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UTILIZATION OF FAMILY-LED MID UPPER-ARM CIRCUMFERENCE SCREENING FOR EARLY DETECTION OF CHILD MALNUTRITION AMONG THE NOMADIC COMMUNITIES IN TURKANA SOUTH – KENYA

Esekon B^{1*}, Situma J¹ and R Shikuri¹



Benedicto Ekai Esekon

*Corresponding author email: benedictoesekon@gmail.com

¹Department of Nutritional Sciences, Masinde Muliro University of Science and Technology, Kakamega, Kenya



ABSTRACT

Malnutrition remains a critical public health challenge in Turkana South sub-County, Kenya. Children from nomadic pastoralist communities frequently present at health facilities with advanced stages of undernutrition. The Family-led Mid Upper-Arm Circumference (F-MUAC) screening approach has been promoted as a community-based strategy to enhance early detection and referral of malnutrition cases. However, evidence on its uptake and effectiveness in this context has remained limited. This study determined the utilization, coverage and key determinants of F-MUAC tape use among caregivers in Turkana South. A cross-sectional survey was conducted among 244 caregivers of children aged 6–59 months, with a 100% response rate. Most respondents were women (97.95%) most of whom were married (92.21%) and engaged in livestock rearing (26%) or petty trade (25%). Findings indicate that caregiver awareness of malnutrition was significantly associated with increased MUAC utilization (Odds Ratio [OR] = 6.05, $p < 0.001$). Approximately 70.49% of households reported screening their children within the two weeks prior to the survey, while 29.51% had not used the tape consistently. A small proportion (5.33%) expressed mistrust in the tool due to discrepancies between home and facility-based MUAC readings. Technical measurement errors were strongly linked to incorrect tape placement (OR = 203.85) and misalignment of the reading window (OR = 136.55) ($p < 0.001$), highlighting the need for improved caregiver training. While 74% of caregivers demonstrated good comprehension of MUAC interpretation, undernutrition prevalence remained high especially among children aged 6–24 months (19.5%) compared to those aged 25–59 months (15.2%). Improved F-MUAC utilization will support earlier detection and treatment of acute malnutrition, reduce child mortality, treatment costs and pressure on overstretched health facilities. Empowering caregivers with screening skills fosters community ownership of child health and strengthens resilience in fragile settings. The findings provide evidence to support scale-up of Family MUAC as a key component of community-based nutrition programming through strengthened caregiver training, timely facility confirmation of readings, sustained community engagement, adaptive support for pastoralist livelihoods and prioritization of children under two for routine screening.

Key words: Family MUAC, Turkana South, pastoralist communities, early detection, utilization

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INTRODUCTION

Turkana County in northwestern Kenya continues to grapple with alarmingly high levels of child malnutrition. According to the 2024 SMART survey, the Global Acute Malnutrition (GAM) rate stands at 26.8%, well above the World Health Organization's emergency threshold of 15% [1]. The situation is compounded by the county's predominantly nomadic pastoralist population, whose mobility, limited access to health infrastructure, and climate-vulnerable livelihoods pose significant barriers to timely health service delivery and early malnutrition detection [2]. This gap in operational data hinders the adaptation and scale-up of Family MUAC in high-risk pastoralist settings.

In literature materials, the Family MUAC approach has been referred differently using alternative terms such as Mother MUAC, Mother-led MUAC, Caregiver MUAC, Caregiver-led MUAC, Family-led MUAC or Household MUAC. While differing in reports by programs and studies, the approach remains the same to empower caregivers at the household level to use MUAC tapes for early detection of acute malnutrition. In line with UNICEF and global nutrition partners, this study adopts the term Family MUAC as the standard reference. Family MUAC (Mid Upper-Arm Circumference) is an innovative community-based approach that empowers caregivers, particularly mothers, to screen children aged 6–59 months for acute malnutrition using color-coded MUAC tapes. This method was pioneered by the Alliance for International Medical Action (ALIMA) in Niger, where over 12,000 caregivers were trained leading to over 70% of Community-based Management of Acute Malnutrition (CMAM) admissions being referred by mothers [3]. In Mauritania, World Vision scaled the approach in five regions training more than 8,500 mothers with support from multiple partners including Action Contre La Faim and Terre des Hommes [3]. Similar interventions in Chad and India also demonstrated significant gains in screening coverage, caregiver engagement and early detection [4,5].

Research from Première Urgence Internationale in Chad reported a rise in screening coverage from 79.6% (CHW-led) to 85.5% (mother-led) [4]. Moreover, evaluations in Kenya's Turkana County show that trained caregivers are capable of sustaining MUAC monitoring when supported through community health volunteers (CHVs). Households with regular CHV follow-ups were 4.5 times more likely to continue screening [6]. However, the nomadic lifestyle posed challenges such as follow-up loss due to seasonal migration [7].

Motivation of caregivers plays a central role in the sustainability of Family MUAC. In India, only 30% of mothers reported measuring their children seven months after training, with screening often stopping once the project support ended [8]. This highlights the need for effective caregiver engagement strategies to ensure long-



term adoption. Evidence indicates that when intrinsically motivated mothers are supported with simple and accessible approaches such as Family MUAC, they demonstrate higher participation and sustained engagement in child health programs contributing to improved nutrition outcomes [9].

Implementation studies further show that Family MUAC contributes to improve program outcomes. Children identified by mothers were admitted at higher rates (63.2%) compared to those screened by CHWs (50.3%), with better outpatient cure rates (95% vs. 91.5%). Mothers were also reported to be more cooperative with health staff and less likely to default [4].

Despite the documented successes, sustainability challenges remain. Community referral forms data revealed that MUAC usage by mothers declines without refresher training or support and only 35–40% of households in Chad and Mali possessed MUAC tapes [4]. In contrast, Indian studies highlighted the effectiveness of mobile health reminders and support groups which increased home use from 42% to 67% in 12 months and reduced severe acute malnutrition by 32% in children aged 6–24 months [5].

Overall, Family MUAC interventions have demonstrated potential for scaling, particularly when aligned with well-functioning community health strategies. Integration with Community Health Units (CHUs), regular follow-up, refresher training and community engagement through elders and CHVs enhance effectiveness and sustainability [6].

In terms of performance, mothers have demonstrated high accuracy in malnutrition classification, often comparable to CHWs. Studies from Niger and Senegal showed that over 90% of trained mothers could correctly identify malnutrition using MUAC tapes [7]. Caregivers' knowledge and skill retention depend heavily on training quality, frequency of use and contextual support [8,10]. Turkana South continues to face a high burden of acute malnutrition with children often presenting late to nutrition programs limiting treatment effectiveness. Recent surveys show worrying trends in both acute malnutrition and stunting with severe acute malnutrition (SAM) prevalence fluctuating between 7.4% and 4.7% in 2023 and stunting rising sharply from 23.0% to 27.8% within one year [1]. Most health facilities in Turkana south sub-county (17 out of 26) are operating at alarm or emergency levels of new admissions, signaling health system strain. These persistent challenges make Turkana South a critical setting for assessing community-based approaches like Family MUAC, aimed at improving early detection and reducing treatment delays. This study builds on global evidence by examining how Family MUAC has been utilized in Turkana South sub-County, Kenya, specifically focusing on caregivers' knowledge, accuracy,

utilization frequency and the contextual factors that affect uptake including socio-economic and demographic conditions.

MATERIALS AND METHODS

Study Design

A cross-sectional mixed-methods study was conducted between June and August 2024 in Turkana South, purposefully selected for its high global acute malnutrition rate (GAM). Three wards (Katilu, Kalapata, Lokichar) were selected for their differing mobility patterns and staggered exposure to Family MUAC interventions. The study focused on households with children aged 6–59 months who were residents of Turkana South and primarily pastoralist. Only households possessing a Family MUAC tape and whose caregivers consented to participate were included. Households without under-five children, without Family MUAC tapes or those that did not give consent, as well as those in insecure areas, were excluded.

Quantitative Component

The quantitative component involved 244 caregivers of children aged 6–59 months who had received Family MUAC training within the past year. Sample size was calculated using Fischer sample size formula $n = (z)^2 p (1 - p) / d^2$ with additional 5% of the sample to cover nonresponse rate. Simple random sampling was used. Structured questionnaires captured demographics, family MUAC knowledge, tape usage, screening frequency and health-seeking behavior. Enumerators observed participants performing MUAC measurements during data collection to assess accuracy.

Qualitative Component

The qualitative component comprised six focus group discussions (FGDs), each with 8–10 caregivers, stratified by livelihood activity and ward. Qualitative data were transcribed, translated and coded thematically.

Data Analysis

Quantitative data was entered into Statistical Package for the Social Sciences (SPSS) v28 and subjected to descriptive and inferential analysis. Descriptive statistics were conducted on the full sample to summarize socio-demographic characteristics, MUAC utilization, knowledge and screening accuracy. Logistic regression was used to identify predictors of MUAC screening and measurement accuracy. Multivariate logistic regression analyses were conducted on the complete dataset ($n = 244$), as all participants had valid and complete responses for the variables included in the models. Participants who identified all the three-, two- and one-color codes of family MUAC tape were categorized as having excellent, good or poor knowledge on family MUAC tape, respectively. Qualitative data were transcribed, translated, with specific themes identified.



Ethical Considerations

Approval was obtained from the Masinde Muliro university of science and technology (MMUST) Institutional Ethics and Review Committee (Ref No. MMU/COR: 509099) and NACOSTI (Ref No. 574395). Informed consent was obtained from all participants. Privacy and confidentiality were ensured.

RESULTS AND DISCUSSION

Factors Influencing Household Utilization of Family MUAC Tape

A total of 244 caregivers participated. Table 5 below shows Caregivers with knowledgeable of color code classification and use of family MUAC tape were 2.64 times more likely to use the MUAC tape than those who lacked knowledge on family MUAC use ($p = 0.006$). Caregivers with good knowledge of malnutrition signs were 6.05 times more likely to utilize the device ($p < 0.001$), this is in line with an increasing amount of evidence showing that training and knowledge of caregivers significantly increase MUAC uptake and early detection. Programmatic and research reports from Kenya, Niger, Ethiopia and other nations show improved caregiver screening performance and increased coverage after training or Family MUAC implementation [9,13,14]. Therefore, it means that direction and significance of relationship is generalizable to similar low-resource and pastoralist settings where supportive supervision accompanies training are.

Geographical disparities were evident in Table 6 as Kalapata ward significantly having higher utilization than Katilu ($OR = 2.82$, $p = 0.006$), likely due to intensified outreach. Pastoralist households in Lokichar had moderate uptake ($OR = 1.51$, $p = 0.214$). Challenges included seasonal migration, long travel distances and limited community health promoters (CHP) interaction.

“We walk for hours to reach the facility and when you get there, there are no drugs, or the health worker is not around.” (FGD, 2024)

Structural constraints, such as time shortages and livelihood commitments including herding and charcoal production, negatively influenced utilization. Economic activities often took priority over child screening, especially when malnutrition signs were not visible. Table 1 provides a view of participants' livelihoods and sources of income indicating that what always occupies participants is not necessarily what brings income to the household.

“When we go out for firewood at dawn and return at sunset, there's no time left to measure children.” (FGD, 2024)

These findings align with studies from South Africa, where caregivers deprioritized MUAC due to workload constraints and lack of institutional support [11]. Households



with income from petty trade relied heavily on public clinics (49.6%), while livestock-dependent households preferred CHPs (OR = 4.04, $p = 0.023$). Households with no income reported higher use of private clinics, suggesting crisis-driven care-seeking.

Confirmation of MUAC color at health facilities motivated continued use. Caregivers whose readings were confirmed were 11.02 times more likely to continue using the tape, increasing to 26.15 times with consistent confirmation ($p < 0.001$).

“When you take your child with a yellow or red MUAC...the health worker takes long to attend to you, then tells you the child is healthy. We ask ourselves why these two measurements do not agree.” (FGD, 2024)

These results underscore the need for coordinated training and messaging at both community and facility levels to reinforce caregiver confidence.

Coverage of Family MUAC

Overall coverage of Family MUAC was 71.49% as shown in Table 4, indicating that over two-thirds of caregivers screened their children in the two weeks preceding the survey. The uptake was relatively consistent across wards: Katilu (72.5%), Kalapata (71%) and Lokichar (71%). Logistic regression showed significantly higher coverage in Kalapata compared to Katilu ($p = 0.006$), likely to reflect targeted health-nutrition outreach programs.

“I don’t take MUAC measurements frequently because I’m busy...Just by looking at her, I can tell if she’s unwell.” (FGD, 2024)

These findings suggest high acceptance of the Family MUAC approach, with a section of caregivers still believing in maternal intuition. However, maintaining consistent coverage requires systematic reinforcement through outreach, supervision and refresher training, consistent with findings from South Sudan and Ethiopia where ongoing support improved household MUAC practice [9,14,16].

Actual Utilization of Family MUAC

Of the children screened, 15.16% were undernourished: 13.11% moderately acute malnourished (MAM) (yellow) and 2.05% severely acute malnourished (SAM) (red). Caregivers identifying MUAC color bands correctly, particularly green, were 2.1 times more likely to use the tape ($p = 0.011$). Misplacement of tape and poor viewing angles when taking family MUAC tape measurements significantly increased errors (OR = 203 and 137, $p < 0.001$), as shown in Table 7.

Referral patterns showed that 96 caregivers referred children through CHPs, while 46 caregivers sought direct referral to health facilities. These findings highlight the complementary role of community- and facility-based care in early detection of malnutrition.



“When you take your child with a yellow or red MUAC...the health worker takes long to attend to you, then tells you the child is healthy. We ask ourselves why these two measurements do not agree.” (FGD, 2024)

Knowledge of Mothers/Caregivers on MUAC Interpretation

Among 244 caregivers, 74% correctly identified all three MUAC color bands, 21% identified two bands, and 5% had fair knowledge, consistent with study findings by Blackwell et al. with different forms of malnutrition not well identified [11,12,13]. Knowledge levels were higher in remote wards (Katilu, Lokichar, Loperot) compared to wards along main roads (RCEA, Kalemngorok, Lochwaa), suggesting more intensive or targeted training in isolated areas.

“I know green means the child is fine, yellow means he is becoming weak, and red means the child is in danger must go to hospital immediately.” (Caregiver, Loperot FGD, 2024)

Caregivers identified 15.16% of children as undernourished, with majority falling within the 6–24-month age group (19.5%), confirming higher vulnerability at younger ages. This aligns with Morri’s study on child malnutrition in Kwale, who found higher malnutrition rates in children under two years in Kwale County, Kenya [18].

“Small babies under two years are the ones who fall sick quickly. They are the ones I measure most.” (Caregiver, Kalemngorok FGD, 2024)

Statistical analysis confirmed that caregiver knowledge was a significant enabler of Family MUAC utilization, consistent with scoping reviews in Mali and Chad showing that lack of knowledge is a key barrier to adoption [11,17].

CONCLUSION AND RECOMMENDATIONS FOR DEVELOPMENT

This study demonstrates that Family MUAC is a feasible and effective strategy for the early detection of acute malnutrition in Turkana South, with caregivers exhibiting high knowledge and substantial household-level utilization. The likelihood of consistent use was strongly associated with caregiver training, knowledge of malnutrition signs and confirmation of MUAC readings at health facilities. However, structural and livelihood-related challenges such as seasonal migration, long travel distances and competing economic activities were observed to limit routine screening. Coverage across nomadic communities was generally high, but sustaining this level of engagement requires ongoing reinforcement through community outreach, supervision and supportive health system linkages.

To enhance the effectiveness and sustainability of Family MUAC, several practical measures are recommended. First, caregiver training should be strengthened through regular refresher sessions that emphasize correct measurement



techniques, colour interpretation and early recognition of malnutrition. Practical demonstrations, peer-to-peer learning and supervision are critical to minimizing measurement errors and maintaining confidence in screening. Second, facility-community linkages need to be reinforced by ensuring that caregivers' MUAC readings are promptly confirmed at health facilities, with clear protocols to address any discrepancies between household and facility measurements. Third, continuous community engagement and outreach should be prioritized, especially in remote pastoralist settlements to sustain high coverage and acceptance. Integration of Family MUAC into broader child health and nutrition programs can further strengthen awareness and utilization. Fourth, structural barriers associated with pastoralist livelihoods should be addressed through flexible approaches such as mobile health teams during migration seasons and community-based support mechanisms that reduce caregiver burden. Finally, children under two years should be prioritized for screening given their increased vulnerability and caregivers should be encouraged to perform routine measurements even when malnutrition signs are not visibly apparent.

Implementing these strategies can enhance household-level MUAC utilization, improve early identification of malnutrition and facilitate timely referrals, ultimately contributing to better nutritional outcomes among children in Turkana South.

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Conflict of Interest

The authors declare no conflict of interest.

Author Contributions

Benedicto Esekoni: Conceptualization, Data Collection, Analysis, Manuscript Drafting
 DR. Jane Situma: Supervision, Review and Editing
 DR. Rose Shikuri: Field Coordination, Data Verification, Manuscript Review



Table 1: Household Characteristics: Primary Occupation and Primary Source of Income (n=244)

Primary Occupation n(% of row)	Petty Trade	Sale of Crops	Casual Labor	Sale of Livestock	Sale of Livestock Products	No Income	Other Sources	Total
Livestock Herding (n=64)	15 (23.4%)	8 (12.5%)	10 (15.6%)	18 (28.1%)	5 (7.8%)	5 (7.8%)	3 (4.7%)	64 (26.2%)
Petty Trade (n=63)	55 (87.3%)	2 (3.2%)	4 (6.3%)	0 (0.0%)	0 (0.0%)	2 (3.2%)	0 (0.0%)	63 (25.8%)
Charcoal/Firewood (n=54)	50 (92.6%)	0 (0.0%)	2 (3.7%)	0 (0.0%)	0 (0.0%)	2 (3.7%)	0 (0.0%)	54 (22.1%)
Own Farm Labour (n=28)	0 (0.0%)	20 (71.4%)	5 ((17.6%)	3 (10.7%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	28 (11.5%)
Wage Labour (Casual) (n=17)	1 (5.9%)	10 (58.8%)	3 (17.6%)	0 (0.0%)	0 (0.0%)	3 (17.6%)	0 (0.0%)	17 (7.0%)
Other Occupations (n=18)	0 (0.0%)	5 (27.8%)	0 (0.0%)	0 (0.0%)	1 (5.6%)	9 (50.0%)	3 (16.7%)	18 (7.4%)
Total (n=244)	121 (49.6%)	45 (18.4%)	24 (9.8%)	21 (8.6%)	6 (2.5%)	21 (8.6%)	6 (2.5%)	244 (100%)

*Note:

"Other Sources" includes Remittance, Permanent Job, and Others (specified)

"Other Occupations" includes Merchant/Trader, Employed (Salaried), and Others (specified)

Percentages are read by row (e.g., 23.4% of Livestock Herding households rely on Petty Trade as their primary income source)*



Table 2: Care-Seeking Behaviour by Primary Household Source of Income

Primary Source of Income	Public Clinic n (%)	Private Clinic n (%)	CHP n (%)	Traditional Healer n (%)	Total HHs n (% of sample)	Odds Ratio (OR)	95% CI	p-value
Petty trade (e.g., firewood)	64(52.9%)	3 (2.5%)	49 (40.5%)	5 (4.1%)	121(49.6%)		Reference	-
Sale of crops	34(75.6%)	2 (4.4%)	9 (20.0%)	0 (0.0%)	45 (18.4%)	-	-	-
Casual labor (wage)	18(75.0%)	0 (0.0%)	4 (16.7%)	2 (8.3%)	24 (9.8%)		-	-
No income	11(52.4%)	4 (19.0%)	6 (28.6%)	0 (0.0%)	21 (8.6%)		-	-
Sale of livestock	4 (26.7%)	0 (0.0%)	11 (73.3%)	0 (0.0%)	15 (6.1%)	4.04	1.22–13.42	0.023
Other (e.g., remittance)	5 (62.5%)	0 (0.0%)	2 (25.0%)	1 (12.5%)	8 (3.3%)	-	-	-
Sale of livestock products	1 (16.7%)	0 (0.0%)	5 (83.3%)	0 (0.0%)	6 (2.5%)	7.35	0.83–64.83	0.073
Permanent job	3 (75.0%)	0 (0.0%)	1 (25.0%)	0 (0.0%)	4 (1.6%)	-	-	-
Total	140(57.4%)	9 (3.7%)	87 (35.7%)	8 (3.3%)	244 (100%)			



Table 3: Family MUAC color confirmation at Health Facility Vs Checking MUAC by the caregivers

	Coefficient B	Standard error	z	p	Odds Ratio	95% conf. interval
Constant	-0.96	0.33	2.95	.003	0.38	0.2 - 0.72
Colour confirmed (Yes)	2.4	0.38	6.33	<.001	11.02	5.24 - 23.17
Colour confirmed (Always Yes)	3.26	0.81	4.03	<.001	26.15	5.34 - 127.98
Color Not confirmed	-18.1	8372.44	0	.998	0	0 - Infinity

Table 4: Coverage of Family MUAC utilization across 3 administrative wards in Turkana south

Ward	BCoefficient B	Std. Error	z	p	Odds Ratio (OR)	95% CI for OR	% Yes (Checked MUAC)	% No	Total Respondents
Katilu (Ref)	-	-	-	-	1.00 (Ref)	-	72.5%	29.5%	102
Kalapata	1.04	0.38	2.74	0.006	2.82	(1.34 – 5.92)	71.0%	29.0%	69
Lokichar	0.41	0.33	1.24	0.214	1.51	(0.79 – 2.91)	71.0%	29.0%	71

Table 5: Family MUAC color identification, referral action and association with its utilization

MUAC Color Reported by Caregiver	Referral via CHP	Direct Referral to HF	Total Referrals	% Excellent Knowledge	Odds Ratio for Family MUAC Use	95% Confidence Interval	p-value
Green	96	46	142	80% (113/142)	2.1	1.2 – 3.9	0.011
Yellow	9	12	21	62% (13/21)	Reference	-	-
Red	4	1	5	100% (5/5)	(unstable)	0 – ∞	0.998
Can't remember	4	0	4	50% (2/4)	0.5	0.1 – 4.1	0.559
Total	113	59	172				

Table 6: Caregivers' Knowledge on family MUAC Color code Classification by Location (n = 244)

Location	Excellent n (%)	Good n (%)	Fair n (%)	Total
Lokichar (Lokichar + RCEA + Lochwaa)	61 (85.9%)	4 (5.6%)	6 (8.5%)	71
Katilu (Katilu + Kalemngorok + Lokapel)	59 (57.3%)	42 (40.8%)	2 (1.9%)	103
Loperot	60 (87.0%)	6 (8.7%)	3 (4.3%)	69
Total	180 (73.8%)	52 (21.3%)	12 (4.9%)	244

Table 7: Logistic Regression Results on Knowledge and Accuracy of Family MUAC Use

Predictor	B	Std. Error	z	p	Odds Ratio (Exp(B))	95% CI
Constant (Model 1)	-1.32	0.18	7.53	<.001	0.27	0.19 – 0.38
Mother is aware of Malnutrition (No)	1.80	0.35	5.18	<.001	6.05	3.06 – 11.96
Constant (Model 2)	-5.67	1.08	5.27	<.001	0.00	0 – 0.03
Incorrect MUAC placement on arm	5.32	1.10	4.84	<.001	203.85	23.72 – 1752.12
Incorrect reading window at eye view	4.92	1.09	4.53	<.001	136.55	16.26 – 1147.14

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