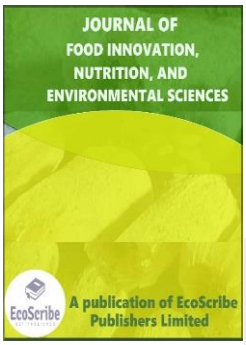
Journal of Food Innovation, Nutrition, and Environmental Sciences
February 2025; 2(1): 63-70
ISSN No:3078-5537



ORIGINAL ARTICLE

Caregivers' Ability to Assess for Wasting Status of Their Under Five Children: A Cross Sectional Study at Mwanamugimu Nutrition Unit, Mulago National Referral Hospital, Kampala, Uganda

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DOI: https://doi.org/10.70851/jfines.2025.2(1).63.70

ABSTRACT

Wasting, a form of malnutrition, continues to be a major childhood health challenge affecting over 50 million children annually. It remains more pronounced in the middle- and low-income countries and continues to pose a great threat to child survival; approximately 800,000 deaths due to wasting worldwide per year. Caregivers may play key roles in early identification and referral of wasted children for care. This study aimed to assess caregivers' ability to measure wasting status of their children aged 6-59 months. A cross sectional study was conducted in September 2022; included caregivers of children 6-59 months while children with cerebral palsy, critical illness and bilateral oedema were excluded; 73 participants were enrolled, oriented on importance and use of Mid Upper Arm Circumference (MUAC), interviewed using pre-coded questionnaire and observational checklist. Reference MUAC measurements were conducted for respective children by a nutritionist. MS Excel 2018 and STATA 15 were used to analyze data. It was observed that caregivers could measure and categorize wasting status of their children using MUAC if supported. Overall, 72 (98.6%) of participants were able to measure MUAC and categorize the wasting status of their children with high sensitivity (100%, 97.5 Positive Predictive Value) and specificity (97.1% 100% Negative Predictive Value). High level of agreement was observed between participant's and Nutritionist's measurement and categorization of MUAC (k = 0.82).

Article history
Received;
11 December 2024
Revised;
20 February 2025
Accepted;
22 February 2025

Keywords
Childhood wasting, MUAC Measurement, Caregivers, Children aged 6-59 months

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Peer review under responsibility of Journal of Food Innovations, Nutrition, and Environmental Sciences.

A Publication of EcoScribe Publishers company Limited, Uganda.

1. Introduction

Childhood wasting is one of biggest global challenges, a major cause and risk factor for diseases among children worldwide (Wali et al., 2021). Child wasting refers to a child who is thin for his/her height, caused by recent weight loss or failure to gain weight due to illness and/or inadequate food intake (UNICEF, 2023). Children who are thin for their weight are more susceptible to diseases, developmental delays with long term untoward effect on their educational attainment and low productivity(de Pee et al., 2015; Mertens et al., 2023). If wasting is not treated promptly and adequately, it may lead to morbidity and death (Laillou et al., 2020). Globally, 7.5% (50million) of children under five years of age are wasted, of these 32% (16 million) are severely wasted and this cause approximately 800,000 deaths annually (Ray & Suri, 2021).

More than three quarters of wasted children live in Asia while 22 percent are from Africa (UNICEF, 2023). Childhood wasting is higher in middle income countries (82%) and lower in higher income countries (1%), while 17% are in lower income countries (WHO/UNICEF/WB, 2020). Childhood wasting is likely to remain above predicted target of less than 5% in lower middle income countries by 2025 (Hawkes et al., 2020). Poor access to timely health care, inadequate complementary feeding and poor breastfeeding practices, unclean environment and consumption of unsafe water are some of the causes of wasting among children (WHO, 2021).

The World Health Assembly developed a plan to improve wasting by reducing and/or maintaining levels of childhood wasting below 5% by 2025 (Ancira-Moreno & Hernández-Cordero, 2024). The progress made towards achieving this target is slow among many countries (Di Cesare et al., 2021). Although Uganda has maintained childhood wasting to less than 5%, the situation is different in the urban settings based on Uganda Demographic Health Survey (UDHS), 2022. Kampala the capital city of Uganda registered increased wasting rates from 3.9% to 5.4% (Muyonga, 2022; Ogenrwoth et al., 2022). Mwanamugimu Nutrition Unit (MNU) alone admitted 343 wasted children to Outpatient Therapeutic Care (MNU, FY 2020/2021), this upward trend is unacceptable, and represents poor performance against the standard target (Boulebatt et al., 2023), and is attributed to weak community structure that is inadequately encompassing. Efforts to reduce levels of childhood wasting in Uganda have primarily focused on facility-based management and community-based interventions through village health teams, while neglecting caregivers, who are important community resource personnel at no monetary cost, despite being recommended in integrated management of acute malnutrition as a family MUAC approach (Sheila Isanaka et al., 2020). Caregivers play a key role in management of acute malnutrition by identifying and referring malnourished children early to appropriate nutrition programs through family MUAC approach(Majiwa et al., 2024). Family Mid-Upper Arm Circumference (MUAC) approach involves training and supporting caregivers to regularly screen their children for wasting status using color coded MUAC tape(Majiwa et al., 2024). Although the approach has shown to improve timely detection of wasting in children compared to using only the village health teams in other countries(Alé et al., 2016), there is paucity of evidence-based knowledge to inform policy and programming on the ability of caregivers to use colored coded MUAC tape to measure and categorize wasting status of their children aged of 6- 59 months in Uganda. Also, the information given to caregivers of malnourished children is inadequate and hence continuity of nutrition care after discharge is compromised (Gagnon-Dufresne et al., 2021).

2. Materials and methods

2.1 Study design and setting

A hospital based cross-sectional study was conducted at Mwanamugimu Nutrition Unit (MNU), located at Mulago National Referral, Kampala. The unit offers inpatient therapeutic care (ITC) and outpatient therapeutic care services (OTC). Study participants were caregivers of children 6-59 months enrolled to OTC between August and September 2022. Exclusion criteria included children admitted with bilateral pitting oedema, cerebral palsy and severe illness/health complications.

2.2 Sample size and sampling techniques

Sample size was determined using Temel and Erdogan (2017a) formular used when the measurements belonging to two independent raters and the agreement coefficient between these raters is not known but the two raters' being in disagreement is possible (Temel & Erdogan, 2017b). Using a 77% probability of agreement from S. Isanaka et al. (2020), probability of disagreement = 0.23 and statistical power of 80%, β= 0.2. The total study participants were 73 caregivers of children 6 – 59 months old including for 7% non-response rate. This ensured that even with participant attrition, the study maintains adequate statistical power.

$$n = \frac{4x0.23(1-0.23)x1.96^2}{0.2^2}$$

$$n = 68$$

The study employed convenience sampling technique, because the population was small, the very reason why the study took on participants who were available at the time of the study, meeting the inclusion criteria and willing to participate in the research and data was collected at three different times to reduce selection bias.

2.3 Data collection instruments

Data was collected using MUAC tape and pre-coded questionnaire that was developed with reference to family MUAC approach in integrated management of acute malnutrition guidelines 2020, approved by Makerere School of

Public Health, pre-tested in similar setting and errors corrected. This included section on demographic characteristics, measurement and categorization of MUAC and checklist for steps taken in measurement of MUAC.

2.4 Data collection procedure

Eligible participants received a short orientation of 120 minutes on the definition, causes and consequences of malnutrition, the use of color coded MUAC tape to measure and categorize wasting status of their children, and why caregivers should be involved in screening for wasting status of their children (IMAM,2020; Community MIYCAN 2022). The training was facilitated by a nutritionist and research assistants, who were national trainers for family MUAC approach. Caregivers were counselled about the research, and those who were willing to participate, signed a consent form. The enrolled participants were interviewed using a pre-coded questionnaire, taken through a practical session on how to use the MUAC tapes to measure and categorize wasting status of children. The standard steps on measurement of MUAC by the caregivers as outline in IMAM (2020) were used. They were then allowed to measure their children under the observation of the research assistants. As a measure of reference, all the children were measured and categorized by the nutritionist. At the end of the exercise, participants were counselled on their performance and on the status of wasting of their children.

2.5 Statistical analysis

Data was double entered into excel sheet to check for any errors and imported to STATA 15 for further analysis. The proportion of caregivers who measured and categorized the nutrition status of their child aged 6-59 months using colour coded MUAC tape was divided by the total number of caregivers enrolled in the study. The ability of caregivers to measure and classify the nutrition status of their child aged 6-59 months using colour coded MUAC tape were compared with that of nutritionist and the degree of agreement determined using the kappa statistic. The nutrition status was categorised into three 'Normal', Moderate Acute Malnutrition (MAM) and Severe Acute Malnutrition (SAM) during analysis and sensitivity and specificity obtained. Sensitivity referred to the caregivers' ability to measure and classify a malnourished child as malnourished whereas specificity related to the caregivers' ability to measure and classify a normal child as normal and ≥80% sensitivity and ≥97% is high (Shreffler & Huecker, 2020).
Caregiver's measurement agreed with that of the health worker if it was within ± 4mm margin of error(Blackwell et al., 2015). Furthermore, the positive predictive value (the proportion of children with a positive assessment result who are truly malnourished) and negative predictive value (the proportion of children with a normal nutrition status from assessment and are truly not malnourished) of the caregivers was also determined.

To follow the standard steps in measurement of MUAC by the caregivers, the interviewer used an observational checklist consisting of 6 steps (IMAM guideline, 2020). This included: "Keep work at eye level," "Remove clothing covering arm," "Find approximate midpoint of child's arm," "Make sure arm is relaxed at child's side and wrap tape around arm," "Make sure tape is flat and not too tight or lose," "Read measurement number on MUAC strip accurately". These were measured as "yes" for caregivers who correctly carried out the mentioned step and "no" for caregivers who did not properly carry out the procedure.

2.6 Quality control

The research assistants were experienced and competent in quantitative research and were trained for 2 days on this research and measurement and categorization of MUAC tape, standard steps taken during measurements and the precautions to be observed to obtain the right measurements, and categorization of MUAC. A questionnaire was pre-tested on 30 caregivers as recommended by Pernegera et al, (2015) who had children with same characteristics in terms of age of their children and admitted on outpatient therapeutic care in the neighboring hospital to check for suitability. Modifications were made accordingly. A trained experienced nutritionist measured and categorized wasting status of the children that were taken as reference measurements. To reduce on chance of caregivers copying the reference values, the nutritionist was the last to take MUAC measurements of the children. The filled questionnaire was reviewed at the end of each interview to check for completeness before releasing study participants. The principal investigator held daily briefing with research assistants before and after data collection to identify challenges and make necessary adjustments.

3. Results and Discussion

3.1 Social economic demographic characteristics of care givers.

The study enrolled 73 caregivers, with the majority (76.6%) being biological mothers of the children. Most participants (75.3%) were married, and a significant proportion (83.6%) reported not having household help. In terms of education level, 41.1% of caregivers had completed primary education, while 42.5% had attended secondary school. The majority of employed participants (87.9%) were engaged in the informal sector. More than half (61.1%) of the children assessed in this study were male. These findings are summarized in Table 1.

3.2 Accuracy of Caregivers in Measuring and Categorizing Wasting Status

The majority (98.6%**,** n = 72) of caregivers were able to measure and classify their child's nutrition status using the color-coded MUAC tape. The agreement between caregiver and nutritionist

measurements was statistically significant (κ = 0.892, 95% CI: 0.792–0.977), indicating strong concordance.

Out of the 34 children classified as normal by the nutritionist, caregivers correctly classified 33 (97.1%) as normal, with one misclassification as MAM. Among the 16 children classified as MAM by the nutritionist, caregivers correctly identified 13 (81.3%), while one was misclassified as SAM and two as normal. Similarly, of the 23 children classified as SAM by the nutritionist, caregivers correctly identified 22 (95.7%), but three were misclassified as MAM (Table 2).

Despite these minor misclassifications, caregivers demonstrated high diagnostic accuracy in distinguishing between normal and malnourished children. The overall sensitivity of caregiver assessments was 100%, meaning that all malnourished children (MAM and SAM) were correctly identified as malnourished. The specificity was 97.1%, indicating that nearly all children classified as normal were indeed well-nourished.

Table 1: Socio-economic demographic characteristics of caregivers

Socio-economic Demographic characteristics	**Frequency**	**Percentage (%)**
Type of caregiver		
Biological caregiver	56	76.7
Non biological caregiver	17	23.3
Gender		
Male	4	5.5
Female	69	94.5
Marital status		
Single	18	24.7
Married	55	75.3
Education level		
No formal education	8	11
Primary	30	41.1
Secondary	31	42.5
Tertiary	4	5.5
Have a maid		
Yes	12	16.4
No	61	83.6
Employed		
Yes	34	46.6
No	39	53.4
Type of employment		
Formal employment	4	12.1
Informal employment	29	87.9

3.3 Performance of Caregivers in MUAC Measurement Steps

The study assessed caregivers' adherence to the six critical steps in MUAC measurement, as outlined in the Integrated Management of Acute Malnutrition (IMAM) guidelines. The majority of caregivers (>80%) performed each step correctly, except for ensuring that the tape was neither too tight nor too loose, which was correctly executed by only 76.7% of participants (Table 3)**.** This finding suggests that additional emphasis is required on proper tape placement during training.

3.4 Sensitivity and Specificity of Caregivers' MUAC Measurements

Caregivers exhibited high diagnostic accuracy in classifying the malnutrition status of their children. The sensitivity of caregiver measurements was 100%, indicating that all malnourished children were correctly identified as malnourished. The specificity was 97.1%, meaning that nearly all children classified as normal were indeed not malnourished. Furthermore, the positive predictive value (PPV) was 97.5%, indicating that nearly all children identified as malnourished by caregivers were truly malnourished, while the negative predictive value (NPV) was 100%, confirming that all children categorized as normal were indeed well-nourished (Table 4).

Discussion

The study was carried out to assess caregivers' ability to measure wasting status of their children (6-59 months) at MNU, Mulago hospital, Kampala Uganda. In this study, caregiver's ability to correctly measure and categorize the wasting status (wasting status was collapsed or classified into normal and malnourished (MAM and SAM)) of their children is the dependent variable. A caregiver was said to have the ability if his/her measurement agreed with that of the nutritionist within ± 4mm margin of error(Blackwell et al., 2015). While independent variables included demographic variables, (Age, sex and marital status) Socio-economic variables, (Education level, and occupation), and Structural Variables (Knowledge about malnutrition).

A comparison between caregivers' mid-upper arm circumference measurements and classification of wasting status and that of the nutritionist, was conducted to determine sensitivity, specificity, and the degree of agreement within a ±4mm margin of error. The study revealed a very high level of agreement between caregivers and the nutritionist in terms of wasting status measurement and classification, with a kappa coefficient of 0.892. Overall, 72 (98.6%) caregivers successfully measured and classified their children's wasting status as either normal or malnourished using color-coded MUAC tapes, achieving an exceptionally high sensitivity of 100% and specificity of 97%. This compares to a study conducted in two villages in Niger, which reported sensitivity >90% and specificity >80% among caregivers (Chitekwe et al., 2018). A similar study in Isiolo County, Kenya, which compared the performance of mothers using simplified mid-upper arm circumference classification devices with an improved MUAC insertion tape, indicated that mothers were able to measure their children's MUAC with high sensitivity (90%) for both devices (Grant et al., 2018).

Additionally, this study showed a positive predictive value of 97.5%, meaning that for every 100 children a caregiver classified as malnourished, 97.5% were truly malnourished. Furthermore, 100% of those classified as normal were indeed not malnourished. The level of agreement was nearly high (k = 0.892), compared to a moderate level of agreement (k = 0.77) observed in a similar study between caregivers and nurses in Niger (Sheila Isanaka et al., 2020). Furthermore, the results are comparable to a similar study in Niger by Blackwell et al. (2015) where mothers reported to have had a sensitivity and specificity for classification of their children's wasting status of > 90% and > 80% respectively for global acute malnutrition and > 73% and > 98% for severe acute malnutrition. The observed differences in results could be attributed to variations in the literacy levels of the study participants. This study, in contrast to previous ones, mainly involved caregivers who were able to read and write. This likely facilitated their ability to absorb and apply the skills and knowledge needed to use the MUAC tape effectively. Furthermore, the caregivers in this study had observed health workers using MUAC tapes on their children during their stay at the MNU, which sparked their interest in learning how to use the MUAC tape, and increased their understanding and application of the technique, leading to more accurate measurements and classifications compared to the community-based study in Niger(Bliss et al., 2018). The majority, 72 (98.6%), of the caregivers were able to correctly follow all the steps involved in MUAC measurement, indicating that caregivers can assess and classify their children's wasting status using color-coded MUAC tapes when provided with proper training, this is similar to findings in the systematic review that was conducted to summarize the evidence and evaluate the use of family led MUAC approach of screening children for malnutrition in Africa(Majiwa et al., 2024). However, ensuring that the MUAC tape was flat and neither too tight nor too loose on the arm was the most challenging step. Despite this, over half (56, 76.7%) of the caregivers were able to perform it correctly. This could be an area to emphasize during training sessions on measuring and classifying wasting status using color-coded MUAC tapes.

This highlights the potential for caregivers to assess their children's wasting status and detect acute malnutrition using color-coded MUAC tapes, concurring with the results of a systematic review on the operational use of MUAC for detecting wasting among children aged 6-59 months by caregivers and community health workers, and with a review of evidence of family MUAC (Bliss et al., 2018; Buttarelli et al., 2021). Both reviews indicated that caregivers can use MUAC to detect wasting with minimal risk and significant benefits for early case detection when trained, this similar to the report of a randomized controlled trial in Kenya, that when caregivers are trained can

screen or monitor the wasting status of their children at home can prevent wasting(Tickell et al., 2023).

Table 2: Comparison Between Caregivers' and Nutritionists' Measurements of Children's Nutritional Status Using MUAC (n=73)

		Nutritionist's measurement and classification of nutrition status of the children		
		Normal	**MAM**	**SAM**
Caregivers' measurement and classification of nutrition status	**Normal**	33(97.1%)	0(0%)	0(0%)
	MAM	1(2.9%)	13(81.3%)	1(4.3%)
	SAM	0(0%)	3(18.8%)	22(95.7%)

The observed agreement between caregivers and nutritionists resulted in high sensitivity (100%) and specificity (97.1%) for detecting malnutrition.

Table 3: Performance of Caregivers in MUAC Measurement Steps

MUAC measurement steps	**Yes**	**No**
Keep work at the eye level	70(95.9)	3(4.1)
Remove clothing covering arm	71(97.3)	2(2.7)
Find approximate midpoint of child's arm	60(82.2)	13(17.8)
Make sure arm is relaxed at child's side and wrap around arm	59(80.8)	14(19.2)
Make sure tape is flat and not too tight or loose	56(76.7)	17(23.3)
Read measurement number on MUAC strip accurately	63(86.3)	10(13.7)

Table 4: Sensitivity, Specificity, PPV, and NPV of Caregivers' MUAC Measurements

		Nutritionist's assessment of the nutrition status of children	
		Normal	**Malnourished**
Caregiver's assessment of the nutrition status of their children	Normal	33(97.1%)	0(0%)
	Malnourished	1(2.9%)	39(100%)

Study limitations

This study was conducted in Kampala, an urban setting; therefore, the findings may not reflect the ability of rural caregivers to measure and categorize the wasting nutritional status of their children using color coded MUAC tape.

As a hospital-based study, the results may not fully represent the community, as the ability of caregivers to measure and categorize the wasting status of their children may be influenced by factors such as experience with malnutrition, and the hospital environment; seeing health workers take MUAC measurement. The study did not look at the ability of caregivers to apply the acquired knowledge and skills after a certain period, this would indicate if caregivers can continuously monitor the mind upper arm circumference of their children for a long period. The study only assessed the ability to apply knowledge and skills immediately after the orientation.

Conclusion

The study showed that caregivers can accurately measure and categorize the wasting status of their children aged 6-59 months using color coded MUAC tape with high level of accuracy. Further studies at community level, in rural areas using a more robust study method and study caregivers for a long period time to understand if care givers can continuously monitor the wasting status of their children.

Acknowledgments

The authors would like to acknowledge the MNU team, the Research Assistants; (Glady Nakasinde, Mukalazi Ronald, Ritah Ochoko) for their support during the data collection.

Conflict of interest

The authors declare that there is no conflicts of interest.

Ethical approval statement

Ethics Statement: This study was approved by Makerere University School of Public Research and Ethics Committee 074 as well as Mulago Hospital Research and Ethics Committee and acceptance MHREC2342 and from head, MNU allowing to conduct the study at this unit. Written consent was obtained and signed by the participants. and the data was collected through interviews. Participants were offered the opportunity to opt out at any time during the study to ensure the anonymity of the participants. They were free to withdraw without at any time of the study.

Data availability

Data for this study is available on request

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