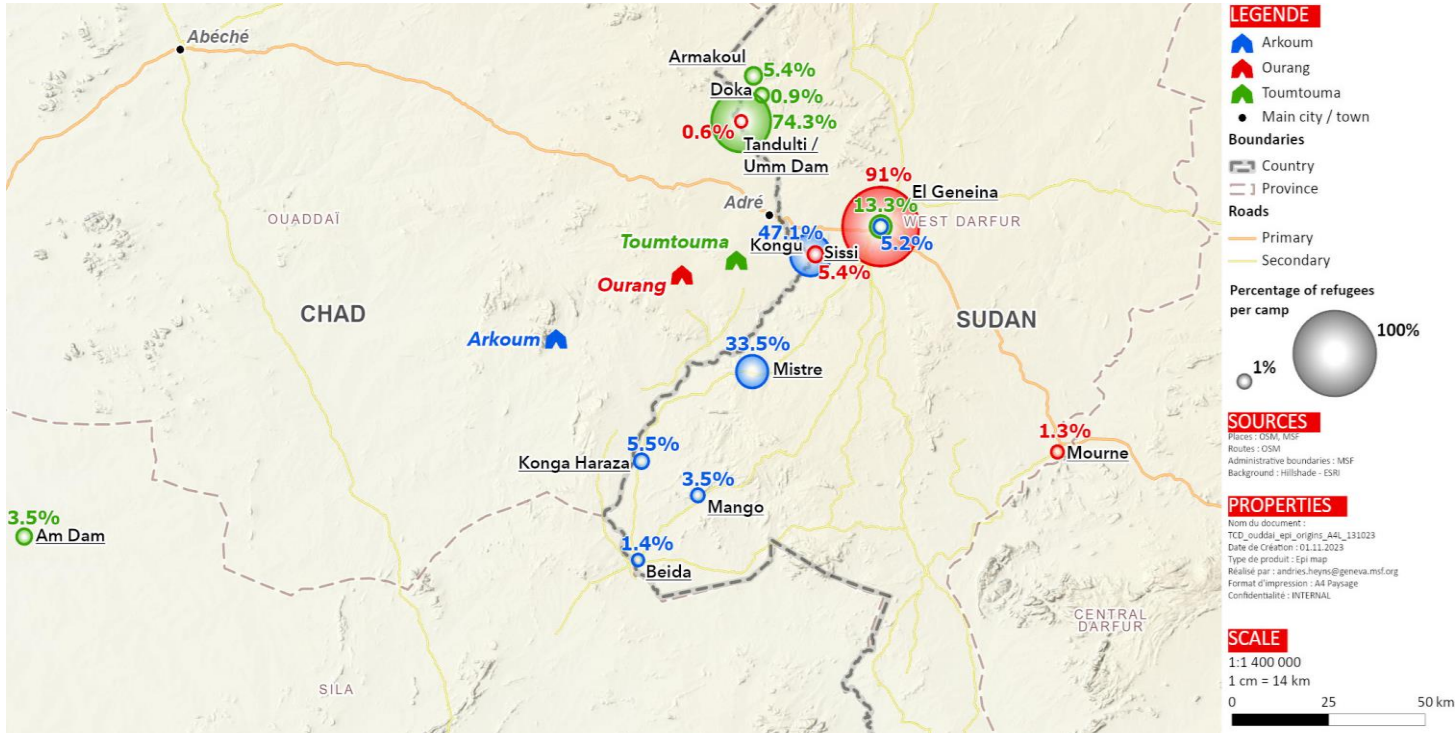


Figure 3. Main places of origin of households in Toumtouma, Ourang and Arkoum camps

7.2 Mortality Retrospective

The recall period was from 1 January to the day of the survey. It covered a minimum of 210, 228 and 241 days for Toumtouma, Ourang and Arkoum camps. Two phases were considered: 1) the pre-crisis phase (Toumtouma: 1 January - 14 March 2023 / Ourang and Arkoum: 1 January - 14 April 2023) and 2) the crisis phase (Toumtouma: 15 March - the day of the survey / Ourang and Arkoum: 15 April - the day of the survey).

Among households in Toumtouma camp, the crude mortality rate (CMR) was significantly higher in phase 2 (CMR: 0.58 deaths/10,000 people/day [95% CI: 0.43 - 0.74] than in phase 1 (CMR: 0.20 deaths/10,000 people/day [95% CI: 0.07 - 0.33]) (Table 3). Three deaths out of 62 were reported in children under the age of 5, including 1 in phase 2. Violence (77%; n=48) was the main cause of death reported (Figure 4), followed by diarrhoea (6%; n=4) and respiratory infection (5%; n=3) (Table 4 and Appendix 3). Violence-related deaths were mainly firearms-related (92%; n=44) and were particularly numerous in March and April (weeks 12 and 16). A quarter of the total deaths were recorded as having occurred between 22 and 23 March, and 89% of those who died were men. Over 4% of all men aged 30 and over died of violent causes (Table 5) and 4.4% of men aged 15-44 were reported missing during the recall period. Of the 62 deaths, 42 (68%) were refugees, 19 (31%) returnees and 1 displaced person; 42 (68%) died in their town or village of origin (including 6 in hospital), 13 (21%) during displacement and 7 (11%) in an unknown location. Most people that died came from El Geneina (40%), Tandulti (35%) and Umm Dam (16%) in Darfur (Table 6).

Among households in Ourang camp, the CMR was significantly higher in phase 2 (CMR: 2.25 deaths/10,000 people/day [95% CI: 1.77 - 2.74]) than in phase 1 (CMR: 0.11 deaths/10,000 people/day [95% CI: 0.02 - 0.20]) (Table 3). Violence (82%; n=147) was the leading cause of death reported (Figure 4), followed by measles (5%; n=9) (Table 4 and Appendix 3). No deaths were reported in children under the age of 5 during phase 1. However, during phase 2, the mortality rate (U5MR) increased significantly to 2.23 deaths/10,000 persons/day [95% CI: 1.27 - 3.19]. Among under-fives, the main cause of death reported was measles (33%; n=9), followed by violence (30%; n=8). In addition, 3 (11%) children were reported to have died from malnutrition (Table 4 and Appendix 3). Violence-related deaths were mainly firearm-related (97%; n=142). These deaths were particularly numerous in June (week 24) and 83% of those who died were men (3.88 deaths/10,000 people/day [95% CI: 3.01 - 4.76] in phase 2). Over 11% of all men aged 30 and over died of violent causes (Table 5) and 4.9% of men aged 15-44 were reported missing during the recall period. Of all deaths (n=179), 124 (69%) occurred in their town or village of origin (including 5 in hospital or in a health centre), 44 (25%) during the displacement and 11 (6%) in Adré, Chad (including 10 in hospital or in a health centre). Most people that died were from El Geneina (96%) in Darfur (Table 6).

Among households in Arkoum camp, the CMR was significantly higher in phase 2 (CMR: 0.67 deaths/10,000 people/day [95% CI: 0.46 - 0.89]) than in phase 1 (CMR: 0.15 deaths/10,000 people/day [95% CI: 0.03 - 0.26]) (Table 3). Violence (50%; n=28) was the main cause of death reported (Figure 4), followed by diarrhoea (16%; n=9) (Table 4 and Appendix 3). Violence-related deaths were mainly due to shootings (82%; n=23) and 70% of those who died were men; the mortality rate among men was 1.14 [95% CI: 0.72 - 1.55] in the second phase. Almost

4% of all men aged 30-44 died of violent causes (Table 5) and 5.2% of men aged 15-44 were reported missing during the recall period. Among the under-fives, the main cause of death was diarrhoea (47%; n=8), followed by malaria/fever (24%; n=4) (Table 4 and Appendix 3). Of all the deaths (n=56), 29 (52%) occurred in their town or village of origin (all in a health centre), 15 (27%) during the displacement, 3 (5%) after arriving in Chad and 9 (16%) in an unknown location. Most people that died came from Mistre (54%) and Kongu (29%) in Darfur (Table 6).

Table 3. Crude and specific mortality rates during the recall period (phase 1 and 2) for Toumtouma, Ourang and Arkoum camps

Mortality / 10,000 people / day	Phase 1 (before the crisis)		Phase 2 (during the crisis)		P-value	
	Rate	(95% CI)	Rate	(95% CI)		
Toumtouma	CMR	0.20	0.07 – 0.33	0.58	0.43 – 0.74	<0.01
	U5MR	0.27	0.00 – 0.65	0.07	0.00 – 0.19	-
	Woman	0.04	0.00 – 0.12	0.12	0.02 – 0.21	-
	Men	0.39	0.12 – 0.65	1.15	0.82 – 1.49	<0.01
Ourang	CMR	0.11	0.02 – 0.20	2.25	1.77 – 2.74	<0.01
	U5MR	0.00	0.00 – 0.00	2.23	1.27 – 3.19	<0.01
	Woman	0.06	0.00 – 0.15	0.75	0.44 – 1.07	<0.01
	Men	0.16	0.02 – 0.30	3.88	3.01 – 4.76	<0.01
Arkoum	CMR	0.15	0.03 – 0.26	0.67	0.46 – 0.89	<0.01
	U5MR	0.33	0.00 – 0.71	1.10	0.50 – 1.69	-
	Woman	0.07	0.00 – 0.17	0.28	0.08 – 0.49	-
	Men	0.24	0.02 – 0.46	1.14	0.72 – 1.55	<0.01

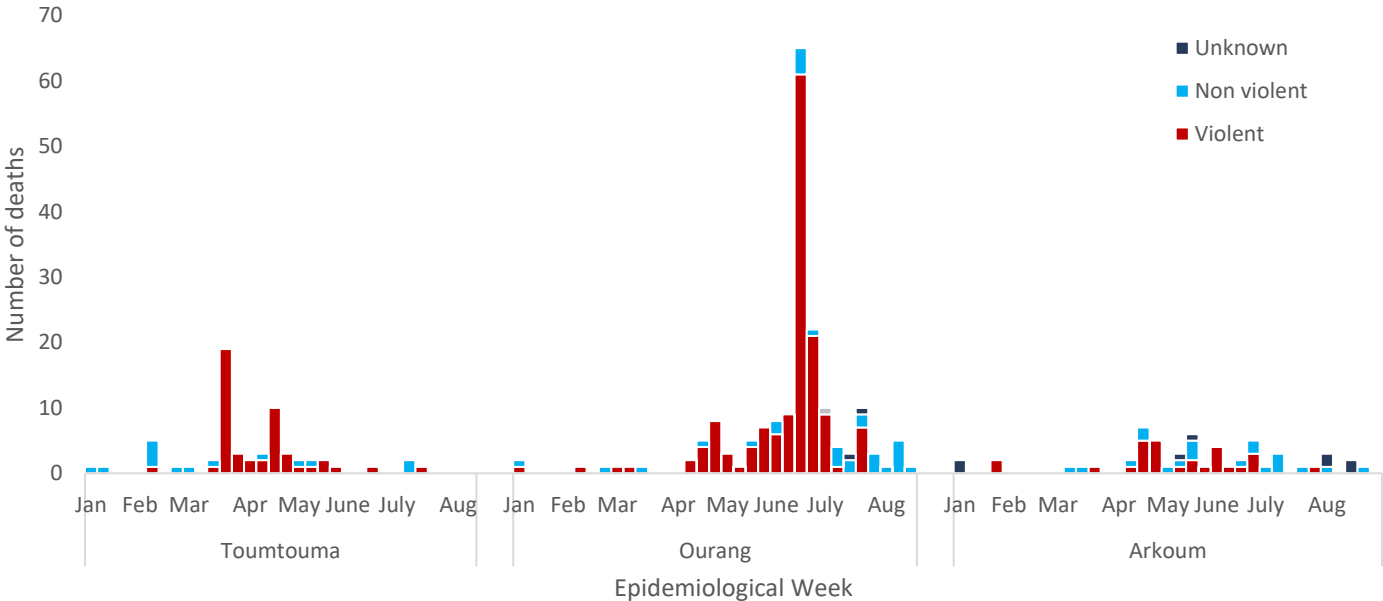


Figure 4: Number of deaths reported during the recall period by epidemiological week and cause of death for Toumtouma, Ourang and Arkoum camps

Table 4. Causes of mortality among the under and over 5s during the recall period for Toumtouma, Ourang and Arkoum camps

Causes of death	Toumtouma			Ourang			Arkoum		
	< 5 years n (%)	5 years + years n (%)	Total n (%)	< 5 years n (%)	5 years + years n (%)	Total n (%)	< 5 years n (%)	5 years + years n (%)	Total n (%)
Diarrhoea	3 (100)	1 (1.7)	4 (6.5)	3 (11.1)	0 (0.0)	3 (1.7)	8 (47.1)	1 (2.6)	9 (16.1)
ARI*	0 (0.0)	3 (5.1)	3 (4.8)	0 (0.0)	2 (1.3)	2 (1.1)	1 (5.9)	0 (0.0)	1 (1.8)
Malnutrition	0 (0.0)	0 (0.0)	0 (0.0)	3 (11.1)	0 (0.0)	3 (1.7)	0 (0.0)	0 (0.0)	0 (0.0)
Malaria/fever	0 (0.0)	0 (0.0)	0 (0.0)	2 (7.4)	2 (1.3)	4 (2.2)	4 (23.5)	2 (5.1)	6 (10.7)
Measles	0 (0.0)	0 (0.0)	0 (0.0)	9 (33.3)	0 (0.0)	9 (5.0)	0 (0.0)	1 (2.6)	1 (1.8)
Trauma/accident	0 (0.0)	2 (3.4)	2 (3.2)	0 (0.0)	5 (3.3)	5 (2.8)	0 (0.0)	1 (2.6)	1 (1.8)
Violence	0 (0.0)	48 (81.4)	48 (77.4)	8 (29.6)	139 (91.4)	147 (82.1)	1 (5.9)	27 (69.2)	28 (50.0)
Don't know	0 (0.0)	0 (0.0)	0 (0.0)	2 (7.4)	1 (0.7)	3 (1.7)	2 (11.8)	6 (15.4)	8 (14.3)
Other	0 (0.0)	5 (8.5)	5 (8.1)	0 (0.0)	3 (2.0)	3 (1.7)	1 (5.9)	1 (2.6)	2 (3.6)
Total	3 (100)	59 (100)	62 (100)	27 (100)	152 (100)	179 (100)	17 (100)	39 (100)	56 (100)

*ARI= Acute Respiratory Infection

Table 5. Violence-related mortality by age group and sex during the recall period for Toumtouma, Ourang and Arkoum camps

Mortality by age group	Toumtouma			Ourang			Arkoum		
	Female n (%)	Male n (%)	Total n (%)	Female n (%)	Male n (%)	Total n (%)	Female n (%)	Male n (%)	Total n (%)
0-4 years	0 (0.0)	0 (0.0)	0 (0.0)	2 (0.4)	6 (1.1)	8 (0.8)	1 (0.2)	0 (0.0)	1 (0.1)
5-14 years	1 (0.1)	1 (0.1)	2 (0.1)	4 (0.4)	5 (0.5)	9 (0.5)	0 (0.0)	2 (0.2)	2 (0.1)
15-29 years old	0 (0.0)	8 (1.3)	8 (0.6)	6 (0.6)	21 (2.8)	27 (1.6)	1 (0.1)	7 (1.4)	8 (0.6)
30-44 years old	3 (0.6)	11 (4.3)	14 (1.9)	5 (1.1)	54 (11.7)	59 (6.4)	0 (0.0)	13 (3.7)	13 (1.7)
≥ 45 years	2 (0.4)	22 (4.7)	24 (2.5)	4 (1.2)	40 (11.5)	44 (6.4)	0 (0.0)	4 (1.3)	4 (0.7)
Total	6 (0.2)	42 (1.4)	48 (0.8)	21 (0.7)	126 (4.1)	147 (2.3)	2 (0.1)	26 (1.0)	28 (0.5)

Table 6. Proportion of deaths by town or village of origin during the recall period for Toumtouma, Ourang and Arkoum camps

Town/village of origin	N	Deaths	%	Violent deaths	%
Toumtouma					
Umm Dam	3 157	10	0.3	7	0.2
Tandulti	1 525	22	1.4	17	1.1
El Geneina	863	25	2.9	21	2.4
Armakoul	351	3	0.9	2	0.6
Amdam (Chad)	265	1	0.4	1	0.4
Doka	59	1	1.7	0	0.0
Other	152	0	0.0	0	0.0
Total	6 372	62	1.0	48	0.8

Ourang					
El Geneina	5 782	172	30	141	2.4
Sissi	289	3	1.0	2	0.7
Mourne	77	1	1.3	1	1.3
Other	153	3	2.0	3	2.0
Total	6 301	179	2.8	147	2.3
Arkoum					
Kongu	2 541	16	0.6	6	0.2
Mistre	1 778	30	1.7	17	1.0
Konga Haraza	284	4	1.4	0	0.0
El Geneina	273	6	2.2	5	1.8
Mango	191	0	0.0	0	0.0
Beida	82	0	0.0	0	0.0
Other	175	0	0.0	0	0.0
Total	5 324	56	1.1	28	0.5

7.3 Frequency and main causes of violence

In Toumtouma, Ourang and Arkoum camps, the overall frequency of violence among households during the recall period was 3.3%, 11.7% and 4.4% respectively. The main types of violence were beatings (2.3% in Toumtouma, 8.3% in Ourang, and 3.5% in Arkoum) and shootings (0.9% in Toumtouma, 4.1% in Ourang, and 0.7% in Arkoum). No cases of sexual violence were reported in Toumtouma and Arkoum, but 5 cases were reported in Ourang (Table 7).

Table 7. Frequency and type of violent episodes among households in Toumtouma, Ourang and Arkoum camps

	Toumtouma	Ourang	Arkoum
	N (%)	N (%)	N (%)
Overall frequency	210 (3.3)	738 (11.7)	232 (4.4)
Deaths by violence	48 (0.8)	147 (2.3)	28 (0.5)
Type of violence (Multiple responses possible)			
Beaten	149 (2.3)	525 (8.3)	185 (3.5)
Sexual	0 (0.0)	5 (0.1)	0 (0.0)
Shot	57 (0.9)	256 (4.1)	35 (0.7)
Stabbed	3 (0.0)	11 (0.2)	2 (0.0)
Detained/Kidnapped	18 (0.3)	28 (0.4)	0 (0.0)
Other	16 (0.3)	20 (0.3)	8 (0.2)
Does not want to answer	0 (0.0)	0 (0.0)	3 (0.1)

* Included in types of violence

7.4 Prevalence of acute malnutrition

In Toumtouma, Ourang and Arkoum camps, among children aged between 6 and 59 months, the prevalence of global acute malnutrition (GAM) according to MUAC and/or bilateral oedema was 5.5% [95% CI: 4.1 - 7.5], 11.3% [95% CI: 9.2 - 13.8] and 11.6% [95% CI: 9.5 - 14.5] respectively. The severe acute malnutrition (SAM) rates were 2.3% [95% CI: 1.4 - 3.6] in Toumtouma, 4.8% [95% CI: 3.6 - 6.4] in Ourang, and 4.6% [95% CI: 3.4 - 6.3] in Arkoum. The prevalence of children suffering from Kwashiorkor was 0.7% [95% CI: 0.3 - 1.6] in Toumtouma, 1.0% [95% CI: 0.5 - 2.0] in Ourang and 1.5% [95% CI: 0.8 - 2.9] in Arkoum. The 6 to 23 month age group was particularly affected by acute malnutrition, with GAM prevalence ranging from 14.4% [95% CI: 10.2 - 20.0] in Toumtouma, 28.4% [95% CI: 22.6 - 35.1] in Ourang, and 30.2% [95% CI: 23.5 - 37.8] in Arkoum, and a prevalence of SAM reaching 5.0% [95% CI: 2.7- 8.9] in Toumtouma, 12.0% [95% CI: 8.4 - 16.8] in Ourang, and 13.6% [95% CI: 9.3 - 19.6] in Arkoum (Table 8).

Table 8. Prevalence of global and severe acute malnutrition according to MUAC and/or bilateral oedema for Toumtouma, Ourang and Arkoum camps

	Toumtouma (N=706)	Ourang (N=794)	Arkoum (N=807)
	% (95% CI)	% (95% CI)	% (95% CI)
Global acute malnutrition	5.5 (4.1 – 7.5)	11.3 (9.2 – 13.8)	11.6 (9.5 – 14.5)
6-11 months	24.1 (16.2 – 34.3)	39.3 (28.8 – 50.9)	31.1 (22.4 – 41.4)
12-23 months	7.6 (4.1 – 13.9)	22.0 (15.9 – 29.5)	29.1 (19.8 – 40.5)
24-59 months	2.0 (1.1 – 3.6)	4.6 (3.1 – 6.7)	6.7 (5.2 – 9.0)
Severe acute malnutrition	2.3 (1.4 – 3.6)	4.8 (3.6 – 6.4)	4.6 (3.4 – 6.3)
6-11 months	9.6 (5.0 – 17.9)	17.9 (11.2 – 27.2)	14.4 (8.5 – 23.5)
12-23 months	1.7 (0.5 – 6.0)	8.5 (5.0 – 14.0)	12.7 (6.8 – 22.4)
24-59 months	1.2 (0.5 – 2.6)	1.9 (1.1 – 3.4)	2.2 (1.3 – 3.7)

7.5 Measles vaccination

In Toumtouma, Ourang and Arkoum camps, among children aged between 6 months and 14 years for whom information on measles vaccination (VAR) was available, vaccination coverage was estimated respectively at 58.6% [95% CI: 56.8 - 60.3] of whom 15.1% had a card, 75.9% [95% CI: 71.3 - 79.9] of whom 43% had a card, and 63.6% [95% CI: 58.2 - 68.7] of whom 22.9% had a card. Table 9 shows the breakdown by age group.

Table 9. Measles vaccination coverage by age group for Toumtouma, Ourang and Arkoum camps

Measles vaccination coverage	Toumtouma % (95% CI)	Ourang % (95% CI)	Arkoum % (95% CI)
With card	15.1 (13.9 - 16.4)	43.3 (36.2 - 50.7)	22.9 (18.5 - 28.1)
6-11 months	25.0 (17.1 - 35.1)	56.7 (42.6 - 69.7)	12.1 (6.0 - 22.9)
12-59 months	20.1 (17.6 - 22.9)	45.2 (38.0 - 52.6)	24.2 (19.0 - 30.2)
5-14 years	12.7 (11.3 - 14.1)	41.9 (34.6 - 49.5)	22.9 (18.3 - 28.3)
Without card	43.5 (41.7 - 45.2)	32.6 (26.6 - 39.2)	40.7 (35.3 - 46.2)
6-11 months	40.9 (31.2 - 51.4)	22.2 (13.5 - 34.4)	34.1 (24.2 - 45.5)
12-59 months	48.2 (44.9 - 51.5)	32.7 (26.6 - 39.4)	40.6 (34.6 - 46.9)
5-14 years	41.6 (39.6 - 43.7)	33.1 (26.8 - 40.0)	41.0 (35.4 - 46.9)
Total	58.6 (56.8 - 60.3)	75.9 (71.3 - 79.9)	63.6 (58.2 - 68.7)
6-11 months	65.9 (55.4 - 75.0)	78.9 (66.5 - 87.6)	46.2 (33.8 - 59.0)
12-59 months	68.3 (65.1 - 71.3)	77.8 (73.1 - 82.0)	64.8 (58.4 - 70.7)
5-14 years	54.3 (52.2 - 56.4)	74.9 (69.7 - 79.5)	64.0 (58.5 - 69.2)

8 DISCUSSION

8.1 Origin and demography

These surveys are representative of the populations living in Toumtouma, Ourang and Arkoum camps at the time of the survey. These populations fled the violent fighting that took place throughout Darfur, Sudan, starting in March and April 2023. As the survey sample shows, the population of these 3 camps was made up of around 17% of children under the age of 5 and almost 55% under the age of 15, with a median age of 15. The age pyramids broadly corresponded to the expected shape of a growing population, characterised by a broad base, indicating a high proportion in the youngest age groups (0-14 years), and a low proportion of elderly people. There remains, however, an under-representation of males aged 15-29 in each camp (with an average male-to-female ratio of 0.7) and for the 30-44 age group in Toumtouma and Arkoum camps (0.4 and 0.7 respectively). However, it is difficult to determine whether this corresponds to the distribution of the population before the crisis, which would provide additional contextual knowledge.

In Toumtouma camp, 60% of the population surveyed were refugees and 36% returnees. The first households arrived in March 2023. They came mainly from Umm Dam (48%), Tandulti (26%), El Geneina (13%) and the small villages around these three West Darfur localities. These first arrivals were ethnic Zaghawa returnees with deep roots in the area, living in localities just outside the border and often returning to see their families back in Chad.

The population of Ourang camp was 99% Sudanese refugees. Most of them Massalit, they arrived in Pessa camp (Adré, Chad) in mid-April and were then transferred to Ourang camp.

Over 90% of these households come from El Geneina and the surrounding area. Before the crisis broke out, there was a high degree of contact between the populations of Adré and El Geneina, two towns separated by around thirty kilometres. This pre-existing situation therefore had a major influence on the choice of Adré as a destination for people fleeing the fighting.

The population of Arkoum camp was 98% refugees. The vast majority were ethnic Massalit from Kongou (47%) and Mistre (33%) in West Darfur. Most of the population arrived in the second week of April, initially in Borota and Goungour camps (Adré district) and then subsequently relocated to their current camp.

8.2 Retrospective mortality and violence

In the three camps investigated, excess mortality was observed among households during the crisis phase (phase 2), with a significant difference in CMR linked to deaths from violence among men. In Toumtouma camp, CMR more than doubled and it more than tripled in Arkoum camp. The population in Ourang camp seem to have been particularly affected by the violence. The CMR was 20 times higher than in the pre-crisis period, with a mortality rate exceeding the standard emergency thresholds (1/10,000/day), with 30% of deaths linked to violence among children under the age of 5. The proportion of deaths attributed to violence was 77% in Toumtouma, 82% in Ourang and 50% in Arkoum, mainly shootings (94%; n=209). The age group most affected was men over 30, of whom over 4%, 11% and 2% respectively died of violent causes in Toumtouma, Ourang and Arkoum during the recall period. Furthermore, these results may be underestimated given the large proportion of men aged between 30 and 44 who were reported missing during the recall period (4 to 5% for each of the three camps).

Considering these results at the household level, 4.3%, 10.7% and 2.7% of households in Toumtouma, Ourang and Arkoum, respectively, experienced one or more violence-related deaths and 5.5%, 41.7% and 13.3% had been exposed to one or more episodes of violence.

Most deaths occurred at the sites of origin or during displacement to Chad (89% in Toumtouma, 94% in Ourang and 79% in Arkoum). The main types of violence, including deaths, were beatings (71.0% in Toumtouma, 71.1% in Ourang and 79.7% in Arkoum) and shootings (27.1% in Toumtouma, 34.7% in Ourang and 15.1% in Arkoum).

Only 5 cases of sexual violence were reported in Ourang, but according to the households interviewed and community leaders, the main victims of violence were men. However, it should be noted that 132 cases of sexual violence were treated during consultations supported by MSF in Adré hospital.

The results of these surveys highlight the scale of the conflict and the violence suffered by these populations during the crisis. However, it should be noted that they reflect the situation of households with survivors who made it to the camps.

8.3 Prevalence of acute malnutrition

The prevalence of GAM based on MUAC and/or oedema in children aged between 6 and 59 months was 5.5% [95% CI: 4.1 - 7.5] in Toumtouma, 11.3% [95% CI: 9.2 - 13.8] in Ourang, and 11.6% [95% CI: 9.5 - 14.5] in Arkoum. According to the Integrated Food Security Phase Classification (IPC) of global partners (6), when the GAM based on MUAC is between 10% and 19% prevalence, the severity of the nutritional situation is considered serious, i.e., in crisis phase (IPC phase 3 out of 5) and requires a significant intensification of the response through better nutritional coverage and food assistance. This was the case for Ourang and Arkoum camps, where the prevalence of SAM was particularly high and worrying, with rates of over 4% (4.8% [95% CI: 3.6 - 6.4] and 4.6% [95% CI: 3.4 - 6.3] respectively). The age group most affected was 6-23 months, particularly in Ourang and Arkoum, where the prevalence of acute malnutrition was 28.4% and 30.2% respectively. In addition, assessing prevalence solely based on MUAC could underestimate the problem of acute malnutrition in the populations surveyed, given that the anthropometric criteria recommended by the WHO, weight-for-height and MUAC, identify different children. A study of 86 cross-sectional surveys in Sudan showed that only 45% of acutely malnourished children were detected with a MUAC <125mm (7).

8.4 Measles vaccination

The availability of vaccination cards remained low. More than half the children in Ourang did not have a vaccination card, compared with more than three-quarters in Toumtouma and Arkoum. Despite the recent vaccination campaigns carried out by MSF and the MSPP, and despite being heavily dependent on verbal confirmation, vaccination coverage was insufficient (58.6% in Toumtouma, 75.9% in Ourang and 63.7% in Arkoum) compared with the minimum rate of 95% required, according to the World Health Organisation, to prevent outbreaks.

8.5 Limitations

Certain trends are likely to have influenced the results of these surveys: the recall period of more than 7 months may have led to recall bias, particularly for deaths occurring at the start of the recall period, including in Ourang where no deaths were reported among children under 5 during phase 1 preceding the crisis. The causes of death must also be interpreted with caution, as they were reported by family members based on symptoms and observations, without autopsy or clinical diagnosis to verify the cause of death.

The related bias of social desirability, stigmatisation and lack of confidentiality may also have led to under-reporting of experiences of sexual violence and other forms of violence, including domestic violence.

Similarly, households that disappeared completely before arriving at the camp or when surviving members joined other households are not represented in the sampled population, leading to an underestimation of mortality rates (known as "survivorship bias").

Finally, bias in MUAC measurements was limited by validating the survey team composition based on results of a standardisation test carried out during training using ENA software (2).

9 CONCLUSION

In the 3 camps investigated, excess mortality was observed among households during the crisis phase (phase 2), with a significant difference in the mortality rate mainly due to violent deaths among men. Among households in Toumtouma camp, the CMR more than doubled and it more than tripled among households in Arkoum camp. The population of Ourang camp, more than 90% of whom come from the town of El Geneina in Sudan, seems to have been particularly affected by the violence, with the CMR 20 times higher than in the pre-crisis period and a mortality rate exceeding the standard emergency thresholds (1/10,000 per day). Most deaths took place at the sites of origin or during displacement to Chad (89% at Toutouma, 94% at Ourang and 79% at Arkoum). The prevalence of GAM and SAM was high in Ourang and Arkoum camps, with an alarming prevalence of SAM of over 4% in the 6–59-month age group and 11% in the 6–23-month age group. In addition, measles vaccination coverage was low in all the camps surveyed; ranging from 59% to 76% and insufficient to prevent outbreaks.

10 REFERENCES

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11 APPENDIX

Appendix 1: Questionnaire

BASIC QUESTIONS		
Variable	Values	Comments
Team ID	Team identification number	
Camp name	Numeric	
Camp section	Numeric	
Shelter ID	Numeric	
Household ID	Numeric	Unique in each group
Date of interview	dd/mm/yyyy	
Verbal consent given by the head of household	Y = Yes N = No	If the answer is no, there is no need to ask any further questions.
Household status	1 = Refugee 2 = Returned 3 = Moved internally 4 = Other (please specify)	
Where does the household come from (town/village of origin)?	1 = Tandulti 2 = Kongu 3 = Adigi 4 = Beida 5 = El Geneina 6 = Zalingei 7 = Nyala 8 = Konoye 9 = Moudeina 10 = Madoua 11 = Andressa 12 = Other (please specify)	(Adapt the options to the survey area)
When did the household leave home?	dd/mm/yyyy	
If refugee or returnee, date of arrival in Chad?	dd/mm/yyyy	
When did the household arrive in the camp?	dd/mm/yyyy	
How many people slept in the shelter last night?	Numeric	
How many people are or were in the household since the start of the recall period?	Numeric	
For each household member		
Gender	M = Male F = Female	
Age	Numeric (month/year)	
Oedema	0 = No 1 = Yes	<i>If 6-59 months current household member</i>
Mid-upper arm circumference (MUAC)	Numeric [mm]	<i>If 6-59 months current household member</i>

For children aged 6 months to 14 years: Measles vaccination?	0 = No 1 = Yes with card 2 = Yes verbal 3 = Unknown	IF 6 months to 14 years and current household member
Did he join the household during the recall period?	Y = Yes N = No	
Date of arrival	(dd/mm/yyyy)	
Left during the recall period	Y = Yes N = No	
If so, did he/she disappear during the recall period?	0 = Yes 1 = No	
Date of departure or disappearance	(dd/mm/yyyy)	
Born during the recall period?	Y = Yes N = No	
Date of birth	(dd/mm/yyyy)	
Died during the recall period	Y = Yes N = No	
In the event of death, main cause of death	1 = Diarrhoea 2 = Respiratory infection 3 = Malaria/fever 4 = Malnutrition 5 = Measles 6 = During pregnancy 7 = During/after childbirth (<1 month) 8 = Trauma/accident 9 = Violence 10 = Don't know 11 = Other (specify)	
If death was caused by violence, type of violence	1 = Beaten 2 = Sexual (specify) 3 = Gunshot 4 = Stabbing 5 = Detained/kidnapped 6 = Don't want to answer 7 = Other (specify)	
In the event of death, place of death	1 = In the village/town of origin 2 = During the displacement 3 = Hospital 4 = Health Center 5 = Don't know 6 = Other (specify)	
Sought health care in the two weeks prior to death?	0 = No 1 = Yes 9 = don't know	
Where was healthcare sought after?	1 = Home, 2 = Primary health unit (specify) 3 = Primary health centre (specify) 4 = Hospital (specify) 5 = Don't know 6 = Other (specify)	
Experienced a violent episode	0 = No 1 = Yes	

Date or period when the violence took place	From dd/mm/yyyy To dd/mm/yyyy	Blank if unknown
Was the perpetrator in uniform?	0 = No 1 = Yes 9 = don't know	
Place where the violence occurred	1 = In the current location 2 = In the village/town of origin 3 = During the move (Sudan) 4 = During displacement (Chad) 5 = In another camp (Sudan) 6 = In another camp (Chad) 7 = Don't know 8 = Other (specify)	
Nature of the violence	1 = Death by violence (please specify) 2 = Beaten 3 = Sexual (please specify) 4 = Gunshot 5 = Stabbing 6 = Detained/kidnapped 7 = Don't want to answer 8 = Other (specify)	Multiple responses possible

Appendix 2: Approval of Chad's National Bioethics Committee

REPUBLIQUE DU TCHAD

PRESIDENCE DE TRANSITION

PRIMATURE

MINISTRE DE L'ENSEIGNEMENT SUPERIEUR DE
LA RECHERCHE SCIENTIFIQUE ET DE L'INNOVATION

SECRETARIAT D'ETAT

SECRETARIAT GENERAL

COMITE NATIONAL DE BIOETHIQUE DU TCHAD

SECRETARIAT GENERAL

Unité - Travail - Progrès
وحدة - عمل - تقدم



جمهورية تشاد
رئاسة الانتقالي
رئاسة الوزراء
وزارة التعليم العالي والبحث والابتكار
امانة الدولة في التعليم العالي والبحث والابتكار
الأدارة العامة
اللجنة الوطنية التشريعية لأخلاقيات البحث
الامانة العامة

N° 044 PT/PM/MESRI/SE/SG/CNBT/SG/2023

N'Djaména, le 25 JUL 2023

CLAIRANCE ETHIQUE

A

Monsieur Le Coordinateur Médicale de MSF France au Tchad
N'Djaména, Tchad

Monsieur,

Votre protocole de recherche intitulé « *Enquête transversale de mortalité rétrospective, d'évaluation nutritionnelle et de couverture vaccinale contre rougeole auprès des réfugiés soudanais et retournés tchadiens dans les camps d'Arkoum, d'Ourang et de Toumtouma, province du Ouaddai, Tchad* » a été examiné par le Comité National de Bioéthique du Tchad (CNBT) durant sa session extraordinaire tenue à son siège à N'Djaména, le samedi 22 juillet 2023.

Nous vous informons à cet égard, que votre protocole répond aux normes éthiques et scientifiques générales pour la recherche impliquant les humains. Il **n'entraîne aucun risque majeur** pour la santé des participants.

Ainsi, nous avons le plaisir de vous délivrer la présente clairance éthique. Toutefois, le Comité vous demande de bien vouloir lui transmettre le rapport final de votre étude.

Avec les meilleurs souhaits du Comité pour le succès de votre projet.

P. le Président du Comité National de Bioéthique du Tchad
Le Vice-Président



Dr. DIONKO M. MOUKOKO



CNBT Comité national de bioéthique du Tchad, BP 731 N'Djaména, Tchad

Appendix 3: Causes and places of death by age group, sex and phase

Toumtouma

Cause of death	< 5 years		≥ 5 years		Male		Female		Phase 1		Phase 2		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Diarrhoea	3	100%	1	2%	4	7%	0	0%	2	22%	2	4%	4	6%
ARI	0	0%	3	5%	3	5%	0	0%	3	33%	0	0%	3	5%
Trauma/accident	0	0%	2	3%	1	2%	1	14%	2	22%	0	0%	2	3%
Violence	0	0%	48	81%	42	76%	6	86%	1	11%	47	89%	48	77%
Other	0	0%	5	8%	5	9%	0	0%	1	11%	4	8%	5	8%
Total	3	100%	59	100%	55	100%	7	100%	9	100%	53	100%	62	100%

Place of death	< 5 years		≥ 5 years		Male		Female		Phase 1		Phase 2		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Home (orig)	2	67%	34	58%	31	56%	5	71%	6	67%	30	57%	36	58%
Hospital/CS (orig)	1	33%	5	8%	6	11%	0	0%	3	33%	3	6%	6	10%
On the road	0	0%	13	22%	12	22%	1	14%	0	0%	13	25%	13	21%
Don't know	0	0%	7	12%	6	11%	1	14%	0	0%	7	13%	7	11%
Total	3	100%	59	100%	55	100%	7	100%	9	100%	53	100%	62	100%

Ourang

Cause of death	< 5 years		≥ 5 years		Male		Female		Phase 1		Phase 2		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Diarrhoea	3	11%	0	0%	2	1%	1	3%	0	0%	3	2%	3	2%
ARI	0	0%	2	1%	2	1%	0	0%	2	29%	0	0%	2	1%
Malnutrition	3	11%	0	0%	2	1%	1	3%	0	0%	3	2%	3	2%
Malaria/fever	2	7%	2	1%	2	1%	2	6%	1	14%	3	2%	4	2%
Measles	9	33%	0	0%	5	3%	4	13%	0	0%	9	5%	9	5%
Trauma/accident	0	0%	5	3%	4	3%	1	3%	0	0%	5	3%	5	3%
Violence	8	30%	139	91%	126	86%	21	66%	4	57%	143	83%	147	82%
Don't know	2	7%	1	1%	3	2%	0	0%	0	0%	3	2%	3	2%
Other	0	0%	3	2%	1	1%	2	6%	0	0%	3	2%	3	2%
Total	27	100%	152	100%	147	100%	32	100%	7	100%	172	100%	179	100%

Place of death	< 5 years		≥ 5 years		Male		Female		Phase 1		Phase 2		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Home (orig)	12	44%	107	70%	96	65%	23	72%	6	86%	113	66%	26	55%
Hospital/CS (orig)	2	7%	3	2%	4	3%	1	3%	1	14%	4	2%	3	6%
On the road	7	26%	37	24%	39	27%	5	16%	0	0%	44	26%	9	19%
Camp	0	0%	1	1%	1	1%	0	0%	0	0%	1	1%	6	13%
Hospital/CS (camp)	6	22%	4	3%	7	5%	3	9%	0	0%	10	6%	3	6%
Total	27	100%	152	100%	147	100%	32	100%	7	100%	172	100%	47	100%

Arkoum

Cause of death	< 5 years		≥ 5 years		Male		Female		Phase 1		Phase 2		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Diarrhoea	8	47%	1	3%	4	9%	5	38%	1	13%	8	17%	9	16%
ARI	1	6%	0	0%	1	2%	0	0%	0	0%	1	2%	1	2%
Malnutrition	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%	0	0%
Malaria/fever	4	24%	2	5%	5	12%	1	8%	2	25%	4	8%	6	11%
Measles	0	0%	1	3%	0	0%	1	8%	0	0%	1	2%	1	2%
Trauma/accident	0	0%	1	3%	1	2%	0	0%	0	0%	1	2%	1	2%
Violence	1	6%	27	69%	26	60%	2	15%	3	38%	25	52%	28	50%
Don't know	2	12%	6	15%	4	9%	4	31%	2	25%	6	13%	8	14%
Other	1	6%	1	3%	2	5%	0	0%	0	0%	2	4%	2	4%
Total	17	100%	39	100%	43	100%	13	100%	8	100%	48	100%	56	100%

Place of death	< 5 years		≥ 5 years		Male		Female		Phase 1		Phase 2		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Home (orig)	9	53%	17	44%	20	47%	6	46%	6	75%	20	42%	26	46%
Hospital/CS (orig)	1	6%	2	5%	2	5%	1	8%	1	13%	2	4%	3	5%
On the road	1	6%	8	21%	6	14%	3	23%	1	13%	8	17%	9	16%
Hospital/ CS en route	4	24%	2	5%	5	12%	1	8%	0	0%	6	13%	6	11%
Hospital/CS (camp)	2	12%	1	3%	1	2%	2	15%	0	0%	3	6%	3	5%
Don't know	0	0%	9	23%	9	21%	0	0%	0	0%	9	19%	9	16%
Total	17	100%	39	100%	43	100%	13	100%	8	100%	48	100%	56	100%



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