EXAMINING THE COMPLEX DYNAMICS INFLUENCING ACUTE MALNUTRITION IN TURKANA COUNTY—A LONGITUDINAL MIXED-METHODS STUDY TO SUPPORT COMMUNITY-DRIVEN ACTIVITY DESIGN

BASELINE REPORT OF FINDINGS FROM THE QUANTITATIVE SURVEY COMPONENT

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ACRONYMS AND ABBREVIATIONS

AMREF-ESRC	AMREF Ethical and Scientific Review Committee
aOR	Adjusted Odds Ratio
APHRC	African Population and Health Research Center
ASAL	Arid and Semi-Arid Lands
ASRH	Adolescent Sexual and Reproductive Health
BCG	Bacille Calmette-Guerin (vaccine for tuberculosis)
BMI	Body Mass Index
CHS	Community Health Services
CI	Confidence Interval
COVID-19	Coronavirus Disease 2019 (SARS-CoV-2)
CSI	Coping Strategy Index
DHS	Demographic and Health Survey
FO	Fecal–Oral
GAM	Global Acute Malnutrition
HAZ	Height-for-Age z-Score
HCD	Human-Centered Design
HWISE	Household Water InSecurity Experiences (scale)
IMAM	Integrated Management of Acute Malnutrition
IYCF	Infant and Young Child Feeding
KAP	Knowledge, Attitudes, and Practices
MAD	Minimum Acceptable Diet
MDD	Minimum Dietary Diversity
MDD-W	Minimum Dietary Diversity for Women
MIYCN	Maternal, Infant, and Young Child Nutrition
MMF	Minimum Meal Frequency
MUAC	Mid-Upper Arm Circumference
NDMA	National Drought Management Authority
NGO	Nongovernmental Organization
PAM	Persistent Acute Malnutrition
PCA	Principal Component Analysis
PPI	Probability Poverty Index

REAP	Rural Entrepreneur Access Project
RTI	RTI International (registered trademark and trade name of Research Triangle Institute)
SBC	Social and Behavior Change
SD	Standard Deviation
SMART	Standardized Monitoring and Assessment of Relief and Transitions
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WASH	Water, Sanitation, and Hygiene
WAZ	Weight-for-Age z-Score
WHO	World Health Organization
WHZ	Weight-for-Height z-Score

EXECUTIVE SUMMARY

The goal of the United States Agency for International Development (USAID) Nawiri program is to sustainably reduce levels of persistent acute malnutrition in Kenya's arid and semi-arid lands (ASALs). In Turkana County, USAID Nawiri is facilitated by a Mercy Corps-led consortium of partners that share a commitment to putting county governments and their citizens in the driver's seat of their own sustainability. In the first phase of Nawiri, the consortium is conducting learning and research activities, including a longitudinal study, to identify household and systemic factors associated with acute malnutrition. In the second phase, Nawiri is using the information collected to tailor and implement program activities to ensure they address the key factors associated with acute malnutrition.

Goal, objectives, and overarching research questions

This report summarizes the results from quantitative data collected during the baseline evaluation of a 24-month longitudinal, mixed-methods observational cohort study of children less than 3 years old, and their mothers or caregivers, in Turkana County, Kenya. The longitudinal study, part of Nawiri Phase 1 activities, aims to discern evidence-based insights for the development of overarching solutions as well as micro-solutions for sustainably reducing persistent acute malnutrition (PAM). It also will inform subsequent pilot studies and Phase 2 Nawiri activities in Turkana. Its two main objectives are to:

- Understand and map how a variety of immediate, underlying, and basic/systemic drivers interact to influence PAM over time, geography, and livelihood zones among infants and young children; and
- Identify and prioritize opportunities and barriers to achieve sustained reductions in PAM.

To address these objectives, the longitudinal study focuses on immediate and underlying factors associated with acute malnutrition, including (1) infant and young child feeding (IYCF) and morbidity and maternal diet; (2) livelihood dynamics and interactions with undernutrition; (3) access to and availability of water, household hygiene, and food safety; (4) health-seeking behavior; (5) gender, women's time poverty, decision-making, and control over resources; and (6) response to and experience with shocks. This study also gathers information that may be useful for improving nutrition surveillance.

The baseline data collection step was designed to produce data to compare to future survey waves. It also collected qualitative information through various methods that will be included in a companion report. The two reports are intended to inform stakeholders on gaps in knowledge, facilitators, and barriers to behaviors that can feed into the initial design of implementation activities and pilots. Further information on seasonal influences will be available after the third wave of data collection. The post-baseline waves are designed to allow comparisons over time, relevant for specific thematic areas, such as when, where, why, and how households engage with the health care system and different actors within the system and how water, sanitation, and hygiene (WASH) practices change. The first analysis of yearly changes with respect to climatic patterns and how households respond to lean versus non-lean seasons and other shocks will be generated from the third wave of data collection.

Study design and data collection procedures

The study sample was population-based, with stratification by sub-counties grouped into four survey zones (Central, North, West, and South) reflecting administrative sub-counties used in the Turkana Standardized Monitoring and Assessment of Relief and Transitions (SMART) Surveys. Stratification by livelihood zones was done through post-stratification analysis. We analyzed the data by livelihood zone because it was hypothesized that undernutrition might be more related to a household's livelihood than to its physical location.

As noted, the study used mixed-method techniques with quantitative and qualitative data collection. The quantitative component included a household survey and a caregiver survey and covered 1,211 households. The qualitative data collection activities yielded rich and in-depth insights that will be triangulated with the quantitative survey findings in a companion report. Therefore, this report focuses only on findings from the quantitative survey component. Results are reported for global acute malnutrition (GAM), stunting, and underweight. However, the discussion focuses only on GAM because the purpose of the Nawiri program is to reduce persistent acute malnutrition.

The baseline data collection was carried out in May and June 2021 following a full household listing operation in the county to establish the sampling frame of households with children under 3 years. Anthropometric data were collected from all under-5 children in the sampled households. Subsequent data collection waves are planned for October–November 2021 (Wave 2), March–April 2022 (Wave 3), September–October 2022 (Wave 4), March–April 2023 (Wave 5), and August–September 2023 (Wave 6).

Results

Mapping GAM among children and underweight among caregivers/mothers

The overall prevalence of GAM when assessed by weight-for-height z-score (WHZ) was greater than when assessed by mid-upper arm circumference (MUAC) (21% versus 17%). Analysis by survey zone and livelihood zone showed that prevalence rankings of GAM depended on whether WHZ or MUAC was used as the indicator. When WHZ was used, the North (25%) and South (24%) had higher rates compared to Central (22%) and West (16%). However, when MUAC was used, the West had the highest prevalence (21%), followed by South (18%), North (15%), and Central survey zones (13%). When assessed by WHZ, the prevalence of GAM was highest among children living in the fisher folk livelihood zone (32%) and lowest in the pastoral zone (19%). However, when assessed by MUAC, the prevalence among fisher folk dropped to about 20%, like that of agro-pastoralists and urban/peri-urban dwellers. The lowest prevalence was in the pastoral zone (16%). Using WHZ, livelihood zone was a significant predictor of GAM. Compared to children in the urban/peri-urban zone, children of fisher folk were more than twice as likely to be acutely malnourished.

Among all children in the sample, 65% of acute malnutrition cases were detected by both WHZ and MUAC. Among children with acute malnutrition (*N*=279), 40% of acute malnutrition cases were detected with both WHZ and MUAC, 38% were detected only using WHZ, and 20% were detected only using MUAC. Thus, using only MUAC, a substantial percentage of acute malnutrition cases would have been missed.

GAM prevalence was similar between girls (22%) and boys (21%) when assessed by WHZ. However, when assessed by MUAC, boys were significantly more likely to be acutely malnourished (21%) compared to girls (13%). There is no clear explanation as to why there would be virtually no sex-specific difference when WHZ was used and such a large difference when MUAC was used as the indicator. Although, the bivariate analysis showed no significant difference between boys and girls (WHZ), an interaction analysis showed that boys less than 10 months were more likely to suffer from GAM but less so between 10 and 25 months compared to girls. There is no clear explanation for this finding.

When WHZ was the assessment method, the prevalence of GAM increased with child age, with infants 0–5 months having the lowest rates (13%) and children 12–35 months having the highest rates (26%). However, when assessed by MUAC, children 12–23 months had the highest rates (23%), and children 24–35 months the lowest (10%). Chi-square analysis, using WHZ, showed that compared to children less than 5 months, children 12–23 months were twice as likely to suffer from GAM and children 24–35 months were two and a half times more likely to suffer from GAM. This finding likely reflects the fact that during the period of exclusive breastfeeding, children are generally protected from pathogens introduced through unhygienic food and utensils while also receiving breast milk, a highly nutritious food. In contrast, after 6 months, they need a variety of additional foods to grow, and the high levels of food insecurity in most households result in a child receiving an inadequate diet. In addition, during this post-6-month period, children are at higher risk of diarrhea because of poor sanitary conditions, including those related to food preparation and feeding.

The highest prevalence of GAM (24%) was found among children of caregivers aged 25–49 years when WHZ was used as the indicator, compared to 15% among children of caregivers less than 25 years and only 11% among caregivers older than 50 years. When MUAC was used as the indicator, the prevalence of GAM among caregivers 35–49 years dropped to 13% while remaining high among caregivers 25–34 years (22%). Regression analysis using WHZ, however, showed that caregiver age was not related to GAM. Sex of household was a significant predictor of GAM; children living in female-headed households were 60% more likely to be acutely malnourished compared to those living in male-headed households. This finding likely reflects fewer assets to purchase food and care for children, especially if women heading households are the sole breadwinners.

The prevalence of underweight among mothers or caregivers was high. Using BMI, more than half (55%) of nonpregnant/lactating mothers or caregivers living in the fisher folk zone were underweight; however, while lower compared to fisher folk, the prevalence was also high among pastoralists (43%), agro-pastoralists (41%), and peri-urban/urban dwellers (39%). Results by survey zone showed that 55% of caregivers in the North were underweight, followed by 53% in the South, 41% in the Central, and 29% in the West. Underweight was highest among mothers or caregivers less than 25 years (48%), and lowest among mothers or caregivers 25–29 years (38%). Assessed by MUAC, underweight among pregnant women was 20%, ranging from 15% to 29% depending on the age category.

Infant and young child feeding, maternal diet, and child morbidity

Three out of every four of the participating newborns were breastfed within the first hour of life and most newborns received colostrum (93.3%). However, only about two-thirds (66.8%) of infants less than 5 months were exclusively breastfed and only about 70% of infants 6–8

months had been fed a solid or semi-solid food the previous day. Nearly 90% of infants 12–15 months were still being breastfed. Only 4% of children met the threshold for minimum dietary diversity (MDD). Children in fisher folk and urban/peri-urban zones had higher MDD at 7% and 12%, respectively. Cereals were the most consumed (74%) food, followed by dairy (46%). Less than 2% of children consumed eggs and other fruits and vegetables. However, 24.7% and 16.5% had received a vitamin A-rich or iron-rich food the previous day. One in five children had received something in a bottle the previous day.

None of the IYCF indicators included in a regression analysis were associated with any of the three indicators of undernutrition (GAM, stunting, and underweight), which may be because of the extremely poor complementary feeding diet among all children, including those with adequate anthropometric measurements, but also because the indicators of IYCF practices were not designed for this purpose. Other studies have shown that the feeding indicators are not significantly associated with anthropometry.

Maternal diet was poor, with only 2% of caregivers reaching the threshold for minimum dietary diversity for women. Most consumed were cereals and tubers (86%), followed by pulses (26%), and dairy and flesh foods (18%). Consumption of dark-green leafy vegetables differed by livelihood zone; it was very low among pastoralist and fisher folk and much higher among agro-pastoralists and urban/peri-urban dwellers. Similar to that of children, consumption of eggs, and other vitamin A-rich foods and vegetables was extremely low among mothers/caregivers. The fact that about a quarter of mothers or caregivers reported eating pulses suggests some access to this nutritious food group. It also suggests that they could potentially be prompted for child feeding.

In the 2 weeks preceding the survey, 39% of children aged 3 years and below had had a cough with difficult breathing, 26% had a fever, and 32% had diarrhea. The prevalence of cough and fever was slightly lower among children of pastoralists compared to children in other livelihood zones. The prevalence of diarrhea was not different across livelihood zones or caregivers' background characteristics. There was also no difference in disease prevalence in general by the child's sex. Care-seeking behavior for child illness was high (78%) and did not vary by livelihood zone, child age, child sex, or other background characteristics of the mother/caregiver or household.

Livelihood dynamics and interactions with undernutrition

Overall, 62% of the households were headed by men while the remaining households were headed by women. The proportion of female-headed households was higher in the urban/peri-urban livelihood zone (48%).

The main occupation for household heads aligned with their livelihood zone. Livestock herding was the most common occupation at 68% in the pastoral livelihood zone, farming was the most common at 46% in the agro-pastoral zone, fishing was the most common at 67% in fisher folk zone, and petty trade was most common at 50% in the urban/peri-urban zone. The dominant source of income across all livelihood zones, except among the fisher folk, was petty trade. The highest percentage of households reporting no income was in the agro-pastoral livelihood zone, at 23%. In terms of productive assets, 78% of households owned livestock. Nearly three quarters (74%) of agro-pastoral households had access to

agricultural/grazing land. A large portion of land in Turkana County is owned communally (100% among fisher folk).

Generally, regular saving of cash was low, with the fisher folk recording the highest rate at 29% and the pastoral and agro-pastoral livelihood zones recording the lowest (8%). Use of credit was relatively high; 29% of all respondents reported taking out a loan, with the highest percentage among urban/peri-urban dwellers (48%). Getting food on credit was also prevalent (52%). It is noteworthy that money was borrowed for food purchases, health care expenses, and personal needs, but not to do business. Only 8% of households reported having received any financial support in the past 4 months, with 61% coming from government programs, 16% from nongovernmental organizations (NGOs), and 32% as unspecified gifts. At the same time, 17.7% of households reported participating in a cash-transfer program.

Severe food insecurity in the past 12 months as measured by the Food Insecurity Experience Scale was reported by 91% households in the pastoral livelihood zone, followed by agro-pastoral (89%), urban/peri-urban (88%), and fisher folk (71%). Households in most survey zones had similar Coping Strategy Index (CSI) scores except those in the West, which had the highest. Among the livelihood zones, the fisher folk had the lowest CSI score. Children in households with mild/moderate food insecurity and severe food insecurity were more than three times more likely to suffer from GAM compared to children in food-secure households.

Access to and availability of water, household hygiene, and food safety

In general, water insecurity was highly prevalent, with households in the pastoral livelihood zone having the highest score. However, the water insecurity score was not significantly associated with GAM in a regression analysis. Children in households that used improved toilet facilities had 21% reduced odds of GAM compared to those using unimproved toilet facilities, a finding that likely reflects the fact that households with improved facilities were better off economically than those without, and thus improved hygiene stemmed from better facilities.

Health-seeking behaviors

Health-seeking behaviors by mothers during pregnancy, delivery, and the postnatal period were within national averages except among fisher folk and pastoral communities, where skilled delivery and postnatal care were significantly lower. However, use of iron and folate supplements during pregnancy was low; only 38% of women reported taking 90 or more tablets in their previous pregnancy, with the highest percentage in the urban/peri-urban livelihood zone (62%). Vaccination coverage for all basic vaccines (Bacille Calmette-Guerin [BCG] vaccine for tuberculosis, measles, and three doses each of pentavalent and polio vaccine [excluding polio vaccine given at birth]) among children was consistently low at 53%. More than half (58%) of children between 12 and 35 months had been given deworming tablets once in the past 6 months. These proportions were slightly higher in urban/peri-urban livelihood zones relative to other livelihood zones.

Gender, women's time poverty, decision-making, and control over resources

About 48% of married women/caregivers from the urban/peri-urban livelihood zone made all decisions by themselves or jointly with their husband/partner on use of household income, child health, their own health care, food purchases, major household purchases, and visits to friends/relatives. Sole or joint decision-making was as follows in the other livelihood zones: agro-pastoral (45%), pastoral (40%), and fisher folk (38%).

Response to and experience with shocks

More than 90% of households reported having experienced one or more types of shocks in the past 4 months, with climatic shocks being dominant across all livelihood zones. Coronavirus disease 2019 (COVID-19) was reported only minimally as a biological shock by the households in urban and peri-urban settings. More than half of households reported no coping strategies to protect themselves from future shocks. The most common strategy for shocks was the reducing food consumption, reported by over 80% of households.

Surveillance

The differences between the results from WHZ and MUAC suggest a nonlinear relationship between the two measures, which should be considered in light of the current nutrition surveillance system, which uses only MUAC. The results also show that using MUAC the prevalence of GAM will be lower than the prevalence using WHZ.

Next steps

With respect to next steps, the information generated by the quantitative results of the baseline of the longitudinal study highlights some specific immediate actions that include:

- Working with communities so that they see acute malnutrition as a collective problem that they have a responsibility to address, focusing on local solutions.
- Focusing on children of fisher folk for interventions to improve dietary intake, building on some already positive complementary feeding practices.
- Focusing on children of female-headed households.
- Introducing or scaling up interventions to promote exclusive breastfeeding among mothers of children less than 6 months and to promote increased dietary diversity and meal frequently among children 6-23 months. Interventions to reduce use of feeding bottles should be targeted at mothers and caregivers of all children.

Lastly, the information generated from this report needs to be integrated with the rich findings from the qualitative results, when that analysis is finalized. Integration of the two complementary research methods will lead to a more in-depth understanding of how interventions can improve nutrition with respect to both the immediate causes of undernutrition that can be addressed in the short term and the underlying causes that will need long-term attention.

1 BACKGROUND AND EVIDENCE GAP ANALYSIS

The causal pathways leading to persistent acute malnutrition (PAM)—including poor maternal, infant, and young child nutrition (MIYCN)—in Turkana are complex; are interlinked; and require in-depth assessment and analysis to fully understand the contextual, seasonal, and shock-specific factors associated with acute malnutrition. Although cross-sectional research has been conducted in Turkana on PAM and its immediate and underlying factors associated with undernutrition, virtually no evidence exists on how these factors vary by season, within the same households, and by the synergistic effects of increasingly frequent and severe climate-related and other shocks.

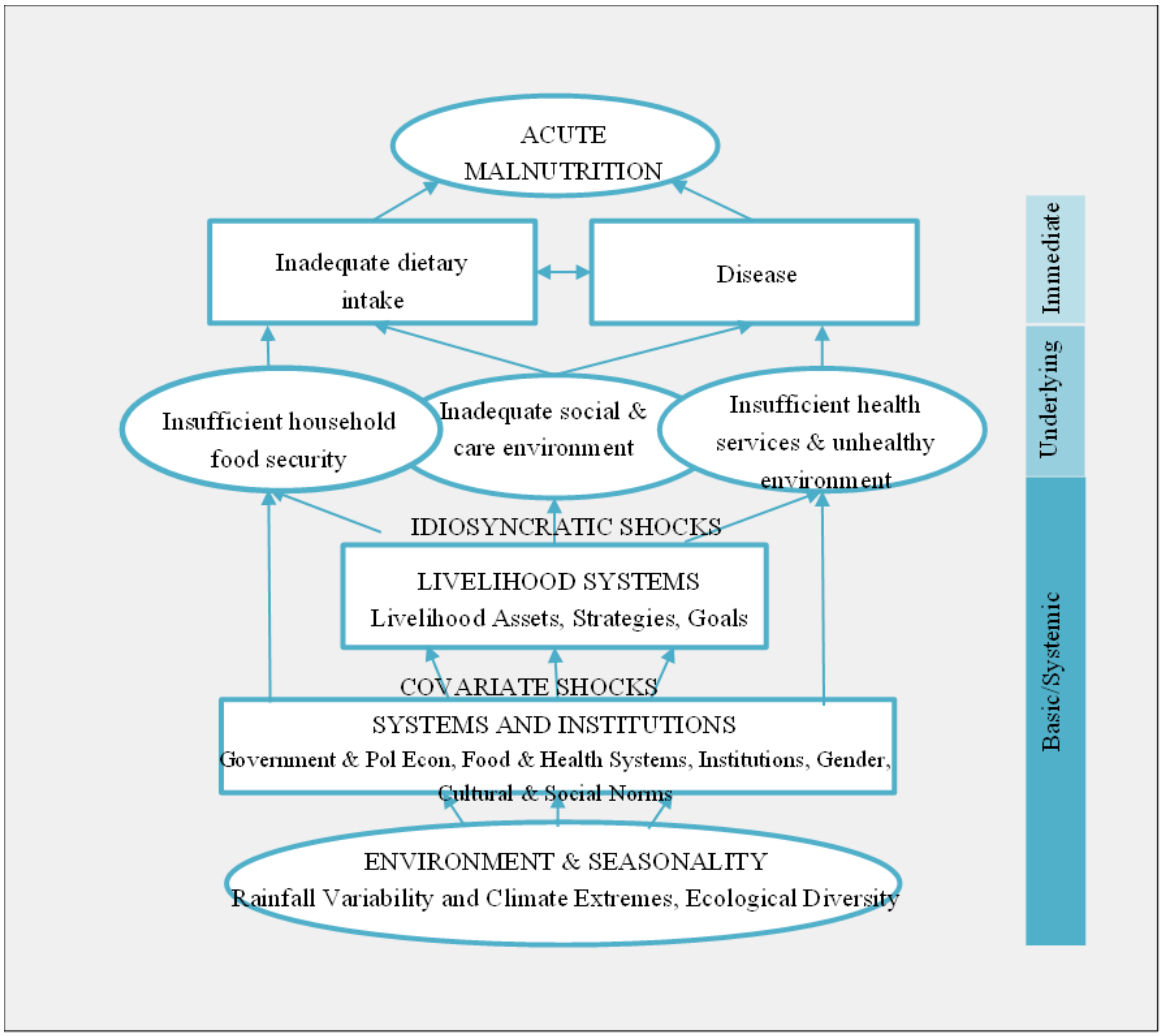
The longitudinal study aims to discern evidence-based insights for developing overarching solutions as well as micro-solutions for sustainably reducing PAM. It will also inform subsequent pilot studies and Phase 2 Nawiri activities in Turkana. Its two main objectives are to:

- Understand and map how a variety of immediate, underlying, basic, and systemic drivers interact to influence PAM over time among infants and young children living in different livelihood zones; and
- Identify and prioritize opportunities and barriers to achieve sustained reductions in PAM.

Thus, the study takes a systems-based approach to crafting contextualized and sustainable interventions to address modifiable factors contributing to PAM, including but not limited to strategies to improve food systems and livelihoods; social and behavior change (SBC); community health systems; water, sanitation, and hygiene (WASH); and gender dynamics, among others.

The conceptual framework for Acute Malnutrition in Africa's Drylands [1] was used as the basis for the study design (**Figure 1**). This conceptual framework highlights the need to deepen the understanding of underlying and basic causes of PAM beyond the traditional linear pathways, looking at synergies between factors as well as existing and emergent trends and patterns that vary over time. Environment and seasonality are at the base of the framework, acknowledging the unique environmental conditions of the drylands. The conceptual framework also emphasizes the need to deepen our understanding of systems, institutions, and livelihoods, as it is hypothesized that natural hazards or climatic shocks do not cause disasters but only trigger them. Therefore, learning about the roles of social and political systems and coping and adaptive strategies and responses is a key to understanding vulnerability to shocks, their impact on food and health systems, and their ultimate effect on nutrition outcomes.

Figure 1. Conceptual framework for addressing acute malnutrition in Africa's drylands



Source: Young, Helen. *Nutrition in Africa's drylands: A conceptual framework for addressing acute malnutrition*. Boston: Feinstein International Center, Tufts University, 2020.

In keeping with this framework, the longitudinal study goes beyond collecting information on immediate and underlying factors, such as maternal and infant and young child dietary intake and disease (e.g., why knowledge about optimal IYCF and care behaviors is not necessarily translated into practice), household food security, health services, and water and sanitation.

While understanding these immediate and underlying factors is critical, to address the basic and systemic factors that create the conditions that enable acute malnutrition to persist, we must also gather information on a broader range of basic and systemic factors such as livelihoods and sources of income, gender relations, and dynamics, as well as women's time poverty, decision-making power, and control over resources. In addition, we will examine strategies that households with children less than 3 years old use to cope with and respond and adapt to shocks and stresses and will collect information relevant to improving existing nutrition surveillance systems. By gathering information on a broader range of factors through our analysis, we can look at interconnections and feedback loops to fully understand the complex causality of acute malnutrition.

The longitudinal study will assemble critical evidence to better explain the connections and relative importance of the household dynamics from the Nawiri theory of change. It will answer the questions: What are the dynamics of the household system? And what are the most promising entry points to modify them? These entry points are interfaces with the systems examined in other formative research areas. This household information can be seen as the "demand" side of the intervention, and all other areas are the "supply" side. Specific examples of implementation design that can be influenced by the longitudinal study include adaptation of SBC strategies and mother and caregiver support groups to enhance IYCF and care practices, tailoring community health services (CHS) interventions to respond to the specific general and integrated management of acute malnutrition (IMAM) services needs of households, and tailoring livelihoods systems to sociocultural dynamics in play in the context.

1.1 EVIDENCE GAP ANALYSIS

The research team conducted an evidence gap analysis exercise before refining the specific research questions. The exercise aimed to identify key gaps—i.e. where little or no evidence is available—from both literature and practice. The exercise involved consultations with county and national stakeholders and a detailed desk review around key themes (shared with our Nawiri Consortium). Key programming gaps that emerged from the analysis are described next.

The Nawiri learning agenda was a primary topic of discussion early in the program, through ongoing county engagement with inception meetings in November 2019, followed by a meeting with county leaders and technical leads across multiple government sectors in March 2020. In June 2020, specific details of the longitudinal study design informed by preliminary consultations were presented and discussed in meetings convened with key technical leads drawn from multiple sectors (health, agriculture, National Drought Management Authority [NDMA], social services, public health, and United Nations Children's Fund [UNICEF]). There were also sub-county and ward-level sensitization meetings with government officials and community leaders. Input and feedback received shaped the focus, scope, and design of the longitudinal study.

There was a consensus that the longitudinal study should generate critical evidence on immediate, underlying, and basic factors associated with PAM in specific livelihood zones to inform evidence-based and contextualized intervention design. The longitudinal study findings will uncover over time how the complex factors interact and are influenced by various dynamics, including seasonality and shocks. Thus, the results will contribute to adaptation or co-creation and design of robust and evidence-informed programs that are sensitive to shocks and seasonal dynamics related to MIYCN, livelihoods, CHS, and WASH, among other thematic areas.

Key gaps identified included:

- Inadequate understanding and evidence of the effect of increasingly unpredictable seasonality and shocks on PAM, including immediate and increasingly frequent and severe climate-related and other shocks (including COVID-19). This topic also includes an inadequate understanding of the government's response to the unpredictable seasonality and shocks over time.

- Inadequate understanding of the interaction and nuances of various factors and their relative importance at the individual, household, and community levels.
- Inadequate understanding and insufficient community input on the factors driving PAM and possible solutions.
- Lack of vital data on trends based on a longitudinal cohort of the same households that provide a high level of internal validity. By applying this method, we can be sure that changes observed are related to external factors (shocks, seasons, COVID-19) and are not occurring solely because we are sampling a different population during each wave of data collection.
- Weak nutrition surveillance system based on anthropometrics, including mid-upper arm circumference (MUAC) data from sentinel sites, particularly stratified by livelihood zones.

1.2 UTILITY OF THE LONGITUDINAL STUDY AND LINKAGES WITH THE REST OF THE NAWIRI LEARNING AND RESEARCH AGENDA

The longitudinal study is adopting a systems-based approach to surface contextualized and sustainable interventions to address modifiable factors contributing to PAM, including but not limited to strategies to improve SBC, MIYCN behaviors, CHS, WASH, and nutrition-sensitive programming such as the Rural Entrepreneur Access Project (REAP) for Nutrition and gender equality, among others. Information generated by the study will contribute substantially to adaptations of Nawiri's theory of change.

The longitudinal study will link to several other parts of the learning and research agenda such as MIYCN, adolescent sexual and reproductive health (ASRH), livelihoods and nutrition resilience, CHS, WASH, REAP for Nutrition, and the fecal–oral (FO) pathogens pathways study.

- Data from the baseline survey, as well as qualitative/participatory data collected during the longitudinal study, will fill knowledge and information gaps and will be triangulated with data from other formative research studies such as CHS, MIYCN, and REAP for Nutrition.
- Data from Years 1 and 2 will clarify how determinants of acute malnutrition vary by season and in response to shocks and stresses. This information will be useful for adapting Nawiri implementation early in Phase 2 of the project so that interventions better accommodate seasonality and shocks/stresses, which in turn will contribute to the goal of reducing PAM and global acute malnutrition (GAM). In addition, information from the longitudinal study will be useful to the county governments to quantify issues related to acute malnutrition and help them direct funding to pull the relevant levers.

The following are examples of how data from the longitudinal study will feed into other research and learning thematic areas and inform action:

- ***Maternal, infant, and young child nutrition and care****:* The longitudinal study will inform program design by identifying the most salient modifiable factors that lead to poor MIYCN, care practices, and PAM, and by offering evidence-based insights for developing overarching solutions as well as micro-solutions for sustainably reducing PAM, refined through the human-centered design (HCD) process in Years 2–3.
- ***Livelihoods and resilience***: The longitudinal study will generate seasonal information and trends on livelihoods, assets, expenditure, market access, household food security, and

household coping strategies. We will gather data on other sources of support to households—such as cash transfers—and how these vary by season and during shocks. Cumulatively, this information will paint a picture of household nutrition resilience that will contribute to the design of contextualized and shock responsive interventions in Year 3.

- ***CHS**:* Evidence generated of the influence of seasonality and shocks on health and nutrition service-seeking behavior for moderate and severe acute malnutrition and related health and nutrition issues, morbidity patterns, and community perception and utilization of CHS will support co-creation of solutions that are adapted to local household and community realities in Year 3 and subsequent years.
- ***ASRH**:* The longitudinal study will identify seasonality factors that affect timely delivery of ASRH services and potential effective platforms to reach adolescents with ASRH and nutrition SBC services. These findings will support prototyping and testing of effective solutions to improve ASRH through the HCD process. Further, the study will provide information on how PAM affects adolescent mothers, and on what potential household and community factors are associated with the effects. This information will be triangulated with that from the ASRH thematic area and contribute to evidence that will inform collaborative strategies and program actions to enhance agency in decision-making among youth; prevent early pregnancies; and improve access to vital services, health, and nutrition of young mothers in Years 2 and 3 and beyond, thereby contributing to breaking the intergenerational cycle of undernutrition in target communities.
- ***WASH**:* We will triangulate information on household water insecurity and its relationship to women's time use and feeding/caring practices within evidence derived from the FO pathogens pathways study, from the water governance desk review, and from the WASH bottleneck analysis. The cumulative results will aid co-decision-making on Nawiri's programmatic niche and actions on WASH in Year 2 and Year 3.
- ***FO pathogens pathways study**:* The longitudinal study will gather social, economic, and demographic characteristics of households sampled for the FO study. It will also surface evidence on social, structural, and behavioral determinants of FO pathogens' transmission pathways in target households and communities. We will triangulate the data generated with that from the FO study in Year 3.
- ***REAP**:* The HCD process will draw upon results of the formative research, the secondary data analysis, other past and present research and learning by The BOMA Project, and preliminary findings of the longitudinal study. Nawiri will rapidly test and iterate ideas to inform what adaptations will be necessary to REAP to enhance its utility in improving nutrition among children under 2 years old in participant households and in communities in Years 2 and 3.
- ***Nutritional surveillance**:* The longitudinal study will generate information and learning that will contribute to improvement of the nutrition information system, including enhanced surveillance for food and nutrition security, early warning systems, and information needed for policy changes and programming.

2 STUDY OBJECTIVES, RESEARCH QUESTIONS, AND METHODS

2.1 STUDY OBJECTIVES AND RESEARCH QUESTIONS

As stated in Section 1, this longitudinal study has two overall research objectives. It is designed to answer six interrelated research questions.

1. ***Infant and young child feeding and morbidity and maternal diet***—How do immediate causes of acute malnutrition (e.g., IYCF and childhood illness) vary across time and space? How do these causes vary for children of adolescent versus adult mothers or caregivers How do they vary for younger children (< 2 years) compared to children between 2 and 5 years? How do they vary by different livelihood zones?
2. ***Livelihoods***—How does the vulnerability linked to livelihood systems and socioeconomic status vary over time and interact with other factors associated with PAM? Which types of households are more vulnerable? Which types of households have the weakest capacity to respond or the least ability to recover from livelihoods' disruptions? What intra-household dynamics explain capacities to adapt and be resilient?
3. ***Access to and availability of water, household hygiene, and food safety***—How do access to and availability of water vary over time and influence hygiene and sanitation practices, including food safety? How do access and availability vary by livelihood zone?
4. ***Health-seeking behavior***—How does caregiver health-seeking behavior for various services, including IMAM, vary over time? How do caregiver perceptions of the quality of and accessibility to services offered influence health-seeking behaviors?
5. ***Gender, women's time poverty, decision-making, and control over resources***—How do gender identity, women's time poverty, decision-making power, and control over resources impact the determinants identified in the preceding questions? Is there a differential impact by household structure (e.g., polygamous versus monogamous households, men-headed versus women-headed) and mother's or caregiver's age?
6. ***Response to shocks***—How do households experience and cope with shocks (including COVID-19, conflict, household violence, etc.)? How do shocks disrupt livelihoods and impact nutritional status? How do government interventions in response to shocks affect the ability of households to respond to shocks?

In addition, the study is intended to shed light on how sampling and indicators used by NDMA and other relevant government entities can effectively generate reliable surveillance data to inform decision-making aimed at reducing acute malnutrition.

While these questions will be answered through the full period of the study, the Wave 1 quantitative survey findings presented in this report are intended to provide baseline information to compare with findings from other survey waves conducted across different seasons and shocks. We also will triangulate the findings with information from qualitative methods, in a companion report, to fill gaps in knowledge and facilitators and barriers to behaviors that can feed into the initial design of Nawiri implementation activities and pilots.

2.2 STUDY METHODOLOGY

2.2.1 Study design and target populations

This study uses a 24-month longitudinal mixed-methods observational design. Households with target populations were recruited and will be followed every 4 months for a total of six

waves of data collection. A description of the indicators, methods, and frequency of data collection for survey data collection at each wave appears in ***Annex A.***

The baseline quantitative survey included caregivers and their children from households with children less than 3 years of age at enrollment. The choice of sampling children under 3 years will facilitate the follow-up of the entire cohort without the burden of replacing those that age out (i.e., reach 5 years before the end of the study). However, anthropometric measurements were taken from all under-5 children in the sampled households to guarantee sufficient numbers of under-5 children to enhance the generalizability of the findings to estimate under-5 GAM prevalence.

2.2.2 Sampling strategy

Survey

A representative sample of children less than 3 years and their mothers or caregivers was obtained using a multistage sampling approach, with survey zones[1] as units of stratification. Nawiri designated four survey zones in Turkana (Central, North, West, and South) that include all the livelihood zones (pastoral, agro-pastoral, fisher folk, and urban/peri urban). The livelihood survey zones were delineated based on the unique nature of vulnerability of communities in various geographies occasioned by repeated shocks and stresses associated mainly with specific livelihoods. Villages were treated as clusters within a survey zone, from which a random sample of 25 villages was drawn. A household listing was conducted in each of the selected villages to identify and enumerate all households with children under 3 years. Almost two-thirds (62.5%) of the occupied households had at least one child under 3 years old and these formed a sampling frame for the final stage of random selection of households. For sampled households with more than one child under 3 years, the youngest child and their mother or caregiver were selected to participate in the study.

One of the aims of the study is to estimate GAM prevalence across different livelihood zones. Stratification by livelihood zones was not possible since the livelihood zones are not aligned to administrative units. Information on the number of villages within livelihood zones and respective household listing was not readily available because population data from the Kenyan National Bureau of Statistics are based on administrative zones.

We collected information on livelihood zones during the baseline survey and used it to generate estimates by livelihood zones by re-computing the weights based on the population size by livelihood zones using a post-stratification analysis method. See ***Annex B*** for details on the methods used for post-stratification analysis.

2.2.3 Sample sizes

Quantitative survey

We computed the sample size for the quantitative survey using the household survey sample size formula created by the United Nations Statistical Division [2]. We assumed an under -3 GAM prevalence of 23.2% and adjusted for a design effect of 1.81. (These decisions yielded a maximum design effect of 1.5 due to stratification and clustering, based on estimates from the 2019 SMART survey [3]; and a design effect of 1.12, due to repeated data collection on

[1] The seven sub-counties were grouped into four survey zones: (1) South (South and East sub-counties), (2) Central (Central and Loima sub-counties), (3) North (North and Kibish sub-counties), and (4) West (West sub-county).

the same individuals at six time points.) A common correction of 0.02 was assumed based on estimates from a previous study that estimated an intraclass correlation of 0.0044 for clustering of children within a household [4]. We assumed a margin of error of ± 5 percentage points, 95% confidence interval (CI), a nonresponse and attrition rate of 20%, the proportion of the population targeted for the study at 7.6% per the 2019 Kenya Census [5, 6], and the average household size of six. Based on these assumptions, the required estimated minimum sample size was 1,544 households.

The number of households was allocated proportionally to the population size of each stratum (or survey zone), as shown in **Table 1**. In each stratum, a random sample of 25 villages was targeted using probability proportional to the population size of the cluster. Equal numbers of households (Central 20, North 7, West 16, and South 20) were then sampled from each village in each of the survey zones to ensure that each of the households had the same probability of being selected. In some villages, the target number of households was not achieved, and a spare village was sampled randomly from the remaining villages and used to complete the target sample size. A few sampled villages were inaccessible due to insecurity or migration and hence were replaced by other villages with similar characteristics. All 2,267 villages from Turkana County were considered.

Table 1. Household allocation and sample size per survey zone

Survey zone	Sub-counties	Population	Villages	Sample size (by proportional allocation)	Sampled villages
Central	Central, Loima	293,100	902	488	25
North	North, Kibish	101,987	379	170	25
West	West	239,627	425	399	25
South	South, East	292,262	561	487	25
Total		**926,976**	**2,267**	**1,544**	**100**

Household listing process

A team of 23 fieldworkers and four team leaders visited all the sampled villages and listed all households to establish a sampling frame of households with children under 3 years old. Two villages from the West survey zone (Edot and Lokapusuk) and three from East (Lochakula B, Kivumbini, and Kapetakini) were replaced due to insecurity or the village migrating in search of pasture. They were replaced by Ata Lomuria, Nasikiria, Canaan, Epetamuge, and Lochorarengan B, respectively. Four out of every five households (82%) were occupied, with 14% having no one at home at the time of household listing. Almost two-thirds (62.5%) of the occupied households had at least one child under 3 years old *(**Annex C**)*.

Sampled households

The sample size required for the study was 1,544 households with children under 3 years. This sample was divided among the four survey zones proportional to their population sizes (**Table 2)**. Within each survey zone, an equal number of households was randomly sampled from each of the 25 sampled villages. The target number of households for each survey zone

was derived by dividing the target sample size of the zone by the number of villages (25). The number was then rounded up to the nearest integer, and this step led to an actual sample size of 1,575 households (31 households over the targeted size for the sample; see **Figure 2**).

Figure 2. Distribution of all households sampled from all sampled villages

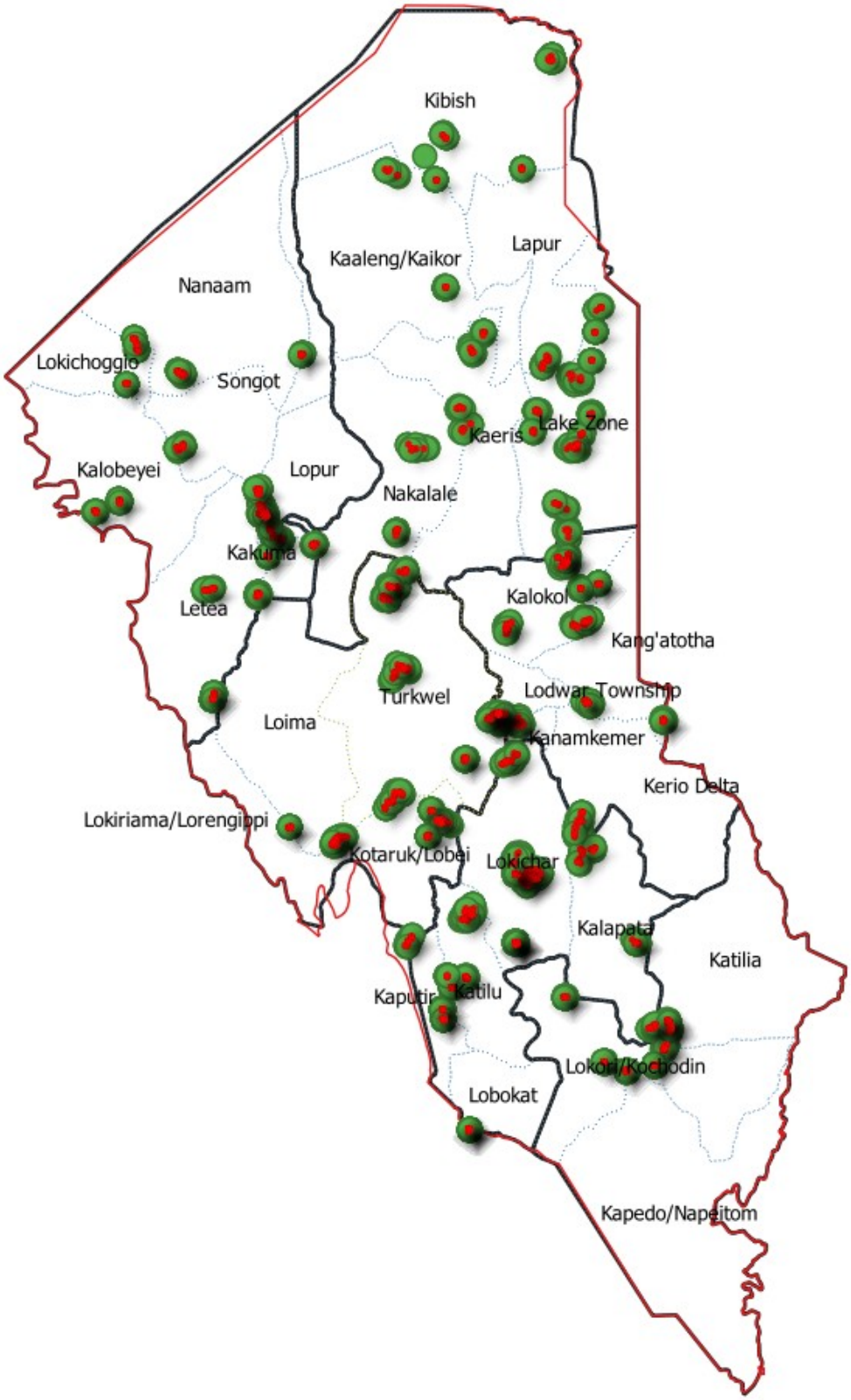


Table 2. Summary of sampled households

Survey zones	Sub counties	Actual sample size	Computed sample size	Target per village	Extra households
Central	Central and Loima	500	488	19.52 (~20)	12
North	North and Kibish	175	170	6.80 (~7)	5
West	West	400	399	15.96 (~16)	1
South	South and East	500	487	19.48 (~20)	13
Total		**1,575**	**1,544**		**31**

Quantitative survey

From the enlisted villages (100) in the household listing exercise, the villages were categorized based on the four county livelihood zones: pastoral, agro-pastoral, fisher folk, and peri-urban/urban (**Table 3**).

Table 3. Distribution of listed villages, per livelihood zone

	Sub-counties	Livelihood zone			
		Pastoral	Agro-pastoral	Fisher folk	Urban/peri-urban
Central	Central and Loima	13	2	4	6
North	North and Kibish	13	0	7	5
South	South and East	12	6	0	7
West	West	19	1	0	5
Totals		**57**	**9**	**11**	**23**

2.3 DATA COLLECTION PROCEDURES

The quantitative data were collected using SurveyCTO, a survey platform for electronic data collection that has in-built skips and quality checks. Using this software increased efficiency and reduced the time needed for cleaning the data. In addition, the platform supported offline data capturing for regions with slow or no internet connectivity and data transmission when the internet became available. Fieldwork was conducted by trained fieldworkers using digital tablets with the questionnaire loaded in SurveyCTO. The questionnaire included the following modules: (1) identification and tracking, (2) demographics and household composition, (3) anthropometry of children <5 years and mothers, (4) socioeconomics, (5) household food security, (6) WASH, (7) health-seeking behavior, (8) MIYCN, (9) shock experience/exposure, and (10) shock preparedness and response. Data were uploaded from the tablets onto a secure African Population and Health Research Center (APHRC) server after each day of data collection. Data were synchronized automatically to a server when the

tablet was in a location with network coverage. The uploaded data were then checked for quality daily by a data manager and a team dedicated to coordinate field procedures and at the APHRC head office in Nairobi.

2.3.1 Training of fieldworkers

A total of 47 experienced women (15) and men (32) fieldworkers were recruited and trained thoroughly on data collection processes for a total of 10 days. All fieldworkers were recruited from the local communities because they were familiar with the local area and customs, spoke the local languages, and were effective at ensuring community participation in study activities. They received intensive training using APHRC's training protocol, which included both theoretical training and practical exercises. They were also trained on (1) the overall aims of the study and study tools, (2) research ethics (including obtaining informed consent/assent), (3) techniques in interviewing, (4) mock interviews, (5) field-based pilots, and (6) debrief sessions after the pilots regarding lessons learned. The team also received training in the use of tablet-based questionnaires and anthropometric measurement techniques.

2.3.2 Monitoring of data quality

Data quality monitoring processes and checks were implemented throughout the data collection process, during the time of developing the data collection tools (through built-in quality control in the tablet-based platform), during training of fieldworkers, in real time during data collection (routine monitoring by the research team and periodic cross-checks against the protocols), and during the data cleaning process. During fieldwork, data quality was enhanced through regular spot checks and sit-ins by supervisors to verify the authenticity of data collected. Data were then reviewed and certified by the field coordinator before they were transferred to the server.

Field operations supervision was done in two layers: daily supervision by team leaders, and a weekly review of activities and data quality by the data coordination team, which included a research officer, a data analyst, a software programmer, and a postdoctoral research scientist. At a higher level, a weekly report on issues arising from the field and discrepancies observed in data were shared with the senior research team, which included the co-principal investigators and co-investigators, who advised on the necessary actions to be taken. The county Nawiri team and county government officials—consisting of sub-county nutrition coordinators from Turkana East and North/Kibish, the county nutrition coordinator, representatives from Mercy Corps and RTI, the Ministry of Health Monitoring and Evaluation Officer, and NDMA staff—were also involved in the whole process, from training fieldworkers to supervising data collection activities in all four survey zones.

2.3.3 Monitoring of anthropometric data quality

After procurement and before use, the anthropometric equipment was calibrated, with the procedure repeated daily during fieldwork to ensure accurate measurements. We used a calibrated digital electronic mother/caregiver–child pair weighing scale (Seca 874–200kg) to measure the weight of study children. For very young children or those who could not stand on the weighing scale, weight was measured using tared weighing, whereby the weight of the mother or caregiver was measured first, after which she was asked to hold the child and stand on the scale. We then subtracted the mother's or caregiver's weight from the combined

weight of the mother/caregiver and child to obtain the child's weight. For older children, mothers or caregivers assisted in removing shoes and outer clothing. Mothers/caregivers were also asked to talk with their child about the need to stand still. This was done in a sensitive and nonfrightening way. The stadiometer (Seca 213–220 cm) and length board (wooden: length/height to 130 cm) were used to measure the height of the adult and child, respectively. The measuring boards were calibrated using piping of a known length, while each scale was tested with a standard weight of 5 kg. Child and adult MUAC was measured to the nearest 0.1 cm using UNICEF-simplified MUAC tapes that showed three classes: red, yellow, and green. All the equipment was daily calibrated during data collection. Each of the weight and height measurements was taken twice and an average was calculated to ensure accuracy. For accuracy in the measurements, respondents were asked to remove all excess clothing (e.g., sweaters, coats, etc.) and other items (shoes, all items from pockets, watches, eyeglasses, belts, necklaces, and jewelry). Data on edema were collected for all children. Fieldworkers were trained on how to identify children with the condition, using visual aids.

MUAC, weight, and height were measured for all children under 5 years in the sampled households. However, the weight and height measurements were used as the main variables for estimating GAM, with the MUAC estimates as a complement.

2.3.4 Ethical considerations

Ethical and research approvals and research permits were obtained from the AMREF Ethical and Scientific Review Committee (AMREF-ESRC) and The National Commission for Science, Technology, and Innovation of Kenya, respectively. A reliance agreement between RTI's and APHRC's Institutional Review Boards was put into place. Fieldworkers were trained on the meaning and process of informed consent or assent and the importance of protecting the privacy and confidentiality of the information obtained from participants. All potential study participants were given information about the study before being asked for their consent to participate. They were adequately informed about the purpose of the study and methods to be used; institutional affiliation of the researchers; anticipated indirect benefits, the lack of direct benefits such as material compensation, and potential risks and follow-up of the study; possible discomfort; the right to abstain from or to withdraw from study at any time, without reprisal; and measures to ensure confidentiality of information provided.

All questionnaires used for data collection, including informed consent forms, were translated from English into the Kiswahili and Turkana language(s). Informed consent was obtained from all participants including adolescent mothers, less than 18 years, who were regarded as emancipated minors. All consent forms were kept in a secure location in APHRC offices in Nairobi. With respect to COVID-19, all risk-reduction mandates issued by the Government of Kenya were followed. Also, all survey staff and participants wore masks, and hand sanitizer was made readily available.

2.3.5 Data and data management

Survey data

The primary dependent variable was GAM (weight-for-height z-score [WHZ] < –2 standard deviations [SD] or MUAC < 125 mm). The secondary dependent variables were stunting (HAZ < –2 SD) and underweight (weight-for-age z-score [WAZ] < –2 SD). The World

Health Organization (WHO) Child Growth Standards [7] were used to calculate both the primary and secondary dependent variables from the anthropometric measurements and child age. To classify a child as acutely malnourished using MUAC, a cutoff of less than 12.5 cm was used.

The height and weight of mothers and caregivers were measured and used to compute maternal BMI. The BMI was computed by dividing weight (in kg) by height in meters squared and categorized into underweight (BMI < 18.5 kg/m^2), normal weight (BMI = 18.5–24.99 kg/m^2), overweight (BMI = 25–29.99 kg/m^2), and obesity (BMI > 30 kg/m^2).

Underweight for pregnant women was assessed using MUAC and a cutoff value of 21 cm, and short stature was assessed using the cutoff value of 145 cm recommended by the Pan American Health Organization/World Health Organization [8]. Independent and mediating variables included factors associated with acute malnutrition at various levels, consistent with the Framework on Acute Malnutrition in Africa's Drylands [1]:

- Immediate factors—child diet and other IYCF indicators (using the WHO IYCF questionnaire) and child morbidity (2-week recall).
- Underlying factors—IYCF knowledge and attitudes; WASH knowledge, attitudes, and practices (KAP); household food security; use of community health services; health-seeking behaviors; and Household Water Insecurity Experiences Scale.
- Basic factors—livelihood systems, livelihood strategies, household coping mechanisms, food produced by the household, sources of income (including transfers), expenditures.
- Basic/systemic factors—systems and institutions, including gender (women's time use, decision-making power); community conflict; household violence.

Infant and young child feeding practices were assessed using indicators from WHO and partners [9]. We assessed the children's minimum dietary diversity (MDD) using the WHO seven-food-group child dietary diversity indicator. We first assessed the consumption of the individual food groups and proceeded to categorize the indicator into whether a child had achieved minimum dietary diversity (four or more food groups). Women's minimum dietary diversity (MDD-W) was determined using a cutoff value of 5 out of the 10 food groups recommended by the Women's Dietary Diversity Project Study Group [10].

A context-specific CSI was also developed to compare food security across livelihood zones and other background characteristics. The CSI was calculated using a specific set of behaviors with a universal set of severity weightings for each behavior [11]. The five standard coping strategies and their severity weightings used in CSI calculation included eating less-preferred foods (1.0), borrowing food/money from friends and relatives (2.0), limiting portions at mealtime (1.0), limiting adult intake (3.0), and reducing the number of meals per day (1.0).

The wealth index created for the households comprised productive and nonproductive assets, and the households' wall materials, floor and roof materials, and light sources. We then selected the variables using the rule of thumb that if a variable or asset was owned by more than 95% or less than 5% of the sample, it would be excluded from the analysis. We then ran the frequencies of the different livelihood zones separately, and if certain assets were owned by very few in either of the zones, we did not include them in the analysis. The variables

were then recoded into binary variables that take 0 and 1. The wealth index was created using principal component analysis (PCA). Finally, we created wealth quintiles by dividing the wealth index into five equal groups; 1 = lowest/first/poorest, 2 = second, 3 = middle, 4 = fourth, and 5 = highest/richest/wealthiest.

Household water insecurity was measured using the Household Water InSecurity Experiences (HWISE) Scale [12].

Data analysis

Survey data analysis

Descriptive data analysis (proportions and means) of sociodemographic variables, individual-level characteristics, anthropometric indicators, and factors associated with acute malnutrition were conducted. The descriptive statistics were computed by livelihood zone and survey zone. Associations between independent, mediating, and dependent variables were evaluated using bivariate and multivariate logistics regression models. Tests for independence and association between variables were established using statistical tests such as the chi-square test for independence as well as the maximum likelihood method. Interactions between various drivers and shocks, and how they interacted with outcomes, were also explored using logistic regression models. All analyses were performed at the individual level by using computed survey weights at the livelihood zone level to ensure that appropriate precision estimates were obtained to guarantee proper inference and generalization of the results at livelihood zone level.

Regression models

We built four regression models per outcome variable. The rationale for doing so was to understand the effects of the various putative factors at each modeling stage. The child-level factors were entered into the first model (model 1), and then adjusted for maternal, household, and community-level factors in models 2, 3, and 4, respectively. In addition to the 0–35 month age group, we stratified the analysis by 6–23 months so as to make it possible for us to use all the IYCF practice indicators. We estimated the adjusted odds ratios (aORs) of the associations between the various factors and child malnutrition.

We first looked at the consumption per each food group by livelihood zones. We then proceeded to assess whether women's dietary intake in these settings met the standard for MDD-W.

We created the interaction terms by multiplying two independent variables. Two common techniques can be used to aid in interpretating interactions: preparing numerical summaries of a series of odds ratios and plotting predicted probabilities. We opted to use plotting predicted probabilities in this analysis. Interaction is said to occur if the lines of the plots cross each other or are nonparallel.

The interaction effect is based on the premise that a third variable influences the relationship between an independent and dependent variable. In other words, we want to know whether an effect of one independent variable (A) on the dependent variable depends on (varies) the values of another independent variable (B) (effect modifier or moderator). As a practical example of interaction, both water and food are essential for a child's survival. Having just one in abundance would negatively affect the child's health, while having both (interaction

between water and food) would enhance the probability of securing a child's nutrition. Thus, missing a vital interaction effect can lead to adverse health outcomes. The quantitative data analyses were performed using Stata Version 15.

2.4 CHALLENGES ENCOUNTERED DURING DATA COLLECTION

The baseline survey faced the following challenges:

Inadequate community mobilization: Inadequate mobilization in some villages led to initial delays in household listing.

Community fatigue: Some respondents complained about participating in so many surveys that did not benefit them directly.

Out migration and insecurity: Some entire villages/households migrated as far as the border region between South Sudan and Ethiopia (the Ilemi triangle) because of recent drought or insecurity in some areas. Field teams were able to follow the villagers into Ethiopia. However, lack of security resulted in the need for some villages—e.g., the entire Lomelo ward—to be replaced in the sample.

Distance and inaccessible road/terrain: The villages and households were generally far apart in some areas; hence, the field team had to travel for long distances before reaching sampled villages/households. Additionally, there were impassable roads due to heavy rain in some areas and also hilly terrain that led to teams walking to access the villages.

Absenteeism: In many households in the Central and West zones, either there was no one in the house to interview or there was no qualified member to be interviewed, and they were recorded as temporarily absent. In some villages, particularly for fisher folk, many household heads and mothers or caregivers spent the better part of the day away from their homes engaged in fishing-related activities; in some other villages, families were absent because of food-relief distribution; and in still others, residents were away for traditional weddings and were missed during the listing exercise. In some villages in Turkana West, the household economic activity was mining, and many of those villagers spent most of their time at the gold mines.

Pandemic effect: The COVID-19 pandemic resulted in a significant delay in initiating data collection.

3 HOUSEHOLD CHARACTERISTICS

3.1 HOUSEHOLD DEMOGRAPHIC AND SOCIOECONOMIC INDICATORS

Overall, 62.3% of the households were headed by men while the remaining 37.7% of households were headed by women. The percentage of female-headed households was higher in the urban/peri-urban areas, where nearly half of households were female-headed (**Table 4**). Most of the respondents (85%) were the mother of the study child, with the remaining being the child's caregiver (data not shown). However, there was variation by livelihood zone; among fisher folk, 67% of respondents were the mother of the study child, whereas among agro-pastoralists, 92% were the mother of the study child.

More than 4 in 10 household heads were 20 to 34 years old. More than two-thirds (72.4%) of household heads did not attend formal education, and only 15.9% and 11.7% of household

heads had attained primary and post-primary education levels, respectively. Primary and post-primary education levels were the lowest in pastoral and agro-pastoral livelihood zones.

Livestock herding was the main (68.0%) occupation of household heads in the pastoral livelihood zone, while farming (45.9%) and livestock herding (26.6%) were the main occupations of household heads in the agro-pastoral zone, fishing was the main occupation for household heads among fisher folk (66.8%), and petty trade was the main occupation for household heads in the urban/peri-urban settings (50.4%).

The main sources of income varied across livelihood zones. Sale of livestock (36.6%) and petty trade for products of livestock (49.0%) were the main sources of household income in the pastoral livelihood zone. The sale of crops (23.3%) and petty trade (41.0%) were the main sources of income in the agro-pastoral livelihood zone. The highest percentage of households reporting no income was in the agro-pastoral livelihood zone (22.7%). The distribution of households by wealth index was similar across all livelihood zones. The highest unemployment rate (12.9%) was observed among households in the urban/peri-urban livelihood zone. Firewood was by far the main household cooking fuel across all livelihood zones. Overall, 17.7% of households reported receiving cash transfers or other social assistance.

Table 4. Percentage distribution of households by demographic and socioeconomic characteristics and by livelihood zone

Characteristic	Livelihood zone				
	Pastoral	Agro-pastoral	Fisher folk	Urban/peri-urban	Overall
Overall averages and totals	**449**	**159**	**88**	**515**	**1,211**
Household head: Sex					
Male	62.7	63.7	64.6	51.9	62.3
Female	37.3	36.3	35.4	48.1	37.7
Household head: Age					
< 20	1.3	1.7	0.6	1.8	1.3
20–34	45.3	43.1	41.0	49.6	44.7
35–44	25.7	25.5	41.9	26.0	27.6
45+	27.7	29.7	16.5	22.6	26.3
Household head: Highest education					
No education	89.9	82.4	53.4	57.3	72.4
Primary	7.1	8.8	37.5	22.1	15.9
Secondary+	2.9	8.8	9.1	20.6	11.7
Household head: Occupation					
Livestock herding	68.0	26.6	2.8	7.2	49.4
Farming	0.0	45.9	0.0	1.0	7.4
Employed/salaried	0.7	1.8	4.9	15.1	2.3
Petty trader	24.1	19.1	15.8	50.4	24.1

Merchant/trader	0.6	1.4	0.0	1.7	0.8
Self-employed	1.0	0.7	2.9	11.5	1.9
Fishing	0.3	0.0	66.8	0.2	8.2
Unemployed	5.3	4.7	6.7	12.9	5.9
Main household source of income					
No income	11.8	22.7	1.7	8.3	12.0
Sale of livestock	36.6	9.9	2.8	1.2	26.0
Sale of crops	0.0	23.3	0.0	1.6	3.8
Petty/merchant trade[a]	49.0	41.0	29.6	70.9	46.9
Income/wages	1.9	3.1	3.9	17.6	3.4
Fishing	0.0	0.0	62.1	0.0	7.4
Remittance/donations/ support	0.7	0.0	0.0	0.5	0.5
Main type of household cooking fuel					
Firewood	98.3	96.6	88.7	84.0	95.9
Charcoal	1.7	3.4	11.3	15.6	4.1
Gas (liquified petroleum gas, biogas)	0.0	0.0	0.0	0.4	0.0
Place of household cooking					
In the house	1.3	4.9	0.0	7.6	2.1
In a separate building	43.1	52.2	88.5	49.2	50.4
Outdoors/open air	55.6	42.9	11.5	43.2	47.5
Source of household lighting					
Electricity	3.0	4.4	9.4	13.7	4.7
Kerosene/candle	0.0	0.9	0.6	2.8	0.4
Firewood	65.5	52.5	28.5	36.9	57.0
Solar	18.9	27.3	38.6	28.0	23.2
Phone/spotlight	12.0	14.4	22.8	15.4	13.9
Nothing	0.6	0.5	0.0	3.3	0.7
Number of rooms (household)					
1	66.4	59.5	56.4	52.2	63.1
2	24.7	24.7	35.1	34.3	26.6
3+	8.9	15.7	8.4	13.5	10.3
Sleeping rooms (household)					
1	83.7	78.8	75.0	76.0	81.4
2+	16.3	21.2	25.0	24.0	18.6
Household wealth index[b]					
Lowest	27.8	25.8	13.6	12.8	20.2
Second	29.8	24.5	14.8	11.8	20.4
Middle	27.6	19.5	20.4	12.8	19.7

Fourth	11.8	20.1	25.0	26.9	20.3
Highest	1.9	10.1	26.1	35.5	19.4
Percentage of household receiving a cash transfer/ social assistance	16.7	21.4	18.2	17.3	17.7
Mean (SD) of household probability poverty index (PPI)[c]	80.3 (9.7)	78.8 (13.7)	69.2 (13.3)	68.5 (19.9)	74.3 (16.5)

Note. Total percentages may not add up to 100% because of households with missing information.
[a] The petty/merchant trade category includes businesses dealing with products and services.
[b] The wealth quintiles are classifications of wealth index by proxy of household possessions and property ownership using PCA.
[c] PPI is the average of individual household poverty.

3.2 HOUSEHOLDS' PRODUCTIVE ASSETS

Overall, more than 9 in 10 households owned a dwelling, with the lowest percentage (83.0%) in the urban/peri-urban livelihood zone. Livestock, including poultry, was owned by the majority (87.8%) of households in pastoral communities, followed by agro-pastoral households (68.2%), fisher folk (51.0%), and urban/peri-urban dwellers (47.3%). Ownership of livestock varied across livelihood zones. Households rarely owned 6+ of the different varieties of livestock or poultry, except for goats and sheep. Nearly three-quarters (73.8%) of agro-pastoral households had access to agricultural/grazing land, followed by pastoral (32.1%), urban/peri-urban (22.5%), and fisher folks (13.3%) (data not shown). A significant portion of these lands were owned communally, and among the fisher folk, 100% of the land was owned communally (**Table 5**).

Table 5. Percentage distribution of households by ownership of productive assets, by livelihood zone

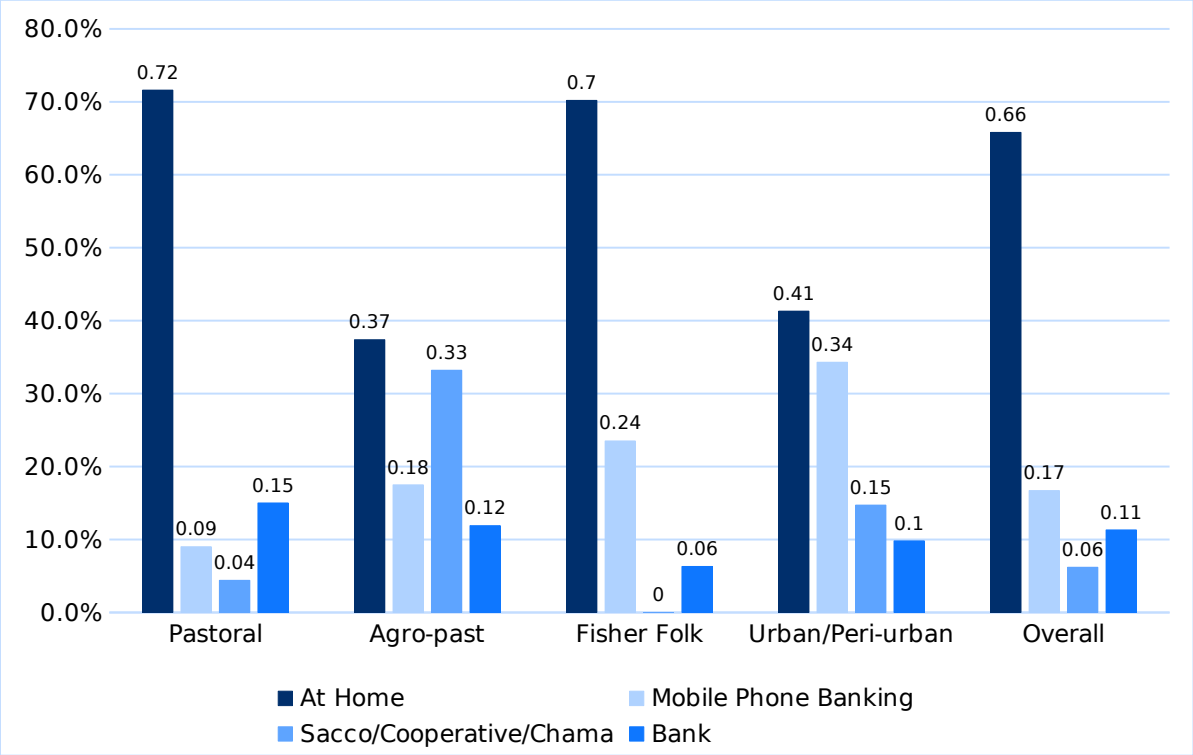
Characteristic	Livelihood zones				Overall
	Pastoral	Agro-pastoral	Fisher folk	Urban/ peri-urban	
Totals	**449**	**159**	**88**	**515**	**1,211**
Ownership of current dwellings					
Owns	97.9	89.3	98.3	83.0	95.6
Pays rent/lease	0.5	2.7	0.0	13.0	1.6
No rent	1.6	8.0	1.7	3.9	2.8
Ownership of livestock, including poultry	87.8	68.2	51.0	47.3	77.5
Owns local/indigenous cattle					
None	89.1	87.9	99.2	97.6	90.1
1–5	5.9	8.4	0.8	1.1	5.6
6+	5.1	3.6	0.0	1.3	4.3
Owns grade cattle					
None	98.4	99.0	100.0	99.5	98.7

1–5	0.8	1.0	0.0	0.0	0.7
6+	0.8	0.0	0.0	0.5	0.6
Owns donkey(s)					
None	79.8	87.8	100.0	93.9	83.1
1–5	18.3	12.2	0.0	5.4	15.5
6+	1.9	0.0	0.0	0.7	1.4
Owns camel(s)					
None	84.0	92.3	99.2	91.4	86.6
1–5	14.6	7.7	0.8	8.2	12.3
6+	1.4	0.0	0.0	0.4	1.1
Owns goat(s)					
None	0.5	7.8	4.1	12.3	2.3
1–5	32.3	41.2	62.3	49.4	36.6
6+	67.2	51.0	33.5	38.3	61.1
Owns sheep					
None	22.2	30.1	66.5	46.9	27.8
1–5	44.0	52.1	24.5	40.9	43.5
6+	33.7	17.8	9.0	12.1	28.6
Owns chicken(s)					
None	79.1	62.5	72.7	59.7	75.5
1–5	16.9	25.4	22.0	33.2	19.2
6+	4.0	12.1	5.4	7.1	5.4
Agricultural/grazing land ownership					
Owned communally	94.5	52.7	100.0	64.3	29.3
Owned individually	5.5	47.3	0.0	35.7	6.6

3.3 HOUSEHOLD SAVINGS AND LOAN HABITS

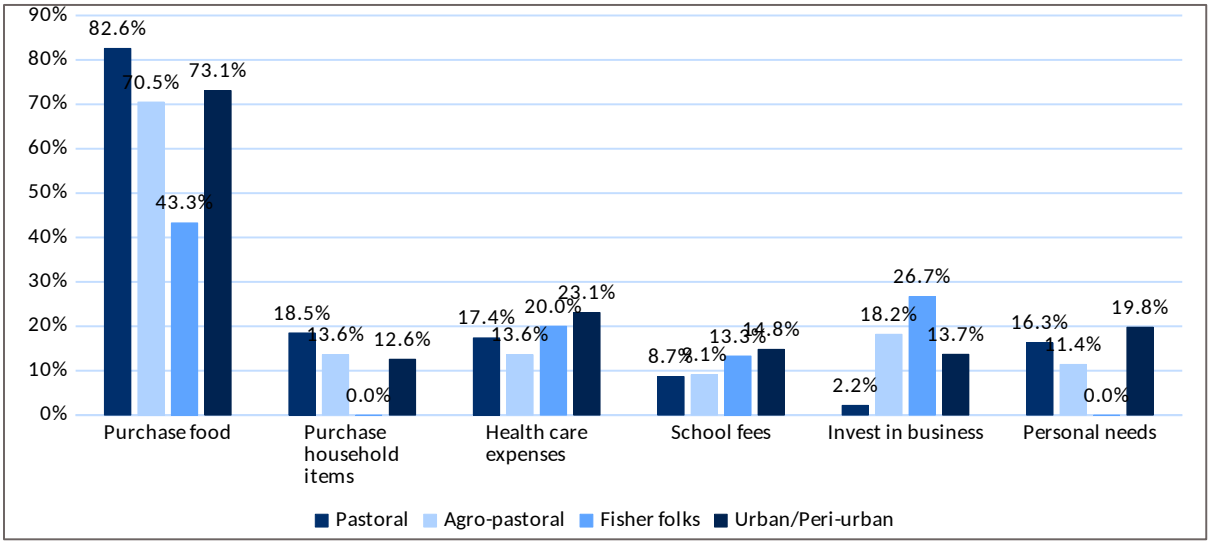
More than a quarter (27.8%) of households in the fisher folk livelihood zone reported that they regularly saved their cash (data not shown), followed by households in urban/peri-urban (12.6%), and pastoral and agro-pastoral livelihood zones (7.9%). These savings were held primarily at home, especially for those in the fisher folk and pastoral livelihood zones (**Figure 3**).

Figure 3. Location of household savings, by livelihood zone



More than one-third of households in urban/peri-urban (35.9%) and fisher folk (33.2%) respondents, as well as 30.1% and 20.5% households, respectively, from agro-pastoral and pastoral livelihood zones, had borrowed money from someone else in the past 4 months (data not shown). As indicated in **Figure 4,** the money borrowed was spent on food purchases (43.3% fisher folk to 82.6% pastoral) followed by health care expenses (13.6% agro-pastoral to 23.1% urban/peri-urban) and personal needs (0% fisher folk to 19.8% urban/peri-urban). More than half of the households that borrowed money reported borrowing from friends or family members.

Figure 4. Reasons reported by households for borrowing money, by livelihood zone



3.4 HOUSEHOLDS' ACCESS TO FINANCIAL SUPPORT OR CASH TRANSFERS

Between 6.1% and 11.6% of households across the livelihood zones reported receiving financial support in the past 4 months, with the lowest percentage among fisher folk and the highest among agro-pastoralists (**Table 6**). It is important to note that these responses could have been subject to bias, because previous interactions at the county level have shown that households tend to underrate the support received during surveys in hope of getting more support. Financial support was mostly received from the government and through bank payments. In the pastoral areas, 34.2% of households reported that the financial support was not received when promised.

Table 6. Percentage distribution of financial support or cash transfers in the past 4 months, by livelihood zone

Characteristic	Livelihood zones				Overall
	Pastoral	Agro-pastoral	Fisher folk	Urban/ peri-urban	
Total respondents	449	159	88	515	1,211
Number who received financial support—e.g., cash transfer—in the past 4 months	33	14	8	43	98
Percentage who received any financial support	7.6	11.6	6.1	8.0	8.1
Source of financial support/cash transfer					
Government programs (elderly, orphans or vulnerable children)	63.5	59.0	48.8	68.2	61.4
Nongovernmental organizations (NGOs)	14.4	28.2	0.0	13.8	16.2
Gift	27.5	31.9	65.1	24.1	31.7
Mode of transfer used for the financial support					
Bank	71.4	80.6	69.5	74.4	73.5
Cash	17.2	19.4	30.5	18.6	19.0
Other, including mobile-money agents	11.4	0.0	0.0	7.1	7.5
Mode of household selection for support from government or NGO					
Attended an organized meeting	9.0	6.3	0.0	8.4	7.5
Filled out forms for support	86.7	90.8	59.0	81.1	84.8
Other (including area chief or local administrators)	4.3	2.9	41.0	10.5	7.7
Financial support received came at the time indicated	34.2	15.1	0.0	19.9	25.8

3.5 HOUSEHOLD EXPERIENCES WITH SHOCKS AND COPING STRATEGIES

More than 9 in 10 households reported having experienced one or more types of shocks in the past 4 months (**Table 7**). Climatic shocks (drought/famine) were the dominant type experienced across all livelihood zones. Livestock disease outbreak was the dominant biological shock among pastoral households, although it was also reported by a significant proportion of the households from other livelihood zones. The next most dominant shock was severe human illness(es). COVID-19 was not reported as a biological shock by the households in all livelihood zones, except an insignificant proportion (0.4%) reported by households from urban/peri-urban settings. Theft of livestock was commonly reported by households from pastoral and agro-pastoral livelihood zones. Increased food prices and delays in food assistance were reported as major economic shocks, though the magnitude varied among households across all livelihood zones.

Table 7. Percentage distribution of households that experienced shocks in the past 4 months, by livelihood zone

Shocks	Livelihood zones				Overall
	Pastoral	Agro-pastoral	Fisher folk	Urban/ peri-urban	
Total respondents	**449**	**159**	**88**	**515**	**1,211**
Climatic shocks					
Excessive rains/flooding	19.6	16.9	34.5	22.4	21.1
Drought/famine	98.3	96.0	80.5	85.1	94.9
Biological shocks					
Livestock disease outbreak	82.7	48.9	34.8	32.5	68.1
Crop pest invasion (e.g., locust)	14.1	41.7	0.0	6.2	16.3
Human disease outbreak	10.7	7.1	17.8	5.4	10.6
Severe human illness	24.6	26.9	14.3	28.6	24.0
COVID-19	0.0	0.0	0.0	0.4	0.0
Conflict shocks					
Theft/destruction of assets	5.4	18.0	7.2	8.6	7.8
Theft of livestock	33.7	38.4	6.5	14.5	29.9
Domestic violence	6.5	11.5	6.7	11.7	7.7
Community conflict	6.8	11.6	4.5	5.9	7.2
Economic shock					
Loss of livelihood/being laid off	11.4	14.1	13.2	13.4	12.2
Increased food prices	89.4	91.6	77.7	90.0	88.4
Decreased prices for agricultural or livestock products	12.7	14.4	0.0	6.1	11.0
Increased prices of agricultural or livestock inputs	14.5	29.3	6.8	10.0	15.6
Unemployment for youths	12.7	16.9	3.5	19.1	12.7

Loss/death of household member	7.5	11.8	10.3	12.2	8.8
Delay in food assistance	38.8	31.3	15.4	28.1	34.1
Delay in other safety net programs from family members	16.6	19.2	4.5	13.2	15.3

Strategies adopted by households to cope with shocks varied across livelihood zones. By far, the most common strategy was to reduce food consumption, reported by over 80% of households in all livelihood zones (data not shown). Reducing nonessential household expenditures and accessing food on credit were practices by over 50% of households across livelihood zones (**Table 8**). Other reported coping strategies included moving livestock in search of pasture, sending children or adults to stay with relatives, and taking out a loan with or without interest. More than half of households reported having no coping strategy to protect themselves from future shocks; this finding was consistent across all livelihood zones (data not included).

Table 8. Percentage distribution of households by strategies adopted to cope with shocks in the past 4 months, by livelihood zone

Coping strategy	Livelihood zones				Overall
	Pastoral	Agro-pastoral	Fisher folk	Urban/ peri-urban	
Numbers of households that experienced any shocks	**447**	**158**	**84**	**512**	**1,201**
Used livestock, agriculture, and land holdings					
Sent livestock in search of pasture	71.6	34.9	16.0	23.2	56.0
Sold livestock	61.5	39.8	20.5	19.4	50.4
Slaughtered livestock	53.3	21.6	25.4	17.3	42.5
Leased out land	0.6	0.7	0.0	0.3	0.6
Migration					
Household member migrated for work	4.1	9.2	24.2	9.8	7.6
Migrate (the whole family)	12.8	10.4	12.5	5.3	11.8
Sent children/adult(s) to stay with relatives	21.0	15.8	20.4	19.9	20.0
Reduction in current expenditure					
Took children out of school	3.9	5.1	10.2	10.1	5.2
Moved to less expensive housing	1.3	2.8	0.0	5.2	1.7
Reduced food consumption	80.9	89.5	82.8	82.4	82.6
Reduced nonessential household expenses	53.2	64.3	56.1	54.5	55.4
Got food on credit from a local merchant	51.5	65.7	55.8	64.9	55.2

Increase in cash flow					
Took up new/additional work	6.6	8.1	21.7	18.8	9.4
Sold household items (e.g., radio, bed)	2.9	1.7	4.3	2.6	2.8
Sold productive assets	0.9	0.7	2.8	0.8	1.1
Took out a loan, with or without interest	27.8	31.4	17.9	48.2	28.7
Used own savings	4.2	4.1	27.1	14.8	7.6
Relied on remittances from a relative that migrated	0.7	0.3	2.2	2.0	0.9
Sent children to work for money	0.8	1.6	4.3	2.4	1.4

3.6 HOUSEHOLDS HEADED BY ADOLESCENTS AND YOUNG PEOPLE

About 11% of households were headed by an adolescent or young person (15–24 years) across survey zones (see ***Annex D*** for additional data), although more than half (56.6%) of such households lived in urban/peri-urban survey zones. A slim majority (55.5%) of adolescent-headed households had 4–6 family members. Most adolescent or young household heads had no formal education (80.4%).

4 MATERNAL AND CHILD NUTRITION

4.1 ANTHROPOMETRY

4.1.1 Prevalence of child undernutrition by survey zones

Depending on whether WHZ or MUAC was used as the indicator, the prevalence of GAM was 21.4% or 17.2%, respectively. Analysis by survey zones (see **Figure 5**) showed that, when assessed using WHZ, the North had the highest proportion of children with GAM (24.9%), followed by the South (24.0%), while the West had the lowest (15.9%). However, when MUAC was used as a measurement, prevalences were lower; the highest prevalence was in the West (21.1%) and the lowest was in the Central zone (13.4%).

The difference between the results from WHZ and MUAC suggests a nonlinear relationship between the two measures.

Figure 5. Prevalence of malnutrition among children 0–35 months, by survey zone

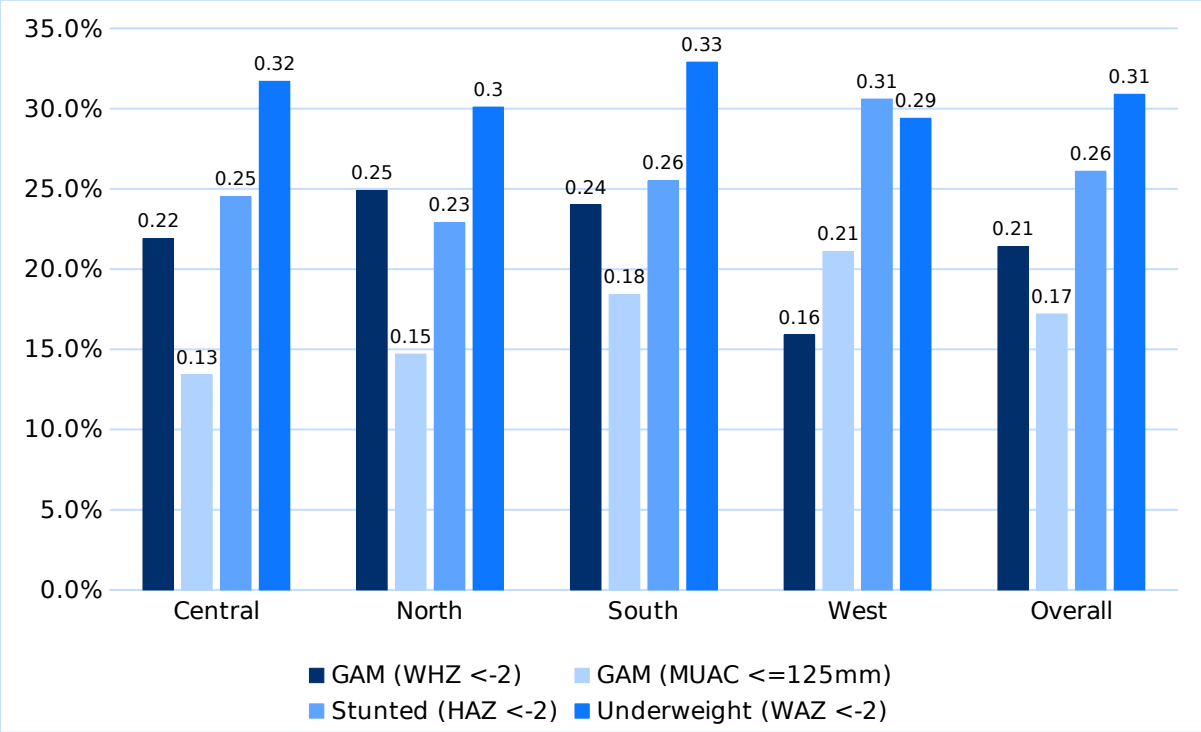
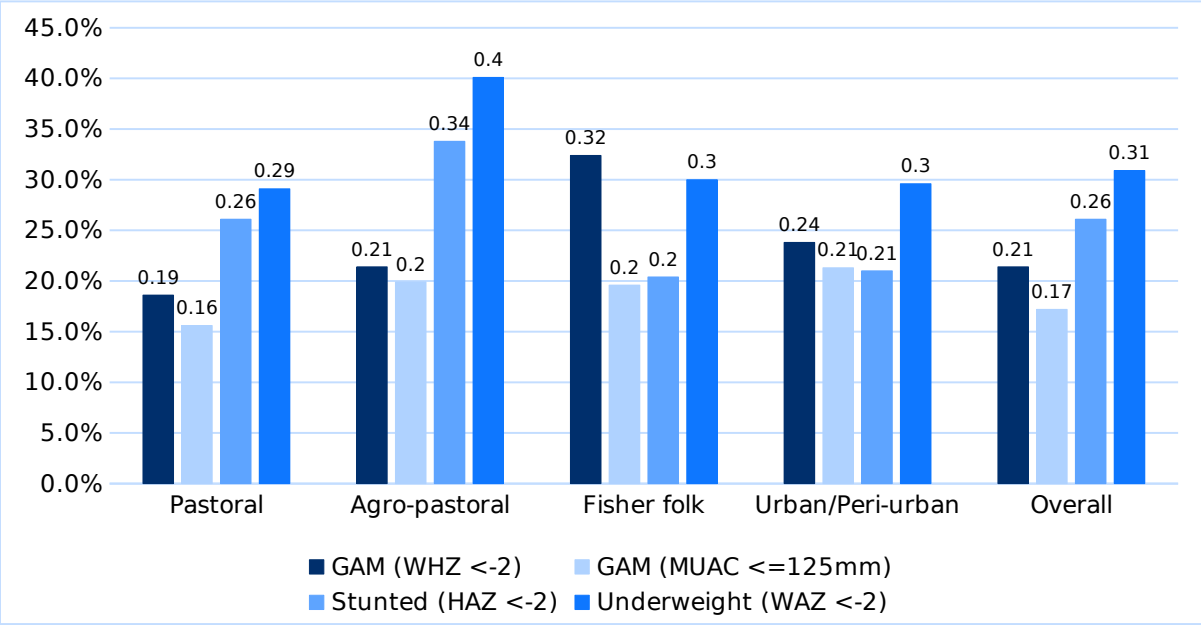


Figure 6. Prevalence of malnutrition among children 0–35 months, by livelihood zone



Regardless of the indicator used, the prevalence of GAM across all survey and livelihood zones showed levels above the emergency threshold of 15%, consistent with recent Standardized Monitoring and Assessment of Relief and Transition (SMART) surveys for Turkana [3, 13, 14]. Prevalence rates from the 2019 SMART survey were for children 0–59 months and so are not directly comparable to our data. However, with the exception of the South, our results were fairly similar when using WHZ as the indicator and are as follows:

- Central was 20.1% in the SMART survey versus 21.9% in our study
- North was 30.2% versus 24.9%
- South was 30.8% versus 15.9%
- West was 23.0% versus 21.4%.

The 2019 SMART survey showed that prevalence rates for acute malnutrition as measured by MUAC, unlike the case for WHZ, were higher than the rates we found. Comparisons of the SMART survey versus our data are as follows:

- Central was 7.4% in the SMART survey versus 13.4% in our study
- North was 11.4% versus 14.7%
- South was 8.9% versus 18.4%
- West was 11.4% versus 21.1%.

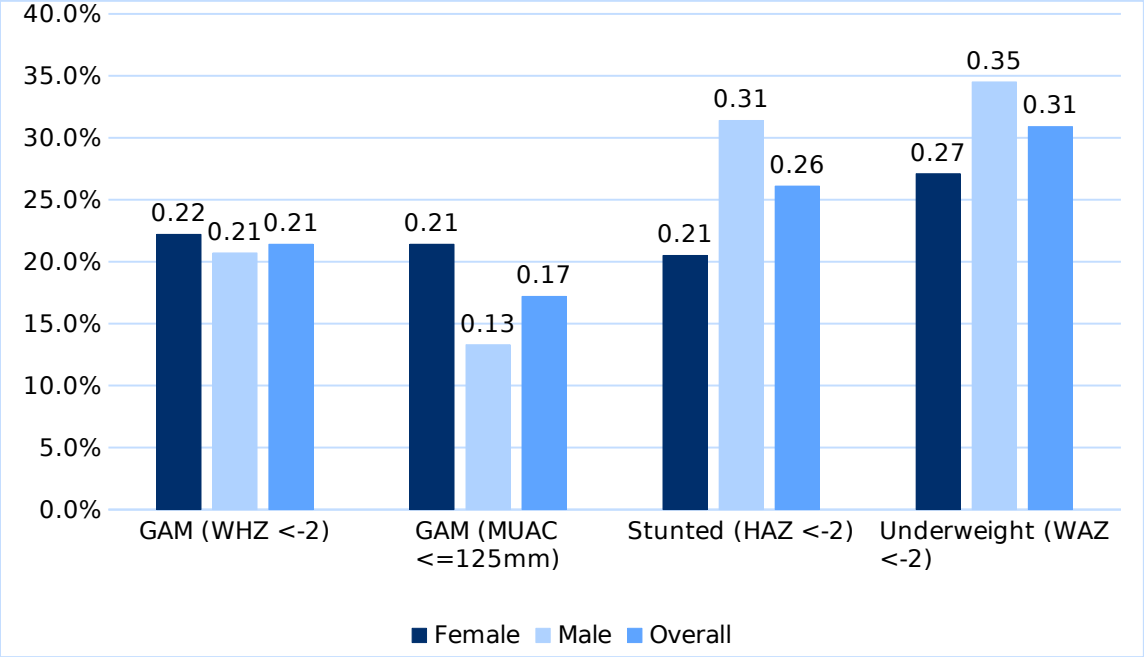
Consistent with our findings, in general, the prevalence of GAM when assessed by WHZ is often greater compared to assessment by MUAC. An analysis of 733 population-representative surveys from 41 countries assessed the correlation between WHZ < –2 and MUAC <125 mm among children 6–59 months and found that the prevalence of acute malnutrition was 10.5% and 6.7% when WHZ and MUAC were used, respectively [15]. However, another study that used 1,832 population-representative surveys from 47 countries found that both the magnitude and direction of the discrepancy between the two indicators varied among countries [16]. In some countries, more children were classified with acute malnutrition by MUAC, whereas in others, nearly all children were diagnosed by WHZ alone. The authors of this second study concluded that the two indicators are complementary and should be used independently to guide admission for treatment. With respect to our results, however, there is no clear explanation as to why prevalence rankings by survey and livelihood zone would change depending on the indicator, which merits further exploration.

4.1.2 Prevalence of child malnutrition by child's age and sex

Figures 7 and **8** present the prevalence of malnutrition by the child's sex and age. The results showed that GAM when measured by WHZ was slightly higher among girls (22.2%) than boys (20.7%). However, when measured by MUAC, the prevalence among girls was significantly greater (21.4%) compared to boys (13.3%). Based on WHZ, the 2019 SMART survey showed that rates were greater among boys (27.8%) compared to girls (23.5%), although the difference was not significant (data not shown). The SMART survey did not report on sex-specific differences using MUAC.

The finding that the two indicators for acute malnutrition produced such different sex-specific results is difficult to explain. An analysis of four Demographic and Health Surveys (DHSs) conducted between 1993 and 2008–2009 showed that at the national level, there were no sex-specific differences using WHZ among children aged 6–59 months for the first three surveys. However, the last survey (2008–2009) showed that boys were significantly more likely to have acute malnutrition than girls [17, 18]. The most recent Kenya DHS (2014) showed nationally that 4.4% of boys and 3.7% of girls less than 59 months of age were acutely malnourished [11]. The survey did not report sex-specific differences for region. Several studies, including one for sub-Saharan countries only, found that acute malnutrition was higher among boys when WHZ was used [19, 20].

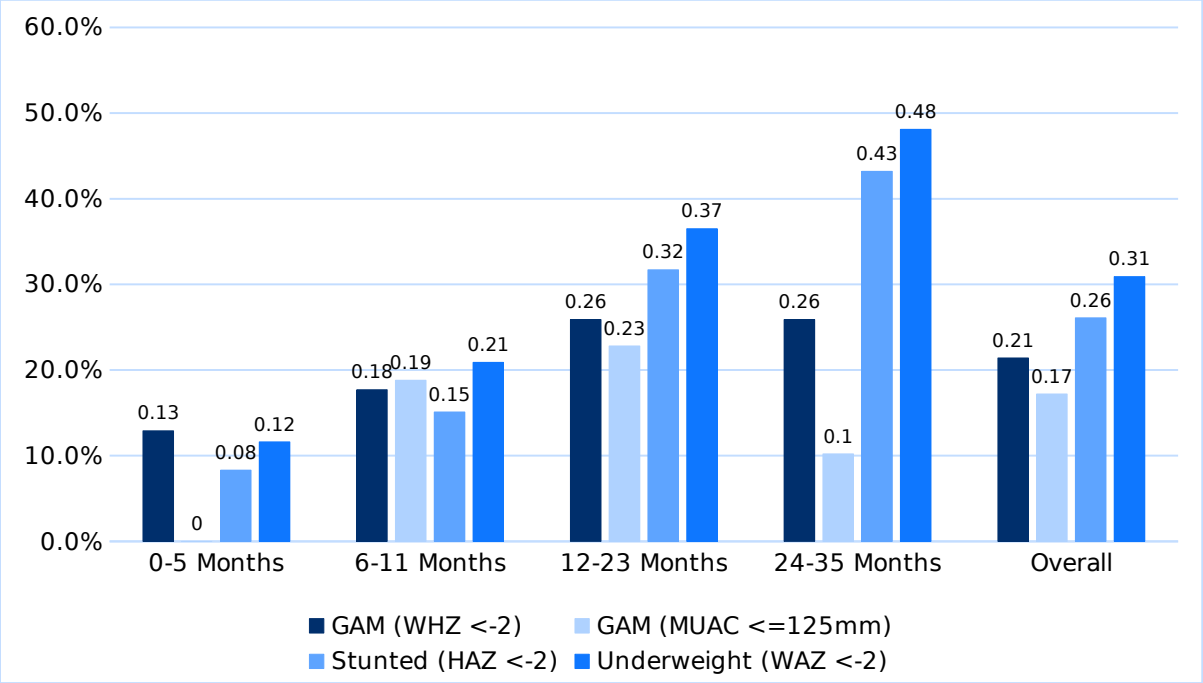
Figure 7. Prevalence of malnutrition among children aged 0–35 months, by sex



Prevalence of GAM, when assessed by WHZ, increased from 12.9% among infants less than 5 months to 25.9% among children 24–35 months (Figure 8). Assessing by MUAC caused a different picture to emerge: children 24–35 months had the lowest prevalence (10.2%). The 2019 SMART survey reported different age categories than our study, such that age-specific prevalence rates cannot be compared.

Our analysis also showed that using WHZ revealed that children tend to suffer from GAM as they grow older, which is consistent with knowledge of the protective effect of exclusive breastfeeding and the risk of undernutrition during the complementary feeding period. Young children, particularly those exclusively breastfed, are generally protected from undernourishment because they are receiving a highly nutritious food and are at reduced risk of illness from contaminated foodstuffs or feeding utensils. At 6 months, when a child needs complementary foods, poverty—and all it entails in terms of food security, water insecurity, and poor sanitation, and women's time poverty, among other factors—plays a large role [21]. Use of bottles, as found in our study (see data on infant and young child feeding practices below), is also a risk factor for diarrhea that can lead to acute malnutrition.

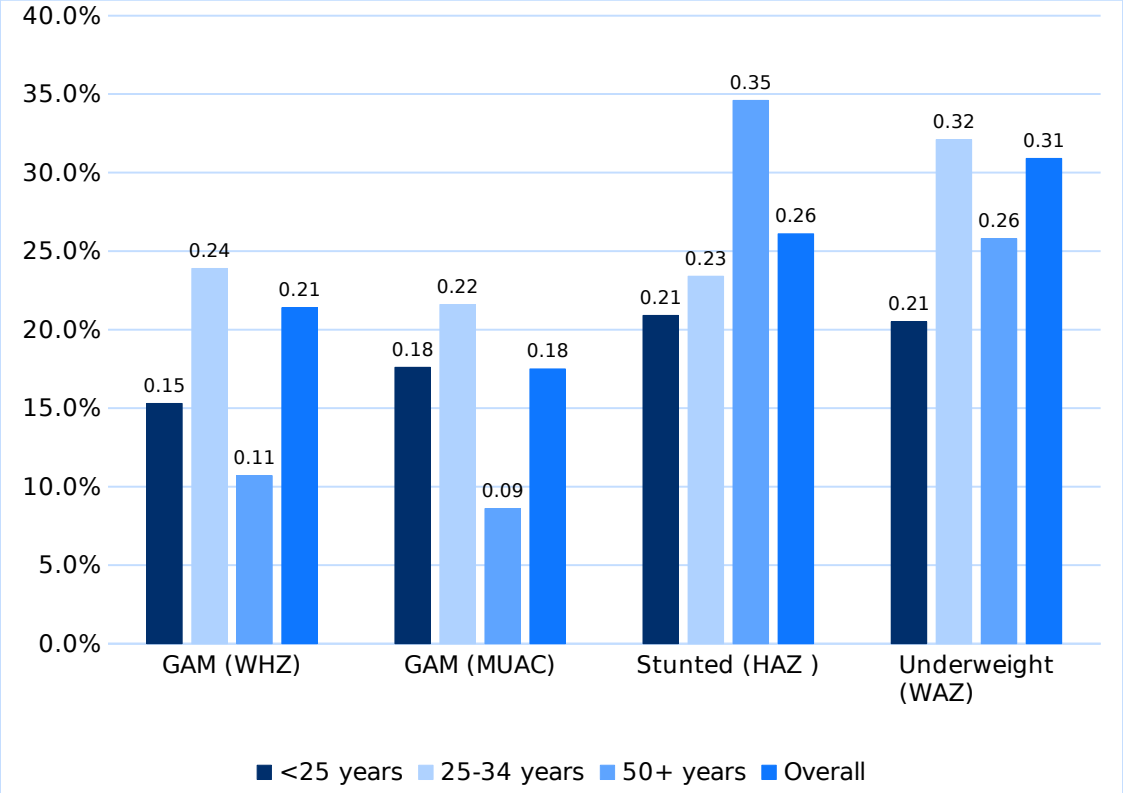
Figure 8. Prevalence of malnutrition among children 0–35 months, by child's age



4.1.3 Prevalence of child malnutrition by mothers' or caregivers' age

Figure 9 presents the results of the prevalence of GAM by mother's or caregiver's age. When assessed by WHZ, the highest prevalence was among mothers or caregivers between 25 and 49 years of age (i.e., 47.5% across two age bands). However, when assessed by MUAC, the prevalence was highest among mothers or caregivers 25 to 34 years of age (21.6%). This difference may stem from the fact that women in the older age group tend to have more children to care for compared to the younger age categories, and parity is a well-known factor associated with undernutrition [22].

Figure 9. Prevalence of childhood malnutrition, by mothers' or caregiver' age



4.1.4 Prevalence of child malnutrition by other maternal and household sociodemographic factors

Analysis of the prevalence of undernutrition by child, mother or caregiver, and household sociodemographic factors (**Table 9**), showed the following:

- Children of fisher folk were significantly more likely to suffer from GAM compared to children of other livelihood zones.
- Male children were significantly more likely to be stunted and underweight compared to female children.
- Older children (12–23 and 24–35 months) were significantly more likely to suffer from stunting, underweight, and GAM compared to children less than 6 months.
- Children of non-polygamous marriages were significantly less likely to be acutely malnourished and stunted compared to children of polygamous marriages.
- Children of caregivers or mothers 25–30 years were significantly more likely to be underweight and acutely malnourished compared to younger or older caregivers or mothers.
- Children of overweight or obese mothers or caregivers were significantly less likely to be stunted compared to mothers or caregivers who were underweight or normal weight.
- Children of mothers or caregivers who achieved MDD-W were significantly less likely to be stunted, underweight, or acutely malnourished compared to those who did not achieve MDD-W.
- Children in female-headed households were significantly more likely to be stunted compared to those in male-headed households.

- Survey zone, whether a child achieved MDD, mother or caregiver education, household ownership of livestock or poultry, level of food insecurity, or wealth quintile were not associated with child stunting, underweight, or acute malnutrition.

Table 9. Prevalence of acute malnutrition by children, maternal, and household socio-demographic factors

Characteristic	Stunted (HAZ <–2)		Number of stunted children	Underweight (WAZ <–2)		Number of under-weight children	Wasted (WHZ <–2)		Number of wasted children
	(%)	*p*-value[a]		(%)	*p*-value[a]		(%)	*p*-value[a]	
Overall averages and totals	**26.1**		**1,184**	**30.9**		**1,194**	**21.4**		**1,184**
Livelihood zone									
Pastoral	26.1	.105	440	29.1	.082	443	18.6	.027	440
Agro-pastoral	33.8		158	40.1		159	21.4		156
Fisher folk	20.4		85	30		88	32.3		87
Urban/peri-urban	21.0		501	29.6		504	23.8		501
Survey zone									
Central	24.5	.555	347	31.7	.837	351	21.9	.333	348
North	22.9		143	30.1		143	24.9		143
South	25.5		388	32.9		388	24		382
West	30.6		306	29.4		312	15.9		311
Child sex									
Female	20.5	.002	591	27.1	.042	594	22.2	.678	591
Male	31.4		593	34.5		600	20.7		593
Child age (months)									
0–11	11.9	<.001	490	16.5	<.001	493	15.5	.036	487
12–23	31.7		421	36.5		423	25.9		421
24–35	43.2		273	48.1		278	25.9		276
Child age 6–23 months with minimum dietary diversity, 4 out of 7 food groups									
No	25.2	.158	607	30.1	.715	609	22.1	.584	605
Yes	12.0		57	24.3		57	29.3		58

Polygamous marriage									
No	28.4	.028	784	31.4	.749	791	23.9	.043	786
Yes	21.7		400	30.0		403	16.8		398
Mother or caregiver highest education									
No education	26.7	.440	916	31.7	.326	924	20.9	.447	916
Primary	23.7		175	26.5		177	23.1		175
Secondary+	15.1		93	20.0		93	33.5		93
Mother or caregiver age (years)									
< 25	20.9	.315	277	20.5	.022	282	15.3	.030	278
25–34	26.8		845	34.0		850	23.8		845
50+	34.5		62	25.8		62	10.7		61
Mother or caregiver nutrition status (nonpregnant)									
Normal	21.5	.041	535	27.0	.151	541	19.0	.350	537
Underweight	28.8		460	33.3		462	23.6		456
Overweight or obese	14.7		71	20.8		71	17.2		71
Mother or caregiver achieved minimum dietary diversity (15–49 years)									
No	25.9	0.019	1,068	31.6	0.011	1,077	22.4	0.062	1,068
Yes	7.7		54	9.6		55	7.2		55
Sex of household head									
Male	22.3	0.021	681	28.7	0.19	684	19.1	0.086	676
Female	32.3		503	34.5		510	25.1		508
Household currently owns any livestock or poultry									
No	25.9	0.945	422	32.8	0.589	429	28.5	0.061	426
Yes	26.2		762	30.3		765	19.2		758
Household water insecurity									
No	24.7	0.637	351	28.7	0.338	353	23.8	0.329	352

Yes	26.6		833	31.7		841	20.6		832
Household food insecurity									
Minimal/none	27.5	0.884	62	23.4	0.492	63	12.5	0.148	62
Moderate	22.4		84	28.7		84	29.6		81
Severe	26.2		1,038	31.6		1,047	21.6		1,041
Wealth quintile									
Lowest	28.5	0.710	240	31.8	0.829	242	19.7	0.388	237
Second	24.4		246	28.8		245	19.2		242
Middle	26.4		233	30.9		235	18.5		236
Fourth	26.1		238	30.5		244	27.6		242
Highest	22.4		227	35.1		228	29.1		227

Note. The totals may vary due to different sample sizes of disaggregate variables or missing information.
[a]The *p*-value is from the chi-square test of independence between two categorical variables.

4.2 CHILD BREASTFEEDING AND COMPLEMENTARY FEEDING PRACTICES

The baseline findings showed that breastfeeding practices were fairly good, although they could be improved (**Table 10**). For example, early initiation of breastfeeding averaged 77.3% and more than 90% of mothers fed colostrum. Exclusive breastfeeding for the recommended 6 months was lower (66.8% on average), although some interesting patterns emerged. The rate was highest among fisher folk (91.3%) and lowest among urban/peri-urban dwellers (58.1%). It was also higher:

- In the Central, South, and West survey zones (greater than 67%) compared to the North (55.7%)
- In male-headed households than female-headed ones (69.9% vs 59.2%)
- Among mothers or caregivers less than 25 years (76.9%) compared to mothers or caregivers 25–34 years (62.0%).

The lowest rate was seen among mothers or caregivers with secondary or more education (30.0%). Most children, 87.5%, continued to be breastfed between 12 and 15 months. Bottle-feeding emerged as a problem, with about 20% of children 6–23 months reported to have received a bottle in the past 24 hours prior to the survey. It was lowest among agro-pastoralists (14.7%), in the South (14.3%), and among mothers or caregivers over 35 years (6.8%).

Three out of 10 children aged 6–8 months were reported as not having received food the day before the survey, illustrating a problem with timely initiation of complementary feeding. Timely complementary feeding was higher among children of women with secondary or more education (93.7%) compared to those with no education or primary education only (around 70%).

Only 4.0% of children 6–23 months met the MDD cutoff value, defined as receiving foods from at least four out of seven food groups. Only about 15% met the minimum meal frequency (MMF) standard, defined as having received at least two meals the previous day. Consumption of an iron-rich or vitamin-rich food was 16.5% and 24.7% on average, respectively.

With respect to the MDD, our data were very different from those of the 2017 Turkana County MIYCN KAP report [23]. The KAP report showed that for non-breastfed and breastfed children, the MDD was 65.6% and 43.5%, respectively. However, similar to our study, cereals were the primary food consumed by children (80.3%), followed by dairy (70.1%). However, consumption of foods from other groups was markedly different, such as legumes (56.9% vs. 10.9%) and flesh foods (37.3% vs 15.6%). Similarly, eggs were consumed by 14.5% of children in the KAP survey versus only 1.6% in our survey. Our data also differed from the KAP survey in that we captured information on livelihood zones, whereas the KAP survey reported on survey zones and likely collected data during different seasons, which may account for the large differences observed. As noted above, none of the IYCF indicators were associated with any of the three indicators of undernutrition (GAM, stunting, and underweight), which may be because of the extremely poor complementary feeding diet among all children, including those with adequate anthropometric measurements;

but also because the indicators of IYCF were not designed for this purpose [9]. Other studies have shown that the IYCF feeding indicators are only weakly or not significantly associated with anthropometry [24, 25].

Table 10. Percentage distribution of IYCF practices

Indicators													
Indicator	**Breast-feeding initiation 1 hour after birth**	**Feeding of colostrum**	**Currently breast-feeding**	**Exclusive breast-feeding (0–5 months)**	**Comple-mentary feeding (6–8 months)**	**Complemen-tary feeding (6–23 months)**	**Continued breast-feeding (12–15 months)**	**MDD (6–23 months)**	**Mini-mum meal fre-quency (MMF) (6–23 months)**	**Minimum accep-table diet (MAD) (6–23 months)**	**Con-sumed vitamin A foods (6–23 months)**	**Con-sumed iron-rich food (6–23 months)**	**Bottle-feeding with a nipple in the past 24 hours**
Overall averages and totals	**77.3**	**93.3**	**69.2**	**66.8**	**70.6**	**82.6**	**87.5**	**4.0**	**15.2**	**0.1**	**24.7**	**16.5**	**21.1**
Livelihood zone													
Pastoral	78.2	93.3	72.9	64.2	67.8	81.5	88.2	0.3	11.6	0.0	12.6	8.2	21.8
Agro-pastoral	77.8	92.0	65.3	67.2	72.5	81.2	97.2	0.0	19.6	0.0	32.9	10.2	14.7
Fisher folk	72.1	95.0	58.3	91.3	78.5	86.7	72.8	4.0	19.9	0.0	58.3	52.6	22.8
Urban/peri-urban	79.8	91.5	66.9	58.1	75.3	85.8	89.7	2.9	24.5	1.2	29.8	15.3	24.0
Survey zone													
Central	81.0	94.2	72.1	73.0	65.5	83.3	93.1	0.3	18.8	0.2	27.3	14.8	20.1
North	69.5	95.6	65.7	55.7	74.0	78.7	83.1	2.7	10.8	0.0	38.7	35.0	27.3
South	76.2	96.9	67.1	67.5	70.8	81.0	80.7	0.3	20.5	0.1	15.3	5.4	14.3
West	81.6	87.5	72.1	67.4	70.9	86.9	99.5	0.9	11.7	0.1	19.2	11.6	21.9
Sex of household head													
Men	77.7	94.0	70.7	69.9	66.8	80.0	90.7	0.2	17.3	0.1	22.9	18.1	20.0
Women	76.7	92.1	66.9	59.2	76.6	86.8	76.4	2.4	11.8	0.0	27.5	14.0	22.8
Household wealth (tertile)													
First	81.1	93.6	68.5	67.7	67.8	79.5	90.9	0.1	16.3	0.0	18.0	11.9	20.7
Second	72.8	92.9	68.1	65.2	72.0	80.4	80.7	0.6	13.8	0.0	20.4	13.9	20.3
Third	78.3	93.3	72.9	67.4	73.2	93.5	96.0	4.1	15.6	0.3	47.1	31.2	23.2
Mother or caregiver highest level of education													
No education	80.0	92.7	68.6	65.4	69.9	81.7	86.3	1.2	13.9	0.1	19.9	12.9	20.7

Primary	62.8	97.4	75.8	82.5	71.9	85.6	91.7	0.2	19.6	0.0	46.9	35.5	23.4
Secondary+	67.0	92.0	57.5	30.0	93.7	98.8	87.1	3.3	31.2	1.7	51.6	16.4	23.0
Mother or caregiver age													
<25 years	80.1	93.5	78.6	76.9	58.4	79.4	93.9	0.3	27.0	0.2	21.5	14.4	23.5
25–34 years	79.7	94.6	70.1	62.0	72.0	82.9	89.1	1.3	12.3	0.1	25.1	16.8	21.6
35+ years	17.2	74.9	27.1	0.0	93.5	90.0	59.8	0.4	13.0	0.0	31.0	18.9	6.8

Children consumed predominantly grains, roots, and tubers, with an average of 74.3% of the children consuming this food group (**Table 11**). The next most commonly consumed food group was dairy (46.1%). Consumption of flesh foods was very low, except for children of fisher folk, over half of whom had consumed such a food the previous day. Other fruits and vegetables and eggs were consumed by less than 5.0% of children in all livelihood zones.

Table 11. Dietary diversity for children 6–23 months of age

Food item	Pastoral (*n* = 237)	Agro-pas-toral (*n* = 90)	Fisher folk (*n* = 55)	Urban/ peri-urban (*n* = 292)	Overall (*N* = 674)
	(%)	(%)	(%)	(%)	(%)
Dairy[a]	50.6	43.8	35.8	36.1	46.1
Grains, roots, and tubers	71.5	75.4	81.1	80.5	74.3
Vitamin A-rich fruits and vegetables	5.1	29.3	12.0	22.0	11.3
Other fruits and vegetables	2.9	2.9	3.6	18.7	4.1
Eggs	0.4	0.8	6.2	3.3	1.6
Flesh foods[b]	7.8	9.5	50.4	12.7	15.6
Legumes and nuts	9.0	5.5	19.4	19.5	10.9
Mean of food items	1.47	1.67	2.08	1.93	1.8
MDD (4 out of 7 food groups)	2.6	3.0	7.0	12.2	4.0

[a] Dairy includes cheese, yogurt, milk, and other milk products.
[b] Flesh foods include red meat, poultry, fish, and organ meat.

4.3 PREVALENCE OF MATERNAL NUTRITIONAL STATUS, BY SURVEY AND LIVELIHOOD ZONE

Figures 10, 11, and 12 present the anthropometric results of nonpregnant mothers and caregivers as assessed by BMI and of pregnant mothers and caregivers as assessed by MUAC. The results by livelihood zone showed that more than half (54.8%) of nonpregnant mothers or caregivers living in the fisher folk zone were underweight and 39.4% of pregnant mothers or caregivers were underweight (Figure 10). In comparison, about 4 out of every 10 nonpregnant caregivers were underweight in the other three livelihood zones. The results by survey zone showed that over 50% of nonpregnant caregivers were underweight in the North and South while 28.7% were underweight in the West (Figure 11). Underweight among pregnant women, as assessed by MUAC, ranged from a low of 4.5% in the West to a high of 33.3% in the South.

Figure 10. Prevalence of mothers' or caregivers' undernutrition and overweight, by livelihood zone

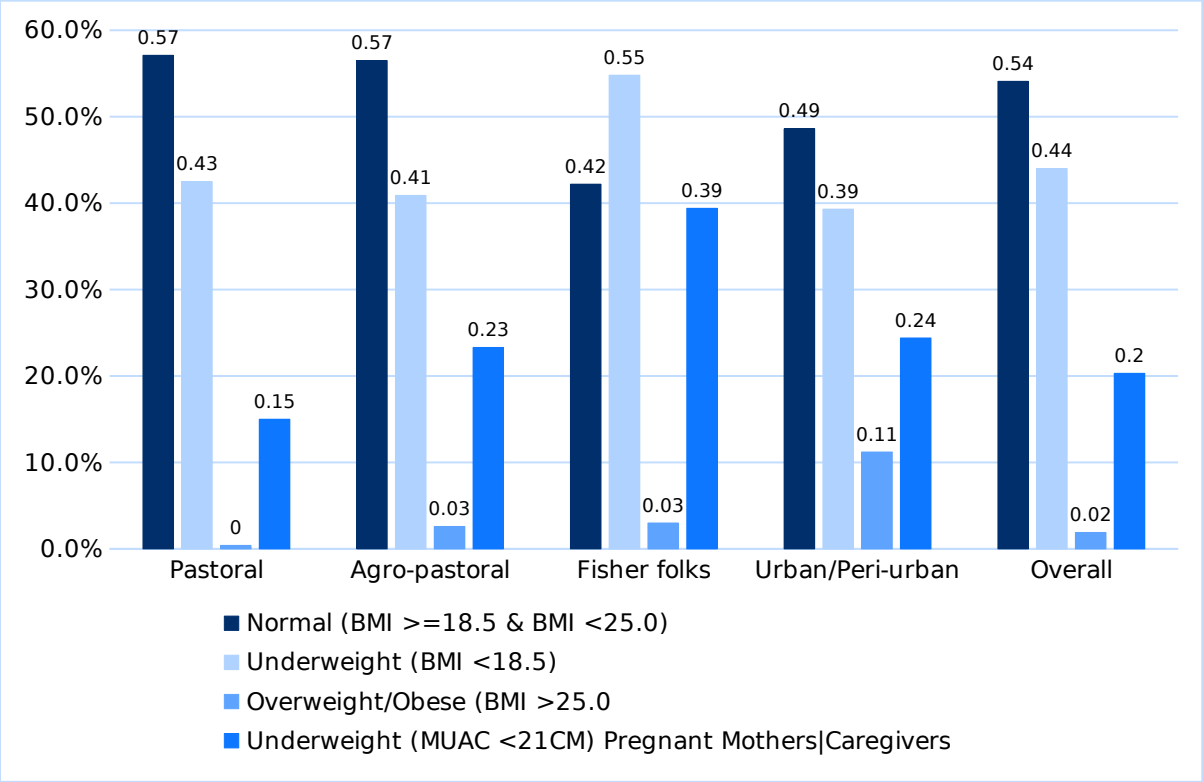
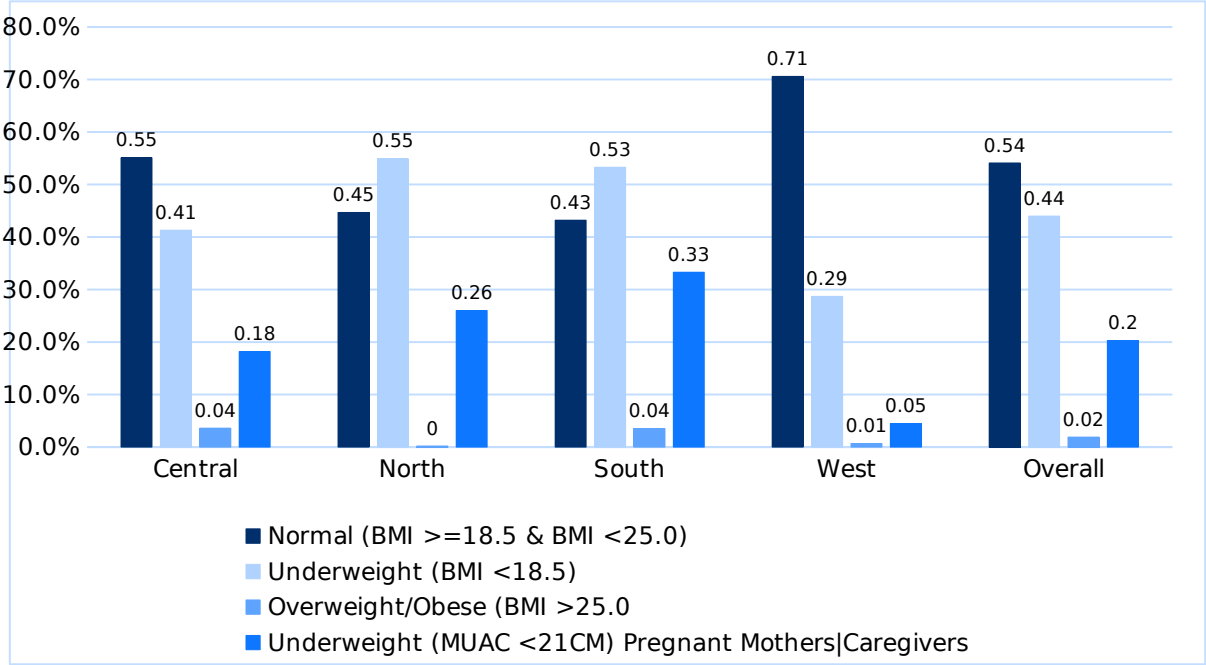


Figure 11. Prevalence of mothers' or caregivers' undernutrition and overweight, by survey zone



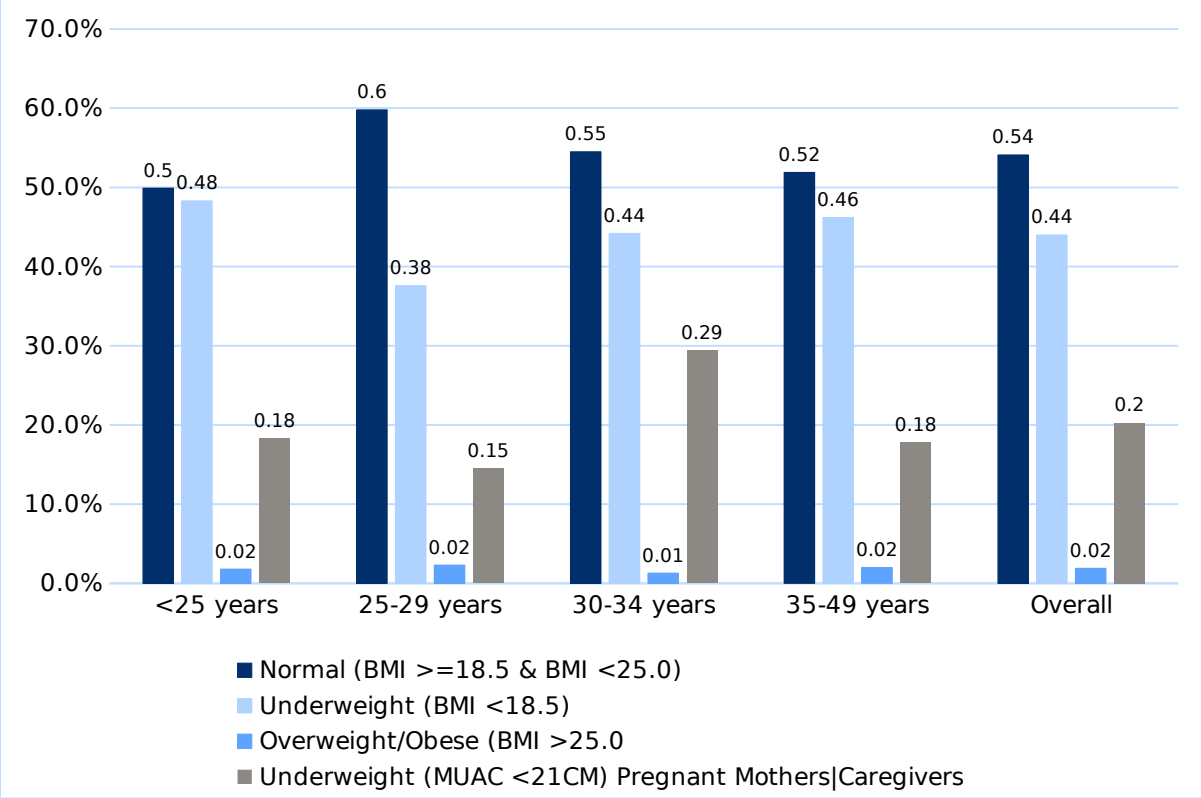
The Turkana 2019 SMART survey reported that 9% of pregnant women were undernourished in the country (MUAC < 21 cm), whereas our study reported that more than double that rate (20.3%) were undernourished. By survey zone, the prevalence rates of the SMART survey versus our data are as follows:

- Central was 8.4% in the SMART survey versus 18.2% in our study
- North was 9.8% versus 14.7%
- South was 8.9% versus 10.7%
- West was 7.2% versus 20.3%.

Only the South had similar rates in both instances, whereas rates in the West were nearly three times greater in our survey compared to the SMART survey, and the rate in Central was more than twice as great in our survey compared to the SMART survey. The SMART survey did not report BMI for nonpregnant women and, therefore, cannot be compared to data from our survey.

With respect to maternal age, the total underweight prevalence among nonpregnant mothers or caregivers was 44.0% and ranged from a low of 37.6% among mothers or caregivers 25–29 years to a high of 48.3% among mothers or caregivers less than 25 years (Figure 12). Among pregnant women, the overall prevalence was 20.3%, with the highest in the age category 30–34 years (29.4%).

Figure 12. Prevalence of mothers' or caregivers' undernutrition and overweight, by age



4.4 MATERNAL DIETARY DIVERSITY

Table 12 examines maternal diet using the 10-food-group MDD-W indicator. The results indicated that women's diet in these settings was highly monotonous, consisting mainly of staple foods made of grains, roots, and tubers (almost 9 out of every 10 women). However, meat (including fish and poultry), dairy, and dark-green leafy vegetable consumption varied across livelihood zones. Meat consumption varied from 9.9% among agro-pastoralists to 52.6% among fisher folk. Dairy consumption, on the other hand, varied from 9.2% among agro-pastoralists to 20.7% among pastoralists. The monotony of the diet was reflected in the MDD-W ratings, given that only 1.8% of women consumed five or more food groups, the threshold for minimally adequate dietary diversity.

Data on dietary diversity among women were not reported in the 2019 SMART survey. However, in the 2017 KAP survey, MDD-W was reported as 33.2%, a percentage-point difference of more than 30. As with our survey, the most commonly consumed food was cereals (90.7%). Dairy was consumed by 53.1%, flesh foods by 39.3%, and eggs by 11.9%, numbers well in excess of those reported in our survey.

Table 12. Minimum dietary diversity for women

Food item	Pastoral (*n* = 419)	Agro-pastoral (*n* = 145)	Fisher folk (*n* = 88)	Urban/ peri-urban (*n* = 497)	Overall (*N* = 1,149)
	(%)	(%)	(%)	(%)	(%)
Grains, white roots tubers, and plantains	85.0	86.5	86.4	89.3	85.7
Pulses	25.4	22.1	26.4	31.8	25.5
Nuts and seeds	0.6	3.2	2.7	1.6	1.3
Dairy	20.7	9.2	16.3	13.2	17.8
Meat, poultry, and fish	10.8	9.9	52.6	14.7	17.5
Eggs	0.3	1.0	0.5	2.4	0.6
Dark-green leafy vegetables	4.5	35.5	2.9	22.9	9.9
Other vitamin A-rich vegetables	1.9	2.3	3.2	5.9	2.4
Other vegetables	2.2	9.7	5.7	16.4	4.8
Other fruits	0.8	1.4	0.0	3.5	0.9
Mean of food items	1.52	1.81	1.97	2.02	1.84
MDD-W	0.6	2.8	3.8	6.9	1.8

4.5 MORBIDITY AND CARE-SEEKING BEHAVIORS

The baseline findings indicated that 38.5% of children aged 3 years and below had a cough in the 2 weeks preceding the survey; 25.9% had a fever and 32.1% had diarrhea (**Table 13**). The prevalences of all types of illnesses studied were not significantly different by livelihood zone, child age, child sex, mother or caregiver education, mother or caregiver age, or wealth quintile. The vast majority of mothers or caregivers sought treatment in a health facility for child illness (77.9%). They were marginally less likely to seek treatment for children 24–35 months compared to younger children ($p < 0.057$. Care-seeking behavior also differed by wealth quintile, with mothers or caregivers in the middle quintile less likely to seek treatment compared to the other quintiles ($p < .013$).

Table 13. Child morbidity and health-seeking behavior, by livelihood zone and background characteristics

Characteristics	Any illness in the past 2 weeks before survey			Type of illness in the past 2 weeks before survey					Sought treatment from health facility for any illness		
	(%)	*p*-value[a]	Number of children	Cough	Cough + difficulty in breathing[b]	Fever	Diarrhea	Diarrhea + bloody stains[c]	(%)	*p*-value[a]	Number of children
Overall averages and totals	**54.3**		**1,211**	**38.5**	**33.7**	**25.9**	**32.1**	**17.8**	**77.9**		**703**
Livelihood zone											
Pastoral	51.0	0.102	449	35.2	31.5	21.4	31.2	20.8	79.1	0.496	239
Agro-pastoral	56.0		159	43.9	43.1	27.7	35.1	15.7	71.3		91
Fisher folk	62.2		88	44.6	36.9	39.5	31.3	12.1	76.9		57
Urban/peri-urban	65.5		515	43.6	21.7	34.2	35.6	7.4	83.4		316
Child age (months)											
0–11	52.7	0.474	499	39.8	35.3	22.9	26.4	12.9	80.6	0.057	283
12–23	58.3		429	37.1	38.9	31.6	41.6	18.8	81.9		261
24–35	52.3		283	37.7	24.6	23.9	30	23.2	68.0		159
Child sex											
Female	53.1	0.580	596	37.1	36.1	24.1	29.6	15.8	73.2	0.079	348
Male	55.9		603	40.0	31.5	27.6	34.6	19.4	82.1		347
Mother or caregiver highest education											
No education	52.9	0.175	933	36.6	27.7	25.9	31.8	17.5	77.6	0.723	526
Primary	63.7		180	50.9	65.6	25.1	34.7	21.9	78.3		117
Secondary+	62.6		98	47.4	32.1	29.3	29.5	1.4	86.1		60

Mother or caregiver age (years)											
15–24	55.6	0.809	289	42.1	40.3	22.2	33.2	8.1	84.9	0.421	179
25–29	57.9		311	40.8	30.1	29.6	30.4	21.2	72.8		172
30–34	53.4		247	38.6	27.5	27.7	35.4	22.3	82.7		139
35–49	51.9		302	36	41.3	24.7	30.4	19.9	74.9		182
50+	49.4		62	26.5	9.5	20.1	30.2	8.6	70.6		31
Wealth quintile											
Lowest	49.9	0.285	237	34.6	28.8	23.8	27.6	21	85.9	0.013	135
Second	51.7		248	43.3	36.2	31.8	34.2	13	83.6		131
Middle	53.6		247	30.5	38.2	23.3	28.6	14.6	64.6		145
Fourth	62.1		241	43.6	31.5	23.6	37	27.8	73.3		140
Highest	62.3		238	51.8	33.3	28.8	40.9	9.5	86.1		152

The *p*-value from the chi-square test of independence between two categorical variables.

[b] The prevalence among the children who were reported to have had a cough in the past 2 weeks.

[c] The prevalence among the children who were reported to have had diarrhea in the past 2 weeks.

4.6 VACCINATION COVERAGE IN CHILDREN

Vaccination coverage for the Bacille Calmette-Gurin (BCG) vaccine, three doses each of pentavalent, and the polio vaccine (excluding polio vaccine given at birth) among children was above 90% in all cases, and did not differ by child sex, livelihood zone, mother or caregiver education, mother or caregiver age, and wealth quintile (**Table 14**). However, only about half of children (53.4%) received the measles vaccine. The proportion of children receiving three doses of pneumococcal vaccine was 90.7%.

The 2019 SMART survey reported only for the measles vaccine, with 51% of children receiving the vaccine at 18 months, similar to our survey. It is not clear from our survey data why the vaccination rate was so high for all vaccines except the measles vaccine.

Table 14. Vaccination coverage for children 12–35 months old, by livelihood zone and background characteristics

Characteristics	BCG	Pentavalent			Polio[a]				Measles	All basic vaccinations[b]	Pneumococcal			Fully vaccinated[c]	No vaccinations	Number of children
		1	2	3	0	1	2	3			1	2	3			
Overall averages and totals	**94.8**	**91.6**	**90.7**	**88.9**	**91.2**	**95.6**	**93.9**	**91.7**	**53.4**	**52.5**	**94.2**	**92.4**	**90.7**	**52.4**	**3.6**	**712**
Child sex																
Male	94.1	90.3	89.6	88.1	91.3	95.5	93.0	91.4	50.4	48.9	92.1	90.9	90.1	48.9	3.1	247
Female	95.3	92.5	91.5	89.5	91.1	95.6	94.7	91.9	54.9	54.9	95.9	93.6	91.2	54.8	4.1	356
Livelihood zone																
Pastoral	94.4	90.9	89.5	87.2	90.5	95.5	93.0	90.4	53.0	52.6	93.5	91.6	89.5	52.5	3.4	252
Agro-pastoral	91.5	86.9	86.9	86.2	89.1	91.0	91.0	89.2	51.5	51.5	89.6	87.9	87.2	51.5	8.5	96
Fisher folk	97.1	95.8	95.8	95.0	93.0	98.9	97.9	96.8	54.3	51.7	98.9	96.9	95.8	51.7	1.1	50
Urban/peri-urban	99.7	98.3	97.7	96.0	98.7	99.7	99.7	96.5	55.6	55.1	98.9	98.9	97.4	54.8	0.3	314
Mother or caregiver highest education																
No education	100.0	99.9	99.8	99.8	94.4	100.0	100.0	97.5	51.1	51.1	100.0	100.0	99.8	51.1	0.0	103
Primary	100.0	100.0	99.3	98.5	100.0	100.0	100.0	98.2	63.2	62.2	100.0	100.0	98.4	61.4	0.0	58
Secondary+	93.9	90.3	89.3	87.2	90.6	94.9	93.0	90.7	53.2	52.4	93.3	91.2	89.3	52.3	4.2	551
Mother or caregiver age																
15–24	98.3	96.6	96.5	96.4	94.0	98.3	96.8	94.3	58.6	58.6	98.3	98.3	96.2	58.1	1.7	128
25–29	95.0	91.9	91.9	87.7	89.3	95.0	95.0	90.1	50.3	50.2	93.1	93.1	90.6	50.1	5.0	172
30–34	95.5	92.7	92.7	90.7	94.9	96.2	95.3	93.9	51.7	50.1	94.5	93.4	92.2	50.1	3.1	145
35–49	94.0	89.2	88.1	87.9	92.2	95.0	94.0	92.6	55.0	54.1	94.6	91.9	90.4	54.1	3.3	210
50+	90.7	89.7	84.2	82.1	80.2	94.5	84.2	84.2	51.2	51.2	89.7	82.1	82.1	51.2	4.5	57
Wealth quantile																
Lowest	97.2	96.5	96.5	95.6	96.0	97.2	97.2	97.1	55.0	55.0	96.5	95.7	95.7	55.0	2.8	141
Second	99.5	94.3	91.6	89.4	91.6	98.8	96.1	92.2	45.4	45.4	98.7	94.9	91.2	45.1	0.5	151

Middle	89.5	83.7	83.1	80.7	84.5	92.6	89.4	85.5	50.2	48.9	88.2	85.6	83.9	48.9	6.8	138
Fourth	91.6	90.4	90.4	88.2	93.1	91.0	91.0	90.9	65.7	65.7	90.4	90.4	90.2	65.6	6.2	141
Highest	96.4	95.8	95.3	95.1	93.7	100.0	97.9	95.5	55.6	51.6	99.9	99.9	97.4	51.4	0.0	141

Note. The number of children does not add up to the totals because of children missing information on sex are not shown separately.

[a] Polio 0 is the polio vaccination given at birth. The data on polio vaccination were adjusted for a likely misinterpretation of polio 0 and polio 1; for children whose mothers reported that they received three doses of pentavalent and polio 0, polio 1, and polio 2, it was assumed that polio 0 was in fact polio 1, polio 1 was polio 2, and polio 2 was polio 3.

[b] BCG, measles, and three doses each of pentavalent and polio vaccine (excluding polio vaccine given at birth).

[c] BCG, measles, three doses each of pentavalent, and polio (excluding polio vaccine given at birth), and pneumococcal vaccine.

4.7 DEWORMING AND VITAMIN A SUPPLEMENTATION COVERAGE IN CHILDREN

Table 15 shows that 63.9% of children between 12and 35 months were given deworming tablets twice in the past year. With respect to coverage with vitamin A supplementation, nearly one-quarter of children 6–11 months received a single dose and 51.8% of children 12–35 months received two doses in the previous year. For the latter, the percentages were higher in the urban/peri-urban livelihood zone, among children with mothers or caregivers with secondary or more education, and in the fourth or fifth wealth quintile.

The 2019 SMART survey reported that 70.2% of children 12–59 months received deworming medications; however, it did not specify whether the treatment involved two doses. The survey did report similar coverage of two doses of vitamin A supplementation, among children 12–59 months (44.4%).

Table 15. Deworming for children 12–35 months and vitamin A supplementation coverage in children 6–35 months, by certain background characteristics

Characteristic	Deworming for children 12-35 months				Vitamin A Supplementation							
	Coverage In the last 6 months	Number of times dewormed in the last 1 year		Number of children	Coverage for children 6 to 35 months in the last 6 months	Number of children	Number of times the children 6-11 months supplemented with vitamin-A in the last 1 year		Number of children	Number of times the children 12-35 months supplemented with vitamin-A in the last 1 year		Number of children
		Once	Twice				Once	Twice		Once	Twice	
Total	**57.8**	**32.4**	**63.9**	**712**	**62.1**	**770**	**46.9**	**24.5**	**245**	**31.5**	**51.8**	**712**
Child Sex												
Female	52.1	31.6	64.8	347	52.6	389	37.6	32.8	126	30.5	51.3	347
Male	62.6	33.4	62.7	356	65.8	373	57.8	15.0	119	32.0	52.5	356
Livelihood Zone												
Pastoral	59.5	32.0	62.8	252	62.6	277	49.1	23.6	94	32.6	51.5	252
Agro-pastoral	51.2	33.1	66.9	96	53.6	94	41.7	35.2	32	30.6	51.4	96
Fisher folks	56.5	30.7	66.2	50	48.7	58	43.9	14.5	24	28.3	48.7	50
Urban/Peri-urban	61.8	37.8	61.3	314	62.4	341	43.0	33.8	95	31.7	63.5	314
Survey Zone												
Central	34.4	24.7	74.8	196	45.3	226	38.8	14.4	74	28.5	33.2	196
North	64.2	34.9	63.4	91	58.4	93	61.2	12.1	28	34.3	58.7	91
South	61.7	30.7	69.1	236	58.6	245	47.9	32.1	86	31.0	65.9	236
West	64.1	36.4	52.7	189	69.7	206	40.7	33.0	57	31.1	46.1	189
Caregiver Education)												
No Education	58.3	33.1	63.2	551	60.2	553	47.0	24.4	186	31.0	51.4	551
Primary	56.0	28.0	67.6	103	54.3	130	45.3	29.2	38	35.5	52.3	103
Secondary+	47.0	25.9	74.1	58	52.4	87	53.4	3.1	21	30.1	68.9	58

Caregiver Age Category												
15-24	59.8	38.4	57.8	128	62.9	259	70.7	9.8	71	30.5	51.7	128
25-29	62.2	36.5	57.1	172	56.6	284	35.9	29.8	70	41.5	44.5	172
30-34	58.3	30.5	65.4	145	59.5	223	51.2	11.5	49	33.3	49.3	145
35-49	54.6	28.8	68.8	210	9.7	4	29.0	43.1	51	26.8	55.1	210
50+	52.9	30.7	69.1	57	0.0	0	0.0	91.2	4	18.5	66.4	57
HH Wealth Index												
Lowest	66.2	37.1	56.1	141	64.7	131	67.8	12.7	53	32.1	52.4	141
Second	50.3	28.3	68.8	151	63.7	142	50.8	22.0	46	33.2	48.6	151
Middle	52.2	35.7	59.3	138	47.9	148	30.8	38.4	52	37.7	42.6	138
Fourth	61.0	20.4	79.4	141	56.5	169	33.8	26.8	47	24.6	62.1	141
Highest	67.1	43.4	56.5	141	65.2	180	43.3	21.6	47	19.2	68.5	141

5 MOTHERS' AND CAREGIVERS' SOCIODEMOGRAPHIC CHARACTERISTICS, EMPOWERMENT, AND HEALTH CARE UTILIZATION

5.1 MOTHERS' AND CAREGIVERS' SOCIODEMOGRAPHIC CHARACTERISTICS

Most mothers or caregivers (47.6%) were between 25 and 34 years old, and only 3.3% were less than 20 years old (**Table 16**). Most were married (83.0%), with 35.1% of those in polygamous marriages. Overall, the vast majority of mothers and caregivers did not have formal education (86.4%), though this proportion ranged from 65.4% among urban/peri-urban dwellers and 93.7% among pastoralists. Post-primary education had been attained by 14.5% of mothers and caregivers in the urban/peri-urban livelihood zone.

Table 16. Percentage distribution of mother/caregiver characteristics, by livelihood zone

Characteristics	Livelihood zone				Overall
	Pastoral	Agro-pastoral	Fisher folk	Urban/ peri-urban	
Total number of respondents	**449**	**159**	**88**	**515**	**1,211**
Age					
<20 years	3.1	3.2	1.9	8.7	3.3
20–24 years	16.9	14.3	15.3	19.9	16.5
25–34 years	47.2	46.4	52.4	43.3	47.6
35–44 years	22.7	25.4	25.8	19.5	23.3
45+ years	10.1	10.8	4.6	8.5	9.3
Marital status					
Married	86.9	76.4	77.0	72.9	83.0
Living together	1.8	6.6	3.3	3.9	2.8
Separated/divorced	2.2	10.0	13.9	9.3	5.5
Widowed	9.2	7.0	5.8	14.0	8.7
Polygamous[a]	38.3	31.8	25.4	33.5	35.1
Highest level of education					
No formal	93.7	81.1	69.7	65.4	86.4
Primary	6.0	14.7	29.1	20.1	11.6
Secondary+	0.3	4.2	1.2	14.5	1.9
Length of time living in the community					
0–15 years	36.6	34.2	33.5	34.6	35.7
15–30 years	29.6	24.0	29.2	38.1	29.3
30+ years	29.8	29.3	34.7	22.6	30.0

Note. Column percentages within each characteristic may not add up to 100% because of households with missing information.

[a] Among polygamous households, 46.6% of respondents reported 2 wives and the rest 3 wives or more.

5.2 MOTHERS' AND CAREGIVERS' EMPOWERMENT AND AGENCY

With respect to livelihood zone, mothers and caregivers had greater authority over decisions regarding their child's health, their own health, food purchases, and their visits to friends and relatives compared to decisions about major household purchases and household income (**Table 17**). Between 38% and 48% had authority over all six types of decisions, with the highest among urban/peri-urban dwellers and the lowest among fisher folk. Similar results were found for survey zones, age of mother or caregiver, level of education, and polygamous versus non polygamous marriage categories. Authority for decisions about major household purchases and household income was lower compared to the other four categories of decision making. Interestingly, one exception was with respect to household wealth categories, where mothers and caregivers in the highest household wealth category had lower decision-making authority compared to mothers and caregivers in the other two wealth categories. Also, mothers and caregivers in polygamous marriages had slightly more authority over decisions about household income (54.5%) compared to those in traditional marriages (44.9%). Women's authority to make decisions is a critical factor for child nutrition [26]. Gender norms are particularly important. The greater authority of mothers and caregivers related to their child's health, their own health, and food purchases can have important effects on child nutrition. This factor likely is related to the high levels of care-seeking in health centers for child illness. The ability to visit friends and family is likely to have benefits to maternal mental health, with spillover effects for child nutrition [27].

Table 17. Percentage of currently married women who usually make specific decisions either by themselves or jointly with their husband/partner, by background characteristics and livelihood zone

Characteristics	Specific decisions						All six decisions	Number of women
	Usage of household income	Child health	Woman's own health care	Food purchase	Major household purchase	Visit to her friends/ relatives		
Overall averages and totals	**48.2**	**83.8**	**82.0**	**79.6**	**57.5**	**72.1**	**40.7**	**988**
Livelihood zone								
Pastoral	47.3	86.5	83.7	80.6	59.1	73.0	39.7	397
Agro-pastoral	59.2	78.5	79.2	81.9	56.4	74.9	44.8	130
Fisher folk	41.0	80.6	82.0	75.6	50.9	72.3	38.3	69
Urban/peri-urban	61.9	92.7	88.8	90.0	71.9	73.3	48.0	392
Survey zone								
Central	45.4	74.3	72.2	69.4	50.3	79.5	30.9	286
North	47.1	84.7	81.2	83.7	54.6	56.5	40.8	112
South	58.5	80.5	79.1	79.7	50.8	70.3	46.4	323
West	44.9	95.5	95.0	86.3	72.5	84.7	42.5	267
Age								
< 25 years	46.6	85.1	82.6	71.4	58.7	78.4	41.0	238
25–34 years	51.6	84.4	83.2	81.8	59.7	70.8	40.8	491
35+ years	45.9	85.6	83.3	84.7	55.7	73.7	40.4	259
Highest level of education								
No education	48.7	85.4	83.1	80.2	59.3	74.5	41.0	769
Primary	48.4	82.5	83.5	82.5	50.9	63.5	39.1	141
Secondary+	64.5	76.7	80.4	91.0	54.6	66.9	33.5	78
Number of living children								
1	39.5	75.1	73.3	66.5	52.9	66.3	35.5	127
2	53.9	90.1	88.0	74.6	55.7	75.9	41.1	161
3	42.9	83.0	80.5	80.7	57.7	67.0	32.0	193

4+	51.5	85.5	84.8	84.7	60.1	75.7	44.6	478
Household wealth (tertile)								
First	54.0	83.4	81.5	75.3	58.5	74.9	44.9	346
Second	49.7	86.1	85.7	82.4	63.1	76.3	44.3	339
Third	35.4	86.0	81.2	89.1	47.6	62.4	23.4	303
Polygamous marriage								
No	44.9	84.7	81.8	81.0	54.4	71.9	38.2	579
Yes	54.5	85.2	85.0	80.2	63.8	74.9	44.2	409

With respect to employment, 35.0% women from the agro-pastoral livelihood zone were employed in the past 12 months, followed by women in the urban/peri-urban (28.8%), pastoral (22.3%), and fisher folk (20.4%) livelihood zones (**Table 18**). By far, the most common form of employment across all categories (e.g., livelihood zone, survey zone, age, level of education, and household wealth) was petty trade. By socioeconomic status, women in poor (32.1%), middle (17.5%), and rich (20.5%) households reported that they were employed in the past 12 months. To the extent that employed women have control over their earnings, it may affect child nutrition, given the established fact that women tend to spend more on household and family needs than men.

Table 18. Percentage of women who were employed at any time in the past 12 months, kind of work, and type of earnings, according to background characteristics

Characteristics	Percentage employed in the past 12 months	*N*	Kind of work			Type of earning				No. of women with earnings
			Farm or herd	Employed	Petty trade	Cash	Cash and in-kind	In-kind	Not paid	
Overall averages and totals	**24.2**	**983**	**13.4**	**10.1**	**76.5**	**47.9**	**35.4**	**6.5**	**10.2**	**263**
Livelihood zone										
Pastoral	22.3	398	14.1	9.6	76.3	45.6	30.1	8.3	15.9	91
Agro-pastoral	35.0	126	23.5	5.4	71.2	42.3	50.2	5.8	1.7	38
Fisher folk	20.4	70	0.0	11.2	88.8	57.1	42.9	0.0	0.0	17
Urban/peri-urban	28.8	389	1.4	26.2	72.4	67.5	26.9	3.2	2.4	117
Survey zone										
Central	18.9	289	0.0	30.1	69.9	76.2	14.6	2.2	7.0	61
North	26.2	113	0.0	6.0	94.0	57.5	33.3	9.2	0.0	33
South	39.9	317	15.8	4.9	79.3	31.9	57.5	7.8	2.8	119
West	13.6	264	41.0	10.3	48.7	43.9	6.2	3.1	46.9	50
Age										
< 25 years	25.5	239	32.5	10.7	56.8	32.1	26.4	8.2	33.3	64
25–34 years	24.7	487	4.5	12.9	82.6	66.1	24.2	8.6	1.2	129
35+ years	22.4	257	14.7	4.7	80.6	27.0	62.6	1.4	9.1	70
Highest level of education										
No education	23.3	76.7	15.9	8.5	75.7	47.6	32.7	7.6	12.0	185
Primary	40.1	21	0.0	3.8	96.2	21.3	78.7	0.0	0.0	10
Secondary+	25.9	195	0.3	28.1	71.7	66.0	32.2	0.5	1.2	68
Household wealth (tertile)										
Poor	32.1	347	18.0	5.7	76.3	44.0	35.2	5.4	15.5	104

Middle	17.5	339	7.9	13.8	78.3	49.4	35.0	12.2	3.4	75
High	20.5	297	7.0	19.1	73.9	58.9	36.6	0.3	4.2	84

Regarding land or house ownership, 74.6%, 74.5%, 62.1%, and 56.2% of women from urban/peri-urban, pastoral, fisher folk, and agro-pastoral livelihood zones, respectively, did not own land, while the remainder owned land alone, jointly, or alone and jointly (**Table 19**). In contrast, only between 4.4% and 18.1% of women reported not owning a house. With respect to survey zone, 90.8% of women in the West did not own land compared to only around 56% in the Central and South. Women in the West were more likely to own a house alone (50.1%) compared to only 15.1% in the South. Ownership of such assets by women alone did not significantly vary by household wealth index (data not shown).

Table 19. Percent distribution of women's ownership of housing and land, by background characteristics and livelihood zone

Characteristics	Percentage who own a house				Percentage who own land				Number of women
	Alone	Jointly	Alone and jointly	Does not own	Alone	Jointly	Alone and jointly	Does not own	
Overall averages and totals	**38.8**	**43.3**	**11.6**	**6.3**	**9.3**	**19.4**	**1.1**	**70.2**	**983**
Livelihood zone									
Pastoral	39.7	39.5	16.4	4.4	6.8	17.8	0.9	74.5	398
Agro-pastoral	36.3	54.3	2.7	6.8	14.8	26.3	2.6	56.2	126
Fisher folk	38.7	51.2	0.0	10.1	16.2	21.7	0.0	62.1	70
Urban/peri-urban	33.8	42.2	5.9	18.1	8.4	15.1	1.9	74.6	389
Survey zone									
Central	58.3	33.4	2.4	5.9	23.5	18.5	1.2	56.7	289
North	31.9	62.0	0.0	6.0	5.3	24.7	0.0	70.0	113
South	15.1	70.5	1.6	12.8	3.0	38.9	2.1	55.9	317
West	50.1	13.1	35.0	1.8	8.2	0.0	0.9	90.8	264

5.3 USE OF SERVICES DURING PREGNANCY, DELIVERY, AND POSTNATAL PERIOD

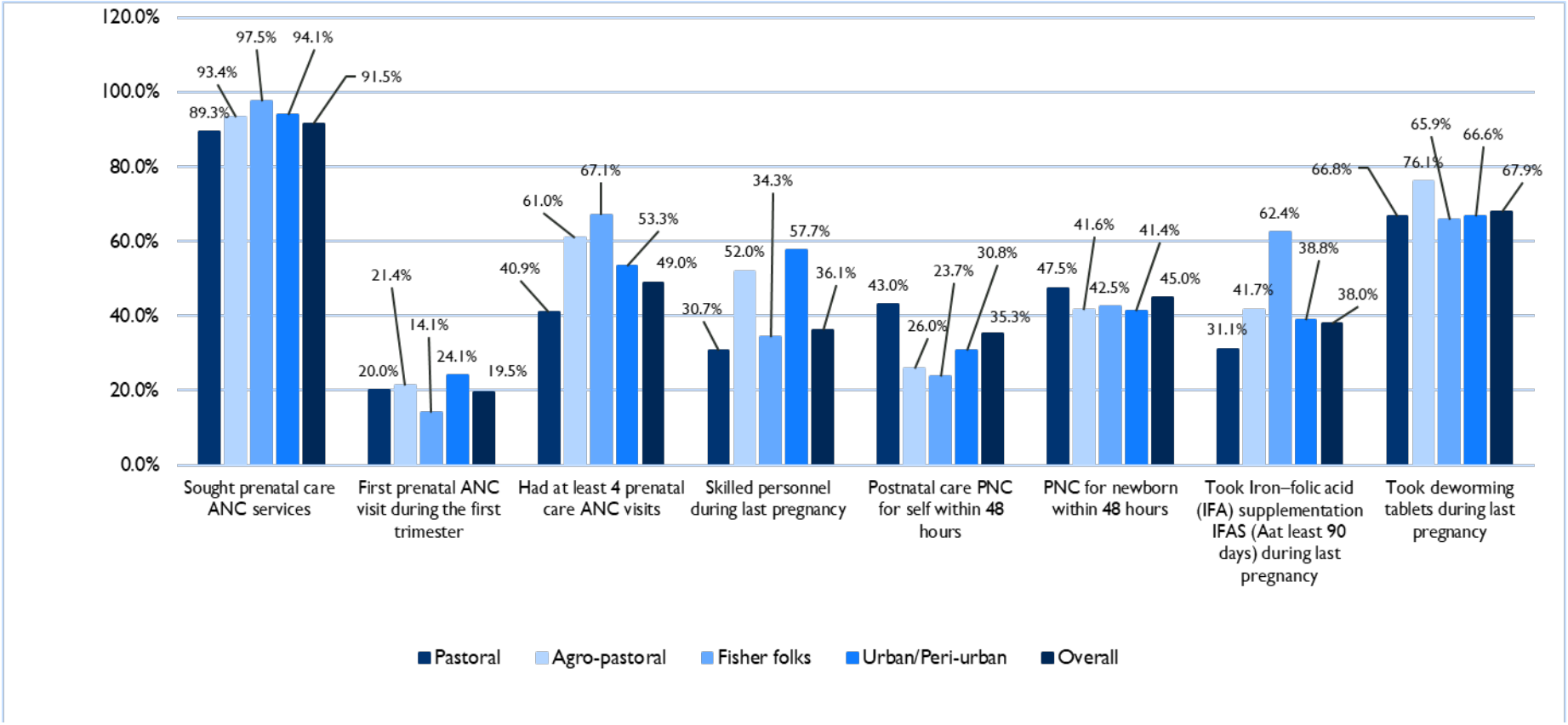
The seeking of prenatal care services was high across all livelihood zones, from 89.3% among pastoralists to 97.5% among fisher folk (**Figure 13**). However, the proportion of women who had at least four visits (49.0%), as recommended by WHO, was far lower, ranging from 40.8% among pastoralists to 67.1% among fisher folk.

The Turkana KAP report indicated that the proportion of women who said they attended at least four prenatal visits was 53.6%, slightly higher than our survey found [23]. The proportion delivering with a skilled birth attendant was relatively low overall (37.1%) and ranged from 31.8% among pastoralists to about 52% among agro-pastoralists and about 60% among urban/peri-urban dwellers. The 2014 Kenya DHS reported that nationally, nearly 62% of women delivered with a skilled attendant, although this number dropped to 26.4% among women with no education, a common characteristic in Turkana. Care for the neonate within 48 hours following delivery was higher than for mothers but still below 50%.

WHO recommends that women take iron–folate supplements throughout pregnancy [28]. In our survey, 17.1% of women reported not taking an iron–folic acid supplement, a cause for concern because postpartum hemorrhage is the most frequent cause of postpartum death, and iron status is a risk factor for morbidity and mortality in the case of hemorrhage [29]. The proportion of women taking 90 or more tablets was only 37.9%, ranging from 31.1% among pastoralists to 62.4% among fisher folk.

The 2014 Kenya DHS reported that only 8% of women took iron tablets for 90 or more days during their last pregnancy; 5% took supplements for 60–89 days, and 53% took supplements for fewer than 60 days [11]. Nearly a third (30%) of women did not take iron supplements at all during their last pregnancy. About two-thirds of women reported taking deworming tablets during their last pregnancy.

Figure 13. Mothers' and caregivers' health care seeking and utilization, by livelihood zone



6 FOOD SECURITY AND WASH

6.1 FOOD INSECURITY EXPERIENCES

Severe food insecurity in the preceding 12 months was reported by 91.1% of households in the pastoral livelihood zone (**Table 20**), followed by agro-pastoral (88.6%), urban/peri-urban (87.8%), and fisher folk (71.2%). Accordingly, only 19.1% of households in the fisher folk livelihood zone, 5.1% in pastoral, 4.7% in urban/peri-urban, and 3.7% in agro-pastoral were food secure. The main reason given was lack of money or other resources to purchase food or to eat healthy food items. Thus, households reported eating only a few kinds of food with less variety, skipping meals, or going without eating for a whole day as coping strategies.

Households in all livelihood zones except fisher folk had similar Coping Strategy Index (CSI) scores (**Table 21**). Fisher folk had the lowest average CSI score (15.7%) compared to others. The West survey zone had the highest average CSI score. Those households with severe food insecurity had the highest CSI scores, although CSI did not significantly vary by other characteristics such as mothers' or caregivers' education, age, main source of income, and wealth index. The most common coping strategies were to purchase less expensive food, to reduce the number of meals, and to limit portion size. Our data are somewhat similar to the findings in the 2019 SMART survey.

Table 20. Percentage distribution of household food insecurity experience and scale of severity in the past 12 months, by livelihood zone and other characteristics

Characteristics	Household food insecurity experience and scale of severity in the past 12 months										
	Household food insecurity experience: Questionnaire items								Scale of severity[a]		
	Worried would not have enough food to eat	Unable to eat healthy and nutritious food	Ate only few kinds of foods	Skipped meals	Ate less	Household run out of food	Hungry	Went without eating whole day	Food secure	Mild/ moderate food insecure	Severe food insecure
Overall averages	**89.9**	**89.5**	**88.6**	**88.9**	**89.7**	**89.6**	**88.7**	**87.1**	**6.9**	**5.5**	**87.5**
Livelihood zone											
Pastoral	93.1	91.3	92.7	91.4	92.5	92.8	92.0	91.2	5.1	3.8	91.1
Agro-pastoral	91.7	93.9	87.6	91.7	92.9	92.1	93.4	94.7	3.7	7.7	88.6
Fisher folk	74.1	76.5	70.7	75.0	73.6	74.0	71.2	63.2	19.1	9.8	71.2
Urban/peri-urban	90.6	91.5	90.9	90.2	90.9	88.5	85.9	83.8	4.7	7.5	87.8
Survey zone											
Central	79.8	81.8	75.4	81.7	77.9	79.9	78.7	77.1	14.4	7.4	78.2
North	83.2	78.8	82.2	78.9	83.0	82.0	79.3	74.4	14.4	5.3	80.3
South	94.7	96.1	94.3	94.0	95.4	94.7	95.8	96.8	0.2	10.2	89.7
West	99.2	99.0	99.0	98.7	99.3	99.2	98.4	97.4	0.7	0.5	98.8
Sex of household head											
Male	89.2	87.6	87.5	87.6	88.4	88.8	87.3	87.1	7.7	6.5	85.7
Female	91.1	92.6	90.3	91.0	91.7	90.9	91.0	87.2	5.7	3.9	90.4
Mother or caregiver highest education											
No education	90.2	89.3	89.1	89.7	89.8	90.1	89.1	87.4	9.0	9.8	81.2
Primary	88.3	91.6	85.3	84.0	89.0	88.5	86.8	86.3	7.1	4.8	88.1
Secondary+	86.7	85.0	87.1	83.8	85.5	75.7	83.9	79.3	5.6	6.0	88.5
Mother or caregiver age											
15–24 years	92.9	90.2	89.1	90.3	89.8	89.9	88.3	89.5	7.6	5.5	86.9
25–29 years	86.7	88.3	88.3	88.2	88.6	88.4	88.3	86.0	8.3	5.6	86.1

30–34 years	88.2	88.0	87.0	87.6	88.1	88.4	87.0	84.1	7.5	4.4	88.1
35–49 years	91.4	89.4	89.1	89.0	90.5	89.9	89.2	86.4	0.9	9.0	90.1
50+ years	93.5	98.9	91.8	91.7	95.8	97.2	97.2	98.8	5.4	10.0	84.7
Household wealth index (quintiles)											
Lowest	88.9	87.8	87.9	87.2	88.0	88.4	88.1	87.0	8.7	5.3	86.0
Second	92.1	93.1	93.1	93.6	92.3	93.1	93.0	90.6	3.9	5.1	91.0
Middle	88.8	85.9	86.3	86.7	89.3	87.0	85.4	84.9	8.5	6.0	85.4
Fourth	90.9	93.5	87.6	90.5	89.8	92.2	91.4	87.6	4.9	6.3	88.8
Highest	88.6	88.0	87.9	85.2	88.2	87.0	84.0	83.6	9.3	4.0	86.7

Note. The mild and moderate food insecurity categories were merged because of small percentages.

[a] Household food insecurity experience was classified as per item, with items 1 through 3 corresponding to mild food insecurity; items 4 through 6 corresponding to moderate food insecurity; and items 7 and 8 corresponding to severe food insecurity.

Table 21. CSI by livelihood zone and other characteristics

Characteristic	Mean frequency score (0–7 days)					Average weighted CSI score[a]	Number of households
	Rely on less preferred and less expensive foods	Borrow food, or rely on help from a friend or relative	Limit portion size at mealtimes	Restrict consumption by adults in order for small children to eat	Reduce number of meals eaten in a day		
Overall average scores and totals	**4.0**	**1.7**	**3.5**	**2.0**	**3.8**	**20.3**	**1,211**
Livelihood zone							
Pastoral	4.4	1.8	4.0	2.5	4.3	23.8	449
Agro-pastoral	3.9	1.8	3.7	1.8	3.9	20.6	159
Fisher folk	3.1	1.5	2.8	1.3	3.1	15.7	88
Urban/peri-urban	4.2	1.6	3.4	1.8	3.8	20.1	515
Survey zone							
Central	3.0	1.7	3.0	2.0	3.4	18.8	335
North	3.5	1.6	3.2	1.6	3.6	18.0	144
South	3.3	2.0	3.4	1.3	3.7	18.2	396
West	6.0	1.8	5.2	3.5	5.1	30.4	316
Mother or caregiver highest education							
No education	4.2	1.8	3.9	2.3	4.1	22.5	933
Primary	3.6	1.7	2.8	1.4	3.4	17.5	180
Secondary+	3.9	1.4	2.8	1.6	3.0	17.4	98
Mother or caregiver age							
15–24 years	4.3	1.8	3.7	2.0	4.0	21.4	289
25–29 years	3.9	1.7	3.7	2.0	3.9	20.9	311
30–34 years	4.0	1.6	3.7	2.2	3.7	21.4	247
35–49 years	4.2	1.9	4.0	2.4	4.3	23.5	302
50+ years	4.1	1.4	3.8	2.1	4.6	21.7	62
Main source of income							
No income	5.3	1.7	4.0	2.4	4.3	24.2	144
Sale of livestock	4.6	1.7	4.4	2.2	4.4	23.5	160
Employment	3.7	1.5	3.7	1.8	4.2	19.9	146
Petty trade	3.8	1.8	3.7	2.1	3.9	21.1	736
Other(s)	3.0	2.0	1.8	1.7	2.9	16.9	25
Household food insecurity							
Food secure	1.6	1.2	3.2	1.0	3.5	13.7	64
Mild/moderate food insecure	2.7	2.0	2.5	0.6	2.8	13.6	86
Severe food insecure	4.4	1.8	3.9	2.4	4.1	23.0	1,061
Wealth index (Quintile)							
Lowest	4.2	1.9	4.1	2.0	4.2	22.3	244
Second	4.2	1.7	3.5	1.9	3.8	20.6	247
Middle	4.2	1.7	4.0	2.5	4.3	23.2	239
Fourth	3.9	1.8	3.7	2.5	4.0	22.6	246
Highest	3.4	1.6	2.9	1.6	3.3	17.8	235

6.2 WATER, SANITATION, AND HYGIENE

Water insecurity was highly prevalent, and the main source of drinking water varied in households across livelihood zones (**Table 22**). Collection of surface water was reported by 36.8% of households in pastoral communities and by 66.5% among fisher folk, and piped/tapped water by 29.8% in agro-pastoral communities and 39.2% in urban/peri-urban communities. Overall, more than one-quarter of households reported traveling more than 2 kilometers round trip to obtain drinking water, with the largest proportion involving households from pastoral communities and the lowest proportion being from the agro-pastoral and urban/semi-urban livelihood zones. The percentage of households using an improved method for water treatment was low, although it was higher among fisher folk (12.3%). Almost all households reported not having a safe method to store water. Households in the pastoral livelihood zone had the highest water insecurity score. However, as previously noted, water insecurity was not associated with acute malnutrition.

Overall improved latrine utilization was reported by 7.4% of the households, with the highest percentage among the urban/peri-urban dwellers (28.1%). Unsafe water, poor sanitation, and inadequate handwashing are major causes of disease in Kenya [30]. At the same time, the evidence that poor WASH practices cause child undernutrition is not conclusive, most likely because a relatively short duration of improved sanitation cannot completely eliminate well-established pathogens in the environment that have accumulated over a long period [31, 32].

Table 22. Percentage distribution of households by source of drinking water, time to obtain drinking water, person who usually collects drinking water, and treatment of drinking water and sanitation facilities, by livelihood zone

Characteristic	Livelihood zone				Overall
	Pastoral	Agro-pastoral	Fisher folk	Urban/ peri-urban	
Totals	**449**	**159**	**88**	**515**	**1,211**
Source of drinking water					
Piped/tapped	15.8	29.8	10.2	39.2	19.0
Tube well/ borehole	18.4	13.0	0.0	21.3	15.5
Unprotected dug well/ spring	23.8	15.0	21.5	13.2	21.4
Surface water	36.8	29.6	66.5	19.1	38.0
Other(s)[a]	5.2	12.6	1.8	7.2	6.1
Time to obtain drinking water (round trip)					
Less than 500 m (less than 15 minutes)	36.2	39.9	35.6	48.7	37.6
More than 500 m to less than 2 km (15 minutes to 1	30.9	34.3	36.4	29.8	32.1

hour)					
More than 2 km (1–2 hours)	31.8	11.1	27.4	9.3	26.4
Person who usually collects drinking water					
Women	85.6	72.3	80.0	66.0	81.5
Girls	10.7	11.2	17.6	14.6	11.9
Men/boys	2.7	1.9	1.7	7.2	2.8
Water treatment prior to drinking					
Boil	0.9	2.9	12.0	5.5	3.1
Water Guard/Aqua Tabs/other chemical (chlorine)	4.3	3.7	12.3	4.1	5.4
Sitting to settle/sedimen-tation	0.0	0.9	0.0	0.1	0.1
Use water filter (ceramic, sand, composite)	0.1	0.0	0.0	0.1	0.1
Sieve through cloth	0.1	0.0	0.0	0.4	0.1
No treatment	94.9	93.4	78.2	90.1	91.9
Percentage using an appropriate treatment method[b]	4.3	3.7	12.3	4.1	5.4
Water storage					
Safe	5.6	17.0	6.9	9.1	7.8
Unsafe	94.4	83.0	93.1	90.9	92.2
Percentage of households experiencing water insecurity[c]	75.5	64.2	47.7	72.0	70.5
Access to water	97.9	89.3	98.3	83.0	95.6
Short access to water					
Rainy season	14.5	12.6	5.5	19.4	16.1
Dry	82.3	85.3	91.7	67.1	76.2
Number (households	345	95	36	386	862

that had access to water)					
Amount of water household normally uses per day[d]					
Less than 60 liters	68.7	55.8	72.7	44.5	65.5
60–100 liters	28.8	40.8	21.8	44.3	31.0
More than 100 liters	2.4	3.4	5.5	11.2	3.5
Amount of water household used yesterday (excluding for animals)[d]					
Less than 60 liters	76.3	78.8	74.8	57.3	75.3
60–100 liters	15.3	17.1	17.0	32.2	16.9
More than 100 liters	8.4	4.1	8.2	10.5	7.8
Type of toilet/latrine facility					
Improved facility[e]	4.4	17.5	2.1	28.1	7.4
Unimproved facility[f]	95.6	82.5	97.8	71.9	92.1
Households sharing improved facility					
< 10	63.3	68.5	60.2	57.9	63.8
10 or more households	36.7	31.5	39.8	41.8	36.2
Distance between the facility and the house					
Within the compound	71.0	84.3	60.2	81.4	77.8
Outside the compound, < 5 minutes	29.0	15.7	39.8	18.6	22.2
Pay to use toilet facility	3.4	5.2	0	3.5	4.0
Number of households with improved facility	25	29	3	165	212
Handwashing event					
After visiting toilet	72.4	82.5	94.7	85.3	77.9
Before eating	96.5	90.0	94.2	93.3	94.9
Before preparing food	63.7	69.2	60.5	62.8	64.2
After handling child's waste	56.0	41.4	46.8	62.1	52.9

Before feeding a child	44.6	39.0	32.4	48.3	42.4
Percentage of households practicing handwashing at 5 critical times	42.9	43.4	54.5	57.5	50.0
Place of garbage disposal/ garbage dump	3.7	14.5	14.4	17.0	7.6
In the river	12.4	8.5	10.2	16.7	11.8
On the road/in drainage or trench	1.8	4.7	0.0	5.3	2.3
In private pit	5.4	11.2	11.0	10.9	7.4
In public pit	0.7	2.7	5.3	2.9	1.7
Garbage disposal services	0.5	0.6	3.5	2.1	1.0
Burning	39.8	42.1	40.2	37.5	40.0
No designated place/all over	47.2	39.6	29.1	28.1	42.5

Note. Total percentages per characteristic may not add up to 100% because of households with missing information.
[a] Other sources included tanker truck and water kiosk.
[b] Improved water treatment methods include boiling, bleaching/adding chlorine, filtering/straining, and solar disinfecting.
[c] Proportion of water-insecure households using the Household Water InSecurity Experiences (HWISE) scale score (0–36), with household having a score of less than 12 classified as water insecure.
[4] Amount of water measured in 20-liter jerry cans.
[5] Improve toilet facility includes flush, traditional pit, ventilated improved pit toilet, which is plastic bag to collect human waste.
[6] Unimproved facility includes no facility, bush, field, and flying toilet.

7 FACTORS ASSOCIATED WITH CHILD UNDERNUTRITION

This chapter reports on the factors associated with GAM, stunting, and underweight at the child, maternal, household, and community levels.

7.1 FACTORS ASSOCIATED WITH GAM (0–35 MONTHS)

The results showed that the odds of a child being acutely malnourished increased with age (**Table 23**). Compared to infants younger than 6 months, children 12–23 months were twice as likely to suffer from GAM and those 24–35 months were two and a half times more likely to suffer from GAM. The statistically significant association was present across all models, indicating that the effect of the child's age on GAM was consistent and robust.

Children whose mothers were overweight were 87% less likely to have acute malnutrition relative to children of normal-weight mothers.

Sex of the household head was significantly associated with GAM. Children who lived in female-headed households were 60% more likely to suffer from acute malnutrition compared to those living in male-headed households.

The type of toilet facility and level of food insecurity were associated significantly with GAM. Children who lived in households with improved toilet facilities were 79% less likely to have acute malnutrition relative to those living in households with unimproved toilet facilities. Compared to children in food-secure households, those in moderate to severe food-insecure households had between three to five times the risk of acute malnutrition.

Lastly, children of fisher folk were twice as likely to suffer from GAM compared to those of urban/peri-urban dwellers.

The factors that were not associated with GAM were child sex, mother or caregiver age, mother or caregiver parity, diarrhea in the previous 2 weeks, and whether the mother or caregiver achieved MDD-W or experienced domestic violence. Additionally, GAM was not associated with mother or caregiver type of employment, whether a household experienced shock in the previous 4 months, or whether the household had no improved source of water. GAM was also not associated with the number of persons in the household or water insecurity.

Table 23. Multivariate logistic regression analysis (acute malnutrition as assessed by WHZ for children 0–35 months)

Variables	Model 1	Model 2	Model 3	Model 4
Total respondents	**1,199**	**1,106**	**1,100**	**1,100**
Child age: (months) 0–5 (reference category)				
6–11	1.36	1.27	1.21	1.21
	(0.67 – 2.77)	(0.61 – 2.67)	(0.56 – 2.62)	(0.56 – 2.63)
12–23	2.10**	2.21**	2.15**	2.05**
	(1.11 – 3.97)	(1.15 – 4.27)	(1.08 – 4.28)	(1.03 – 4.10)
24–35	2.25**	2.38**	2.55**	2.52**
	(1.19 – 4.27)	(1.22 – 4.65)	(1.24 – 5.26)	(1.20 – 5.30)
Child sex: Female (reference category)				
Male	0.86	0.85	0.85	0.88
	(0.57 – 1.30)	(0.56 – 1.32)	(0.55 – 1.31)	(0.56 – 1.37)
Diarrhea: No (reference category)				
Yes	1.25	1.23	1.27	1.25
	(0.79 – 1.97)	(0.75 – 2.02)	(0.77 – 2.09)	(0.76 – 2.05)
Mother or caregiver age (years): 35+ (reference category)				
10–24		0.82	0.84	0.86
		(0.37 – 1.84)	(0.36 – 1.94)	(0.37 – 2.02)
25–29		1.23	1.20	1.26

		(0.66 – 2.27)	(0.62 – 2.34)	(0.64 – 2.47)
30-34		1.10	1.10	1.12
		(0.60 – 2.02)	(0.59 – 2.06)	(0.60 – 2.10)
Mother or caregiver BMI (kg/m^2) 18.49–24.99 (reference category)				
< 18.50		1.41	1.40	1.37
		(0.91 – 2.19)	(0.90 – 2.19)	(0.88 – 2.15)
25.00–29.99		0.26**	0.12***	0.13***
		(0.09 – 0.81)	(0.03 – 0.41)	(0.04 – 0.42)
30.00+		2.10	1.33	1.40
		(0.54 – 8.14)	(0.33 – 5.31)	(0.33 – 5.92)
Mother or caregiver parity: 1–2 (reference category)				
3–5		1.05	1.08	1.03
		(0.57 – 1.93)	(0.58 – 2.02)	(0.55 – 1.93)
5+		1.44	1.75	1.76
		(0.69 – 3.01)	(0.80 – 3.86)	(0.81 – 3.85)
Mother or caregiver achieved MDD-W: Yes (reference category)				
No		1.15	1.61	1.61
		(0.41 – 3.22)	(0.51 – 5.08)	(0.49 – 5.23)
Mother or caregiver experienced domestic violence: No (reference category)				
Yes		0.60**	0.75	0.75
		(0.38 – 0.95)	(0.46 – 1.21)	(0.46 – 1.21)
Household main source of income in the past 4 months: Employment (reference)				
No income			0.54	0.57
			(0.17 – 1.72)	(0.17 – 1.92)
Sale of livestock/livestock products			0.68	0.73
			(0.24 – 1.91)	(0.24 – 2.21)
Petty trade/other			1.06	1.04
			(0.42 – 2.65)	(0.39 – 2.73)
Sex of household head: Male (reference category)				
Female			1.56*	1.60**
			(0.98 – 2.48)	(1.00 – 2.56)
Household experience of shocks in the past 4 months: No (reference category)				
Yes			0.26*	0.32
			(0.06 – 1.06)	(0.08 – 1.35)
Source of drinking water: Improved (reference category)				
Unimproved			1.23	1.11
			(0.75 – 2.02)	(0.68 – 1.82)
Type of toilet facility: Unimproved (reference category)				
Improved			0.22***	0.21***

			(0.10 – 0.50)	(0.09 – 0.47)
Number of household members: 2–5 (reference category)				
5+			0.97	0.99
			(0.58 – 1.64)	(0.59 – 1.69)
Household food insecurity: Food secure (reference category)				
Mild/moderate food insecure			5.12**	5.76***
			(1.46 – 17.98)	(1.57 – 21.14)
Severe food insecure			2.94**	3.35**
			(1.00 – 8.60)	(1.12 – 9.99)
Household water insecurity: Yes (reference category)				
No			0.93	0.85
			(0.55 – 1.57)	(0.50 – 1.45)
Livelihood zone: Urban/peri-urban (reference category)				
Pastoral				1.18
				(0.67 – 2.06)
Agro-pastoral				1.28
				(0.66 – 2.46)
Fisher folk				2.17**
				(1.01 – 4.64)

Note. As described in Section 2.2, Study Methodology, Model 1 included only child factors; Model 2 included both child and maternal factors. Model 3 included child, maternal, and household factors. Finally, Model 4 adjusted for child, maternal, household, and community factors.
95% CI in parentheses. ***$p < .01$, **$p < .05$, *$p < .1$.

7.2 FACTORS ASSOCIATED WITH CHILDHOOD STUNTING (0–35 MONTHS)

Biological factors such as a child's age and sex were associated significantly with stunting. Compared to children aged 0–5 months, children who were 12–23 and 24–35 were 5 (CI = 2.69, 9.66) and 7.93 (CI = 4.09, 15.40) times more likely to be stunted, which is not surprising because stunting is cumulative, and increases occurs over time (**Table 24**). The results further showed that being a boy increased the child's odds of being stunted by 1.65 (CI = 1.08, 2.52) times relative to girls. Children living in female-headed households were 1.63 (CI = 1.05, 2.53) times more likely to suffer from stunting compared to those in male-headed households.

Table 24. Multivariate logistics regression analysis (stunting for children 0–35 months)

Variables	Model 1	Model 2	Model 3	Model 4
Total respondents	**1,184**	**1,176**	**1,176**	**1,176**
Child age (months): 0–5 (reference category)				
6–11	2.03*	1.98*	1.90	1.87
	(0.97 – 4.28)	(0.93 – 4.22)	(0.86 – 4.17)	(0.86 – 4.09)

12–23	5.22***	5.25***	5.08***	5.10***
	(2.78 – 9.82)	(2.77 – 9.96)	(2.67 – 9.65)	(2.69 – 9.66)
24–35	8.52***	8.37***	7.97***	7.93***
	(4.42 – 16.41)	(4.26 – 16.43)	(4.11 – 15.48)	(4.09 – 15.40)
Child sex: Girl (reference category)				
Boy	1.78***	1.69**	1.70**	1.65**
	(1.18 – 2.67)	(1.12 – 2.55)	(1.11 – 2.59)	(1.08 – 2.52)
Caregiver age (years): 35+ (reference category)				
10–24		0.89	0.87	0.86
		(0.49 – 1.63)	(0.47 – 1.62)	(0.47 – 1.61)
25–29		0.95	0.95	0.95
		(0.55 – 1.62)	(0.55 – 1.64)	(0.55 – 1.64)
30–34		0.56*	0.56*	0.55*
		(0.31 – 1.02)	(0.31 – 1.04)	(0.30 – 1.02)
Caregiver BMI (kg/m^2) 18.49–24.99 (reference category)				
< 18.50		1.12	1.19	1.22
		(0.74 – 1.70)	(0.78 – 1.83)	(0.80 – 1.88)
25.00–29.99		0.50	0.53	0.58
		(0.15 – 1.64)	(0.15 – 1.88)	(0.19 – 1.81)
30.00+		0.52	0.61	0.68
		(0.03 – 9.43)	(0.04 – 10.61)	(0.03 – 14.15)
Caregiver achieved MDD-W: Yes (reference category)				
No		1.41	1.74	1.84
		(0.65 – 3.08)	(0.82 – 3.69)	(0.86 – 3.92)
Household main source of income in the last 4 months: Employment (reference category)				
No income			2.62	2.14
			(0.83 – 8.23)	(0.67 – 6.86)
Sale of livestock/livestock products			1.73	1.53
			(0.55 – 5.42)	(0.48 – 4.94)
Petty trade/other			1.41	1.29
			(0.49 – 4.08)	(0.45 – 3.68)
Sex of household head: Male (reference category)				
Female			1.61**	1.63**
			(1.04 – 2.48)	(1.05 – 2.53)
Household experience of shocks in the past 4 months: No (reference category)				
Yes			2.24	2.31
			(0.15 –	(0.16 –

			32.77)	33.37)
Source of drinking water: Improved (reference category)				
Unimproved			1.11	1.18
			(0.70 – 1.78)	(0.73 – 1.90)
Household food insecurity: Food secure (reference category)				
Mild/moderate food insecure			1.11	1.02
			(0.36 – 3.47)	(0.32 – 3.23)
Severe food insecure			0.97	0.90
			(0.40 – 2.32)	(0.37 – 2.16)
Household water insecurity: Yes (reference category)				
No			0.97	1.00
			(0.61 – 1.57)	(0.61 – 1.63)
Livelihood zone: Urban/peri-urban (reference category)				
Pastoral				1.23
				(0.73 – 2.07)
Agro-pastoral				1.71*
				(0.92 – 3.17)
Fisher folk				0.88
				(0.40 – 1.94)

Note. As described in Section 2.2, Study Methodology, Model 1 included only child factors; Model 2 included both child and maternal factors. Model 3 included child, maternal, and household factors. Finally, Model 4 adjusted for child, maternal, household, and community factors.
95% CI in parentheses. ***$p < .01$, **$p < .05$, *$p < .1$.

7.3 FACTORS ASSOCIATED WITH CHILDHOOD UNDERWEIGHT (0–35 MONTHS)

Child age is a key driver of being underweight. The results in **Table 25** show that compared to children aged 0–5 months, children aged 12–23 (aOR = 3.94; CI = 2.11, 7.36) and 24–35 (aOR = 8.31; CI = 4.25, 16.24) had higher odds of being underweight. The findings suggest that the older a child was, the more likely they would suffer from underweight. Improved toilet facilities were associated with 61% (aOR = 0.39; CI = 0.17, 0.89) reduced odds of childhood underweight.

Table 25. Multivariate logistics regression (underweight for children 0–35 months)

Variables	Model 1	Model 2	Model 3	Model 4
Total respondents	**1,194**	**1,055**	**1,050**	**1,050**
Child age: (months) 0–5 (reference category)				
6–11	2.07**	2.02*	2.03*	2.00*
	(1.02 – 4.18)	(0.98 – 4.14)	(1.00 – 4.14)	(0.98 – 4.05)
12–23	4.41***	3.99***	3.98***	3.94***
	(2.40 – 8.10)	(2.09 – 7.61)	(2.11 – 7.50)	(2.11 – 7.36)
24–35	7.07***	7.76***	8.46***	8.31***

	(3.74 – 13.35)	(3.91 – 15.41)	(4.33 – 16.51)	(4.25 – 16.24)
Child sex: Female (reference category)				
Male	1.38	1.48*	1.51*	1.48*
	(0.94 – 2.03)	(0.98 – 2.25)	(0.99 – 2.31)	(0.96 – 2.28)
Caregiver age (years): 35+ (reference category)				
10–24		1.44	1.51	1.51
		(0.67 – 3.09)	(0.69 – 3.30)	(0.69 – 3.32)
25–29		1.56	1.74*	1.75*
		(0.83 – 2.93)	(0.92 – 3.30)	(0.92 – 3.35)
30–34		1.24	1.29	1.28
		(0.68 – 2.27)	(0.71 – 2.37)	(0.69 – 2.36)
Antenatal care attendance: 4+ (reference category)				
<4		0.82	0.75	0.78
		(0.54 – 1.25)	(0.49 – 1.15)	(0.51 – 1.19)
Caregiver BMI (kg/m^2) 18.49–24.99 (reference category)				
< 18.50		1.22	1.36	1.38
		(0.80 – 1.85)	(0.89 – 2.07)	(0.90 – 2.12)
25.00–29.99		0.31**	0.16***	0.18***
		(0.11 – 0.83)	(0.05 – 0.47)	(0.06 – 0.51)
30.00+		2.80	2.44	2.86
		(0.48 – 16.19)	(0.32 – 18.47)	(0.38 – 21.71)
Parity: 1–2 (reference category)				
3–5		1.71*	1.57	1.58
		(0.96 – 3.06)	(0.86 – 2.87)	(0.86 – 2.91)
5+		2.44**	2.21*	2.20*
		(1.16 – 5.12)	(0.99 – 4.96)	(0.97 – 4.95)
Caregiver achieved MDD-W: Yes (reference category)				
No		1.61	2.25	2.33*
		(0.62 – 4.21)	(0.85 – 5.97)	(0.85 – 6.39)
Household main source of income in the past 4 months: Employment (reference category)				
No income			2.14	1.87
			(0.67 – 6.79)	(0.58 – 5.96)
Sale of livestock/livestock products			0.83	0.79
			(0.27 – 2.50)	(0.26 – 2.42)
Petty trade/other			1.07	1.01
			(0.39 – 2.91)	(0.37 – 2.72)

Sex of household head: Male (reference category)				
Female			1.48*	1.52*
			(0.94 – 2.35)	(0.96 – 2.42)
Source of drinking water: Improved (reference category)				
Unimproved			0.98	1.01
			(0.62 – 1.56)	(0.63 – 1.61)
Household experience of shocks in the past 4 months: No (reference category)				
Yes			0.32	0.32
			(0.04 – 2.52)	(0.04 – 2.67)
Type of toilet facility: Unimproved (reference category)				
Improved			0.36**	0.39**
			(0.17 – 0.79)	(0.17 – 0.89)
Number of household members: 2–5 (reference category)				
5+			1.45	1.49
			(0.88 – 2.40)	(0.90 – 2.46)
Household food insecurity: Food secure (reference category)				
Mild/moderate food insecure			1.58	1.49
			(0.44 – 5.60)	(0.42 – 5.32)
Severe food insecure			1.83	1.75
			(0.65 – 5.12)	(0.62 – 4.91)
Household water insecurity: Yes (reference category)				
No			0.77	0.76
			(0.46 – 1.26)	(0.47 – 1.25)
Livelihood zone: Urban/peri-urban (reference category)				
Pastoral				1.10
				(0.65 – 1.87)
Agro-pastoral				1.68*
				(0.91 – 3.09)
Fisher folk				1.05
				(0.46 – 2.39)

Note. As described in Section 2.2, Study Methodology, Model 1 included only child factors; Model 2 included both child and maternal factors. Model 3 included child, maternal, and household factors. Finally, Model 4 adjusted for child, maternal, household, and community factors.

95% CI in parentheses. ***p < .01, **p < .05, *p < .1.

7.4 FACTORS ASSOCIATED WITH GAM, STUNTING, AND UNDERWEIGHT (6–23 MONTHS)

To investigate the role of IYCF on GAM, stunting, and underweight, we stratified the analysis by the child's age (6–23 months). The results showed that none of the IYCF indicators included in the analysis were associated significantly with any of the three indicators of undernutrition (results not shown). As noted above, this is not surprising, because the indicators were developed as a rough proxy of dietary quality for use in large-scale surveys [9]. Other studies have shown that the IYCF indicators are only weakly or not significantly associated with anthropometry [24, 25].

7.5 INTERACTION ANALYSIS

7.5.1 Interaction between child sex, age, and livelihood to predict acute malnutrition

Figures 14, 15, and **16** show the interaction effects of child sex, age, and livelihood zone on GAM. The results in Figure 14 suggest that child sex interacted significantly with livelihood zone to predict GAM, indicating that the effect of child sex on GAM depended on the child's livelihood zone, with male children at greater risk of GAM than female children in the agropastoral livelihood zone. Therefore, the null finding of child sex on GAM (WHZ), reported in Section 3, resulted from differing prevalence across livelihood zones that canceled each other out. Similarly, in the interaction plot shown in Figure 15, the lines are nonparallel, suggesting a significant interaction between a child's age and livelihood zones. Whereas the risk of GAM increased with child age among pastoralists and fisher folk, it declined or was static among urban/peri-urban dwellers and agro-pastoralists. The graph also shows that at all ages, children of fisher folk were at higher risk of GAM compared to children in the other livelihood zones. The interaction effect between child sex and age (Figure 16) was also significant, showing that the risk of GAM among female children was lower at younger ages compared to male children, but compared to male children, increased more rapidly as they grew older.

Figure 14. Interaction between child sex and livelihood zone to predict GAM

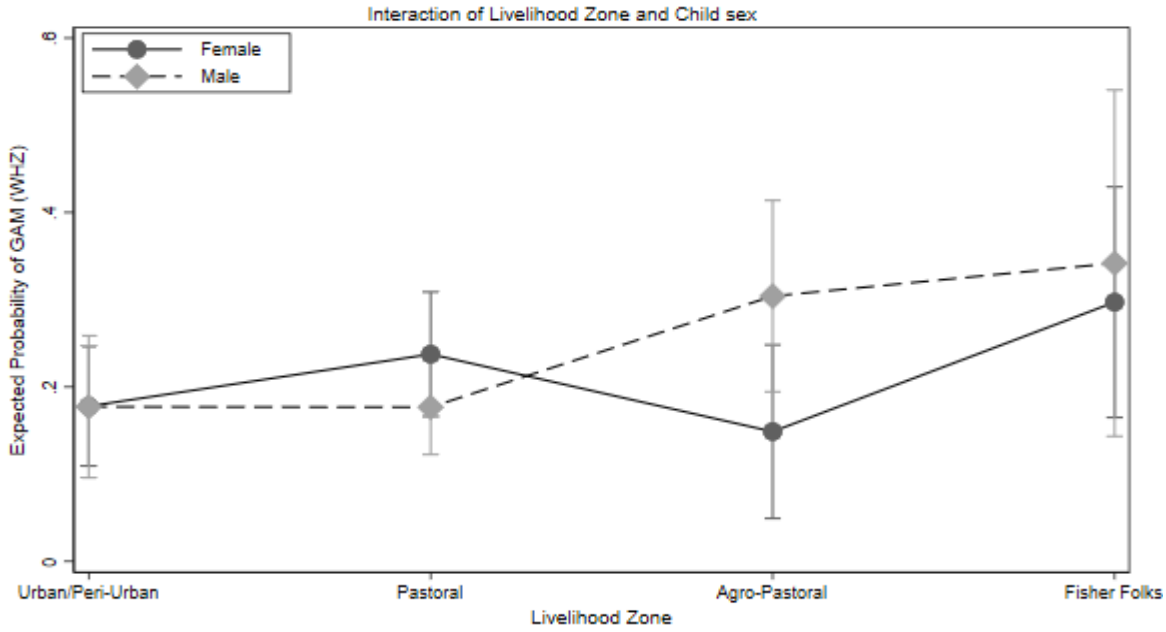


Figure 15. Interaction between child age and livelihood zone to predict GAM

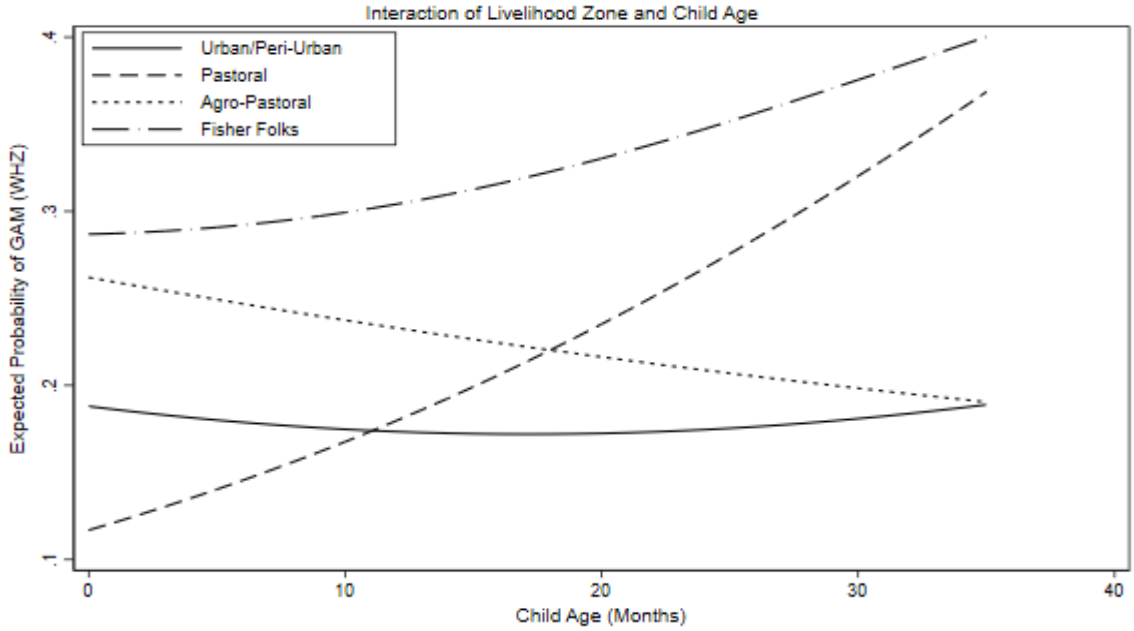
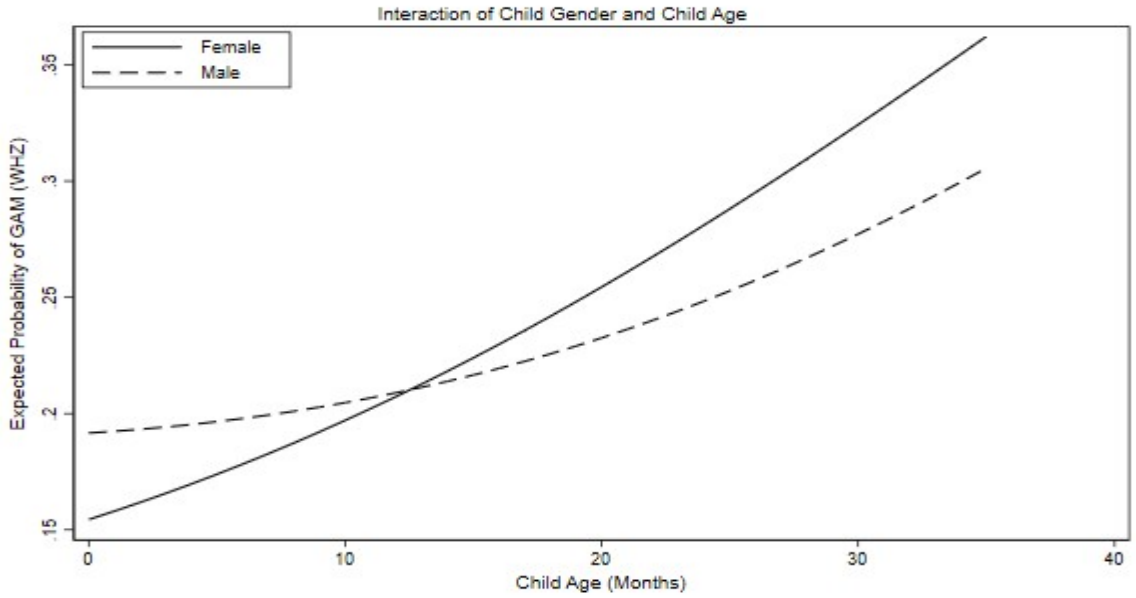


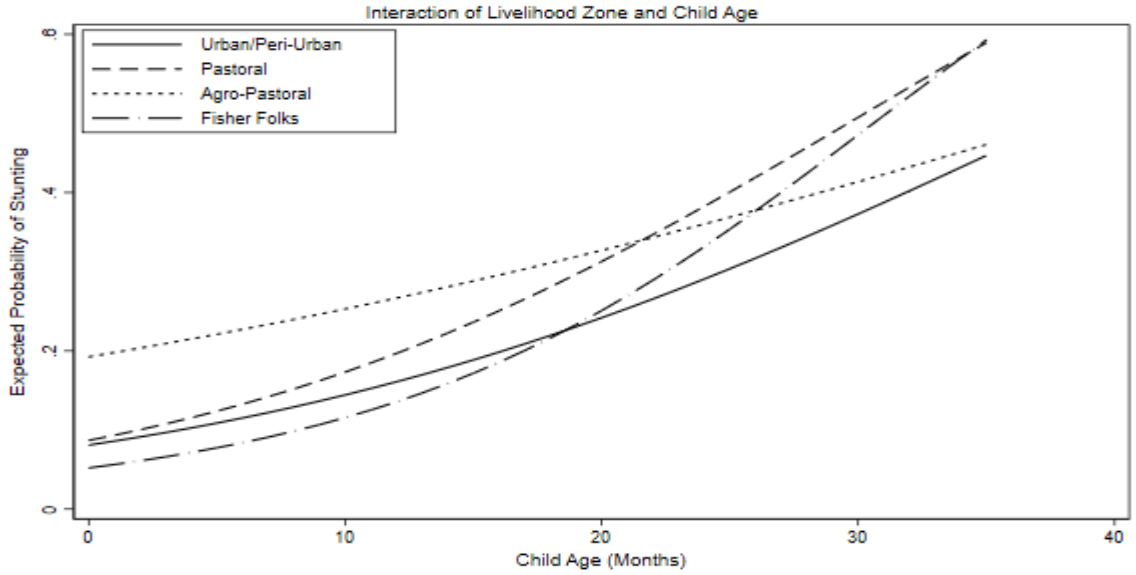
Figure 16. Interaction between child sex and age to predict GAM



7.5.2 Interaction between child sex, age, and livelihood to predict childhood stunting

Figure 17 presents the results of the interaction between child age and livelihood zone and the association of the interaction with childhood stunting. The results suggest the presence of an interaction effect. Thus, the effect of the livelihood zone on child stunting depended on the child's age. No interaction was observed between child sex and livelihood zone and child sex and age (results not shown).

Figure 17. Interaction between child's age and livelihood zone to predict stunting



8 DISCUSSION, CONCLUSIONS, AND NEXT STEPS

The results show that GAM across all survey zones in Turkana has exceeded the emergency threshold (GAM > 15%). The high prevalence suggests that the interventions being

implemented in the county over the years have not worked to reduce GAM rates sustainably. Alternatively, it could indicate that conditions affecting PAM have grown substantially worse over the years; therefore, programs have served at best to maintain the status quo. Nonetheless, there is a need to take a second look at the implementation of the existing interventions and introduce new robust programs or adapt existing programs to reduce the GAM rates sustainably. The longitudinal survey findings are consistent with those of recent SMART surveys, which have consistently shown a high prevalence of GAM and other undernutrition metrics [3, 13, 14].

The vastly different prevalence rates of acute malnutrition when assessed by MUAC, compared to when WHZ was used as the indicator for GAM, will require further research and analysis for targeting based on mother- or caregiver-led MUAC and surveillance.

Disaggregating the analysis further by livelihood zones showed that the GAM prevalence varied widely and was different from what was obtained at the sub-county level. It showed that children of fisher folk were at greatest risk of GAM compared to children in other livelihood zones and perhaps should be targeted specifically for nutrition interventions. It confirmed the need for disaggregated analysis, because limiting the analysis to survey zones may mask some differences at the livelihood zone level, with implications for programming. Therefore, nutrition interventions must be carefully specified with regard to a livelihood zone to achieve maximum effect.

Our analysis also showed that children tend to suffer from GAM, stunting, and underweight as they grow older. Young children, particularly those exclusively breastfed for 6 months, are generally protected from undernourishment because they are receiving a highly nutritious food, and they are at reduced risk of illness caused by contact with contaminated foodstuffs or feeding utensils. At 6 months, when a child needs complementary foods, poverty—and all it entails in terms of food security, water insecurity, etc.—plays a large role. This finding does imply, however, that different messages are needed for infants less than 6 months compared to those for older children. For younger children, the focus should be on promoting exclusive breastfeeding and supporting mothers to achieve it.

For older infants and younger children, the emphasis should be on increasing dietary diversity by reducing the multiple barriers that prevent adequate access and increasing meal frequency. Short-term interventions could also focus on promoting pulse consumption among young children, given that pulse consumption among mothers and caregivers was more than twice as high as for children (27% versus 11%), indicating that some households with access to this highly nutritious food group could potentially be encouraged to also feed it to their children. Also, although about 50% of both women and children in the fisher folk livelihood consumed fish, thereby indicating some availability at the household level, the portions given to children may have been too small to affect their nutrition. Research into portion size may be warranted to determine whether promoting increased size is a feasible intervention to pursue. Because about 20% of children are fed with a bottle, given risks of pathogenic contamination, discouraging this practice is also warranted.

The results of the minimum dietary diversity indicator among children (4.0%) and mothers or caregivers (1.8%) is worrying and consistent with their mostly monotonous diets composed of cereals and dairy [3, 33, 34]. It is also one of the few variables in our study that is vastly different from an early study, conducted in 2017 [23]. Certainly, poor dietary diversity intake

has a severe adverse effect on health outcomes, especially among children, who need a diverse diet to support their physical growth and cognitive development. Reported illnesses of common acute conditions among young children in the past 2 weeks before the survey was high (54%) and there was no difference among children in different livelihood zones. A large percentage of mothers or caregivers also treatment from a health facility for such illnesses, though less so for children 24-35 months ($p=0.06$) and for children living in lower quintiles of household wealth compared to older quintiles ($p<0.01$). Child illness is an immediate cause of undernutrition and interacts with diet to affect undernutrition [35]. Interventions to reduce the prevalence of common childhood illnesses, particularly diarrhea, are needed to reduce GAM.

Analysis by mothers' and caregivers' age suggested that older age was associated with a high prevalence of undernutrition. Mothers and caregivers older than 35 had the highest proportion of children who suffered from GAM, while children of younger mothers had the lowest. This was also the case for stunting and underweight. These findings are surprising, because the literature generally shows that children of older mothers tend to have better health outcomes than children of younger mothers [36]. If this result is confirmed in subsequent survey waves, it will be an encouraging finding, suggesting that younger mothers and caregivers may be shifting to better nutrition and caregiving practices and may be more receptive to child nutrition interventions compared to older mothers, with implications over the long term for improved child nutrition. Intervention efforts should build on these good practices, while also paying attention to measures to improve the nutrition of children among older mothers and caregivers.

The sex of the household head had a significant effect on GAM. Children living in female-headed households were more likely to suffer from GAM relative to those living in male-headed households. The most plausible explanation for this finding is that women who head households are likely to be single, significantly affecting the accessibility of nutritious food and other resources needed for proper childcare. Similar findings have been observed in the literature [37, 38]. Our study findings suggest that programs aimed at reducing PAM should target female-headed households in particular.

Sanitation was also found to be an essential driver of GAM. Children who lived in households with improved toilet facilities were less likely to suffer from GAM than those with unimproved facilities. This result may have occurred because improved toilet facilities reduce the likelihood of children being exposed to disease pathogens [38], which can have a ripple effect on health and nutrition outcomes. It could also be that households with improved toilet facilities have a higher socioeconomic status, which means that their children may have access to nutritious food and other resources. This finding shows that WASH interventions need to be included in programming that addresses both hygiene around the preparation of food and households' treatment of drinking water. More broadly, access to and use of improved toilets would benefit child nutrition.

Lastly, household food security was the most important variable associated with GAM. Children who lived in moderate to severe food-insecure households had a three- to five-fold higher likelihood of suffering from GAM relative to those in food secure households. Consistent with the conceptual framework for addressing acute malnutrition in Africa's drylands, household food insecurity is related to underlying and basic/systematic factors

encompassing livelihoods systems, systems and institutions, and environment and seasonality[1]. It is also affected by idiosyncratic shocks. Improving availability of and access to a diverse diet, including flesh foods, nutrient-rich vegetables, and pulses and legumes—so that they could replace energy-rich but relatively nutrient-poor cereals (currently the basis of the child complementary feeding diet)—could be the most important intervention to reduce GAM and improve overall maternal and child nutrition.

With respect to next steps, the information generated by the quantitative results of the baseline of the longitudinal study highlights some specific immediate actions:

- Working with communities so that they see acute malnutrition as a collective problem that they have a responsibility to address, focusing on local solutions.
- Focusing on children of fisher folk for interventions to improve dietary intake, building on some already positive complementary feeding practices.
- Focusing on children of female-headed households.
- Introducing or scaling up interventions to promote exclusive breastfeeding among mothers of children less than 6 months and to promote increased dietary diversity and meal frequently among children 6 to 23 months. Interventions to reduce use of feeding bottles should be targeted at mothers and caregivers of all very young children.

Lastly, the information generated from this report needs to be integrated with the rich findings from the qualitative results, when that analysis is finalized. Integration of the two complementary research methods will lead to a more in-depth understanding of how interventions can improve nutrition with respect to both the immediate causes of undernutrition that can be addressed in the short term and the underlying causes that will need long-term attention.

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ANNEX A. INDICATORS, METHODS, AND FREQUENCY OF DATA COLLECTION FOR HOUSEHOLD SURVEYS

Variable/indicator	Methods	Frequency of data collection
Identification and tracking ▪ Global positioning system (GPS) coordinates ▪ Village and community name, etc. ▪ Names and contact information of primary adults in the household ▪ Names and contact information for community leader(s)	Survey	Wave 1 with checks for any changes in subsequent waves
Demographics and household composition ▪ Number of household members, number of children <5 years, maternal/paternal education, paternal/maternal occupation, ethnicity, religion, etc.	Survey	Wave 1 with checks for any changes in subsequent waves
Anthropometry of children <5 years and mothers or caregivers ▪ Mid-upper arm circumference (MUAC) ▪ Weight ▪ Length/height	Survey	At all survey waves
Socioeconomics ▪ Household wealth ▪ Livelihoods (household asset base, income sources, social protection, livestock number, access to markets, access to land/pasture) ▪ Household decision-making and control over resources ▪ Women's time use	Survey	At all survey waves, with some modifications for indicators unlikely to vary sub-annually
Household food security ▪ Coping Strategy Index (CSI), Food Insecurity Experience Scale (FIES) ▪ Household Dietary Diversity Score (HDDS)	Survey	At all survey waves
Water, sanitation, and hygiene (WASH) ▪ Water source, access, availability, and seasonality ▪ Household Water InSecurity Experiences (HWISE) scale ▪ Hygiene practices	Survey	At all survey waves
Health-seeking behavior ▪ Integrated Management of Acute	Survey	At all survey waves, with some modifications for

Malnutrition (IMAM) ▪ Community health service (CHS) experience ▪ Child morbidity		indicators unlikely to vary sub-annually
Maternal, infant, and young child nutrition (MIYCN) ▪ Standard infant and young child feeding (IYCF) questionnaire and indicators (exclusive breastfeeding, minimum dietary diversity [MDD], minimum meal frequency [MMF], and minimum acceptable diet [MAD]) ▪ Minimum dietary diversity for women (MDD-W) questionnaire ▪ Child morbidity ▪ IYCF knowledge, attitudes, and practices ▪ Food safety and WASH knowledge, attitudes, and practices	Survey	At all survey waves
Shock experience/exposure ▪ Drought ▪ Locusts ▪ COVID-19 ▪ Flooding ▪ Market shocks ▪ Livelihood disruption ▪ Illness/death etc. ▪ Violence and community conflict, etc.	Survey	At all survey waves
Shock preparedness and response ▪ Various coping strategies beyond CSI ▪ Participation in formal social safety nets and other humanitarian/development activities, particularly the Rural Enterprise Access Project (REAP) ▪ Role of informal social capital (including in-group/out-group dynamics) ▪ Psychosocial well-being, locus of control, and measures of aspiration	Survey	All survey waves

ANNEX B. SAMPLING AND POST-STRATIFICATION WEIGHTS

This annex summarizes the steps taken to compute the sampling weights based on the survey zones as well as the post-stratification weights based on livelihood zones for the Nawiri longitudinal study.

STUDY DESIGN AND SAMPLING

Sampling design

The sample was population based, stratified by survey zones. The sampling frame comprised households with children less than 3 years at baseline, and their mothers or caregivers. To obtain a representative sample of children and mothers or caregivers, a multistage sampling method was adopted. In the first stage, we stratified the population according to survey zones. Within each stratum, a random sample of villages was drawn. Household listing was conducted in the sampled villages and a sampling frame of households with children under 3 years was established. Households were then randomly selected and included in the study from the sampling frame.

Sampling and stratification strategy

Although interest lies in comparing estimates across different livelihood zones, stratification by livelihood zones was a challenge because the livelihood zones are not aligned to administrative units. That is, information on the number of villages within livelihood zones, and a respective household listing, were not available, given that population data are based on administrative units. However, the data collectors did capture information on livelihood zones and we used it to generate estimates of interest by livelihood zones by performing post-stratification analyses. The survey zones in this context refer to the administrative sub-counties used by the June 2019 Standardized Monitoring and Assessment of Relief and Transitions (SMART) surveys for Turkana. Nawiri designated four survey zones in Turkana: Central, North, West, and South. **Table B-1** (which repeats Table 1 from the body of the report, for easy reference) shows the administrative sub-counties covered in each of the survey zones. Villages within each survey zone were treated as clusters. Within each stratum, a random sample of villages was drawn. Household listing was conducted in the sampled villages to establish a sampling frame for the final stage of the sampling.

Table B-1. Sample size determination and allocation

Survey zone	Sub-counties	Population	Villages	Sample size (by proportional allocation)	Sampled villages
Central	Central, Loima	293,100	902	488	25
North	North, Kibish	101,987	379	170	25
West	West	239,627	425	399	25
South	South, East	292,262	561	487	25
Total		**926,976**	**2,267**	**1,544**	**100**

Sample size determination and allocation

We used a household survey sample size formula created by the United Nations Statistical Division [1] to compute the sample size needed, adjusting for design effect due to stratification and clustering, and design effect due to repeated data collection on the same study participants over the 24 months. The sample size was computed to estimate an expected prevalence of acute malnutrition assuming an under-3 global acute malnutrition (GAM) prevalence of 23.2% (SMART survey, June 2019). We adjusted for a design effect of 1.81. (These decisions yielded a maximum design effect of 1.5 due to stratification and clustering based on estimates from the 2019 SMART survey. We assumed a design effect of 1.12 due to repeated data collection on the same individuals at seven time points and common correction of 0.02, based on estimates from a previous study [2], which estimated an intraclass correlation of 0.0044 for clustering of children within a household.) A margin of error of +/– 5 percentage points was assumed, along with a 95% confidence level, a nonresponse and attrition rate of 20%, the proportion of the population targeted for the study (children less than 3 years) at 7.6% per the 2019 Kenya Census [3–5], and the average household size of six persons. Based on these assumptions, the required estimated minimum sample size became 1,544 households.

Calculation of sampling weights

We used the MEASURE Demographic and Health Survey (DHS) program document [6] as a guide to calculate sampling weights for both households and mother or caregiver. We first computed the *design weight* of a sampling unit (household or mother/caregiver), defined as the inverse of the overall probability with which the sampling unit was selected in the sample. The final *sampling weight* of a sampling unit was derived from the computed design weight correcting for nonresponse.

The longitudinal study sample was drawn with two-stage, stratified cluster sampling; i.e., stratified by the four survey zones and two stages of sampling at village and household levels. We computed the design weights based on the separate sampling probabilities for each sampling stage and for each village: the first-stage sampling probability of the village in a survey zone and the second-stage sampling probability of a household within the village. The probability of selecting the i^{th} village in the sample was calculated as follows:

$$P_{1hi} = \frac{n_h M_{hi}}{\sum M_{hi}},$$

where

n_h is the number of villages selected in survey zone h,
M_{hi} is the number of households in the selected village from the sampling frame, and
$\sum M_{hi}$ is the total measure of size in the survey zone h.

The second-stage selection probability for each household in the village was calculated as follows:

$$P_{2hi} = \frac{t_{hi}}{L_{hi}},$$

where

Let L_{hi} is the number of households listed in the household listing operation in village *i* in survey zone *h,* and

t_{hi} is the number of households selected in the village.

The overall selection probability of each household in village *i* of survey zone *h* was computed as the product of the selection probabilities of the two stages:

$$P_{hi} = P_{1hi} \times P_{2hi}$$

The design weight for each household in village *i* of survey zone *h* is the inverse of its overall selection probability:

$$d_{hi} = 1 / P_{hi}$$

Correcting for nonresponse rate

The design weight was then corrected for nonresponse at the village level and at the household level by dividing it by the response rate for each response group. Assuming that the response groups coincided with the sampling strata, we calculated the sampling weight by first calculating the various weighted response rates for unit nonresponse, as shown below.

The village-level response rate in survey zone *h* is therefore

$$R_{ch} = n_h^* / n_h$$

where

n_h is the number of village selected in survey zone *h,* and

n_h^* is the number of villages interviewed.

The household response rate in survey zone *h* is calculated by

$$R_{hh} = \sum d_{hi} m_{hi}^* / \sum d_{hi} m_{hi}$$

where

m_{hi} is the number of households found in village *i* of survey zone *h,*

m_{hi}^* is the number of households interviewed in the village,

d_{hi} is the design weight of village *i* in survey zone *h,* and

Σ is the summation over all villages in the survey zone *h*.

The individual response rate in survey zone *h* is calculated as

$$R_{ph} = \sum d_{hi} k_{hi}^* / \sum d_{hi} k_{hi}$$

here

k_{hi} is the number of eligible individuals found in village *i* of survey zone *h,*

k_{hi}^* is the number of individuals interviewed,

d_{hi} is the design weight of village *i* in survey zone *h,* and

Σ is the summation over all villages in the survey zone *h*.

The household sampling weight of village *i* in survey zone *h* was the calculated by dividing the household design weight by the product of the village and the household response rates, for each of the sampling survey zones:

$$D_{hi} = d_{hi} / (R_{ch} \times R_{hh}),$$

for village *i* of survey zone *h*.

The individual sampling weight of village *i* in survey zone *h* was calculated by dividing the household sampling weight by the individual response rate, or equivalently, by dividing the household design weight by the product of the village response rate, the household response rate, and the individual response rate, for each of the sampling strata:

$$W_{hi} = D_{hi} / R_{ph} = d_{hi} / (R_{ch} \times R_{hh} \times R_{ph}),$$

for village *i* of survey zone *h*.

Post-stratification

One objective of the longitudinal study is to estimate GAM rates at the livelihood zone level. There was no adequate information (i.e., population size, GAM rates, or village details by livelihood zones) to enable us to stratify and compute the sample size needed for the study by livelihood zones. As a result, an agreement was made to base the sampling strategy on known survey zones as used by previous studies (the SMART surveys) and to construct post-stratification survey weights to allow us to partially correct for the biases mathematically when estimating the GAM rates by livelihood zones. Post-stratification adjusts the weights of undersampled and oversampled subpopulations so that the overall sample better represents the true subpopulation distributions of the actual target population. Post-stratification reweights observations based solely on the joint distribution of the stratification variables and post-stratification variables. That is, the auxiliary information required consists of the population counts of each subgroup belonging to the post-stratification variables within each stratum of the survey.

Nawiri divided Turkana County into four main livelihood zones, with populations as follows: nearly 60% pastoral, 20% agro-pastoral, 12% fisher folk, and 8% urban/ peri-urban in formal or informal employment [7]. These proportions were taken as the "true benchmark" zones for population distribution by livelihood. We then used the information collected during the baseline survey on livelihood zones of the sampled households to **compute the post-stratified sampling weights** at the county level as shown in Table B-2; and to further estimate the population by livelihood zone for each survey zone using information from the 2019 National Drought Management Authority (NDMA) report [7] to compute post-stratified sampling weights at survey zone level. The post-stratification weight was then computed as:

Wpoststr =livelihood zone proportion in the population %/ livelihood zone proportion in the sample %

The final weights ($Wpost_{hi}$) were then computed by multiplying the sampling weights (W_{hi}) by the post-stratification weights ($Wpoststr_h$):

$$Wpost_{hi} = W_{hi} * Wpoststr_h .$$

Table B-2. Computation of post-stratified sampling weights at the county level

Survey zone	Livelihood zone	Population	Population %	Sample	Sample %	Post-stratification weight
Overall	Pastoral	556,186	60.0%	449	37.1%	1.62
	Agro-pastoral	185,395	20.0%	159	13.1%	1.52
	Fisher folk	111,237	12.0%	88	7.3%	1.65
	Urban/peri-urban	74,158	8.0%	515	42.5%	0.19
Central	Pastoral	146,550	50.0%	124	34.9%	1.43
	Agro-pastoral	55,689	19.0%	70	19.7%	0.96
	Fisher folk	64,482	22.0%	53	14.9%	1.47
	Urban/peri-urban	26,379	9.0%	108	30.4%	0.30
West	Pastoral	182,117	76.0%	111	35.1%	2.16
	Agro-pastoral	38,340	16.0%	34	10.8%	1.49
	Fisher folk	—	0.0%	0	0.0%	—
	Urban/peri-urban	19,170	8.0%	171	54.1%	0.15
North	Pastoral	54,053	53.0%	63	43.8%	1.21
	Agro-pastoral	—	0.0%	0	0.0%	—
	Fisher folk	42,835	42.0%	35	24.3%	1.73
	Urban/peri-urban	5,099	5.0%	46	31.9%	0.16
South	Pastoral	169,512	58.0%	151	38.1%	1.52
	Agro-pastoral	99,369	34.0%	55	13.9%	2.45
	Fisher folk	—	0.0%	0	0.0%	—
	Urban/peri-urban	23,381	8.0%	190	48.0%	0.17

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ANNEX C. SUMMARY OF THE HOUSEHOLD LISTING EXERCISE

Indicator	Survey zone				Total (*N*)	Total (%)
	Central and Loima	North and Kibish	South and East	West		
Residential status						
Nonresidential	148	19	30	48	245	3.0
Residential	2,434	1,419	1,962	2,023	7,838	97.0
Number of villages listed	28	25	28	26	107	
Spare villages	3	0	3	1	7	
Replacement villages	0	0	3	2	5	
Dwelling status						
Occupied	1,650	1,183	1,669	1,520	6,022	81.9
Temporary absence	442	181	33	380	1,036	14.1
Vacant	124	55	29	46	254	3.5
Nonresidential	13	0	0	0	13	0.2
Other	16	0	5	3	24	0.3
Total					**7,349**	
Total number of households with at least one under-3 child						
No	660	450	693	451	2,254	37.5
Yes	984	732	976	1,069	3,761	62.5

ANNEX D. SOCIODEMOGRAPHIC CHARACTERISTICS OF ADOLESCENT AND YOUNG HOUSEHOLD HEADS, BY LIVELIHOOD ZONE

Characteristic	Livelihood zone				Overall (*N* = 139)
	Pastoral	Agro-pastoral	Fisher folk	Urban/peri-urban	
Sex of household head					
Male	35.3	54.3	68.8	40.6	43.4
Female	64.7	45.7	31.2	59.4	56.6
Household size					
< 4	13.9	61.6	14.1	43.2	24.5
4–6	60.1	31.2	69.8	46.8	55.5
7+	25.9	7.2	16.2	10.0	20.1
Religion					
Christian	96.6	100.0	100.0	98.9	97.9
Others	3.4	0.0	0.0	1.1	2.1
Level of education					
No education	94.8	72.5	57.7	34.1	80.4
Primary	4.0	14.5	42.3	25.9	12.9
Secondary+	1.2	13.0	0.0	39.9	6.6
Household head occupation					
Livestock herding	69.8	4.5	3.5	5.5	44.2
Crop farming	0.0	76.3	0.0	0.0	12.4
Employed/salaried	0.0	0.0	5.3	8.1	1.5
Petty trader	25.6	19.2	7.0	41.6	23.6
Merchant/trader	0.0	0.0	0.0	2.3	0.2
Self-employed	0.6	0.0	0.0	22.0	2.4
Fishing	0.0	0.0	65.1	0.0	8.7
Unemployed	4.0	0.0	19.1	20.6	7.0
Main source of household income					
No income	8.1	22.0	0.0	14.0	9.8
Sale of livestock	35.2	4.5	3.5	5.5	23.1
Sale of crops	0.0	11.4	0.0	0.0	1.8
Petty/merchant trade	56.8	39.3	32.9	66.9	51.7
Employment	0.0	0.0	5.3	10.3	1.7
Fishing	0.0	0.0	58.2	0.0	7.8
Other(s)	0.0	22.8	0.0	3.4	4.0

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