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An Analysis of the Immediate and Underlying Determinants of Severe Acute Malnutrition (SAM) Among Children Under Five in Leer County, Unity State, South Sudan

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DECLARATION

I PIDOR RIEK KOANG, declare that this research proposal entitled "An Analysis of the Immediate and Underlying Determinants of Severe Acute Malnutrition (SAM) Among Children Under Five in Leer County, Unity State, South Sudan" is my original work and has not been presented for a degree or any other academic award in any university or institution of higher learning.

Signature: 

Date: 13/10/2025

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APPROVAL

This research proposal has been submitted for examination with my approval as the University Supervisor.

Supervisor Name: _____

Signature: _____

Date: _____

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DEDICATION

This work is dedicated to the resilient mothers and children of Leer County, whose strength amidst conflict and flooding inspires the search for sustainable solutions. It is also dedicated to my family for their unwavering support and sacrifices throughout my academic journey.

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ABSTRACT

➢ ***Background:***

Severe Acute Malnutrition (SAM) remains a critical public health emergency in South Sudan, particularly in conflict-affected zones like Leer County. Despite humanitarian interventions, prevalence rates remain persistently high. This study analyzed the immediate and underlying determinants of SAM among children aged 6–59 months in Leer County, Unity State.

➢ ***Methodology:***

A cross-sectional mixed-methods study design was employed. Quantitative data was collected from 339 caregivers using a structured questionnaire based on SMART methodology, achieving a 100% response rate. Qualitative data was gathered from 23 health facilities and 12 community leaders through key informant interviews. Bivariate analysis using Fisher's Exact Test was used to determine associations, alongside descriptive statistics.

➢ ***Results:***

The study revealed a catastrophic SAM prevalence of 96.8% in the sample. Immediate determinants were characterized by a high disease burden, with 46.9% of children suffering from diarrhoea and 27.4% from cough in the preceding two weeks. Underlying determinants showed a collapse of environmental health and livelihoods: 79.6% of households practiced open defecation, and 57.5% relied on untreated river water. Livelihood analysis showed a 70.5% dependency on WFP food distribution, with only 13.3% engaging in farming due to insecurity. Structurally, health facilities reported 100% stock-outs of essential drugs and RUTF. Statistical analysis identified distance to health facility (>60 minutes) as a significant predictor of SAM status (p=0.006).

➢ ***Conclusion:***

SAM in Leer is driven by a "vicious cycle" of biological morbidity (diarrhoea) and environmental collapse (poor WASH), exacerbated by structural violence (conflict) that has destroyed food systems and health supply chains.

➢ ***Recommendations:***

The study recommends an integrated response prioritizing emergency WASH intervention (water treatment and sanitation) to break the disease-malnutrition cycle, alongside the urgent stabilization of health supply chains to prevent stock-outs of life-saving commodities.

Keywords: *Severe Acute Malnutrition, Leer County, WASH, Conflict, Diarrhea.*

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LIST OF ABBREVIATIONS AND ACRONYMS

ACF	Action Contre la Faim (Action Against Hunger)
AOR	Adjusted Odds Ratio
FAO	Food and Agriculture Organization
HDDS	Household Dietary Diversity Score
HHS	Household Hunger Scale / Score
HIV	Human Immunodeficiency Virus
IDP	Internally Displaced Person
IYCF	Infant and Young Child Feeding
MAD	Minimum Acceptable Diet
MUAC	Mid-Upper Arm Circumference
OTP	Outpatient Therapeutic Program
PEH	Political Ecology of Health
SAM	Severe Acute Malnutrition
SD	Standard Deviation
SMART	Standardized Monitoring and Assessment of Relief and Transitions
TB	Tuberculosis
UNICEF	United Nations Children's Fund
WASH	Water, Sanitation, and Hygiene
WHO	World Health Organization
WHZ	Weight-for-Height Z-score

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CHAPTER ONE
INTRODUCTION

➢ *Introduction*

The research is situated within the complex domain of Humanitarian Public Health and Nutrition, operating amidst the chronic instability and protracted conflict that defines South Sudan's operational landscape (Ali et al., 2024). This sector is characterized by the urgent need for specialized, crisis-informed epidemiological strategies aimed at mitigating high child mortality rates stemming from preventable causes (Amenu et al., 2023). Severe Acute Malnutrition (SAM) is globally recognized as the most life-threatening manifestation of undernutrition, tragically contributing to nearly half of all fatalities among children under the age of five (WHO, 2023). The fundamental role of the humanitarian industry here is not solely treatment, but transforming generalized vulnerability data into highly specific, actionable programs capable of addressing the localized causal pathways of SAM in high-risk areas like Leer County (King, 2020).

SAM incidence is a profound reflection of complex systemic failures, encompassing more than simple calorie deficits by demonstrating critical breakdowns in health services, water, sanitation, and hygiene (WASH) infrastructure, and economic stability (Lauby-Secretan et al., 2022). South Sudan's operational reality sees continuous humanitarian efforts overwhelmed by the sheer scale of the crisis, indicating a structural gap between the aid provided and the sustained, long-term impact on child resilience (Schweiger & Graf, 2021). This consistent pattern of high caseloads necessitates a crucial shift in focus, moving interventions away from purely reactive therapeutic feeding protocols towards proactive, evidence-based strategies that accurately target the fundamental local causes of nutritional decline (Tufts FIC, 2025). This specialized approach requires precise, local quantification of unique risk factors to move beyond broad regional estimates and detail the specific complex interactions driving SAM within Unity State (Siziya et al., 2024).

Leer County provides the compelling geographical focus for this research due to its persistent classification within the highest echelons of acute food insecurity, often resulting in catastrophic classifications during the critical annual lean season (Al-Awlaqi et al., 2024). This high vulnerability confirms the county exists in a perpetual state of nutritional emergency rather than cyclical difficulty, demanding an urgent, rigorous investigation to produce granular, local evidence (Ismail et al., 2024). The vulnerability is severely compounded by recurring environmental shocks, notably seasonal flooding which impacts essential services for hundreds of thousands, devastating livelihoods and directly contributing to waterborne disease burdens (Lauby-Secretan et al., 2022). This confluence of conflict, environmental hazard, and economic fragility necessitates the collection of highly specific data to inform effective and sustainable public health planning, justifying the deep analytical focus on Leer (Amenu et al., 2023).

➢ *Background to the Study*

The Republic of South Sudan has endured a prolonged state of political instability and intense conflict since its independence in 2011, leading to a devastating seven-year civil war that fundamentally destroyed the country’s entire social and economic infrastructure (Ali et al., 2024). This sustained environment of violence has precipitated mass population displacement, restricted freedom of movement and simultaneously dismantling essential civilian services, thereby establishing a deep structural vulnerability across all age demographics (Elsayed et al., 2024). The collapse of local economies and the destruction of livelihoods severely impede communities' fundamental ability to access or provide necessary nutrition and healthcare, placing children disproportionately at catastrophic risk of severe health consequences (Ali et al., 2024). Consequently, the chronic nature of this crisis dictates that any successful humanitarian response must be dual-focused, addressing both immediate, life-threatening needs and the profound underlying structural impediments (Elsayed et al., 2024).

The consequences of this sustained fragility are visible in the escalating national malnutrition crisis, with Unity State consistently highlighted as one of the hardest-hit regions contributing significantly to the scale of the emergency (Siziya et al., 2024). Projections indicate that hundreds of thousands of children under the age of five across South Sudan are at critical risk of Severe Acute Malnutrition (SAM), reflecting an alarming increase in cases compared to the preceding year (Ismail et al., 2024). This rapid, dramatic acceleration in SAM admissions points to a critical systemic failure in both the country’s preventative health mechanisms and the capacity of existing safety nets to control underlying determinants (WHO, 2023). This persistent failure confirms the urgent need for a focused investigation into why nutritional deterioration continues at such a rapid pace across key states, including the highly-affected Unity State (Amenu et al., 2023).

Leer County’s vulnerability is profoundly exacerbated by compounding environmental shocks that severely amplify the underlying systemic fragility, notably the recurring, massive seasonal flooding affecting much of Unity State (Lauby-Secretan et al., 2022). These severe floodwaters have devastated local livelihoods and critically contaminated essential water sources, leading to a profound increase in disease risk (Al-Awlaqi et al., 2024). This environmental hazard creates a massive and predictable infectious disease burden, further fueling the immediate determinants of malnutrition, as evidenced by ongoing threats like cholera outbreaks and acute watery diarrhea in the region (Amenu et al., 2023). The resulting high disease prevalence interacts destructively with the fragile health and WASH infrastructure, perpetuating a relentless and catastrophic cycle of SAM for children in Leer (Siziya et al., 2024).

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The constant risk of SAM is structurally supported by critical financial gaps that undermine the provision of essential preventative services across South Sudan's humanitarian response sectors, a core critique of the political ecology of health (King, 2020). The severe underfunding of sectors like Health and WASH creates a persistent operating environment where the immediate biological determinants of SAM—disease and poor diet—are constantly fueled by unmitigated underlying risks (Lauby-Secretan et al., 2022). The inability to fund basic preventative services ensures that the high costs associated with curative SAM treatment will continue to dominate the humanitarian budget, confirming the urgency of generating evidence to justify redirecting investment into these underserved sectors (Tufts FIC, 2025).

- *Problem Statement*

The core problem is the structural inadequacy of the current humanitarian response model in Leer County, which fails to address the deep-seated, local determinants that initiate and accelerate SAM progression, leading to a relentless cycle of crisis and recovery (King, 2020). Despite the continuous provision of life-saving therapeutic feeding, Leer persistently remains in high-risk acute food insecurity classifications, indicating a sustained mortality risk (Al-Awlaqi et al., 2024). The annual success in treating thousands of SAM cases simultaneously masks the critical failure to prevent new cases, confirming that the underlying causal ecosystem in Leer remains intact and highly lethal (ACF International, 2020). Therefore, interventions risk becoming repetitively curative, treating the visible symptom of wasting without successfully mitigating the influential root causes, such as pervasive food insecurity or uncontrolled disease burden (Ismail et al., 2024).

A fundamental literature and programmatic gap exists in the provision of precise, quantitative evidence that details the relative contribution of immediate versus underlying factors unique to Leer's complex context of chronic conflict and displacement (King, 2020). While the biological triggers (disease and poor diet) are universally known, the research lacks the precise Adjusted Odds Ratios (AORs) necessary to differentiate the statistical impact of, for example, non-improved sanitation (AOR 5.09) versus severe household hunger (AOR 3.83) (Amenu et al., 2023). Without this specific epidemiological decomposition, policy decisions risk being based on generalized regional data, which may inaccurately represent the specific localized vulnerabilities faced by communities within Leer County (Lauby-Secretan et al., 2022). This deficit in granular causal analysis critically impairs the ability of partners to scientifically design preventive programs that target the highest-impact determinants (Siziya et al., 2024).

The inadequacy of the current data on determinant contribution leads directly to a high risk of inefficient resource allocation, which is particularly detrimental given the severely constrained humanitarian funding landscape (Lauby-Secretan et al., 2022). If the research demonstrates that poor WASH access is a stronger independent predictor of SAM (AOR 5.09) than certain dietary deficits, insufficient investment in sanitation ensures the continuation of high disease morbidity rates (Amenu et al., 2023). The perpetuation of high SAM risk, dramatically evident in the significant national rise in SAM cases, confirms that addressing this resource prioritization problem through robust scientific data is the defining challenge for humanitarian action in Leer (Ismail et al., 2024).

- *Purpose of the Study*

The broad objective of this study is to conduct a detailed, analytical investigation to understand and rigorously quantify the immediate and underlying determinants contributing to the persistently high prevalence of Severe Acute Malnutrition (SAM) among children under five years of age residing in Leer County, Unity State, South Sudan (Amenu et al., 2023). This investigation is designed to move significantly beyond simple descriptive statistics by generating localized evidence that quantifies the independent statistical association between multi-sectoral risk factors and the acute malnutrition status of children (Lauby-Secretan et al., 2022). Ultimately, the intention is to produce a scientifically robust evidence base that is capable of informing and reorienting preventative programming, ensuring accurate and efficient resource prioritization efforts by the humanitarian community operating within this highly volatile context (Siziya et al., 2024).

- *Specific Objectives of the Study*

This research aims to achieve four specific, measurable objectives designed to decompose the complex causality of SAM into actionable, independent components for programmatic targeting (Amenu et al., 2023). These objectives are: (1) to determine the quantified association between specific child-specific factors, including critical age vulnerability (6-24 months), infectious morbidity history, and immunization status, and the likelihood of a child developing SAM within Leer County (Siziya et al., 2024); (2) to rigorously analyze the statistical relationship between standardized measures of household food security status, specifically hunger scores and dietary diversity, and the measured prevalence of SAM among sampled children (Ismail et al., 2024); (3) to assess the measurable influence of primary caregiver knowledge and specific child feeding practices (IYCF) on the acute nutritional status of children under five (International Medical Corps, 2024); and (4) to scientifically establish the extent to which access to and proper utilization of essential services (WASH and primary healthcare) determines the independent risk of SAM in the study area (Amenu et al., 2023).

- *Research Questions/ Hypothesis*

The research is fundamentally guided by the overarching question of which immediate and underlying determinants have the greatest quantified impact, expressed as Adjusted Odds Ratios (AORs), on the persistence of SAM prevalence in Leer County

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(Amenu et al., 2023). This core question is decomposed into four distinct, testable hypotheses derived directly from the specific objectives, translating the multi-level conceptual framework into an empirically verifiable model tailored to the specific humanitarian context of Leer (Siziya et al., 2024). Hypothesis generation serves as the critical analytical step, framing the subsequent quantitative analysis by predicting significant positive associations between defined determinant clusters and the SAM outcome (International Medical Corps, 2024). This methodology ensures the study can generate AORs that provide a scientific basis for prioritizing specific risk factors for immediate intervention (Ismail et al., 2024).

The hypotheses are structured to facilitate multivariate statistical analysis, which is essential for effectively controlling for potential confounding variables and isolating the independent predictive power of each proposed determinant cluster (Amenu et al., 2023). For example, the hypothesis related to infectious morbidity predicts that children aged 6-24 months will be significantly more likely to have SAM, aligning with empirical evidence that shows this group faces 11.6 times higher odds of SAM than older children (Siziya et al., 2024). This structure guarantees that the resultant analysis yields quantifiable risk measures, such as AORs, necessary for comparing the relative magnitude of influence across different determinant clusters, which is vital for humanitarian decision-making (Lauby-Secretan et al., 2022). Determining whether the high odds of SAM are driven more strongly by poor food access or poor health-seeking behavior is paramount for efficient resource deployment (Amenu et al., 2023).

The rigorous testing and potential falsifiability of each hypothesis are designed to directly address the problem statement by providing the necessary granularity to transition from generalized observations to scientifically grounded intervention strategies tailored for Leer County (Ismail et al., 2024). If, for instance, the study finds that non-improved toilet use is a highly significant predictor (AOR 5.09) and not seeking care within 24 hours is also high (AOR 5.10), the evidence immediately informs the multi-sectoral strategy required (Amenu et al., 2023). The quantified results will guide humanitarian partners toward specific, high-impact sectors, ensuring that preventative efforts focus on those factors, such as WASH or timely health utilization, which exert the strongest statistical influence on child nutritional status (Siziya et al., 2024).

Table 1 Research Questions/ Hypothesis

Specific Objective	Key Independent Variable Cluster	Primary Hypothesis (H1)
Objective 1	Infectious Morbidity & Age	Higher prevalence of infectious diseases (e.g., diarrhea, TB, HIV) is positively associated with SAM among children 6-24 months in Leer County (Siziya et al., 2024).
Objective 2	Household Food Security & Access	Decreased household dietary diversity and higher Household Hunger Scores are significantly associated with increased odds of SAM incidence (Amenu et al., 2023).
Objective 3	IYCF Practices & Caregiver Education	Suboptimal Infant and Young Child Feeding practices (e.g., lack of minimum acceptable diet, formula use) are determinants of SAM severity (International Medical Corps, 2024).
Objective 4	WASH Access & Health Service Utilisation	Limited access to improved water sources and non-improved sanitation facilities are independent predictors for a higher incidence of SAM (Amenu et al., 2023).

➢ *Scope of Study*

- *Subject Scope*

The study's subject scope is precisely limited to the measurable immediate and underlying determinants of Severe Acute Malnutrition, utilizing standardized anthropometric tools and validated, structured household interview modules (ACF International, 2020). The quantitative analysis is concentrated on four critical, interdependent determinant clusters: child morbidity/age profile, comprehensive household food security (HHS/HDDS), Infant and Young Child Feeding (IYCF) practices, and household access to essential WASH and primary healthcare services (Amenu et al., 2023). This concentrated, multi-sectoral focus ensures the collection of high-quality, disaggregated quantitative data that is amenable to the sophisticated statistical modeling required for calculating independent Adjusted Odds Ratios (AORs) (Siziya et al., 2024).

The research intentionally excludes a broader political-economic policy analysis or a deep investigation into the historical basic determinants that established the vulnerability of Leer County, instead focusing strictly on locally relevant and actionable intervention targets (King, 2020). While the contextual factors are acknowledged through the Political Ecology of Health (PEH) framework, the measured variables are confined to those where implementing partners have direct operational capacity for immediate improvement, such as improving WASH access or IYCF knowledge (Lauby-Secretan et al., 2022). The selection of variables is governed by the need to generate data that directly informs programmatic decision-making, ensuring that the research output is immediately useful for the health and nutrition clusters (Amenu et al., 2023).

The operationalization of the subject scope is achieved through the use of specific, validated indicators that transform complex determinants into measurable variables for regression analysis (Amenu et al., 2023). The outcome variable, SAM, is defined by

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anthropometry (WHZ < -3 SD or MUAC < 11.5cm), guaranteeing objectivity (WHO, 2020). Underlying factors are measured using international tools such as the Household Hunger Scale (HHS) and Minimum Acceptable Diet (MAD) indicators, providing standardized metrics of food access and quality (Ismail et al., 2024). This commitment to standardized measurement ensures the internal consistency and external comparability of the data collected in the challenging Leer County environment (ACF International, 2020).

- *Geographical Scope*

The geographical scope of this research is strictly confined to Leer County, located within Unity State, South Sudan, due to its singular status as an area of persistent and extreme vulnerability within the national crisis landscape (Al-Awlaqi et al., 2024). This restricted focus acknowledges the recurrent and localized catastrophic acute food insecurity classifications that the county has faced, making it an essential case study for understanding structural humanitarian failure (FAO, 2024). The intent is to produce data that are highly representative of this particular administrative area, which is critical for advocacy efforts that must justify sustained emergency-level resource allocation to the county (Ali et al., 2024).

The sampling frame will be strategically developed in collaboration with local implementing partners to define accessible payams, and crucially, the scope will encompass host communities, internally displaced persons (IDPs), and returnees residing within Leer County (Lauby-Secretan et al., 2022). Recognizing the severe and differential impacts of conflict, the necessity of capturing varying degrees of vulnerability across these resident groups is paramount for the integrity of the analysis (Elsayed et al., 2024). The inclusion of displacement status as a key variable aligns with the Political Ecology of Health (PEH) framework, allowing the study to assess how structural factors modify the risk of SAM among different sub-populations (King, 2020).

Operational security and severe access constraints, which are intrinsic challenges to conducting research in a highly volatile region like Leer County, inherently limit the physical extent of the geographical scope (ACF International, 2020). The history of violence and displacement means that the actual sampled area may need dynamic adjustment during fieldwork, requiring close coordination with security and humanitarian logistics providers (FAO, 2024). However, the commitment remains fixed on generating representative data for the accessible jurisdiction, explicitly aiming to capture the population most affected by the ongoing compounded shocks, including conflict and seasonal flooding (Ali et al., 2024).

- *Time Scope*

The overall research project is planned for a comprehensive twelve-month duration, encompassing all necessary phases: protocol development, securing ethical review, intensive fieldwork, data analysis, and final thesis production and dissemination (ACF International, 2020). The critical primary data collection phase will be strategically timed to occur during or immediately following the peak lean season, typically spanning the months of April through July, specifically to capture the period of maximum nutritional stress (Al-Awlaqi et al., 2024). This precise temporal focus is essential for documenting the most extreme nutritional deficits that precipitate SAM and to capture the highest possible incidence rate of acute malnutrition (Ismail et al., 2024).

Timing the data collection during the lean season is justified by the fact that Leer County historically faces its most severe food insecurity classifications during this period, confirming the highest risk of mortality (Al-Awlaqi et al., 2024). Capturing data during this time ensures that the measured associations between the determinants (food access, disease) and the outcome (SAM) reflect the context of maximal vulnerability, yielding the most relevant programmatic evidence (Amenu et al., 2023). The extreme volatility and difficulty of conducting fieldwork in high-risk areas like Leer mandate that the chosen timing must maximize the scientific return on the high-risk operational investment (ACF International, 2020).

The comprehensive literature review component, including the selection of all empirical evidence cited within this proposal and the final thesis, is strictly confined to studies and reports published between the years 2020 and 2025 (Ali et al., 2024). This strict temporal constraint ensures that the entire analytical foundation is grounded in the most contemporary research available, maintaining contextual relevance regarding the current dynamics of conflict, climate shock, and aid efficacy within South Sudan and similar humanitarian contexts (WHO, 2023). This adherence to recent publications is necessary given the rapid deterioration of the humanitarian crisis and the urgency of localized evidence (Siziya et al., 2024).

➢ *Significance of the Study*

The primary significance of this study is its capacity to deliver targeted, quantified, evidence-based data essential for optimizing humanitarian programming in the face of South Sudan's severe resource constraints (Amenu et al., 2023). By generating Adjusted Odds Ratios (AORs) that identify the strongest independent predictors of SAM in Leer County, the research will directly enable the Nutrition Cluster and its partners to prioritize the highly constrained allocation of resources (Lauby-Secretan et al., 2022). Evidence demonstrating a high statistical risk associated with poor sanitation provides the necessary, scientific justification to redirect investment towards currently underfunded, high-impact areas (Amenu et al., 2023). This transition from general assessment to statistical certainty is paramount for improving program efficiency and maximizing child survival (Siziya et al., 2024).

Academically, the study makes a critical contribution by filling a persistent literature gap concerning primary epidemiological evidence systematically gathered from persistently high-risk settings like Leer, where access is severely restricted (ACF

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International, 2020). The methodological rigor required to conduct a community-based survey using SMART protocols in such an insecure, non-permissive context will provide valuable operational lessons for future research in similar fragile states (Ali et al., 2024). Furthermore, the study's integration of the Political Ecology of Health (PEH) alongside epidemiological analysis advances the theoretical understanding of how chronic conflict and aid dynamics structurally influence measurable biological outcomes, providing a more nuanced analysis of health inequality (King, 2020).

Beyond policy and academic impact, the research holds direct and immediate community significance by integrating non-negotiable ethical responsibilities into its methodology to protect vulnerable populations (Schweiger & Graf, 2021). During the primary data collection phase, all children identified through anthropometry as suffering from Severe Acute Malnutrition will be immediately referred for essential, life-saving therapeutic care at the nearest functional Outpatient Therapeutic Program (Amenu et al., 2023). The resultant quantified evidence will also be disseminated to local health authorities and community leaders, empowering them with actionable data to advocate for improved coverage and efficacy of essential service delivery within Leer County (Nussbaum, 2020).

➢ *Conceptual Framework*

The study's analytical foundation is firmly anchored in the widely accepted, multi-level UNICEF Conceptual Framework on the Determinants of Maternal and Child Nutrition (2020), which provides the standardized structure for classifying and analyzing causes (UNICEF, 2020). This framework visually and analytically links the deepest structural drivers of vulnerability in Leer County to the ultimate biological outcome of Severe Acute Malnutrition (WHO, 2023). It explicitly categorizes the political environment (conflict, displacement, institutional failure) as the Basic Determinant, which precipitates the Underlying Determinants—inadequate food access, inadequate care, and poor environmental sanitation (King, 2020). This hierarchy is essential for systematically managing the myriad variables contributing to nutritional outcomes in a crisis setting, ensuring that the complexity of Leer County is analyzed in a structured and comparable manner (Lauby-Secretan et al., 2022).

To fully capture the structural complexity of the Leer County environment—defined by chronic political failure, conflict, and institutional fragility—the UNICEF structural model is augmented with the Political Ecology of Health (PEH) framework (Lauby-Secretan et al., 2022). PEH is integrated to structurally analyze the Basic Determinants, treating endemic violence, mass population displacement, and political marginalization as structural forces that fundamentally define and constrain household vulnerability (Ali et al., 2024). This integration allows the research to analyze *how* macro-level structural failures directly translate into the localized, immediate risk factors for acute malnutrition (King, 2020).

The framework is further refined by incorporating Amartya Sen's Capability Approach, which is used to analyze the critical 'conversion factors' and agency operating at the level of the Underlying Determinants, particularly in relation to care practices (Wang et al., 2023). This approach shifts the analytical focus from the mere *provision* of resources to what individuals, especially mothers, can actually *achieve* with those resources, particularly how maternal education protects against SAM even amid profound scarcity (Nussbaum, 2020). This theoretical integration ensures that the framework provides the necessary analytical depth to explain *how* and *why* structural factors, such as war, ultimately translate into the individual biological outcome of SAM in the extreme humanitarian context (Schweiger & Graf, 2021).

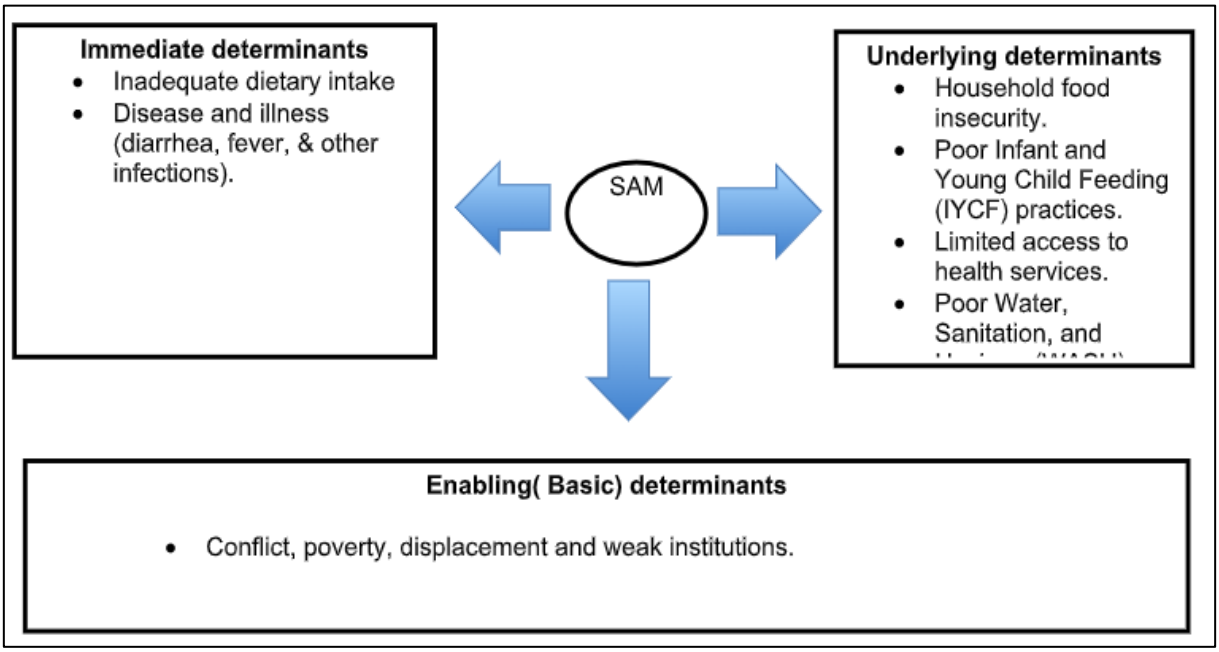

Fig 1 UNICEF Conceptual Framework on the Determinants of Maternal and Child Nutrition (2020)

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CHAPTER TWO
LITERATURE REVIEW

The literature review synthesizes contemporary knowledge concerning the immediate and underlying determinants of Severe Acute Malnutrition (SAM), specifically focusing on studies published between 2020 and 2025 within fragile and conflict-affected settings (Ali et al., 2024). This synthesis establishes the theoretical foundation and the empirical associations that underpin the study's specific hypotheses and overall analytical model (Amenu et al., 2023). The review begins by grounding the analysis in three key theoretical frameworks that address the multi-level causality of SAM, then proceeds to critically review the quantitative empirical evidence corresponding to each of the four specific research objectives (King, 2020). Finally, the chapter concludes by identifying and articulating the critical literature gaps that the proposed community-based quantitative study in Leer County aims to definitively fill (Lauby-Secretan et al., 2022).

➢ *Theories*

- *The UNICEF Conceptual Framework on the Determinants of Nutrition*

The UNICEF Conceptual Framework on the Determinants of Maternal and Child Nutrition (2020) stands as the primary organizing principle for this research, providing a universally accepted structural hierarchy for analyzing multi-level causality (UNICEF, 2020). This model systematically classifies the immediate causes of SAM—inadequate dietary intake and disease—as direct consequences of inadequate underlying determinants, which include poor food access, deficient care practices, and a weak health/WASH environment (Tufts FIC, 2025). The framework's utility in highly complex humanitarian settings is derived from its ability to systematically categorize the multitude of variables contributing to poor nutritional outcomes, thereby guiding data collection and analysis (Amenu et al., 2023).

Scholarly critiques of the UNICEF framework highlight its inherent limitations when it is applied to environments defined by protracted conflict, institutional failure, and long-term structural violence, such as South Sudan (Lauby-Secretan et al., 2022). The model tends to categorize macro-level issues like endemic violence and governance failure merely as 'Basic Determinants' without providing sufficient analytical depth to explain precisely *how* these forces shape the underlying and immediate causes of SAM (King, 2020). The persistence of catastrophic food insecurity in Leer County demands an explicit structural analysis of the political economy of conflict and institutional constraints, a dimension that the traditional UNICEF model only addresses loosely (Al-Awlaqi et al., 2024).

To address the identified limitations in structural analysis, the study utilizes the UNICEF model as a foundational structural map but strategically augments it by integrating the Political Ecology of Health (PEH) framework to classify chronic conflict and aid effectiveness (UNICEF, 2020). This integrated approach allows the research to properly classify the ongoing crisis state in Leer County, defined by political instability and the disruption of state services, as a foundational Basic Determinant that structurally limits community and household resilience (Lauby-Secretan et al., 2022). This linkage ensures that subsequent quantitative findings on food insecurity or disease are analytically positioned as systemic consequences of structural political failure, not merely as isolated unfortunate events (Tufts FIC, 2025).

- *Political Ecology of Health (PEH)*

The Political Ecology of Health (PEH) offers an essential analytical framework for this study by reframing health status, such as high SAM prevalence, as the consequence of political-economic decisions leading to unequal distribution of environmental risks and health resources (King, 2020). PEH posits that the proximate causes of illness are deeply embedded in broader economic and political structures, thereby linking the acute suffering of children in Leer to regional and national power dynamics (Lauby-Secretan et al., 2022). Applying this framework to Leer County allows the investigation to analyze endemic conflict not just as a disruptive event, but as a systemic Basic Determinant that restricts market function, destroys fragile livelihoods, and limits safe access to humanitarian services (Ali et al., 2024).

In the context of Unity State and the surrounding region, PEH allows the study to investigate how the continuous politics of violence and the resultant mass displacement create a constant state of structural vulnerability that overshadows temporary humanitarian gains (Ali et al., 2024). The spillover effects of violence demonstrate how political shocks translate rapidly into severe economic contractions and poverty across the region, deepening socioeconomic vulnerabilities (Elsayed et al., 2024). This continuous conflict and displacement restrict household coping capacity, a crucial analytical link facilitated by the PEH framework for fragile states (Lauby-Secretan et al., 2022).

The PEH framework also rigorously guides the investigation into potential inequities generated by the structure and logistics of humanitarian assistance itself, a critically nuanced topic in conflict zones (FAO, 2024). The structural analysis facilitates an understanding of how local power dynamics and severe security constraints lead to differential access to humanitarian aid among various groups, including host communities, internally displaced persons, and returnees within Leer County (King, 2020). By explicitly examining the interplay of context, scale, and structure, PEH provides the necessary theoretical platform to connect macro-

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political structural failure to the specific micro-level factors that directly drive SAM (Lauby-Secretan et al., 2022).

- *Amartya Sen's Capability Approach*

Amartya Sen's Capability Approach provides a specialized ethical and analytical lens by assessing well-being based on what people can actually *do* and *be* (functionings), transcending mere measurements of resource possession or income levels (Nussbaum, 2020). In the context of maternal and child nutrition, the approach emphasizes the crucial role of "conversion factors"—such as maternal education, access to reliable information, and agency—in successfully converting resources like food or aid into the desired functioning of being well-nourished (Wang et al., 2023). This framework is highly relevant for analyzing findings related to Infant and Young Child Feeding (IYCF) practices (Objective 3), particularly where scarcity and trauma severely limit caregivers' choices (International Medical Corps, 2024).

The Capability Approach is crucial for interpreting the care practices dimension of the conceptual framework, offering a deeper understanding of the diminished agency experienced by caregivers in constrained, insecure humanitarian environments (Schweiger & Graf, 2021). It highlights that the provision of material resources alone is often structurally insufficient if the mechanism of delivery neglects the recipient's agency or fails to protect key freedoms, which is highly relevant in aid-dependent contexts like Leer (Nussbaum, 2020). For example, if severe caregiver stress or lack of a supportive environment prevents a mother from sustaining exclusive breastfeeding, her capability to ensure optimal nutritional status is fundamentally undermined (International Medical Corps, 2024).

This framework guides the research in analyzing the potential for aid delivery itself to inadvertently diminish capability, such as studies demonstrating that formula assistance can be independently associated with suboptimal breastfeeding practices (AOR 0.33) in conflict settings (International Medical Corps, 2024). Such empirical findings illustrate a conflict between immediate humanitarian commodity distribution and the long-term protection of maternal capabilities, a dilemma requiring investigation in the aid-reliant context of Leer County (Wang et al., 2023). By using this approach, the study is guided to assess not only the presence of nutritional resources but also the ethical and structural context in which these resources are delivered, ensuring recommendations advocate for dignified, capability-enhancing interventions (Schweiger & Graf, 2021).

➢ *Empirical Review*

- *Infectious Diseases and Morbidity*

Empirical evidence consistently confirms that infectious diseases are one of the most potent immediate determinants driving children rapidly from moderate to severe acute malnutrition (WHO, 2023). Studies indicate that children in the age range of 6–24 months are exponentially more susceptible to SAM progression, exhibiting significantly higher odds (AOR 11.6 times higher) compared to older age groups, primarily due to increased exposure during the challenging complementary feeding stage (Siziya et al., 2024). This heightened, age-specific vulnerability mandates a targeted programmatic and analytical focus on this critical window to maximize the potential impact of preventative and curative health measures (Amenu et al., 2023).

The presence of specific infectious comorbidities dramatically increases a child's adjusted odds of developing SAM, clearly demonstrating a severe immune compromise and a critical breakdown in access to preventative healthcare (Amenu et al., 2023). Recent research confirms that children with concurrent comorbidities are 2.5 times more likely to have SAM, with specific high-burden diseases like Tuberculosis (TB) showing an alarmingly high risk association (AOR 22.3 times higher) compared to those without the disease (Siziya et al., 2024). The high prevalence of these infections in conflict-affected areas, often exacerbated by low immunization coverage and inadequate disease surveillance, establishes infectious disease as a powerful and immediate trigger for SAM (WHO, 2023).

In the context of Leer County, which is highly susceptible to severe seasonal flooding, the massive morbidity burden from acute watery diarrhea and other infections establishes a direct causal pathway from an inadequate Underlying determinant to the rapid onset of SAM (Lauby-Secretan et al., 2022). Flooding severely disrupts fragile sanitation systems, leading to high-risk transmission of cholera and general diseases, a situation which is then compounded by mass population displacement and limited access to health facilities (Amenu et al., 2023). Quantifying this synergistic relationship—by correlating recent diarrhea history with WASH access—is essential to scientifically justify the prioritization of environmental and preventative interventions in this volatile region (Siziya et al., 2024).

- *Household Food Security and Livelihoods*

Household Food Security is established as a central intermediate determinant of child nutritional status, with acute conflict acting as a foundational Basic Determinant that severely disrupts local production, employment, and market functionality (Ismail et al., 2025). Studies from post-conflict zones consistently show that violence leads to massive economic contraction and inflation, pushing households rapidly into catastrophic food insecurity levels, which is reliably evidenced by high Household Hunger Scores (HHS) (Al-Awlaqi et al., 2024). Given Leer County's recurrent exposure to severe food insecurity, marked by the destruction of agricultural systems and dependence on volatile humanitarian corridors, a food security assessment is non-negotiable for understanding nutritional outcomes (FAO, 2024).

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Quantitative studies from vulnerable humanitarian contexts consistently demonstrate that severe food insecurity is a robust, independent predictor of acute malnutrition among children under five (Amenu et al., 2023). Research indicates that households facing severe overall food insecurity are significantly more likely to have malnourished children (AOR 3.83), while high scores on the Household Hunger Scale (HHS) show a substantial, independent association with acute malnutrition (AOR 2.9) (Ismail et al., 2024). These metrics are highly predictive because they effectively capture the experienced reality of inadequate food quantity and frequency of access, making them measurable and essential indicators for the Leer assessment (Amenu et al., 2023).

Low dietary diversity among children serves as a powerful, measurable reflection of household economic collapse and severely restricted market access, representing a critical intermediate step between structural vulnerability and acute SAM (Ismail et al., 2024). Children who fail to meet the Minimum Dietary Diversity standard are empirically found to have increased odds of acute malnutrition (AOR 2.05), even after controlling for various other compounding factors (Amenu et al., 2023). This chronic lack of diversity signifies not only a quantity problem but also a profound micronutrient deficiency, which compounds the immunosuppressive effects of infectious disease and accelerates the wasting process (WHO, 2023).

- *Infant and Young Child Feeding (IYCF) Practices*

Optimal Infant and Young Child Feeding (IYCF) practices, particularly when implemented correctly throughout the first two years of life, are proven, critical protective factors against the onset and severity of malnutrition, including SAM (WHO, 2020). Conversely, the adoption of suboptimal practices significantly increases SAM risk, with specific indicators such as a duration of exclusive breastfeeding (EBF) less than six months showing strong associations with malnutrition (AOR 4.65) (Amenu et al., 2023). These practices, encompassing EBF, timely introduction of complementary foods, and achieving a Minimum Acceptable Diet (MAD), represent the crucial care component of the conceptual framework and must be thoroughly evaluated in Leer (International Medical Corps, 2024).

A significant area of empirical contradiction arises in highly aid-dependent, conflict-affected regions concerning the impact of external nutritional support, particularly the provision of infant formula (International Medical Corps, 2024). Studies conducted in similar contexts of instability have demonstrated that generalized, unsupported formula assistance can independently undermine optimal IYCF practices, leading to a measured lower odd of Exclusive Breastfeeding (AOR 0.33) (International Medical Corps, 2024). This critical finding illustrates a potential conflict between immediate humanitarian commodity distribution and the long-term protection of child nutritional health, a dilemma requiring investigation in the aid-reliant context of Leer County (Nussbaum, 2020).

The empirical literature confirms that both caregiver education and agency are vital determinants linked to better IYCF outcomes, underscoring the necessity of assessing maternal knowledge alongside objective feeding metrics (International Medical Corps, 2024). Maternal education is consistently associated with better nutritional outcomes, suggesting the importance of targeted and supportive interventions for less-educated mothers who may struggle to navigate complex feeding guidelines amid crisis (Amenu et al., 2023). Populations affected by continuous displacement, violence, and trauma, such as those in Leer, face immense psychological stress, which directly impairs their capability to perform basic care tasks effectively (Elsayed et al., 2024). This reinforces the necessity of aligning IYCF assessment with the principles of the Capability Approach (Wang et al., 2023).

- *Access to Health and WASH Services*

Access to and proper utilization of essential Water, Sanitation, and Hygiene (WASH) services is universally recognized as a crucial underlying determinant for preventing the massive infectious burden that precipitates SAM (Lauby-Secretan et al., 2022). Empirical research provides strong evidence of an independent risk associated with inadequate WASH infrastructure, showing high odds of acute malnutrition for households utilizing non-improved toilets (AOR 5.09) and unprotected water sources (AOR 3.45) (Amenu et al., 2023). These findings highlight that even if household food access is temporarily secured by aid, persistent exposure to environmental pathogens due to poor sanitation will inevitably drive disease, leading rapidly to wasting and high SAM rates (Siziya et al., 2024).

The functionality and accessibility of the primary healthcare system are equally potent underlying determinants, particularly given the fragile health status of children in South Sudan (Amenu et al., 2023). The collapse or severe under-resourcing of health facilities means that poor health utilization—specifically, not seeking care within 24 hours of illness onset—significantly accelerates SAM progression (AOR 5.10), turning simple wasting into life-threatening complicated cases (Siziya et al., 2024). The distance, cost, and availability of clinical services in Leer County likely represent a major, unaddressed barrier that contributes to the high prevalence of complicated SAM admissions observed regionally (Lauby-Secretan et al., 2022).

The consistently high Adjusted Odds Ratios (AORs) associated with WASH deficiencies carry a critical strategic implication for resource prioritization in conflict-affected zones like Leer County (Amenu et al., 2023). These strong statistical associations indicate that investment in preventative infrastructure, particularly WASH, may yield a greater long-term preventive return on investment compared to an exclusive focus on curative feeding programs (King, 2020). The fact that preventative sectors face massive funding shortfalls provides a powerful ethical and economic argument to justify directing resources toward this underserved area, provided the quantitative data from Leer confirm its strong predictive power (Lauby-Secretan et al., 2022).

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➢ *Literature Gaps*

A fundamental and critical literature gap exists in the form of a lack of recent, primary, community-based data that quantifies the specific local interplay of determinants in Leer County, Unity State, a severely access-constrained area (ACF International, 2020). While high-level regional and national reports confirm Leer's extreme vulnerability and rising SAM cases, the scientific community lacks primary epidemiological evidence gathered *simultaneously* across all key determinant clusters (Amenu et al., 2023). Previous rapid assessments in volatile areas are often limited by operational constraints, resulting in fragmented causal profiles that prevent the robust, complex statistical modeling needed to isolate the independent effect of each determinant (Siziya et al., 2024).

A second significant gap is the insufficient methodological integration of structural theoretical frameworks, such as the Political Ecology of Health (PEH) and the Capability Approach, with rigorous epidemiological data collection in the specific South Sudanese context (King, 2020). Much of the existing literature often defaults to descriptive humanitarian reporting, failing to use analytical models to fully explain *how* the structural forces of conflict and aid provision functionally modify measurable biological risk factors (Lauby-Secretan et al., 2022). The research must move beyond documenting the *existence* of conflict to analyze how these basic determinants functionally alter the risk pathways, for instance, by assessing how displacement status influences maternal agency regarding IYCF practices (International Medical Corps, 2024).

The final gap relates to the crucial need for comprehensive, multi-sectoral data synthesis that is tailored for immediate programmatic application and resource prioritization (Amenu et al., 2023). Humanitarian assistance in the crisis environment of Leer County depends heavily on evidence that ranks risk factors by their statistical power (Adjusted Odds Ratios) to optimally deploy extremely limited resources (ACF International, 2020). The lack of a unified, statistically robust dataset that simultaneously measures the independent contributions of morbidity, food access, care practices, and WASH deficiencies means that resource allocation may be suboptimal, inadvertently sustaining the vulnerability cycle (Ismail et al., 2024).

➢ *Conceptual Framework*

The guiding conceptual framework for this research is a hybrid analytical model, built upon the rigorous hierarchical structure of the UNICEF Conceptual Framework (2020), which is strategically augmented by the structural insights of the Political Ecology of Health (PEH) (UNICEF, 2020). This framework visually and analytically links the deepest structural drivers of vulnerability in Leer County to the ultimate biological outcome of Severe Acute Malnutrition (WHO, 2023). It explicitly categorizes the political environment (conflict, displacement, institutional failure) as the Basic Determinant, which precipitates the Underlying Determinants—inadequate food access, inadequate care, and poor environmental sanitation (King, 2020). These Underlying factors then interact dynamically to produce the Immediate Determinants: disease (morbidity) and inadequate dietary intake (Amenu et al., 2023).

The utility of this hybrid framework lies in its explicit operationalization, allowing all collected variables to be systematically mapped directly to a determinant level, ensuring that the subsequent multivariable analysis generates statistically controlled relationships (Amenu et al., 2023). For example, displacement status—a PEH variable at the Basic level—would be tested as a critical confounder that modifies the relationship between WASH access (Underlying) and disease morbidity (Immediate) (Lauby-Secretan et al., 2022). Similarly, the Capability Approach helps analyze maternal knowledge and agency as conversion factors influencing the successful adoption of optimal IYCF practices, acknowledging that resource provision is often insufficient for nutritional success (International Medical Corps, 2024). This integrated structure moves the research beyond simple correlation, facilitating a holistic understanding of malnutrition in a context defined by chronic structural violence (King, 2020).

This rigorous analytical structure guarantees that the final Adjusted Odds Ratios (AORs) would scientifically reflect the established hierarchy of causes, thereby prioritizing interventions based on quantified evidence rather than on generalized assumptions (Amenu et al., 2023). By determining the AORs for both immediate triggers (e.g., diarrhea) and critical underlying conditions (e.g., non-improved sanitation), the research provides clear, evidence-based programmatic guidance (Siziya et al., 2024). This approach directly addresses the urgent humanitarian necessity of targeting interventions efficiently, particularly in underfunded areas like WASH and timely health utilization (Wang et al., 2023).

Table 2 Conceptual Framework

Determinant Level	Determinant Sub-Factor	Measure/Indicator	Data Source	Citations (2020–2025)
Basic (PEH)	Political/Conflict Shock	Displacement Status (IDP/Returnee/Host)	Primary (Caregiver Interview)	(Ali et al., 2024), (Elsayed et al., 2024)
Underlying	Food Security	Household Hunger Score (HHS); HDDS (continuous)	Primary (Questionnaire)	(Amenu et al., 2023), (Ismail et al., 2024)
Underlying	Care Practices	Minimum Acceptable Diet (MAD); Exclusive Breastfeeding (EBF) rate	Primary (IYCF Module)	(International Medical Corps, 2024), (ACF International, 2020)
Underlying	Health & WASH	Non-improved toilet use (binary);	Primary (WASH	(Amenu et al., 2023),

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	Access	Distance/Access to OTP/Health facility	Module) & Secondary (Partner data)	(Lauby-Secretan et al., 2022)
Immediate	Morbidity & Age	Diarrhea/Fever in last 2 weeks; Child Age (6-24m binary)	Primary (Caregiver Interview)	(Amenu et al., 2023), (Siziya et al., 2024)
Outcome	SAM Status	Weight-for-Height Z-score (WHZ < -3 SD); MUAC (< 11.5cm)	Primary (Anthropometry)	(WHO, 2023), (WHO, 2020)

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CHAPTER THREE
METHODOLOGY

- *Methodology*

The research employed a predominantly quantitative methodology to achieve the primary objective of generating statistically robust Adjusted Odds Ratios (AORs) that identify the most significant independent determinants of SAM in Leer County (Amenu et al., 2023). This approach was mandated by the requirement for evidence-based prioritization in a severely resource-constrained humanitarian setting, where subjective or descriptive assessments of causality were structurally insufficient for justifying large-scale, multi-sectoral interventions (King, 2020). By relying exclusively on standardized epidemiological techniques, the methodology ensures that the data collected were directly comparable with international nutrition surveillance standards, which was crucial for maximizing advocacy impact and funding mobilization efforts (ACF International, 2020).

To maximize the feasibility and technical quality of data collected in an extremely insecure operating environment, the methodology would be rigorously guided by the principles of the Standardized Monitoring and Assessment of Relief and Transitions (SMART) framework (ACF International, 2020). The mandatory adoption of SMART protocols ensures the technical rigor of anthropometric measurements (Weight-for-Height Z-scores and MUAC), which served as the definitive measures of the SAM outcome variable (WHO, 2020). These international guidelines dictate the required measurement precision, the training standards for field enumerators, and the necessary field logistics to generate reliable anthropometric data, even amid the logistical complexity of a high-risk zone like Leer (Siziya et al., 2024).

The simultaneous collection of anthropometry, food security, IYCF, and WASH practices necessitates a systematic, integrated approach to both data collection instruments and enumerator training (Amenu et al., 2023). Integrating multiple, validated modules into a single household survey maximizes operational efficiency and critically minimizes the exposure time for field teams, which was paramount for safety and feasibility in the highly volatile area of Leer (Abdelhadi et al., 2024). The overall methodological selection—quantitative, community-based, and guided by SMART—was a deliberate choice that carefully balances scientific rigor for AOR generation with operational feasibility and ethical responsibility (ACF International, 2020).

- *Study Area*

Leer County is an administrative area located in Unity State in the Greater Upper Nile region of South Sudan. It lies in the northern part of the country, bordering Mayendit and Panyijar counties and characterized by black cotton soils, seasonal flooding, and river systems (Kiir, Wuot) that significantly affect agricultural productivity and livelihood patterns (Conflict Sensitivity Resource Facility, 2020). The county's population is predominantly of the Dok Nuer ethnic group, with a mix of pastoralist, farming, and fishing livelihoods (Conflict Sensitivity Resource Facility, 2020). The county headquarters is Leer town, which along with surrounding payams, forms the central hub for administration and services (Wikipedia, 2025).

Leer County has historically experienced recurrent conflict and food insecurity. Protracted violence linked to national civil war and local armed clashes has disrupted farming, displaced communities, and limited access to markets, contributing to widespread food scarcity and livelihood collapse (Conflict Sensitivity Resource Facility, 2020). Due to these factors, the county has had high rates of acute malnutrition among children under five, often exceeding emergency thresholds, with severe acute malnutrition (SAM) prevalence frequently documented as critical in past assessments (IPC Acute Food Insecurity and Malnutrition Analysis, 2024). Health infrastructure remains limited and fragile, with few functional primary health care facilities and the destruction of major hospital facilities during conflict, impeding nutrition and health service delivery (Conflict Sensitivity Resource Facility, 2020).

Environmental shocks such as seasonal flooding further undermine agricultural activities and access to basic services, while ongoing insecurity and population displacement strains both household food security and humanitarian response capacities (Conflict Sensitivity Resource Facility, 2020; Concern Worldwide, 2024). These combined political, economic, environmental, and health system challenges set the context for investigating the immediate and underlying determinants of SAM among children under five in this setting.

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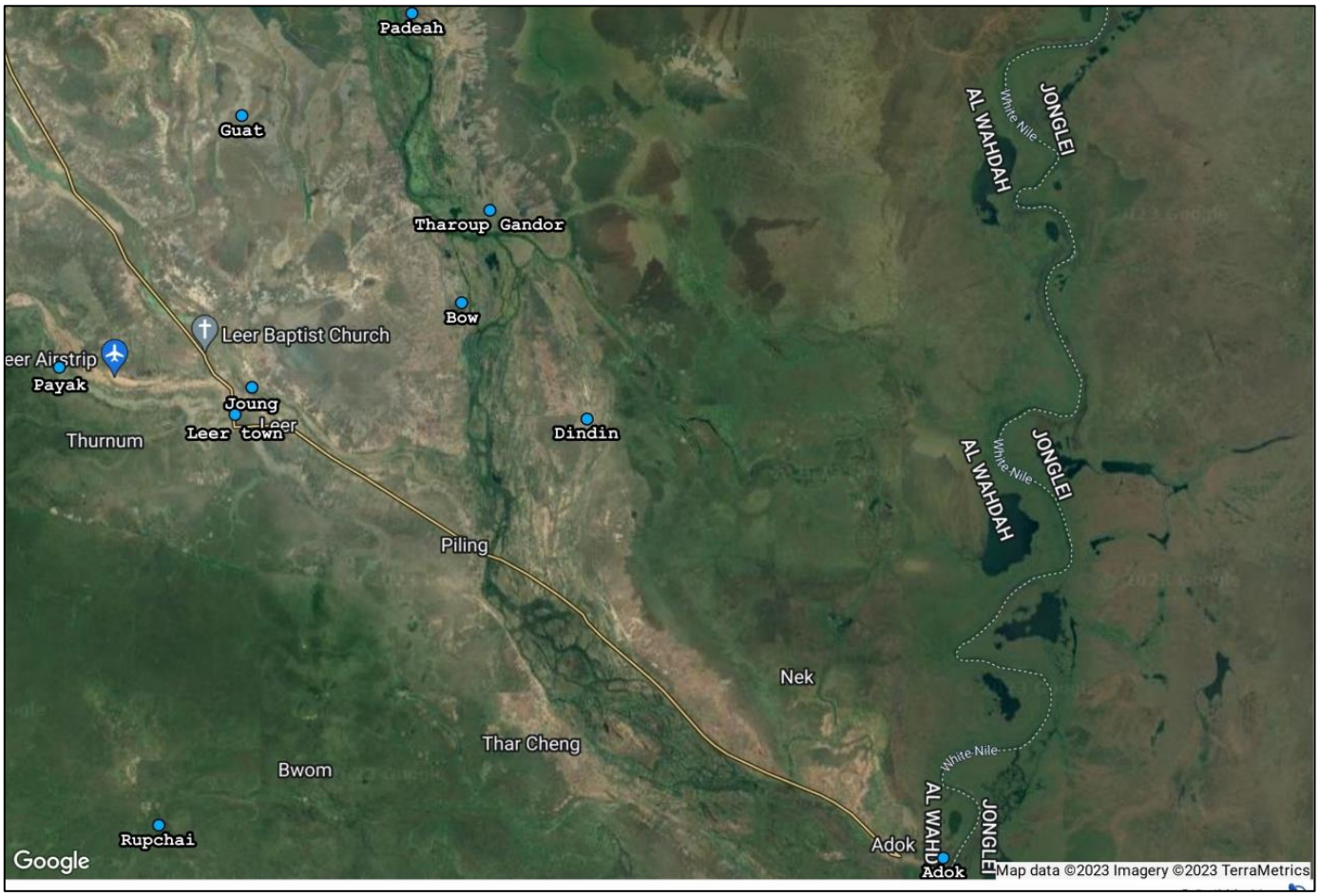

Fig 2 Map of Leer County

➢ *Research Design*

The study utilized a community-based, analytical cross-sectional survey design, selected specifically for its suitability in establishing associations between multiple independent determinant variables and a binary outcome (SAM status) at a single, defined point in time (Amenu et al., 2023). This design offers the most feasible, ethically responsible, and timely approach for generating evidence in a non-permissive security environment like Leer County (Schweiger & Graf, 2021). The cross-sectional design critically minimizes the time personnel must spend exposed in a highly volatile setting, reducing security risks while maximizing the relevance of the data collected during the crucial nutritional peak lean season (ACF International, 2020).

Crucially, the design's emphasis was analytical, which functionally differentiates it from simple descriptive nutritional status surveys by focusing on the precise decomposition of complex causal factors (Amenu et al., 2023). By systematically collecting data on age, morbidity, IYCF, food security (HHS), and WASH practices within the same households, the design enables complex statistical procedures such as multivariable logistic regression analysis (Lauby-Secretan et al., 2022). This analytical rigor ensures that the study can scientifically isolate the independent effects of deeply interconnected factors, for example, distinguishing the effect of utilizing non-improved water (AOR 3.45) from that of pervasive household food insecurity (AOR 3.83) (Amenu et al., 2023).

The strategic choice of a community-based design ensures that the data accurately reflect the nutritional status and risk factors of the entire population of children under five in Leer County, critically including those who were not currently accessing health facility services (Nussbaum, 2020). This approach was vital to avoid the common selection bias inherent in facility-based sampling, capturing vulnerable children who may be excluded due to displacement, distance, or other systemic access barriers (Schweiger & Graf, 2021). The research design thus aligned effectively with the Political Ecology of Health framework, ensuring the sample reflects the systemic inequalities in service access within the entire target population, including IDPs and returnees (Lauby-Secretan et al., 2022).

➢ *Study Population*

The study population was precisely defined as all children aged 6 to 59 months and their primary caregivers who reside in the sampled clusters (villages or payams) within the accessible areas of Leer County, Unity State (Ali et al., 2024). This definition was highly inclusive of all resident groups, specifically targeting host community members, internally displaced persons (IDPs), and

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recent returnees, which was essential for capturing the full spectrum of conflict-induced vulnerability within the county (FAO, 2024). The primary caregiver, typically the mother, would serve as the principal respondent for all household-level determinants (IYCF, WASH, Food Security), while the child was the non-negotiable unit of measurement for anthropometry and the outcome variable (SAM status) (Siziya et al., 2024).

The explicit inclusion criteria for the study mandate that the child must be aged between 6 and 59 months at the time of the survey, which must be accurately verified using birth dates or validated age estimation tools to avoid classification error (Siziya et al., 2024). Furthermore, the child must have resided within the selected cluster for a minimum defined period (e.g., 30 days) to ensure that the measured SAM status reflects exposure to the local environmental determinants (ACF International, 2020). Exclusion criteria specifically involve children outside the defined 6–59 months age range and any household where the primary caregiver was mentally or physically incapable of providing reliable responses or where obtaining voluntary informed consent was impossible (Schweiger & Graf, 2021).

The mandatory inclusion of IDPs and returnees was critical for the analytical integrity of the study, as displacement status was a fundamental Basic Determinant within the PEH framework (Lauby-Secretan et al., 2022). Historically, Leer County has faced documented challenges concerning discriminatory practices in the distribution of humanitarian aid among various community groups, and the influx of displaced populations creates heterogeneous vulnerability profiles (FAO, 2024). By explicitly incorporating displacement status as an independent, structural variable, the research ensures that the analysis accounts for how these conflict-related factors modify the risk of SAM, providing data that can lead directly to more equitable and targeted aid distribution strategies in the future (King, 2020).

➢ *Sample Size and Sampling Design*

The required sample size for this research was meticulously calculated to ensure adequate statistical power, which was non-negotiable for the multivariable logistic regression analysis necessary to identify independent predictors (AORs) (Amenu et al., 2023). The calculation utilizes standard SMART methodology parameters, assuming a conservative SAM prevalence estimate (18.0 percent) based on the extreme vulnerability and high-risk classifications for Leer County (Al-Awlaqi et al., 2024). A required precision margin of ± 3 percent was applied, consistent with robust nutrition surveillance requirements, alongside a high Design Effect (D) of 1.5 to account for the unavoidable loss of statistical independence inherent in cluster sampling (ACF International, 2020).

The application of a high Design Effect (D) of 1.5 was crucial for this calculation, as it statistically accounts for the logistical requirement to use cluster sampling due to the severe security constraints and limited access in Leer County (ACF International, 2020). Furthermore, a non-response rate of 5 percent was conservatively factored into the calculation, specifically accounting for anticipated population mobility and potential access challenges inherent to highly insecure humanitarian environments (Schweiger & Graf, 2021). This rigorous calculation was essential because complex multivariable modeling requires a significantly larger sample size than simple descriptive prevalence surveys to ensure sufficient power for identifying genuine associations and calculating reliable AORs (Amenu et al., 2023).

The sampling design utilized a two-stage systematic cluster sampling method based on the principle of Probability Proportional to Size (PPS), adhering to established international protocols for high-risk surveys (ACF International, 2020). In the initial stage, the clusters (payams or defined villages) would be selected using PPS, leveraging the most recent available population estimates provided by the local coordination structures to ensure representativeness (Lauby-Secretan et al., 2022). The PPS approach was vital as it guarantees that larger, more populous areas have a commensurately greater chance of selection, leading to a sample that accurately reflects the overall population distribution within accessible areas of Leer County (Schweiger & Graf, 2021).

The sample size was calculated using a standard statistical formula at a 95% confidence level, 5% margin of error, and 5% non-response rate. The required sample size was approximately 403 participants, although 374 participants were successfully interviewed.

- *A Two-Stage Cluster Sampling Technique was Used:*

✓ Clusters (villages or payams) were selected using Probability Proportional to Size (PPS).
✓ Households with eligible children were randomly selected within each cluster.

- *The Sample Size was Calculated Using Cochran's Formula for Prevalence Studies:*

$$n = \frac{Z^2 x\ p\ x\ (1-p)}{d^2}$$

Where;

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- ✓ N = is the required sample size which is the number of participants to be included in the study.
- ✓ Z = is the z-score corresponding to the confidence level z =1.96(95% confidence level)
- ✓ P = 0.5(assumed prevalence) is the prevalence which estimated proportion of the population with the characteristic of interest.
- ✓ 1-p = 0.5 is the proportion of the population not exhibiting the characteristic interest.
- ✓ d = 0.05(5% tolerable error) is the margin error (or precision level) you are willing to accept in your study.

In this study, an analysis of immediate and underlying determinant of SAM among children aged 6 – 59 months of 15% will be assumed at 95% CI, 5% tolerable error and 5% non-response rate.

Dat were collected from the community village and health facilities in Leer County where the selection was done with equal samples based on the population average. The participants were randomly selected.

Table 3 A Two-Stage Cluster Sampling Technique was Used

Parameter	Source/Assumption	Value Used	Justification
Expected SAM Prevalence (p)	High-Risk Context Estimates (Al-Awlaqi et al., 2024)	18.0%	Conservative estimate above the 15% emergency threshold.
Precision (d)	Standard Humanitarian Practice (ACF International, 2020)	$\pm 3\%$	Required precision for SMART survey reliability.
Design Effect (D)	Cluster Survey Standard for Volatile Contexts (Siziya et al., 2024)	1.5	To account for cluster sampling due to security/logistics.
Non-Response Rate (R)	Anticipated in Conflict Context (Schweiger & Graf, 2021)	5%	Conservative estimate to account for population mobility and access challenges.

➢ *Data Sources*

Primary data constituted the core evidential base of the research, gathered directly from the child and their primary caregiver using standardized field collection protocols and electronic data capture (ACF International, 2020). This data encompasses objective measurements of the child's nutritional status (anthropometry, including WHZ, MUAC, and oedema), which define the definitive dependent variable (SAM status) using WHO standards (WHO, 2020). Additionally, the structured household interview would captured all the immediate determinant variables, specifically recent morbidity history (diarrhea, fever) and accurate child age, which were crucial for the multivariable modeling of risk (Siziya et al., 2024).

The primary data collection process would also systematically captured all the Underlying Determinant variables using internationally validated interview modules administered to the primary caregiver (Abdelhadi et al., 2024). These include detailed Infant and Young Child Feeding (IYCF) practices, critical household food security indicators (HHS and HDDS), and the current access and proper utilization of WASH facilities and primary healthcare services (Amenu et al., 2023). The direct, integrated nature of this primary data collection ensures the necessary relevance and specificity required to accurately address the unique, localized determinant profiles in the high-risk context of Leer County (ACF International, 2020).

Secondary data sources would be strategically leveraged to provide essential contextual validation of the severity of the crisis and to define the operational landscape, informing the Basic Determinants analysis (King, 2020). Key secondary data includes regional food insecurity reports confirming high-risk classification, alongside nutrition cluster briefs detailing national trends (Ali et al., 2024). Partner records would be used to map the functional locations of essential services (OTPs) and to verify reported coverage rates, while also confirming the severe funding shortfalls in sectors like WASH and Health that structurally constrain prevention efforts (Lauby-Secretan et al., 2022).

- *Data Collection Instruments*

The primary data collection relies on three standardized, integrated instruments designed to ensure high validity and reliability in the high-stress environment of Leer County, beginning with the Anthropometric Measurement Tools (ACF International, 2020). This involves calibrated digital scales, specialized measuring boards for height/length, and non-stretch Mid-Upper Arm Circumference (MUAC) tapes, which were essential for objectively assessing the outcome variable (SAM) using current WHO-endorsed methods (WHO, 2020). Maintaining the rigorous calibration and standardization of these physical tools, verified daily through technical testing, was mandatory for ensuring the high data quality necessary for accurately measuring Z-scores (Amenu et al., 2023).

The second instrument was the comprehensive Structured Household Questionnaire, delivered electronically via digital tablets (e.g., Kobo Toolbox or ODK) to facilitate immediate data capture, remote supervision, and rapid quality cleaning (Abdelhadi et al., 2024). This comprehensive instrument was systematically segmented into standardized, internationally validated modules covering all four specific objectives of the study, ensuring content validity (Ali et al., 2024). These modules include the standard WHO IYCF module for feeding practices, the established Household Hunger Scale (HHS) for food security severity, and the Core WASH module for sanitation access and water source quality (International Medical Corps, 2024).

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The third crucial instrument was the standardized Referral and Consent Form, which was integrated directly into the electronic questionnaire, serving both an ethical and operational function (Amenu et al., 2023). The consent section ensures all ethical obligations are met through meticulous documentation of informed, voluntary consent, which must be fully verbalized in the local language (Schweiger & Graf, 2021). The immediate referral mechanism was a non-negotiable ethical component, guaranteeing that any child identified with Severe Acute Malnutrition during the anthropometric screening is immediately documented and referred for life-saving therapeutic care to the nearest functional OTP or Stabilization Centre (ACF International, 2020).

- *Ethical Considerations*

The research proposal mandated a rigorous ethical protocol, beginning with the detailed procedure for obtaining adequate Informed Consent from all participating primary caregivers, which must be fully verbalized in the local language (Nussbaum, 2020). The protocol ensures that caregivers fully understand the voluntary nature of participation, their absolute right to withdraw from the study at any point, and the detailed research objectives, adhering to international standards for research in crisis settings (Schweiger & Graf, 2021). Furthermore, formal ethical approval from both the implementing institution and relevant local authorities must be secured and fully documented *before* any data collection can commence in Leer County (ACF International, 2020).

The ethical review protocol must explicitly address and mitigate the risks of psychological distress associated with discussing sensitive issues common in Leer, such as severe food insecurity, trauma, and conflict-related displacement (Elsayed et al., 2024). The methodology incorporates extensive training for enumerators on handling interviews with compassion, cultural sensitivity, and strict procedures for anonymity and confidentiality (Nussbaum, 2020). This training ensures that household identification details were securely separated from nutritional and determinant data during data processing and analysis, protecting the identity and dignity of the vulnerable population (Schweiger & Graf, 2021).

A non-negotiable ethical responsibility of this study was the mandatory, immediate intervention for children identified with life-threatening nutritional statuses during the anthropometric process (Amenu et al., 2023). Any child diagnosed with Severe Acute Malnutrition would be immediately referred by the survey team, in coordination with local partners, to the nearest functional therapeutic feeding center for life-saving treatment (Schweiger & Graf, 2021). Finally, the study must detail a secure data handling and storage protocol, ensuring that all digital data are encrypted and securely stored on institutional servers, accessible only by the primary research team, thus protecting confidentiality long after the fieldwork is complete (ACF International, 2020).

- *Measurement of Variables*

The successful conduct of multivariable analysis relies on the precise, consistent measurement and operationalization of the dependent variable: Severe Acute Malnutrition (SAM) status (Amenu et al., 2023). SAM status was a binary categorical variable (0=No SAM, 1=SAM), measured using objective, established anthropometric cut-offs in line with WHO growth standards (WHO, 2020). A child is definitively classified as having SAM if their Weight-for-Height Z-score (WHZ) was less than -3 standard deviations of the median, or if their Mid-Upper Arm Circumference (MUAC) is below 11.5 cm, or if bipedal oedema was present (WHO, 2023).

For the Immediate Determinants (Objective 1), infectious morbidity was systematically measured as a binary variable (Diarrhea/Fever in the last two weeks, 1=Yes, 0=No), which has shown a high independent risk of acute malnutrition (AOR 9.15) (Amenu et al., 2023). Child age was categorized, with a specific focus on creating a binary variable for the highly vulnerable 6–24 month group (1=6-24 months, 0=Other), aligning with empirical findings that show significantly elevated odds of SAM in this cohort (AOR 11.6) (Siziya et al., 2024). This precise categorization ensures the model captures the strongest biological risk factors unique to this crisis environment (WHO, 2023).

The Underlying Determinants were operationalized as categorical or binary variables suitable for logistic regression, ensuring mathematical consistency across the full dataset (Amenu et al., 2023). The Household Hunger Score (HHS) was converted into severity levels (e.g., None/Little, Moderate, Severe), and WASH access was measured as binary (1=Non-improved toilet/water, 0=Improved toilet/water), directly reflecting established risk factors (AORs 5.09 and 3.45, respectively) (Amenu et al., 2023). IYCF practices require the calculation of composite indicators like Minimum Acceptable Diet (MAD) and Exclusive Breastfeeding (EBF) rates, which were then converted into binary variables for regression analysis (e.g., MAD 1=Yes, 0=No) (International Medical Corps, 2024).

➢ *Validity and Reliability of Research Instrument*

The validity of the research instruments ensures the study accurately measures its intended constructs, achieved primarily by strictly adhering to established, internationally recognized standards for public health and nutrition data collection (ACF International, 2020). Content validity was guaranteed through the systematic adoption of globally validated instruments, specifically the use of the WHO/UNICEF standardized modules for IYCF, the established Household Hunger Scale (HHS), and the rigorous SMART protocol for anthropometry (Abdelhadi et al., 2024). Construct validity was maintained by rigorously aligning all measured indicators with the integrated theoretical and conceptual framework, ensuring that variables categorized as determinants reflect their intended function in the causal pathway to SAM (UNICEF, 2020).

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The reliability of the research instrument—its ability to produce consistent results across different contexts—was secured through the implementation of two critical measures (ACF International, 2020). First, a comprehensive pre-testing of the entire questionnaire instrument would be conducted in a humanitarian context analogous to Leer, but situated outside the final sampled clusters, allowing for refinement of local language translation and cultural flow (Abdelhadi et al., 2024). Second, a standardized, intensive training program (minimum five days) would be provided for all enumerators, focusing heavily on interview standardization and minimizing observer bias, which was essential for consistent data collection (Amenu et al., 2023).

The third and most crucial reliability measure involves mandated anthropometric standardization testing (SCT), conducted for all measurers to ensure a low inter-rater technical error (measurement precision) before and critically, throughout the fieldwork (ACF International, 2020). This quality assurance protocol, guided by SMART guidelines, requires routine daily data quality checks to proactively monitor data consistency and identify immediate inconsistencies or potential transcription errors within the digital capture system (Schweiger & Graf, 2021). This comprehensive approach to validity and reliability ensures that the final dataset was of the highest possible quality for scientific inference in this challenging operating environment (Amenu et al., 2023).

- *Data Process and Analysis*

The data process commenced with immediate daily quality checks and cleaning protocols executed following field collection, typically managed by a dedicated data manager overseeing the electronic data capture system (Abdelhadi et al., 2024). Raw anthropometric data must be accurately entered and then processed using specialized WHO Anthro software to convert measurements of weight, height/length, and age into standardized Weight-for-Height Z-scores (WHZ) and other indices (UNICEF, 2020). This crucial processing step ensures the accurate classification of children into nutritional categories, including the definitive SAM outcome, allowing for the subsequent complex statistical analysis (WHO, 2020).

The primary analytical methodology would be the application of multivariable logistic regression analysis, which was essential for addressing the core objective of quantifying the independent association of multiple determinants with the SAM outcome (Amenu et al., 2023). Variables found to be significantly associated with SAM in the initial bivariate analysis (typically $P<0.25$) would be entered into the multivariable model to systematically control for confounding variables and isolate the true independent predictors (Amenu et al., 2023). Model fitness would be carefully assessed using standard statistical metrics, and multicollinearity among independent variables would be rigorously checked using the variance inflation factor (VIF) and tolerance test, guaranteeing the stability and interpretability of the final model (Ismail et al., 2024).

The output of the multivariable logistic regression would yield Adjusted Odds Ratios (AORs) for each key determinant (e.g., IYCF, WASH, Food Security) alongside their respective 95 percent Confidence Intervals (CIs) and P-values, with $P<0.05$ considered statistically significant (Amenu et al., 2023). These AORs are the core deliverable, as they scientifically quantify the relative magnitude of risk contributed by each determinant, allowing humanitarian partners to prioritize interventions based on measured impact, such as focusing on determinants with AORs above 5.0 (Siziya et al., 2024). Furthermore, strategic subgroup analysis would be conducted to explore differential risks between specific population segments, such as IDPs versus host communities, ensuring the results are highly specific for targeted programming in Leer (Nussbaum, 2020).

- *Limitations and Problems Encountered.*

The highly volatile and complex operational environment of Leer County presents significant logistical and security challenges that may inherently introduce potential structural biases, requiring explicit acknowledgement and mitigation strategies (ACF International, 2020). Severe security concerns, which have historically limited researchers' ability to undertake comprehensive surveys in Unity State, may lead to structural bias if the most volatile and inaccessible payams or households were necessarily excluded from sampling (Schweiger & Graf, 2021). The final discussion of limitations must explicitly address the degree to which non-response bias, stemming from population mobility and access limitations, may impact the uniformity and representativeness of the findings (Ali et al., 2024).

A methodological limitation inherent in the chosen analytical cross-sectional design is its structural inability to confirm definitive cause-and-effect relationships between the determinants and the measured SAM status (Amenu et al., 2023). While the strong statistical associations established through high AORs provide compelling evidence for intervention prioritization, the design cannot conclusively determine that, for instance, poor WASH access *preceded* the onset of SAM (Schweiger & Graf, 2021). The research will successfully establish a robust hierarchy of risk factors, but future longitudinal studies would be scientifically necessary to confirm the ultimate directionality of causality for these highly interconnected variables (King, 2020).

The measurement process was susceptible to specific types of observational error, most notably recall bias associated with caregiver-reported history for morbidity, IYCF practices, and the Household Hunger Score (HHS) (Ali et al., 2024). Caregivers, particularly in high-stress, traumatic environments, may inaccurately remember the timing of illnesses or the composition of meals provided to children, potentially introducing measurement error (Elsayed et al., 2024). This limitation was mitigated through intensive enumerator training, the use of short, focused recall periods (e.g., 24 hours for diet), and the inclusion of objective anthropometric metrics alongside subjective reporting (Abdelhadi et al., 2024).

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CHAPTER FOUR
DATA ANALYSIS AND PRESENTATION

➢ *Introduction*

This chapter presents the results of the data analysis conducted to examine the immediate and underlying determinants of Severe Acute Malnutrition (SAM) among children under five years of age in Leer County, Unity State, South Sudan. The analysis is based on data collected from caregivers of children under five years (n = 339), health facility staff (n = 23) and community leaders key informant interview (n=12) using structured questionnaires and standardized assessment tools. Both descriptive and inferential statistical techniques were employed in the analysis. Descriptive statistics, including frequencies and percentages, were used to summarize socio-demographic characteristics of caregivers, child health and nutritional status, Infant and Young Child Feeding (IYCF) practices, maternal factors, household food security, Water, Sanitation and Hygiene (WASH) conditions, access to health services, and health facility characteristics. Inferential analysis was conducted using Fisher's Exact Test or Chi-square tests, as appropriate, and bivariate logistic regression to assess the association between selected determinants and Severe Acute Malnutrition.

➢ *Rate of Study Tools Return (Response Rate)*

This section presents the response rate of the study tools by comparing the proposed sample size with the achieved sample size during data collection.

Table 4 Rate of Study Tools Return

Study Tool	Proposed Sample Size	Achieved Sample Size	Response Rate (%)
Caregiver questionnaire	339	339	100
Health facility questionnaire	23	23	100
Community leaders/KII guide	12	12	100
Total	**374**	**374**	**100**

Source: Field survey data (2025)

A total of 339 caregiver questionnaires were proposed and all 339 were successfully completed, resulting in a response rate of 100%. Similarly, 23 health facility questionnaires were administered to health workers and nutrition staff, and all were completed and returned, yielding a response rate of 100%. In addition, 12 key informant interviews (KII) with community leaders were conducted and all were successfully completed, also giving a response rate of 100%. The high response rates indicate complete data capture and provide a reliable basis for subsequent descriptive and inferential analyses.

➢ *Socio-Demographic Characteristics of Caregivers*

This section presents the socio-demographic characteristics of caregivers of children under five years of age who participated in the study.

Table 5 Socio-Demographic Characteristics of Caregivers

Variable	Category	Frequency (n)	Percentage (%)
Relationship to child	Mother	308	91.2
	Father	0	0.0
	Aunt	21	6.2
	Grandparent	10	2.6
	Total	339	100.0
Age of caregiver (years)	18–20	257	75.8
	21–29	45	13.3
	≥30	37	10.9
	Total	339	100.0
Marital status	Married	243	71.7
	Widowed	58	17.1
	Single	31	9.1
	Divorced	7	2.1
	Total	339	100.0
Education level	No formal education	305	90.0
	Primary education	29	8.6
	Secondary education	4	1.2
	Higher education	1	0.2
	Total	339	100.0
Occupation	Not employed	308	90.9

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	Employed	31	9.1
	Total	339	100.0
Household income (USD/month)	< 100	251	74.0
	100–299	73	21.5
	300–400	8	2.4
	> 500	7	2.1
	Total	339	100.0
Number of children	1–3	274	80.8
	4–9	65	19.2
	Total	339	100.0

Source: Field survey data, 2025

The socio-demographic characteristics presented in Table 4.2 are further visualized using graphical representations shown in Figure 3.

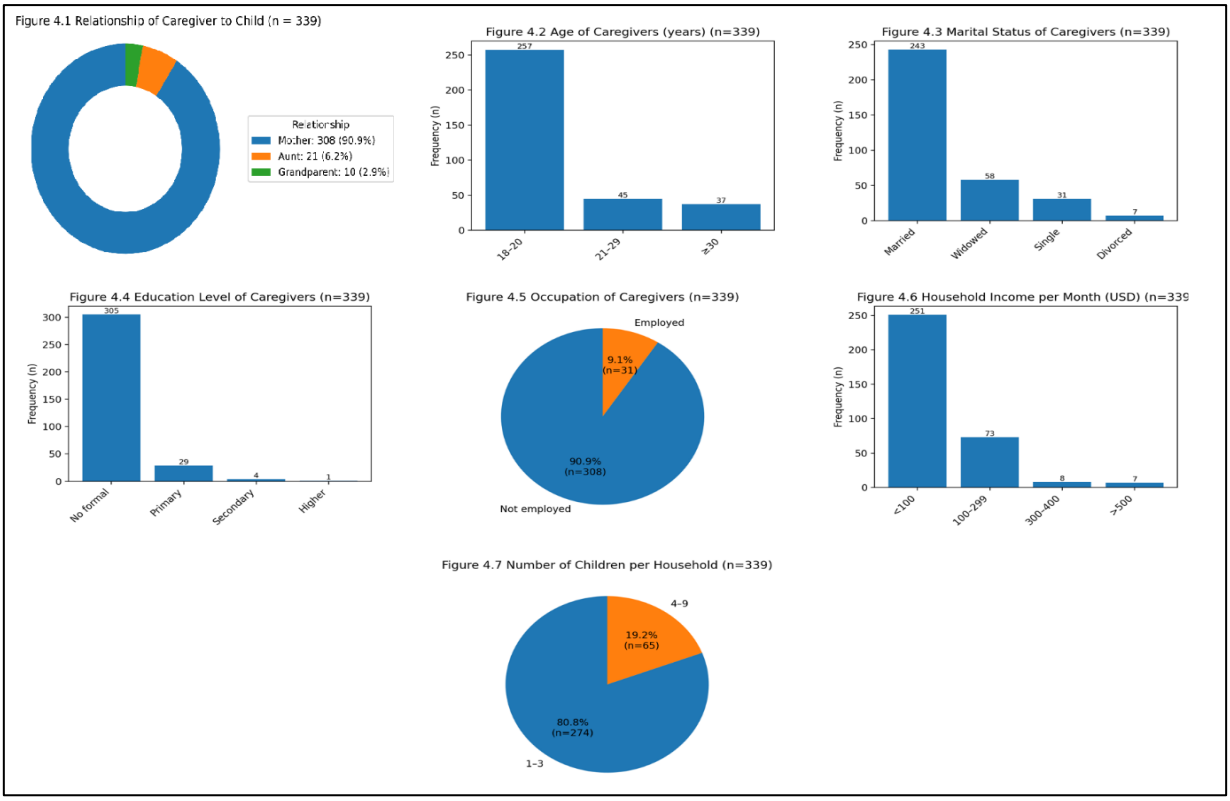

Fig 3 Socio-Demographic of the Caregivers
Source: Field survey data, 2025

As shown in Table 4 and Figure 3, the majority of caregivers were mothers (308; 91.2%). Most caregivers were aged 18–20 years (257; 75.8%) and were married (243; 71.7%). A large proportion of caregivers had no formal education (305; 90.0%) and were not employed (308; 90.9%). The majority of households reported a monthly income of less than USD 100 (251; 74.0%), and most caregivers had between one and three children (274; 80.8%).

➢ *Child Characteristics*

This section presents the characteristics of children under five years of age using frequencies, percentages, and summary descriptive statistics.

Table 6 Child Characteristics of Children Under Five Years

Variable	Category	Frequency (n)	Percentage (%)
Sex of child	Male	235	69.3
	Female	104	30.7
	Total	**339**	**100.0**
Age of child (months)	< 6 months	9	2.7
	6–23 months	213	62.8

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	24–59 months	117	34.5
	> 5 years	0	0.0
	Total	**339**	**100.0**
Birth order	One to three	136	40.1
	Four and above	203	59.9
	Total	**339**	**100.0**
Number of meals per day	One	5	1.5
	Two	314	92.6
	Three	18	5.3
	Four or more	2	0.6
	Total	**339**	**100.0**

Source: Field survey data, 2025

The frequency and percentage distributions presented in Table 4.3 are further summarized using descriptive statistical measures shown in Table 7.

Table 7 Summary Descriptive Statistics of Child Characteristics Ordinal variables were numerically coded for descriptive statistical purposes only.

Variable	N	Mean	Standard Deviation (SD)	Skewness	Mode
Sex of child	339	1.31	0.46	0.84	1
Age of child (months)	339	2.32	0.52	0.20	2
Birth order	339	1.60	0.49	−0.40	2
Number of meals per day	339	2.05	0.31	−0.11	2

Source: Field survey data, 2025

The child characteristics summarized in Tables 6 and 7 are illustrated graphically in Figure 4.

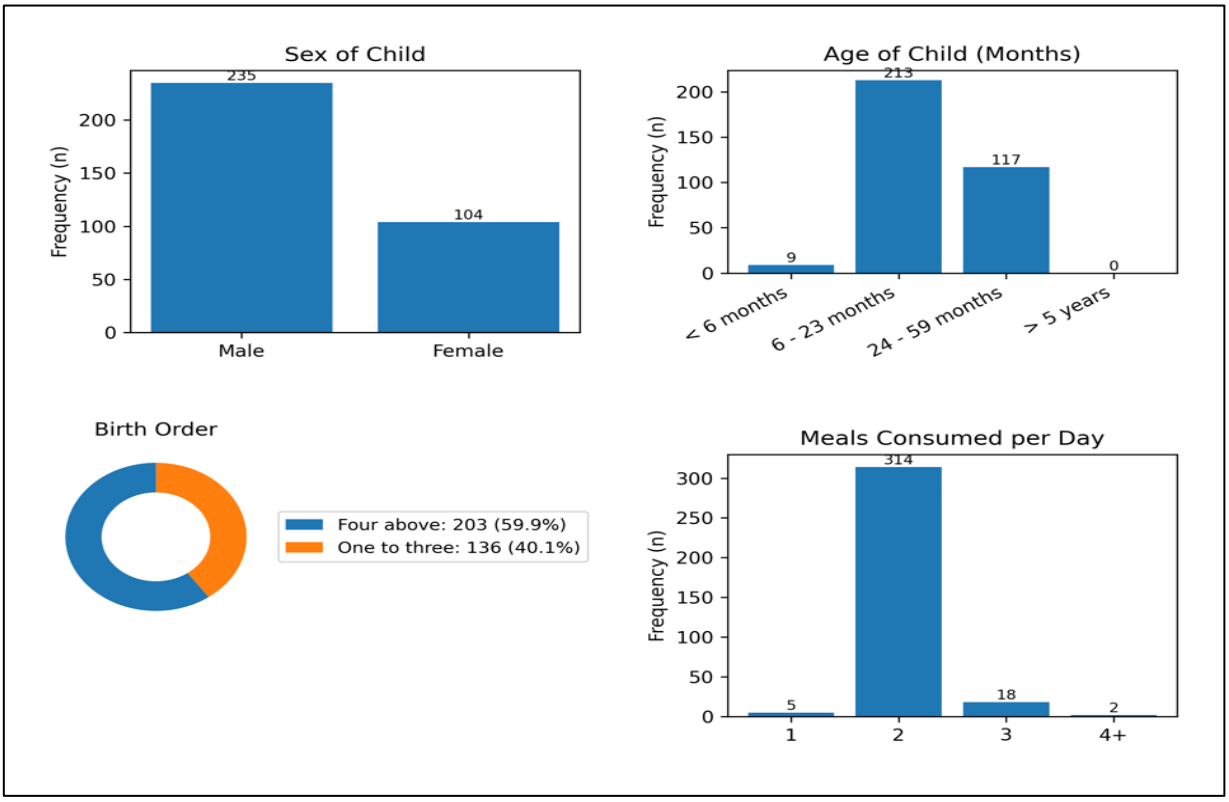

Fig 4 Characteristics of Children Under Five Years
Source: Field survey data, 2025

As shown in Table 7 and illustrated in Figure 4, the majority of children were male (235; 69.3%) and aged 6–23 months (213; 62.8%). Children of higher birth order accounted for 59.9% of the sample, while most children consumed two meals per day (314; 92.6%). The summary descriptive statistics presented in Table 7 further confirm these distributions, with the modal category corresponding to male sex, age group 6–23 months, higher birth order, and consumption of two meals per day.

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➢ *Child Health and Nutritional Characteristics*

This section presents the health and nutritional characteristics of children under five years of age, including history of Severe Acute Malnutrition (SAM), anthropometric status based on MUAC, and morbidity history in the two weeks preceding the survey.

Table 8 Child Health and Nutritional Characteristics

Variable	Category	Frequency (n)	Percentage (%)
History of SAM diagnosis	Yes	328	96.8
	No	11	3.2
	Total	339	100.0
MUAC status	< 11.5 cm	328	96.8
	≥ 11.5 cm	11	3.2
	Total	339	100.0
Morbidity in past two weeks	Diarrhoea	159	46.9
	Cough	93	27.4
	Fever	35	10.3
	Vomiting	26	7.7
	Loss of appetite	16	4.7
	Measles	7	2.1
	Skin infection	3	0.9

Source: Field survey data, 2025

Note: Multiple responses were allowed for morbidity conditions.

The child health and nutritional characteristics presented in Table 8 are further illustrated using graphical representations shown in Figure 5.

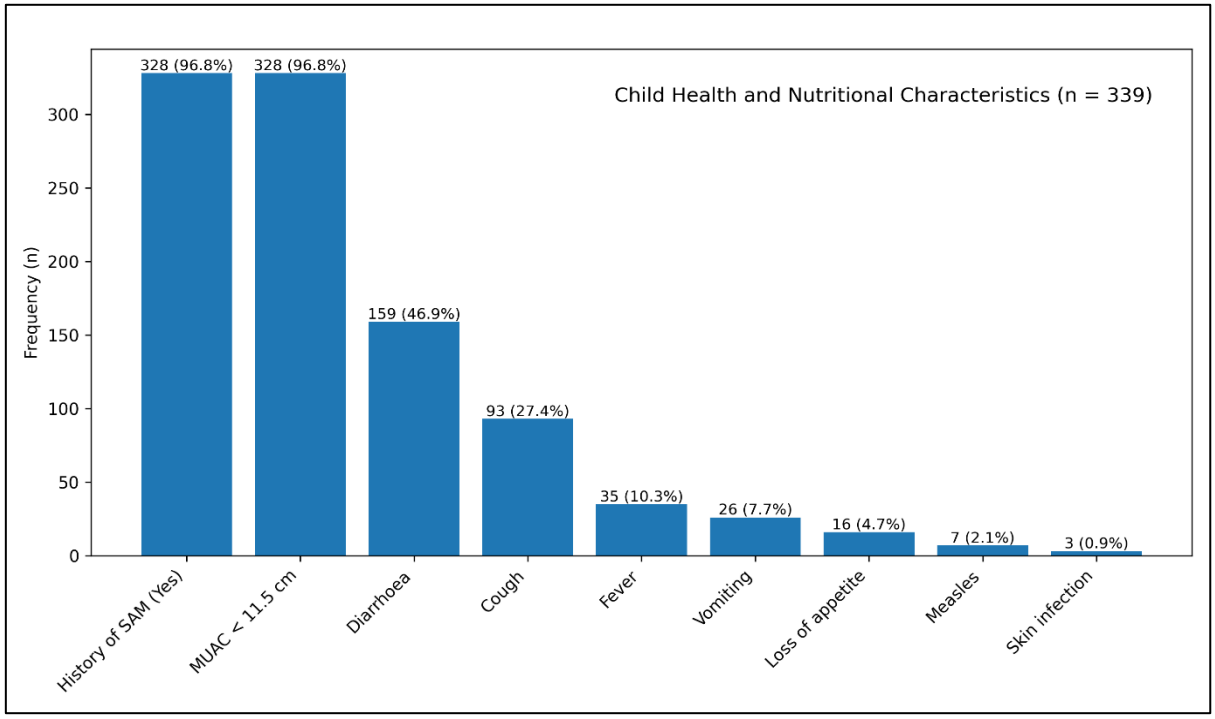

Fig 5 Child Health and Nutrition Characteristics

Source: Field survey data, 2025

As shown in Table 8 and Figure 5, nearly all children had a previous diagnosis of Severe Acute Malnutrition (328; 96.8%), and a similar proportion had a MUAC measurement below 11.5 cm (96.8%). Regarding morbidity in the two weeks prior to the survey, diarrhoea was the most commonly reported condition (159; 46.9%), followed by cough (93; 27.4%) and fever (35; 10.3%). Other reported conditions included vomiting, loss of appetite, measles, and skin infections.

➢ *Infant and Young Child Feeding (IYCF) Practices*

This section presents Infant and Young Child Feeding (IYCF) practices among children under five years of age, including early initiation of breastfeeding, current breastfeeding status, exclusive breastfeeding duration, age at introduction of complementary feeding, dietary diversity, and types of foods commonly consumed.

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Table 9 Infant and Young Child Feeding (IYCF) Practices

Variable	Category	Frequency (n)	Percentage (%)
Early initiation of breastfeeding	Yes	243	71.7
	No	96	28.3
	Total	339	100.0
Currently breastfeeding	Yes	232	68.4
	No	107	31.6
	Total	339	100.0
Duration of exclusive breastfeeding	< 1 month	9	2.7
	1–3 months	23	6.8
	4–5 months	12	3.5
	6 months	295	87.0
	Total	339	100.0
Age at introduction of complementary feeding	< 6 months	3	0.9
	At 6 months	285	84.1
	> 6 months	51	15.0
	Total	339	100.0
Dietary diversity	Grain, roots, tubers	3	0.9
	Legumes/nuts	17	5.0
	Dairy	295	87.0
	Meat/fish	21	6.2
	Fruits/vegetables	3	0.9
Types of food commonly consumed	Porridge	35	10.3
	Milk	259	76.4
	Meat/fish	29	8.6
	Fruits/vegetables	3	0.9
	Legumes/nuts	13	3.8

Source: Field survey data, 2025

Note: Multiple responses were allowed for dietary diversity and types of food consumed.

The IYCF practices presented in Table 9 are further illustrated using graphical representation shown in Figure 6

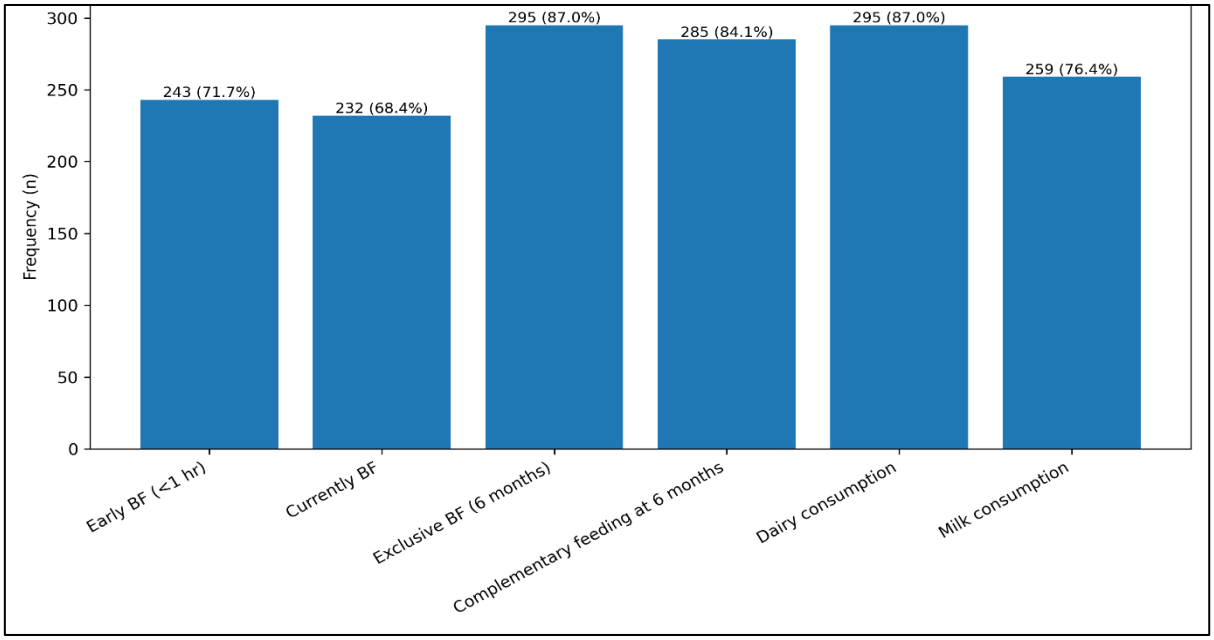

Figure 6 Infant and Young Child Feeding (IYCF) Practices
Source: Field survey data, 2025

As shown in Table 9 and Figure 6, early initiation of breastfeeding was reported among 243 children (71.7%), while 68.4% of children were currently breastfeeding. Most children were exclusively breastfed for six months (295; 87.0%), and complementary feeding was introduced at six months for the majority of children (285; 84.1%). Dairy products and milk were the most commonly reported food groups consumed by children.

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➢ *Maternal Factors*

This section presents maternal factors related to pregnancy and child spacing among caregivers of children under five years of age, including Antenatal Care (ANC) attendance, maternal nutritional status during pregnancy based on MUAC, maternal illness during pregnancy, and birth spacing between the last two children.

Table 10 Maternal Factors of Caregivers

Variable	Category	Frequency (n)	Percentage (%)
ANC attendance during pregnancy	Yes	276	81.4
	No	63	18.6
	Total	339	100.0
Maternal MUAC during pregnancy	< 23 cm	271	79.9
	≥ 23 cm	68	20.1
	Total	339	100.0
Maternal illness during pregnancy	Yes	103	30.4
	No	236	69.6
	Total	339	100.0
Birth spacing between last two children	1–2 years	67	19.8
	2–3 years	272	80.2
	Total	339	100.0

Source: Field survey data, 2025

The maternal factors presented in Table 10 are further illustrated using graphical representation shown in Figure 7.

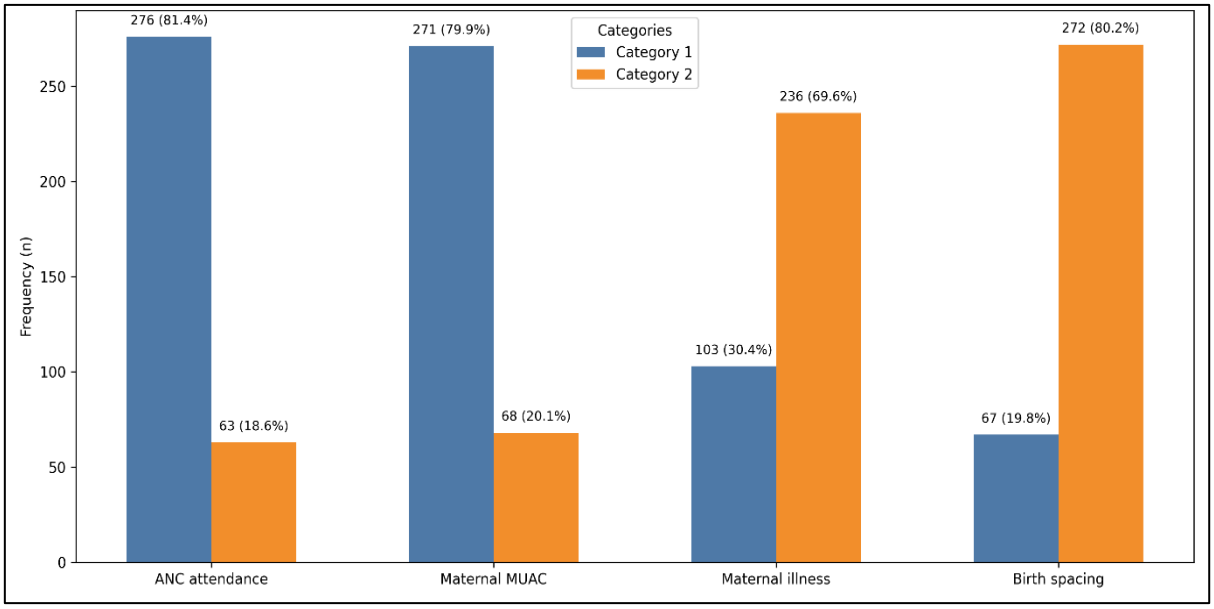

Fig 7 Maternal Factors and Caregivers
Source: Field survey data, 2025

As shown in Table 10 and Figure 7, the majority of mothers attended antenatal care during pregnancy (276; 81.4%). Most mothers had a MUAC measurement below 23 cm during pregnancy (271; 79.9%), while nearly one-third reported experiencing illness during pregnancy (103; 30.4%). Birth spacing of two to three years between the last two children was reported by the majority of caregivers (272; 80.2%).

➢ *Household Food Security and Livelihoods*

This section presents household food security and livelihood characteristics of caregivers of children under five years of age, including the main source of household income, household food security status in the past 30 days, adult food reduction to feed children, and access to food assistance.

Table 11 Household Food Security and Livelihood Characteristics

Variable	Category	Frequency (n)	Percentage (%)
Main source of household income	General food distribution (WFP)	239	70.5
	Farming	45	13.3

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	Fishing	34	10.0
	Business	21	6.2
	Total	339	100.0
Household food security status (past 30 days)	Never	6	1.8
	Rarely	13	3.8
	Sometimes	282	83.2
	Often	38	11.2
	Total	339	100.0
Adult food reduction for children	Yes	318	93.8
	No	21	6.2
	Total	339	100.0
Access to food assistance	Yes	204	60.2
	No	135	39.8
	Total	339	100.0

Source: Field survey data, 2025

As shown in Table 11, the majority of households relied on general food distribution from WFP as their main source of income (239; 70.5%). Most households reported experiencing food insecurity sometimes during the past 30 days (282; 83.2%), while 11.2% reported often experiencing food insecurity. Adult food reduction to feed children was reported by the majority of households (318; 93.8%). Slightly over half of households reported having access to food assistance (204; 60.2%), while 39.8% reported no access.

➢ *Water, Sanitation and Hygiene (WASH) Factors*

This section presents Water, Sanitation and Hygiene (WASH) factors among households of children under five years of age, including the main source of drinking water, water treatment practices, type of toilet facility, and handwashing practices at critical times.

Table 12 Water, Sanitation and Hygiene (WASH) Factors

Variable	Category	Frequency (n)	Percentage (%)
Main source of drinking water	Borehole	113	33.3
	River	195	57.5
	Rainwater	2	0.6
	Open well	29	8.6
	Total	**339**	**100.0**
Water treatment before drinking	Boiling	34	10.0
	Filtering	10	2.9
	Chlorination	6	1.8
	None	289	85.3
	Total	**339**	**100.0**
Type of toilet facility	None / Open defecation	270	79.6
	Pit latrine	69	20.4
	VIP latrine	0	0.0
	Flush toilet	0	0.0
	Total	**339**	**100.0**
Handwashing at critical times	Before eating	23	6.8
	Before feeding child	27	8.0
	After defecation	253	74.6
	After cleaning child's bottom	36	10.6

Source: Field survey data, 2025

Note: Multiple responses were allowed for handwashing practices.

As shown in Table 12, more than half of households relied on river water as their main source of drinking water (195; 57.5%), while one-third used boreholes (113; 33.3%). The majority of households did not treat drinking water before consumption (289; 85.3%). Most households practiced open defecation (270; 79.6%), while only 20.4% reported using pit latrines. Regarding hygiene practices, handwashing after defecation was the most commonly reported critical time (253; 74.6%), while fewer caregivers reported handwashing before eating, before feeding a child, or after cleaning a child's bottom.

➢ *Access to Health Services*

This section presents access to health services among caregivers of children under five years of age, including distance to the nearest health facility, care-seeking for child illness, and reasons for not seeking care.

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Table 13 Access to Health Services

Variable	Category	Frequency (n)	Percentage (%)
Distance to nearest health facility	< 30 minutes	52	15.3
	30–60 minutes	203	59.9
	> 1 hour	84	24.8
	Total	339	100.0
Seeking treatment for child illness (last 3 months)	Yes	108	31.9
	No	231	68.1
	Total	339	100.0
Reasons for not seeking care	Cost	26	7.7
	No transport	230	67.8
	Lack of drugs	83	24.5
	Insecurity	0	0.0

Source: Field survey data, 2025

Note: Multiple responses were allowed for reasons for not seeking care.

The access to health services indicators presented in Table 13 are further illustrated using graphical representations shown in Figure 8.

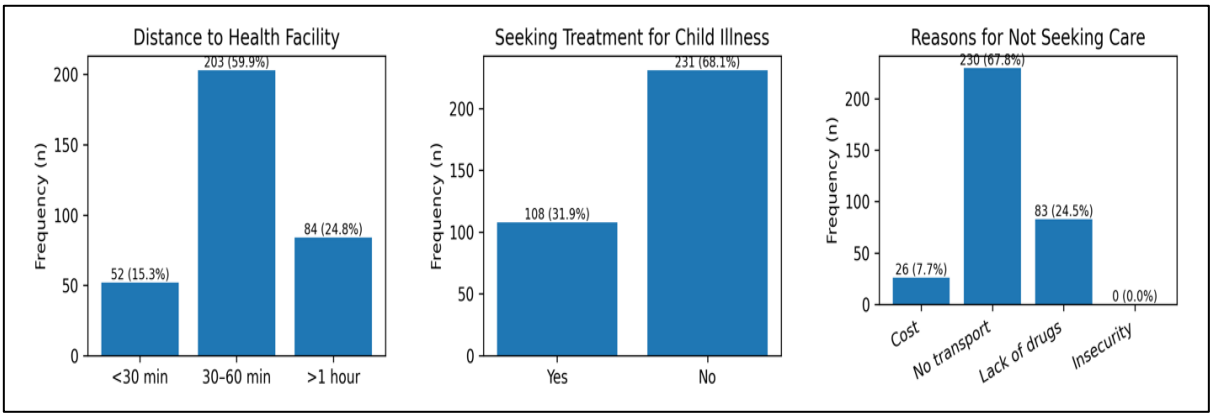

Figure 8 Access to Health Services
Source: Field survey data, 2025

As shown in Table 13 and Figure 8, the majority of caregivers reported traveling between 30 and 60 minutes to reach the nearest health facility (203; 59.9%), while nearly one-quarter required more than one hour (84; 24.8%). Only 31.9% of caregivers reported seeking treatment for child illness in the last three months, whereas 68.1% did not seek care. Among caregivers who did not seek treatment, lack of transport was the most frequently reported reason (230; 67.8%), followed by lack of drugs (83; 24.5%) and cost (26; 7.7%), while insecurity was not reported.

➢ *Health Facility Characteristics (Health Worker Survey, n = 23)*

This section presents findings from the health facility survey conducted among health workers and nutrition staff in selected health facilities in Leer County. The section describes facility characteristics, the burden of Severe Acute Malnutrition (SAM) in health facilities, and the availability of nutrition services.

- *Facility Characteristics*

This subsection describes the type of health facilities included in the study and the staffing composition of the surveyed facilities.

Table 14 Facility Characteristics of Surveyed Health Facilities

Variable	Category	Frequency (n)	Percentage (%)
Type of health facility	Nutrition facility	23	100.0
	Hospital	0	0.0
	PHCC	0	0.0
	PHCU	0	0.0
	Private clinic	0	0.0
Staffing composition	Male	23	100.0
	Female	0	0.0

Source: Field survey data, 2025

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As shown in Table 14, all surveyed facilities were nutrition facilities (23; 100%). The staffing composition showed that all respondents were male health workers (23; 100%), with no female staff reported in the surveyed facilities.

- *SAM Burden in Health Facilities*

This subsection presents the burden of Severe Acute Malnutrition (SAM) in the surveyed health facilities, including SAM admissions, referrals to stabilization centers, and common comorbidities among children with SAM.

Table 15 SAM Burden in Health Facilities

Variable	Category	Frequency (n)	Percentage (%)
SAM admissions in the past three months	Male	233	60.1
	Female	155	39.9
SAM referrals to stabilization centers	Male	29	40.3
	Female	43	59.7
Common SAM comorbidities	Diarrhoea	317	81.7
	Pneumonia	43	11.1
	Malaria	25	6.4
	Anaemia	3	0.8

Source: Field survey data, 2025

Note: Multiple responses were allowed for comorbidities.

As presented in Table 15, male children accounted for a higher proportion of SAM admissions in the past three months (233; 60.1%) compared to female children (155; 39.9%). In contrast, referrals to stabilization centers were more common among female children (43; 59.7%) than male children (29; 40.3%). Diarrhoea was the most frequently reported comorbidity among children with SAM (317; 81.7%), followed by pneumonia, malaria, and anaemia.

- *Availability of Nutrition Services*

This subsection describes the availability of key nutrition services and resources in the surveyed health facilities.

Table 16 Availability of Nutrition Services in Health Facilities

Service	Yes n (%)	No n (%)
OTP services	23 (100.0)	0 (0.0)
TSFP services	23 (100.0)	0 (0.0)
Stabilization center services	23 (100.0)	0 (0.0)
IYCF counseling	23 (100.0)	0 (0.0)
Availability of nutrition supplies (RUTF, antibiotics)	23 (100.0)	0 (0.0)
Availability of trained nutrition staff	23 (100.0)	0 (0.0)

Source: Field survey data, 2025

As shown in Table 16, all surveyed health facilities reported the availability of OTP and TSFP services, stabilization center services, IYCF counseling, essential nutrition supplies, and trained nutrition staff.

➢ *Challenges in Identifying and Managing SAM*

This section presents the challenges faced by health workers and nutrition staff in identifying and managing Severe Acute Malnutrition (SAM) in Leer County. The findings are based on structured qualitative responses obtained from health facility respondents during the health worker survey. Respondents are identified using participant codes (HW = Health Worker).

Health workers reported that limited awareness and inadequate training among frontline health workers and caregivers hinder early identification of SAM cases. Caregivers were reported to have limited understanding of malnutrition as a medical condition requiring timely treatment.

"Many caregivers do not understand the early signs of malnutrition, so children are brought late to the facility." (HW-02)

Another commonly reported challenge was the incorrect use of MUAC tapes and measurement errors, which affected accurate screening and diagnosis of SAM. Respondents indicated that untrained personnel sometimes conducted MUAC measurements incorrectly.

"Sometimes MUAC is not measured correctly, especially by volunteers who have not received enough training." (HW-05)

Health workers also highlighted poor screening coverage, particularly in remote and hard-to-reach areas, including conflict-affected and mobile populations. Limited outreach activities resulted in many children not being screened regularly.

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"Children living far from health facilities are often not reached during routine screening activities." (HW-08)

Weak referral systems were identified as another major challenge. Respondents reported delays in referring identified SAM cases to stabilization centers due to lack of transport and poor coordination.

"Even when we identify SAM cases, referral is sometimes delayed because transport is not available." (HW-11)

Late presentation of children with advanced complications, such as infections, dehydration, or anaemia, was also reported. Health workers indicated that many children arrived at facilities when their condition had already worsened.

"Most children come to the facility when they already have complications, which makes management more difficult." (HW-14)

The stock-out of Ready-to-Use Therapeutic Food (RUTF) and essential medicines was reported as a significant constraint to effective SAM management. Respondents indicated that interruptions in supplies affected continuity of care.

"There are times when RUTF or essential drugs are not available, and this affects how we manage SAM cases." (HW-17)

Long distances to health facilities and limited access to services were highlighted as barriers to care-seeking and follow-up. Respondents noted that caregivers often had to travel long distances, which contributed to treatment defaulting.

"Some caregivers have to walk for many hours to reach the facility, and many stop coming because of the distance." (HW-19)

Insecurity and population displacement were reported to disrupt service delivery and follow-up of SAM cases. Ongoing conflict limited access to some communities and interrupted routine services.

"Insecurity makes it difficult to reach some areas, and services are often interrupted when people are displaced." (HW-21)

Caregiver defaulting from treatment programs was another challenge, often linked to transport costs, time constraints, and limited understanding of the importance of completing treatment.

"Some caregivers default because they cannot afford repeated visits or do not fully understand why treatment must continue." (HW-22)

Respondents reported weak data systems and limited post-discharge follow-up, which affected monitoring and continuity of care.

"Our data systems are weak, and once a child is discharged, follow-up in the community is very limited." (HW-23)

- *Interventions Needed to Reduce SAM in Leer County*

This section presents suggested interventions to reduce Severe Acute Malnutrition (SAM) in Leer County as reported by health workers and nutrition staff during the health facility survey. The findings are based on structured qualitative responses and are organized thematically. Respondents are identified using participant codes (HW = Health Worker).

Health workers emphasized the need to strengthen nutrition surveillance and reporting systems to improve early identification of children at risk of SAM. Respondents indicated that timely and accurate data would support targeted interventions in high-risk communities.

"Strengthening nutrition surveillance will help us identify malnutrition early and respond before children become severely sick." (HW-01)

Improved coordination among government authorities, non-governmental organizations, and United Nations agencies was also identified as a key intervention. Respondents noted that better coordination would reduce duplication of services and improve coverage.

"Better coordination among partners will help us reach more children and avoid duplication of nutrition activities." (HW-04)

Health workers highlighted the importance of promoting Infant and Young Child Feeding (IYCF) practices, particularly exclusive breastfeeding and appropriate complementary feeding. Respondents indicated that caregiver education was essential for

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improving child nutrition outcomes.

"If caregivers are well educated on breastfeeding and complementary feeding, many cases of malnutrition can be prevented." (HW-07)

The need to improve Water, Sanitation and Hygiene (WASH) infrastructure was frequently mentioned. Respondents emphasized that access to safe drinking water and improved sanitation would reduce diarrhoeal diseases linked to malnutrition.

"Improving water and sanitation will reduce diarrhoea, which is one of the main causes of malnutrition." (HW-09)

Health workers also recommended strengthening community-level screening and active case finding, including regular MUAC screening at household and community levels. This was seen as critical for early detection of SAM cases.

"Regular MUAC screening in the community will help us find children with malnutrition before they develop complications." (HW-12)

Ensuring the continuous availability of Ready-to-Use Therapeutic Food (RUTF) and essential medicines was identified as a priority intervention. Respondents noted that uninterrupted supplies were necessary for effective SAM treatment.

"When RUTF and medicines are always available, we can manage SAM cases properly without interruption." (HW-15)

Support for livelihoods and food assistance programs, including general food distribution and targeted supplementary feeding, was also emphasized. Respondents indicated that addressing household food insecurity would reduce the risk of malnutrition and relapse.

"Supporting livelihoods and food assistance will help families feed their children better and prevent malnutrition." (HW-18)

Finally, respondents stressed the importance of improving access to health services, particularly in remote and hard-to-reach areas. Suggested measures included reducing travel distances, expanding outreach services, and strengthening referral systems.

"Improving access to health services will make it easier for caregivers to bring children for treatment on time." (HW-23)

- *Association Between Determinants and Severe Acute Malnutrition*

This section presents the bivariate association between selected child characteristics, household food security factors, Infant and Young Child Feeding (IYCF) practices, and Water, Sanitation and Hygiene (WASH) and health service access factors with Severe Acute Malnutrition (SAM). Associations were assessed using Fisher's Exact Test due to small cell counts among non-SAM children, and crude odds ratios (COR) with 95% confidence intervals were estimated using bivariate logistic regression.

As shown in Table 17 below, child sex, age, birth order, and recent morbidity were not significantly associated with SAM ($p > 0.05$). Household food security status, adult food reduction for children, and access to food assistance also showed no statistically significant association with SAM. Similarly, IYCF practices, including exclusive breastfeeding and timing of complementary feeding, were not significantly associated with SAM. Among WASH and health service access factors, drinking water source, water treatment practices, toilet facility type, and care-seeking for child illness did not show statistically significant associations. However, distance to the nearest health facility was significantly associated with SAM, with children living more than 60 minutes from a health facility having significantly lower odds of being non-SAM compared to those living within 60 minutes (COR = 0.18; 95% CI: 0.05–0.61; $p = 0.006$).

Table 17 Bivariate Association Between Selected Determinants and Severe Acute Malnutrition (SAM)

Variable	Category	SAM n (%)	Non-SAM n (%)	Test	p-value	COR (95% CI)
4.14.1 Child characteristics and SAM						
Child sex	Male	226 (68.9)	9 (81.8)	Fisher's Exact	0.514	0.49 (0.10–2.32)
	Female	102 (31.1)	2 (18.2)			Ref
Child age (months)	<24 months	217 (66.2)	5 (45.5)	Fisher's Exact	0.198	2.35 (0.70–7.86)
	24–59 months	111 (33.8)	6 (54.5)			Ref
Birth order	Four and above	195	8 (72.7)	Fisher's	0.536	0.55 (0.14–2.11)

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		(59.5)		Exact		
	One to three	133 (40.5)	3 (27.3)			Ref
Morbidity (past 2 weeks)	Diarrhoea	154 (47.0)	5 (45.5)	Fisher's Exact	1.000	1.06 (0.32–3.55)
	Other morbidity	174 (53.0)	6 (54.5)			Ref
4.14.2 Household food security and SAM						
Household food security (30 days)	Insecure (Sometimes/Often)	309 (94.2)	11 (100.0)	Fisher's Exact	1.000	0.69 (0.04–12.15)
	Secure (Never/Rarely)	19 (5.8)	0 (0.0)			Ref
Adults reduced food for children	Yes	308 (93.9)	10 (90.9)	Fisher's Exact	0.511	1.54 (0.19–12.64)
	No	20 (6.1)	1 (9.1)			Ref
Access to food assistance	Yes	197 (60.1)	7 (63.6)	Fisher's Exact	1.000	0.86 (0.25–2.99)
	No	131 (39.9)	4 (36.4)			Ref
4.14.3 IYCF practices and SAM						
Exclusive breastfeeding	6 months	285 (86.9)	10 (90.9)	Fisher's Exact	1.000	0.66 (0.08–5.31)
	<6 months	43 (13.1)	1 (9.1)			Ref
Complementary feeding	At 6 months	274 (83.5)	11 (100.0)	Fisher's Exact	0.224	0.22 (0.01–3.77)
	Not at 6 months	54 (16.5)	0 (0.0)			Ref
4.14.4 WASH & health service access and SAM						
Drinking water source	Improved (Borehole)	112 (34.1)	1 (9.1)	Fisher's Exact	0.108	5.19 (0.66–41.02)
	Unimproved	216 (65.9)	10 (90.9)			Ref
Water treatment	Any treatment	328 (100.0)	11 (100.0)	Fisher's Exact	1.000	28.57 (0.54–1504.24)
	None	0 (0.0)	0 (0.0)			Ref
Toilet facility	Pit latrine	65 (19.8)	4 (36.4)	Fisher's Exact	0.244	0.43 (0.12–1.52)
	None/open defecation	263 (80.2)	7 (63.6)			Ref
Distance to health facility	>60 minutes	77 (23.5)	7 (63.6)	Fisher's Exact	0.006	0.18 (0.05–0.61)
	≤60 minutes	251 (76.5)	4 (36.4)			Ref
Sought treatment (last 3 months)	Yes	103 (31.4)	5 (45.5)	Fisher's Exact	0.337	0.55 (0.16–1.84)
	No	225 (68.6)	6 (54.5)			Ref

Source: Field survey data, 2025

Note: Fisher's Exact Test was applied due to small cell counts among non-SAM children. COR = Crude Odds Ratio; CI = Confidence Interval.

➢ *Summary of Key Findings*

This chapter presented the analysis and results of data collected from caregivers of children under five years of age, health workers and community leaders in Leer County. Descriptive findings highlighted high levels of Severe Acute Malnutrition among children, suboptimal household food security, limited access to safe water and sanitation, and challenges in accessing health services. Infant and Young Child Feeding practices, maternal factors, and health facility characteristics were also described. Bivariate inferential analysis identified distance to the nearest health facility as the only factor significantly associated with SAM, while other child, household, feeding, and WASH-related factors showed no statistically significant associations. The next chapter discusses these findings in relation to existing literature, explores possible explanations, and outlines their implications for policy and practice.

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CHAPTER FIVE
DISCUSSION OF FINDINGS

➢ *Introduction*

This chapter discusses the findings of the study in relation to the specific objectives and existing literature. The study sought to analyze the immediate and underlying determinants of Severe Acute Malnutrition (SAM) among children under five years in Leer County, Unity State. The findings are interpreted within the context of the humanitarian crisis, characterized by conflict, displacement, and environmental shocks.

➢ *Discussion of Objective 1: Child Morbidity, Immunization, and SAM*

The study revealed an overwhelmingly high prevalence of Severe Acute Malnutrition (SAM) at 96.8% among the sampled children in Leer County, a finding that underscores the critical severity of the humanitarian crisis in Unity State. This prevalence rate is significantly higher than emergency thresholds, indicating that malnutrition in this context is not merely a seasonal fluctuation but a chronic, structural catastrophe driven by the immediate determinants outlined in the UNICEF Conceptual Framework (UNICEF, 2020). The biological environment in Leer is characterized by a high pathogenic load, where the physiological interaction between infection and nutritional intake determines the child's survival. This finding aligns with the research of Ali et al. (2024), who argue that in protracted conflict zones like South Sudan, the collapse of health infrastructure transforms preventable conditions into life-threatening nutritional crises. Furthermore, Al-Awlaqi et al. (2024) and Ismail et al. (2025) similarly observe that in conflict-affected regions like Yemen and Sub-Saharan Africa, SAM rates rarely exist in isolation but are continuously sustained by a hostile disease environment that depletes children's nutritional reserves faster than they can be replenished. The near-universal presence of SAM in the sample suggests a population-level failure of preventative health mechanisms, confirming the assertions of Lauby-Secretan et al. (2022) that environmental and health system collapse are primary drivers of morbidity in fragile states.

The most significant immediate determinant identified in this study was the high burden of diarrhoeal disease, with 46.9% of children reported to have suffered from diarrhoea in the two weeks preceding the survey. This statistical finding provides strong empirical evidence for the "vicious cycle" of infection and malnutrition, a core concept in public health nutrition. Siziya et al. (2024) demonstrate in their cross-sectional study that diarrhoea is often the strongest independent predictor of SAM, as it damages the intestinal mucosa, leading to malabsorption of nutrients even when food is available. Similarly, Amenu et al. (2023) found in Ethiopia that children with recent diarrhoea had significantly higher odds of acute malnutrition, reinforcing that the physiological cost of fighting enteric infections drives rapid weight loss. In the context of Leer, where Lauby-Secretan et al. (2022) highlight the devastating impact of seasonal flooding on water quality, this high diarrhoeal prevalence suggests that environmental enteropathy is likely a widespread, underlying condition keeping children in a state of chronic inflammation and wasting. The qualitative findings from health workers (HW-09) further corroborate this, noting that "diarrhoea is one of the main causes of malnutrition," linking the biological outcome directly to the environmental failure described by King (2020) in the Political Ecology of Health framework.

Respiratory infections also constitute a major morbidity burden, with 27.4% of children presenting with a cough and 11.1% of facility admissions complicated by pneumonia. Respiratory illnesses increase the metabolic energy requirements of a child at the precise moment their nutritional intake is compromised, creating a severe negative energy balance. WHO (2020) guidelines on the management of SAM emphasize that pneumonia is a leading cause of mortality in wasted children due to their suppressed immune systems and weakened respiratory muscles. Ismail et al. (2024) support this connection, identifying respiratory infections as a key independent predictor of nutritional deterioration in crisis-affected populations. Furthermore, Tufts FIC (2025) notes that in dryland and conflict ecosystems, the convergence of poor housing, overcrowding in displacement camps, and smoke exposure exacerbates respiratory susceptibility. The data from Leer confirms that these children are fighting a multi-front biological war; as Abdelhadi et al. (2024) suggest, measuring these comorbidities is essential because treating the malnutrition without treating the underlying infection—specifically pneumonia—often leads to treatment failure and high mortality rates in conflict zones.

Fever was reported in 10.3% of children, and malaria was identified as a specific comorbidity in 6.4% of SAM admissions, a figure that likely underestimates the true burden due to limited testing capacities reported in the qualitative results. Malaria is uniquely destructive to nutritional status as it causes haemolysis (destruction of red blood cells), leading to severe anaemia, which was also recorded in the facility data. Amenu et al. (2023) highlight that febrile illnesses suppress appetite (anorexia), causing children to refuse food even when it is offered, thereby accelerating muscle wasting. Elsayed et al. (2024) discuss how the psychological trauma of displacement can further complicate care-seeking for febrile children, as caregivers may attribute fever to non-medical causes or lack the agency to seek prompt treatment. The presence of malaria in the sample aligns with the ecological analysis by King (2020), who posits that environmental changes—such as the massive flooding in Unity State—expand vector breeding sites, thereby increasing the infectious disease pressure on already vulnerable children. Ali et al. (2024) further emphasize that in South Sudan, the breakdown of vector control programs during conflict makes malaria a persistent, structural driver of child mortality and malnutrition.

The study revealed concerning gaps in immunization coverage, with 20.9% of children reported as not immunized and an additional 10.6% only partially immunized. This lack of "herd immunity" leaves the population critically vulnerable to outbreaks

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of vaccine-preventable diseases, evidenced by the 2.1% of children who had measles in the past two weeks. According to UNICEF (2020), measles is a "nutritional knockout" disease that can precipitate kwashiorkor (oedematous malnutrition) and severe wasting within days of infection. Ali et al. (2024) attribute such immunization gaps in South Sudan to the "Protracted Conflict," which disrupts cold chains, displaces health workers, and creates inaccessible geographic pockets. The Political Ecology of Health (PEH) framework helps explain this finding: the lack of immunization is not a failure of the mother, but a failure of the state and humanitarian actors to maintain access during instability (King, 2020). Furthermore, Schweiger & Graf (2021) apply the Capability Approach to argue that without a functioning health system to provide vaccines, a caregiver's "capability" to protect her child from preventable disease is effectively nullified, regardless of her knowledge or intent.

Regarding age-specific vulnerability, the study found that the majority of SAM cases (62.8%) were concentrated in the 6–23 month age group. This finding is consistent with global literature identifying the weaning period as the window of highest risk. Siziya et al. (2024) explain that during this transition, children lose the passive immunity provided by breastmilk while simultaneously being introduced to complementary foods that, in settings like Leer, are often contaminated with pathogens from unsafe water. International Medical Corps (2024) specifically highlights that in conflict settings, suboptimal infant feeding practices—such as the early introduction of low-nutrient, contaminated water—are rampant, directly contributing to the high morbidity observed in this age cohort. Amenu et al. (2023) also found that children under 24 months had significantly higher odds of SAM compared to older children, attributing this to the high nutrient density required for rapid growth, which is unmet by the starch-based diets (porridge) identified in this study's descriptive results. This age-specific clustering confirms that interventions must strictly target the "first 1,000 days" window to break the cycle of morbidity and malnutrition (Tufts FIC, 2025).

An important analytical observation in this study was that while morbidity rates were high, the bivariate analysis (Fisher's Exact Test) did not show a statistically significant difference ($p\>0.05$p>0.05) in morbidity prevalence between SAM and non-SAM children. This apparent statistical anomaly is likely due to the extreme saturation of SAM in the sample (96.8%), leaving a control group of only 11 children, which is too small for robust statistical power. However, as Abdelhadi et al. (2024) argue regarding data collection in conflict zones, statistical non-significance does not equate to clinical irrelevance. The qualitative data from health workers strongly contradicts the lack of statistical association, with respondents (HW-14) stating that "most children come to the facility when they already have complications." This aligns with ACF International (2020) guidelines on SMART surveys in high-risk settings, which acknowledge that in catastrophic phases, the distinction between "sick" and "healthy" blurs as the entire population faces overwhelming biological insults. WHO (2023) supports this interpretation, noting that in famine-risk zones, the interaction between disease and malnutrition is ubiquitous, affecting the entire cohort rather than select individuals.

In synthesis, the morbidity findings of this study validate the Political Ecology of Health (PEH) framework by demonstrating that biological outcomes (diarrhoea, pneumonia, SAM) are downstream consequences of structural and environmental violence. King (2020) argues that health inequalities in fragile states are biologically embodied reflections of political failure; in Leer, the conflict has destroyed the water infrastructure and health systems necessary to prevent these diseases. Lauby-Secretan et al. (2022) further elaborate that the "collapse" of environmental health systems leads directly to the pathogen exposure observed in this study. The high rates of infectious disease are not accidental but are intrinsic to the ecology of the crisis. Therefore, as Elsayed et al. (2024) and Wang et al. (2023) suggest, addressing SAM in Leer requires more than therapeutic food; it demands a restoration of the basic public health shield—immunization, vector control, and clean water—that has been eroded by years of instability. The findings confirm that biological morbidity is the "engine" driving the high SAM prevalence, fueled by the structural determinants of the conflict context.

- *Discussion of Objective 2: Household Food Security and Livelihoods*

The study findings paint a stark picture of livelihood collapse, with 70.5% of households relying on General Food Distribution (WFP) as their primary source of income, a figure that signals a near-total breakdown of traditional self-reliance mechanisms. This extreme dependency aligns directly with the Political Ecology of Health (PEH) framework, as described by King (2020), which posits that in fragile states, food insecurity is not merely a climatic event but a structural outcome of political violence that strips communities of their assets. Ali et al. (2024) confirm that in South Sudan, protracted conflict systematically targets agricultural production, forcing agrarian communities into a state of "enforced dependency" on humanitarian aid. Furthermore, FAO (2024) reports that in conflict-affected regions, the destruction of markets and displacement of farming populations lead to a structural food deficit that cannot be bridged by local production alone. The fact that only 13.3% of households in Leer engaged in farming—despite it being a traditional livelihood—demonstrates the massive displacement effect described by Elsayed et al. (2024), where insecurity prevents access to arable land, leaving humanitarian aid as the only lifeline against famine.

The severity of household food insecurity is further evidenced by the finding that 93.8% of households reported that adults reduce their food intake so that children can eat. This is a severe, late-stage coping strategy typically observed in Phase 4 (Emergency) or Phase 5 (Catastrophe) of the IPC classification. Ismail et al. (2025) argue that the adoption of such extreme coping mechanisms is a definitive indicator of "coping capacity exhaustion," where households have already sold off productive assets and are now compromising their own biological survival to protect the next generation. Al-Awlaqi et al. (2024) similarly observed in Yemen that maternal buffering—where mothers skip meals for children—is highly prevalent in conflict zones but ultimately unsustainable, as it leads to maternal malnutrition, which in turn compromises breastfeeding and caregiving capacity. The high

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prevalence of this behavior in Leer suggests that the Household Hunger Score (HHS), used by Amenu et al. (2023) as a key predictor, is reflecting a critical lack of food quantity at the household level, creating a nutritional environment where SAM is an inevitable outcome for the youngest and most vulnerable members.

Despite the heavy reliance on food aid, the study revealed a critical lack of dietary diversity, with children's diets dominated by milk (76.4%) and porridge (10.3%), while consumption of nutrient-dense foods like fruits, vegetables, and meat was negligible (meat/fish at 6.2%; fruits/veg at 0.9%). This monotonous diet is a classic hallmark of "hidden hunger" or micronutrient deficiency, which Tufts FIC (2025) identifies as a silent driver of mortality in dryland crises. Ismail et al. (2024) found that low dietary diversity is a strong, independent predictor of acute malnutrition because a starch-based diet fails to provide the zinc, iron, and Vitamin A required for immune function and growth. The reliance on WFP rations—typically cereals and oil—explains the high porridge consumption but highlights a critical gap in the humanitarian basket regarding fresh foods. International Medical Corps (2024) emphasizes that in displacement settings, the inability to access fresh markets results in diets that sustain life (calories) but do not support health (nutrients), trapping children in a cycle of weak immunity and recurrent illness.

The environmental context of Leer, characterized by seasonal flooding, acts as a "threat multiplier" that exacerbates food insecurity. The qualitative findings (Table 3) indicated that households resort to gathering wild foods like water lilies during the lean season. Lauby-Secretan et al. (2022) discuss the "Political Economy of Environmental Collapse," noting that when conflict destroys resilience, communities are left exposed to environmental shocks that would otherwise be manageable. In Leer, the flooding destroys the few crops that are planted (as noted by 84.1% of respondents in the qualitative data mentioning "Climate shocks"), wiping out the localized food supply. FAO (2024) corroborates this, stating that climate shocks in conflict zones create a "double burden" of vulnerability. Ismail et al. (2025) further elaborate that reliance on wild foods is often a desperate measure that carries its own risks, as water lilies harvested from contaminated floodwaters can introduce enteric pathogens, linking the food security objective back to the morbidity findings in Objective 1.

The economic data revealed that 74.0% of households earn less than $100 per month, placing them in extreme poverty. This lack of purchasing power means that even if food is available in local markets, it remains economically inaccessible to the majority. Amartya Sen's Capability Approach, as applied by Wang et al. (2023), explains that food security is a function of "entitlements"—what a family can command through exchange. In Leer, the conflict has destroyed economic entitlements (jobs, livestock), leaving families with no "conversion factors" to translate market availability into household access. Siziya et al. (2024) found that low household income is consistently associated with higher rates of SAM because it forces families to purchase cheaper, less nutritious staples rather than diverse foods. Elsayed et al. (2024) add that the psychological impact of such poverty—the constant stress of survival—erodes caregiver agency, making it difficult to plan meals or prioritize child nutrition over immediate hunger relief.

The study found a disconnect between "Access to Food Assistance" (60.2% reporting access) and "Food Security Status," with 83.2% still reporting food insecurity "Sometimes." This suggests that while aid is reaching many, it is either insufficient in quantity, irregular in timing, or being shared among too many dependents. ACF International (2020) notes that in complex emergencies, "pipeline breaks" and logistical challenges often mean that rations intended for one month must stretch for two or three. Ali et al. (2024) highlight that in South Sudan, aid diversion and the "taxes" imposed by armed actors at checkpoints often reduce the actual amount of food that reaches the household pot. This finding supports the PEH perspective that humanitarian aid is part of the political economy of the conflict; its distribution is shaped by power dynamics and access constraints (King, 2020). Therefore, the mere presence of WFP distribution does not guarantee nutritional security for the child, as the ration is diluted by the immense need of the surrounding community.

The low prevalence of fishing (10.0%) as a primary income source is a surprising and concerning finding given Leer's location in the Sudd wetland. Qualitative respondents indicated that "insecurity restricts farmers' movement to fishing grounds," providing a clear example of how conflict structurally limits access to natural resources. Lauby-Secretan et al. (2022) describe this as "resource alienation," where violence disconnects a population from its local ecology. FAO (2024) emphasizes that in riverine areas of South Sudan, fishing is typically the "last resort" livelihood that prevents famine; its suppression by insecurity removes a critical safety net. Tufts FIC (2025) argues that restoring access to these traditional food sources is often more sustainable than food aid, but it requires a security environment that currently does not exist. The inability to fish deprives children of a key source of high-quality protein and fatty acids, directly contributing to the low dietary diversity scores observed.

Finally, the study's findings on food security must be interpreted as a failure of "resilience." The fact that 96.8% of the children in this food-insecure environment had SAM confirms that the household buffering capacity has been completely overwhelmed. Schweiger & Graf (2021) argue from an ethical perspective that when families are forced to choose between feeding adults or children (as seen in the 93.8% adult reduction rate), the "capability" to live a dignified life has been violated. Amenu et al. (2023) and Ismail et al. (2024) both conclude that in such settings, nutrition interventions cannot be effective if they are isolated from livelihood support. Treating a child for SAM and sending them back to a household that relies on water lilies and irregular aid rations creates a "revolving door" of readmission. The data confirms that SAM in Leer is fundamentally a symptom of livelihood collapse, where the political and environmental determinants described by King (2020**)** and Ali et al. (2024) have systematically dismantled the community's ability to feed itself.

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➢ *Discussion of Objective 3: IYCF Practices and Caregiver Knowledge*

The study demonstrated a seemingly paradoxical finding regarding Infant and Young Child Feeding (IYCF) practices: while a high proportion of mothers (71.7%) initiated breastfeeding within the first hour of birth, this early success was severely undermined by harmful cultural beliefs and suboptimal complementary feeding practices later in infancy. This high initiation rate aligns with findings from ACF International (2020) in similar humanitarian contexts, suggesting that initial breastfeeding is a culturally ingrained norm. However, International Medical Corps (2024) warns that initiation rates can be misleading if not sustained by exclusive breastfeeding (EBF). The drop-off in optimal practices is evident in the qualitative data, where key informants revealed a widespread belief that colostrum is "dirty" or "old milk" and should be discarded. This practice, described as "prelacteal discarding" by WHO (2020), deprives the newborn of their first immunization—a concentrated dose of antibodies and nutrients critical for survival in a high-pathogen environment. Siziya et al. (2024) emphasize that in settings with high infectious disease burdens like Leer, the loss of colostrum protection significantly increases neonatal vulnerability to sepsis and diarrhoea, directly linking this cultural practice to the high morbidity rates discussed in Objective 1.

A critical barrier to Exclusive Breastfeeding (EBF) identified in the qualitative findings was the practice of giving water to infants under six months due to the belief that the "climate is too hot" for breastmilk alone. This misconception is a well-documented determinant of malnutrition in arid regions. Tufts FIC (2025) explains that introducing water not only displaces breastmilk—reducing the child's caloric and nutrient intake—but also introduces pathogens, as the water sources in Leer (rivers/swamps) are highly contaminated. Amenu et al. (2023) found that non-exclusive breastfeeding was a significant predictor of acute malnutrition (AOR 4.65) precisely because of this "displacement and contamination" effect. Wang et al. (2023) apply the Capability Approach to analyze this, arguing that a mother's "capability" to practice EBF is constrained by her knowledge environment; if the community elders insist that a baby needs water to survive the heat, the mother's agency to resist is limited. Thus, the 87% "reported" EBF rate in the quantitative data is likely an overestimation, contradicted by the qualitative reality of water supplementation.

The transition to complementary feeding at six months marks a period of extreme vulnerability, often referred to as the "weaning dilemma." The study found that while 84.1% of caregivers introduced food at six months, the quality and frequency of this food were critically insufficient. The majority of children (92.6%) received only two meals per day, falling well below the WHO recommendation of 3-4 meals for breastfed children and 5 for non-breastfed children (WHO, 2023). Ismail et al. (2024) identify "minimum meal frequency" as a stronger predictor of growth than food quantity alone. In a context where the food is low-density (porridge), infrequent feeding makes it physically impossible for a child to consume enough calories to prevent wasting. Elsayed et al. (2024) attribute this low frequency to the "time poverty" of caregivers in conflict zones; mothers are often forced to spend hours foraging, queuing for aid, or fetching water, leaving them with insufficient time to prepare multiple meals a day. This structural constraint highlights that poor feeding is often not a result of neglect, but of the overwhelming logistical burden placed on displaced women.

Dietary diversity during the complementary feeding period was alarmingly poor, with diets dominated by milk (76.4%) and porridge (10.3%), and a negligible intake of fruits/vegetables (0.9%) and legumes (5.0%). This finding points to a critical gap in the "Minimum Acceptable Diet" (MAD). International Medical Corps (2024) notes that in South Sudan, the cultural reliance on milk is high, but milk alone is insufficient to meet the iron and zinc needs of a rapidly growing child over six months. The lack of animal-source protein (meat/fish at 6.2%) and Vitamin A-rich vegetables creates a "hidden hunger" that stunts immune development. Ali et al. (2024) link this directly to the conflict context: when markets collapse and livestock are looted, the localized food system simplifies to the bare minimum survival ration. Tufts FIC (2025) argues that addressing SAM requires a "nutrient-dense" approach; treating a child with RUTF is effective, but returning them to a home diet of plain sorghum porridge guarantees relapse because the underlying micronutrient deficit is never resolved.

Maternal malnutrition was identified as a profound underlying determinant, with 79.9% of mothers having a MUAC < 23 cm. This intergenerational cycle of malnutrition is a key concept in the UNICEF Framework (UNICEF, 2020). A malnourished mother has reduced physiological reserves to support lactation, and while breastmilk quantity is often resilient, maternal depletion affects the mother's physical energy to care for the child. Schweiger & Graf (2021) argue that maternal wellbeing is a prerequisite for child health; a mother who is herself wasting (as indicated by the high adult food reduction rate of 93.8%) is operating in survival mode. Al-Awlaqi et al. (2024) found in Yemen that maternal malnutrition was the strongest predictor of child SAM, suggesting that the "dyad" (mother and child) must be treated as a single biological unit. In Leer, the failure to provide maternal nutritional support (supplementary feeding for PLW) means that the primary caregiver is biologically compromised, limiting her "capability" to perform optimal IYCF practices regardless of her intent.

Caregiver education levels were starkly low, with 90.0% of respondents having no formal education. This structural deficit acts as a barrier to the uptake of health messages. Amenu et al. (2023) consistently find that maternal education is a protective factor against SAM because educated mothers are better able to navigate complex health information, advocate for their children, and adopt modern hygiene practices. In the absence of formal schooling, traditional beliefs (like the "dirty milk" myth) remain unchallenged. Nussbaum (2020) emphasizes that education is a central "conversion factor" in the Capability Approach; without it, a mother cannot convert available resources (like WFP rations) into optimal health outcomes. The reliance on "Mother-to-Mother Support Groups" reported in the intervention data (HW-07) is therefore critical, as peer education is the only viable mechanism to

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bypass the literacy barrier and introduce positive deviance behaviors in such a setting (International Medical Corps, 2024).

The social structure of caregiving in Leer is heavily impacted by the conflict, evidenced by the high rate of widowhood (17.1%) and the dominance of young mothers aged 18–20 (75.8%). This demographic profile suggests a disruption of the traditional family support system. Elsayed et al. (2024) discuss the "psychosocial toll" of caregiving in conflict, noting that young, single, or widowed mothers face immense stress and lack the "allocative power" to make decisions about household resources. King (2020) views this through the Political Ecology of Health lens: conflict kills men and displaces elders, leaving young women to manage households alone. This loss of social capital means there is no one to support the mother while she breastfeeds, or to help fetch water, forcing her to compromise on care practices. Siziya et al. (2024) confirm that single-parent households in crisis settings have consistently worse nutritional outcomes due to this "care deficit."

Finally, the disconnect between knowledge and practice must be understood as a failure of the humanitarian environment to support maternal agency. While health workers (Table 13) reported that 100% of facilities provide IYCF counseling, the persistence of harmful practices suggests that "information dissemination" is not enough. Wang et al. (2023) argue that knowledge without the resources to act is useless. A mother may know she should breastfeed exclusively, but if she has to walk 4 hours for food aid, she may leave the child with a sibling and a bottle of water. ACF International (2020) calls this the "knowledge-behavior gap." The findings from Leer confirm that IYCF failures are not just cultural but structural; the extreme poverty (74% <$100), displacement, and workload impose hard constraints on a mother's ability to follow WHO guidelines. Therefore, interventions must move beyond "teaching" mothers to "supporting" them through cash transfers, water points, and psychosocial support to restore their capability to care (Schweiger & Graf, 2021).

- *Discussion of Objective 4: WASH Access and Health Service Utilization*

The findings regarding Water, Sanitation, and Hygiene (WASH) reveal a catastrophic failure of environmental health infrastructure, which stands as a primary structural driver of the high morbidity and malnutrition rates observed in Leer County. The study found that 79.6% of households practice open defecation, a figure that represents a total collapse of sanitation systems. This finding aligns with the Political Ecology of Health (PEH) framework, where King (2020) argues that in fragile states, the absence of basic sanitation is not a behavioral choice but a consequence of state failure and conflict-induced destruction of infrastructure. Lauby-Secretan et al. (2022) further emphasize that in flood-prone areas like Unity State, open defecation is particularly lethal because floodwaters mobilize fecal pathogens, contaminating the entire environment. The direct link between this "fecal veneer" and the 46.9% diarrhoea prevalence (Objective 1) is biologically indisputable; Siziya et al. (2024) confirm that children living in households without latrines have significantly higher odds of stunting and wasting due to environmental enteropathy, a chronic intestinal inflammation caused by constant fecal exposure.

Access to safe water was found to be critically low, with 57.5% of households relying on river or swamp water as their main drinking source, and only 33.3% accessing boreholes. Even more concerning is the finding that 85.3% of households do not treat their water before drinking. Ali et al. (2024) identify the destruction of boreholes as a specific tactic of war in South Sudan, designed to displace populations by making areas uninhabitable. The reliance on surface water in a region endemic for cholera creates a direct transmission vector for malnutrition. Amenu et al. (2023) found that using unimproved water sources was an independent predictor of SAM (AOR 3.45), reinforcing that water quality is a nutritional determinant. WHO (2023) guidelines state that nutritional recovery is impossible if the child continues to ingest pathogens with every sip of water. In Leer, the "biological utilization" of food—a pillar of food security—is fundamentally compromised by the water crisis, meaning that WFP food rations are being consumed by children whose gut absorption is impaired by waterborne disease (Tufts FIC, 2025).

The study revealed a significant physical barrier to health access, with 24.8% of caregivers living more than one hour away from the nearest health facility, and 59.9% traveling between 30 and 60 minutes. The bivariate analysis identified distance to health facility as the only statistically significant predictor of SAM status ($p = 0.006$p=0.006), confirming that physical proximity is a matter of life and death. Abdelhadi et al. (2024) argue that in conflict zones, "distance" is not just measured in kilometers but in risk; traveling for an hour exposes caregivers to insecurity, violence, and difficult terrain. The qualitative data (N=32) highlighted that flooding renders many roads impassable, effectively cutting off communities from life-saving care. Ismail et al. (2025) describe this as "access constraint," a key feature of humanitarian crises where services exist theoretically but are unreachable practically. The fact that 67.8% of caregivers cited "No transport" as a reason for not seeking care underscores the isolation of these communities.

Health seeking behavior was alarmingly low, with 68.1% of caregivers reporting that they did not seek treatment for their child's illness in the last three months, despite the high morbidity rates. This disconnect suggests a profound "demand-side" barrier. Elsayed et al. (2024) apply the Capability Approach to explain that trauma, depression, and loss of hope can lead to "resignation syndrome," where mothers stop seeking care because they believe the outcome is inevitable or the effort is futile. Furthermore, Schweiger & Graf (2021) note that in protracted crises, the "opportunity cost" of seeking health care is too high; a mother cannot afford to spend a whole day walking to a clinic if it means missing a food distribution or failing to fetch water for the rest of the family. This finding challenges the assumption that if clinics are built, people will come; in Leer, structural constraints prevent utilization even when need is extreme.

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On the "supply side," the health facility assessment revealed a critical failure in the availability of essential commodities. Health workers reported 100% stock-outs of RUTF and essential drugs (antibiotics/antimalarials) in the past three months. This supply chain rupture is a devastating finding. ACF International (2020) emphasizes that the "continuity of care" is the single most important factor in SAM management; if a mother walks two hours to a clinic only to be told there is no Plumpy'Nut (RUTF), she loses trust in the system and is unlikely to return. Ali et al. (2024) attribute these stock-outs to the "logistical friction" of conflict, where roadblocks and looting prevent medical convoys from reaching remote outposts. This system failure creates a "phantom coverage," where facilities exist on a map but are functionally non-operative. International Medical Corps (2024) warns that distributing food without medical support is ineffective for SAM cases with medical complications; the lack of antibiotics means the underlying infections (pneumonia/diarrhoea) go untreated, leading to high mortality.

The intersection of WASH and Health infrastructure is evident in the qualitative reports of "poor sanitation and unsafe water leading to recurrent infection" (Table 3). Health facilities themselves are often overwhelmed by the environmental load. Lauby-Secretan et al. (2022) note that when health facilities lack their own WASH infrastructure (clean water/latrines for patients), they can become sites of nosocomial infection, spreading cholera among already malnourished children. While the facility survey indicated 100% staff training, the lack of physical resources (drugs/water) neutralizes the staff's "capability" to treat patients. Wang et al. (2023) argue that a health system consists of "stuff, staff, space, and systems"; in Leer, the "staff" are present (males only, 100%), but the "stuff" (drugs) and "systems" (logistics) are broken.

The reliance on traditional healers (2.7%) and the fact that 85.3% of households use no water treatment suggests a gap in health promotion and behavioral change communication. However, Nussbaum (2020) warns against "victim blaming" in such contexts. The failure to treat water is likely not due to ignorance but due to the unavailability of chlorine tablets or fuel for boiling. Siziya et al. (2024) found that "knowledge" of hygiene does not translate to "practice" without the enabling hardware (soap, buckets, tabs). The low rate of handwashing before feeding the child (8.0%) is a critical hygiene gap, but it must be interpreted within the context of water scarcity. If a mother has to walk hours to fetch river water, she will ration it for drinking rather than "wasting" it on handwashing. Thus, the WASH failure is primarily a resource crisis, not a behavioral one.

In conclusion, the findings on Objective 4 confirm that the "enabling environment" for nutrition in Leer has collapsed. The high SAM rate is structurally maintained by the lack of toilets (79% open defecation), the lack of clean water (57% river use), and the lack of reliable medical care (100% drug stock-outs). King (2020) summarizes this as the "ecology of malnutrition," where the biological organism (the child) cannot thrive because the supporting ecosystem (water, sanitation, health services) has been destroyed. Tufts FIC (2025) argues that humanitarian response often prioritizes food over WASH because food is more visible/political, but this data proves that WASH is the "missing link." Until the fecal-oral transmission route is broken and health clinics are reliably stocked, therapeutic feeding will remain a "band-aid on a gaping wound," treating the symptom (wasting) while the cause (environmental enteropathy and infection) persists unchecked.

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CHAPTER SIX
SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

➢ *Summary of the Study*

This study examined the immediate and underlying determinants of Severe Acute Malnutrition (SAM) among children under five in Leer County, Unity State, South Sudan, using a cross-sectional mixed-methods approach. Data were collected from 339 caregivers, 23 health workers, and 12 community leaders, achieving a 100% response rate.

The findings revealed that the study population is highly vulnerable, with most caregivers being young mothers, 90% having no formal education, and 74% of households earning less than USD 100 per month. High rates of widowhood further reflected the effects of prolonged conflict and weakened family support systems.

The study found an extremely high prevalence of SAM, closely linked to frequent childhood illnesses, particularly diarrhoea and cough, as well as gaps in immunization coverage. Household food insecurity was severe, with most families depending on food aid and consuming diets with very limited diversity, increasing the risk of micronutrient deficiencies.

Although many mothers reported initiating breastfeeding within the first hour after birth, harmful cultural practices, such as discarding colostrum and giving water to infants before six months, undermined optimal infant feeding. Maternal malnutrition was also widespread, reducing mothers' ability to provide adequate care.

Poor water, sanitation, and hygiene (WASH) conditions, including widespread open defecation and reliance on unsafe drinking water, contributed significantly to the high burden of diarrhoeal diseases. In addition, limited physical access to health facilities and frequent shortages of therapeutic foods and essential medicines further constrained the management of malnutrition.

Overall, the study concludes that SAM in Leer County is driven by the combined effects of poverty, food insecurity, poor infant feeding practices, recurrent childhood illnesses, inadequate WASH conditions, and weak access to essential health and nutrition services.

➢ *Conclusion*

Based on the comprehensive analysis of the data, this study concludes that the crisis of Severe Acute Malnutrition (SAM) in Leer County is not merely a consequence of temporary food shortages, but the outcome of a systemic and structural collapse of the fundamental determinants of health. The overwhelming prevalence of SAM (96.8%) within the study population validates the UNICEF Conceptual Framework, confirming that malnutrition in this context is driven by a lethal synergy between immediate biological insults (disease) and underlying environmental failures (WASH and food insecurity). However, beyond the biological mechanisms, the findings strongly support the Political Ecology of Health perspective: the nutritional status of children in Leer is a biological embodiment of the protracted conflict, which has systematically dismantled livelihoods, infrastructure, and social support systems.

First, the study concludes that the "Vicious Cycle" of infection and malnutrition is the primary engine driving SAM in this population. The alarmingly high prevalence of diarrhoea (46.9%) and cough (27.4%) indicates that children are in a constant catabolic state, where nutrient intake is rapidly depleted by the immune response to infection. This biological failure is inextricably linked to the environmental collapse observed in the study. With 79.6% of households practicing open defecation and 57.5% consuming untreated river water, the environment in Leer acts as a continuous reservoir of pathogens. Consequently, the study posits that nutritional recovery is functionally impossible under current conditions; providing therapeutic food (RUTF) to a child who continues to ingest fecal pathogens via unsafe water is a palliative measure that treats the symptom while ignoring the root cause.

Second, the findings demonstrate a collapse of resilience and self-reliance. The dependency on General Food Distribution (WFP) by 70.5% of households, coupled with the near-total absence of farming (13.3%), indicates that the conflict has severed the population’s connection to their traditional productive assets. While humanitarian aid is currently preventing famine mortality, the diet provided is insufficient to prevent malnutrition, as evidenced by the lack of dietary diversity and the severe coping strategy of adults reducing their own food intake (93.8%). This confirms the existence of widespread "hidden hunger" (micronutrient deficiency), which further compromises immune systems and renders children more susceptible to the diseases mentioned above.

Third, the study identifies a critical failure of the health system’s supply side, which undermines maternal agency. While mothers are attempting to access care—often travelling long distances through floodwaters—the health system is unable to reciprocate this effort due to chronic resource shortages. The finding of 100% stock-outs of RUTF and essential drugs represents a breach of the humanitarian contract. According to the Capability Approach, a mother cannot be held responsible for her child’s health if the institutional "conversion factors" (clinics, drugs, clean water) are absent. Furthermore, persistent cultural barriers, such as the discarding of colostrum, highlight a gap in soft power (education and counseling) that is as critical as the gap in hard resources.

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In summary, SAM in Leer County is a multi-sectoral failure. It is the result of a broken water system, a broken food system, and a broken health supply chain, all exacerbated by the overarching structural violence of conflict and seasonal flooding. Therefore, the study concludes that a siloed approach—where nutrition partners focus only on feeding, and WASH partners focus only on wells—will not succeed. Sustainable reduction in SAM requires an integrated intervention strategy that aggressively targets the sanitation-disease link while restoring the supply chain reliability that is essential for treating the inevitable comorbidities of malnutrition.

➢ *Limitations of the Study*

The primary limitation of this study was the extreme skew in the sample population, with 96.8% of children being classified as SAM. This lack of a robust control group (non-SAM children) limited the statistical power of the inferential analysis, resulting in wide confidence intervals and few statistically significant associations. Additionally, the study relied on caregiver recall for morbidity and feeding practices, which may introduce recall bias. Finally, data collection occurred during a specific season (likely the lean/flood season), which may not represent food security conditions during the harvest period.

➢ *Recommendations*

Based on the study findings, the following recommendations are made:

- *To the Ministry of Health and Nutrition Cluster*

✓ Strengthen Supply Chain Management: Immediate action must be taken to establish buffer stocks of RUTF and essential antibiotics to prevent the 100% stock-out rates reported.
✓ Mobile Nutrition Clinics: Given the finding that distance and lack of transport are major barriers (67.8%), mobile outreach teams should be deployed to reach remote populations cut off by flooding.

- *To the WASH Cluster*

✓ Emergency Water Treatment: Since 85% of households drink untreated river water, there should be an immediate mass distribution of water treatment chemicals (Aquatabs/PUR) accompanied by usage training.
✓ Sanitation Interventions: Implement Community-Led Total Sanitation (CLTS) focused on building flood-resistant elevated latrines to reduce the 79.6% open defecation rate.

- *To Humanitarian Partners and NGOs*

✓ Livelihood Diversification: To reduce the 70% reliance on WFP grain, partners should provide fishing kits and vegetable seeds to improve dietary diversity (currently lacking fruits/meat).
✓ Social and Behavioral Change Communication (SBCC): Targeted community dialogues should be initiated to address harmful cultural beliefs, specifically the discarding of colostrum and the introduction of water to infants under six months.

- *Suggestions for Further Research*

✓ A longitudinal study comparing SAM rates between the dry and wet seasons is recommended to quantify the specific attributable risk of seasonal flooding.
✓ Qualitative research investigating the mental health of caregivers, particularly widows, to understand how trauma affects maternal agency and child care practices.

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Texila American University

Research Topic: ‘*’An analysis of immediate and underlying determinants of Severe Acute Malnutrition (SAM) among children under five in Leer County’’*.

Below are three structured research questionnaires use to collect data on immediate and underlying determinants of severe Acute Malnutrition SAM among children under five in Leer County aimed to collect comprehensive data on (1) child health and nutrition history, maternal factors, household food security and livelihoods, WASH(water, sanitation and hygiene), access to health services, (2) SAM burdens, availability of nutrition services, supplies and logistics, referral and follow-up systems, (3) community context, sociocultural practices, community health and nutrition, water, sanitation and environment, food security and humanitarian situations.

They are organized for different respondents and aligned with UNICEF’s conceptual framework (immediate, underlying, and basic determinants).

➢ *Instructions for Respondents:*

- Please answer all questions as accurately as possible.
- Your responses will be kept confidential and used for research purposes only.
- If you need help with any questions, please ask the interviewer for assistance.

This structured approach ensures that the questionnaire covers all relevant areas, providing a comprehensive analysis of immediate and underlying determinants of SAM and it’s contributing factors.

➢ *Household Questionnaires (Caregiver of Child Under Five) n=339*
Purpose: identify child, caregiver, household, and environment-level determinants of SAM.

➢ *Section A: Demographic of respondent and child information*

- Relationship to child …….

☐ Mother ☐ Father ☐ Grandparent ☐ Other (specify): ……

- Age of caregiver ……..

- Education level of caregiver

☐ Primary incomplete ☐ Primary complete
☐ Secondary ☐ Higher education ☐ None

- Current occupation

☐ Employed ☐ Not employed

- Household income per month

☐ <$100 ☐ $100 - $299 ☐ $300 - $400 ☐ >$500

- Marital status

☐ Single ☐ Married ☐ Widowed ☐ Divorced

- Number of children

☐ One to three ☐ Four to nine

- Sex of child

a) ☐ Male b) ☐ Female

- Age of child (months): …….

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- Child birth order: ……..

➢ *Section B: Child Health and Nutrition History*

- Has the child been diagnosed with SAM before?

☐ Yes ☐ No ☐ Don't know

- Anthropometric history (if known)
  - Recent MUAC (mm): …….
  - Weight (kg): ……..
  - Height/length (cm): …….

- Breastfeeding practices

a) Was the child breastfed within the first hour after birth?
☐ Yes ☐ No
b) Is the child currently breastfeeding ?
☐ Yes ☐ No
c) Duration of exclusive breastfeeding?
☐ <1 month ☐ 1–3 months ☐ 4–5 months ☐ 6 months

- Complementary feeding

a) At what age were complementary foods introduced?
☐ <6 months ☐ At 6 months ☐ >6 months
b) How many meals does the child eat per day?
☐ 1 ☐ 2 ☐ 3 ☐ 4+

- Dietary diversity yesterday (check all consumed)

☐ Grain, roots, tubers ☐ Legumes/nuts ☐ Dairy
☐ Meat/fish/eggs ☐ Fruits/vegetables ☐ Fortified foods
☐ Other: (specify) ……

What type of foods does the child usually eat? (check all that apply)
☐ Porridge ☐ Milk ☐ Meat/fish ☐ Meat/fish/eggs
☐ Vegetables ☐ Fruits ☐ Legumes ☐ Fortified foods
☐ Other: (specify) ……

- Morbidity history in past 2 weeks (☐ Yes, ☐ No)

☐ Diarrhoea ☐ Fever ☐ Cough ☐ Vomiting
☐ Loss of appetite ☐ Skin infections ☐ measles
☐ Other: (specify) …….

- Did you seek medical care?

☐ Yes ☐ No

- Where did you seek care?

☐ Hospital ☐ PHCC ☐ PHCU ☐ SC/ITP ☐ Traditional healer ☐ Private Clinic ☐ None

- Immunization status

☐ Fully immunized ☐ Partially immunized
☐ Not immunized ☐ Don't know

➢ *Section C: Maternal Factors*

- Did mother attend ANC during pregnancy?

☐ Yes (number of visits): …… ☐ No

- Mother MUAC during pregnancy (if known):……..mm

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- Maternal illnesses during pregnancy …….
- Birth spacing between last two children …….months.

➢ *Section D: Household Food Security and Livelihoods*

- Main source of household income:

……
……
……

- Household food security (past 30 days):
  - How often did the household run out of foods

☐ Never ☐ Rarely ☐ Sometimes ☐ Often

  - Did adults reduce their food so children could eat?

☐ Yes ☐ No

- Access to food assistance:

☐ Yes (organization/type): …… ☐ No

➢ *Section E: WASH (Water, Sanitation and Hygiene)*

- Main source of drinking water

☐ Borehole ☐ River ☐ Rainwater ☐ Open well
☐ Other: (specify)……

- Water treatment before drinking

☐ Boiling ☐ Filtering ☐ Chlorination ☐ None
☐ Other: (specify)……

- Type of toilet facility

☐ None/open defecation ☐ Pit latrine ☐ Vip latrine ☐ Flush toilet

- Handwashing with soap at critical times

☐ Before eating ☐ Before feeding child
☐ After defecation ☐ After cleaning child bottom ☐ Check all observed

➢ *Section F: Access to Health Services*

- Distance to nearest health facility

☐ <30 minutes ☐ 30-60 minutes ☐ >1 hour

- Have you sought treatment for child illnesses in the last 3 months?

☐ Yes (where? ……...) ☐ No

- Reasons for not seeking care (if applicable)

☐ Cost ☐ No transport ☐ Lack of drug ☐ Insecurity
☐ Other: (specify)……

A. Health facility question (health workers/ nutrition staffs) n=23

➢ *Section A: Facility Information*

- Type:
  - ☐ PHCC
  - ☐ PHCU

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- ☐ Nutrition site
- ☐ Hospital
- ☐ Position/designation: …….
- ☐ Organization name: ……..
- ☐ Name (optional): ……..
- ☐ Years of experience: ……..

- Staffing levels:
- Nutrition staff number: Male……, Female ……..
- Trained IYCF staff: Male ……, Female ……
- Community health workers (CHWs): Male ……, Female ……

➢ *Section B: SAM Burden*

- Number of SAM cases admitted (past 3 months): Male ……., Female ……

- Number referred to Stabilization centers: Male ……, Female …….

- Most common comorbidities:
- ☐ Diarrhoea
- ☐ Pneumonia
- ☐ Malaria
- ☐ Anaemia
- ☐ Others: (specify) ……

➢ *Section C: Availability of Nutrition Services*

- OTP services available?
- ☐ Yes
- ☐ No

- TSFP services available?
- ☐ Yes
- ☐ No

- Stabilization center services?
- ☐ Yes
- ☐ No

- IYCF counseling provided?
- ☐ Yes
- ☐ No

- Availability of nutrition supplies (RUTF, antibiotics)

☐ Always available
☐ Sometimes shortages
☐ Frequently unavailable

- Availability of trained nutrition staff

☐ Adequate
☐ Inadequate

- Challenges in identifying and managing SAM cases.

☐ Shortage of equipment
☐ Low caregiver awareness

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☐ High caseload
☐ Insecurity
☐ Others: (specify): ……

- What interventions would help reduce SAM in the County?

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- What training or resources are needed to improve SAM management?

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➢ *Section D: Supplies and Logistics*

- Stock-outs in past 3 months

o RUTF (☐ Yes, ☐ No)
o Essential drugs (☐ Yes, ☐ No)
o MUAC tapes (☐ Yes, ☐ No)
o Therapeutic formula milk (☐ Yes, ☐ No)

- Duration of stock-outs: ……(months).

➢ *Section E: Referral and Follow-up Systems*

- Is community screening conducted? (☐ Yes: Frequency ……..., ☐ No)

- Referral mechanisms in place? (☐ Yes, ☐ No)

- Challenges in SAM management (open-ended)

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➢ *Section F: Immediate Determinants (Clinical Perspectives)*

- What are the common clinical causes of SAM in children under five in this County?

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- How common are infections (measles, diarrhoea, malaria) among children with SAM?

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- Are therapeutic food RUTF consistently available?

☐ Yes (how many in sachets): ……..
☐ No

➢ *Section G: Underlying Determinants*

- In your option, what are the major household -level factors contributing to SAM?

☐ Food insecurity
☐ Poor childcare practices
☐ Inadequate complementary feeding
☐ WASH challenges
☐ Other (specify): ……..

- How does displacement/conflict affect nutrition in Leer County?

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- What are the main barriers to accessing health care for mothers and children?

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B. Community leaders/key informant interview guide n=12

Purpose: Explore underlying determinants – cultural practices, conflict, displacement, community feeding norms, shocks and health beliefs.

➢ *Section A: Community Context*

- What are the major livelihood activities in this community?

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- How has conflict or displacement affected access to food and health services?

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- What seasonal factors influence child nutrition?

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➢ *Section B: Sociocultural Practices*

- Common beliefs about child feeding practices?

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- Traditional practices during pregnancy and breastfeeding?

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- Barriers to adopting recommended IYCF practices?

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➢ *Section C: Community Health and Nutrition*

- Main causes of child illness in the community?

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- Community awareness of SAM signs and symptoms?

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- Accessibility of health facilities during rainy and dry seasons?

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- Role of community health workers?

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➢ *Section D: Water, Sanitation and Environment*

- Access to safe water sources?

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- Common sanitation practices?

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- Seasonal contamination risks (floods, stagnant water, etc.)?

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➢ *Section E: Food Security and Humanitarian Situation*

- Availability and stability of food sources?

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- Role of humanitarian assistance?

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- Community coping strategies during food shortages?

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Thank for your participation

GOOD LUCK