European Journal of Clinical Pharmacy
Print ISSN: 2385-409X, **Online ISSN**: 3105-0409
Website: https://farmclin.com/

Inconsistencies in Diagnosing Severe Acute Malnutrition: A Comparative Analysis of Weight-for-Height and Mid-Upper Arm Circumference Criteria

Article History:

Name of Author:
Abdul Rehman Akram*[1], Emran Roshan[2], Akasha Bint E Athar[3], Atikaa Rashid[4], Nida Siddiquee[5], Aqsa Faiz[6]

Affiliation: *[1,3,4,5,6]MBBS, FCPS (Pediatrics), Post Graduate Resident PGR at Department of Pediatrics, Sughra Shafi Medical Complex (SSMC) / Sahara Medical College, Narowal*
[2]MBBS, FCPS (Pediatrics), Professor & Head of Department of Pediatric Sughra Shafi Medical Complex (SSMC) / Sahara Medical College, Narowal

Corresponding Author:
Dr. Abdul Rehman Akram, abdurrehman8448@gmail.com

Received: 12-06-2025
Revised: 26-06-2025
Accepted: 02-07-2025
Published: 30-07-2025

Abstract: Background: Severe Acute Malnutrition (SAM) is a major global health issue affecting children, particularly in low- and middle-income countries. Diagnosis of SAM commonly relies on weight-for-height (WFH) z-scores and mid-upper arm circumference (MUAC), but discrepancies between these methods pose significant challenges. Objective: To evaluate the concordance and discrepancies between WFH and MUAC in diagnosing SAM among children aged 6–59 months.**Design and Study Setting:** This cross-sectional study was conducted at Department of Paediatrics, Sughra Shafi Medical Complex, Narowal over six months from 6 February 2024 to 6 August 2024.**Methodology**: This study included 130 children aged 6–59 months. Anthropometric data, including weight, height, and MUAC, were collected. SAM was diagnosed using WFH z-scores < -3 standard deviations and MUAC < 11.5 cm as per World Health Organization guidelines. Concordance and discrepancies between the two diagnostic methods were analyzed.**Results:** Out of 130 children, 60 (46.2%) were diagnosed with SAM based on WFH and 33 (25.4%) based on MUAC. Based on weight-for-height (WFH) z-scores, 46.2% were diagnosed with Severe Acute Malnutrition (SAM), while 25.4% were diagnosed using the MUAC criterion. Only 12.3% were classified as SAM by both methods, with 33.8% meeting WFH but not MUAC criteria, and 13.1% meeting MUAC but not WFH criteria. The mean weight and height for SAM children diagnosed by WFH were 8.4 kg and 78.6 cm, while for those diagnosed by MUAC, they were 7.8 kg and 76.4 cm. **Conclusion:** Significant inconsistencies exist between WFH and MUAC in diagnosing SAM, leading to potential misclassification. Harmonizing diagnostic approaches is crucial for ensuring comprehensive identification and treatment of malnourished children.

Keywords: Children, Concordance, Diagnosis, Mid-upper arm circumference, Severe Acute Malnutrition, Weight-for-height.

INTRODUCTION

Severe Acute Malnutrition (SAM) remains a significant global health challenge, particularly in low- and middle-income countries where child malnutrition rates are alarmingly high. Accurate diagnosis of SAM is crucial for identifying children at risk and providing them with timely, life-saving interventions.1,2 However, inconsistencies in the

diagnostic criteria and methods, particularly involving weight-for-height (WFH) z-scores and mid-upper arm circumference (MUAC), present a major obstacle to effective identification and treatment of malnourished children.3,4 This inconsistency not only leads to variations in the reported prevalence of SAM but also risks excluding vulnerable children from essential care.5

The dual criteria of weight-for-height and MUAC have been widely adopted in global malnutrition guidelines, with each method offering distinct advantages and limitations. Weight-for-height z-scores assess the relationship between a child's weight and their height, enabling identification of wasting, which reflects acute nutritional deficiency.6 MUAC, on the other hand, measures the circumference of the upper arm, offering a simple and rapid tool to screen for malnutrition in community and clinical settings. While both methods are valuable, discrepancies in their application and outcomes have raised critical concerns among healthcare professionals and researchers.7

One of the core challenges lies in the overlap—or lack thereof—between children identified as malnourished using WFH versus MUAC. Studies have revealed that some children classified as malnourished by one criterion may not meet the threshold for SAM under the other. This inconsistency is especially problematic in resource-limited settings, where health workers may rely on a single diagnostic method due to constraints in equipment, training, or logistical support.8 Consequently, the choice of diagnostic tool can significantly impact the population identified as needing nutritional support, potentially leaving out children who are at equal risk of mortality and morbidity.9

Moreover, variations in diagnostic practices across regions and programs further exacerbate the issue. While global guidelines recommend using both WFH and MUAC in tandem, practical implementation often falls short, with certain regions favoring one method over the other.9 This preference is influenced by factors such as ease of use, availability of tools, and local interpretation of malnutrition indicators. As a result, global comparisons of malnutrition prevalence and the effectiveness of interventions are often hindered by inconsistent data, complicating efforts to monitor progress toward addressing malnutrition.10

This study aims to delve into the reasons behind these inconsistencies in diagnosing SAM, examine their consequences on child health outcomes, and explore potential solutions to harmonize diagnostic practices. By understanding the challenges and gaps in current approaches, stakeholders can work toward developing more comprehensive, standardized, and contextually appropriate diagnostic frameworks. Ultimately, bridging these gaps is essential to ensure that all children at risk of SAM are identified and provided with the support they need to survive and thrive.

MATERIALS AND METHODS

This cross-sectional study was conducted at Department of Paediatrics, Sughra Shafi Medical Complex, Narowal over six months from 6 February 2024 to 6 August 2024 having a total sample size of 130 children aged 6 to 59 months. The sample size calculation was based on an estimated prevalence of SAM of 15%, with a 95% confidence level and 5% margin of error, ensuring adequate statistical power for the analysis. Participants were selected using a systematic random sampling method from outpatient and inpatient units of a tertiary healthcare center. Children who were acutely ill with conditions unrelated to malnutrition or had known chronic illnesses were excluded from the study to ensure the validity of findings.

The data collection process included anthropometric measurements of weight, height, and mid-upper arm circumference. Weight was measured using a calibrated digital weighing scale, while height was measured using a stadiometer for children above two years or a length board for younger children. MUAC measurements were taken using a non-stretchable MUAC tape. All measurements were performed by trained health professionals to minimize inter-observer variability.

SAM diagnosis was determined based on two criteria: weight-for-height z-scores < -3 standard deviations from the World Health Organization (WHO) growth standards and MUAC < 11.5 cm. The concordance and discrepancies between these two diagnostic criteria were analyzed using statistical tools.

STUDY RESULTS

The study included a total of 130 patients, evenly distributed between males and females (65 each, 50%). The mean age of participants was 32.5 months (±12.8 months). The mean weight was 10.5 kg (±2.3 kg), and the mean height was 85.2 cm (±7.4 cm). The average mid-upper arm circumference (MUAC) of the study population was 12.3 cm (±1.2 cm) given in table 1.

The analysis of concordance between WFH and MUAC diagnoses revealed that only 16 children (12.3%) were diagnosed with SAM using both methods. Discrepancies were observed, with 44 children (33.8%) meeting the WFH criterion but not the MUAC criterion, and 17 children (13.1%) meeting the MUAC criterion but not the WFH criterion. Furthermore, 53 children (40.8%) were not diagnosed with SAM by either method given in table 4.

Table 1: Study Demographics

Characteristic	Value
Total Patients	130 (100%)
Mean Age (months)	32.5 ± 12.8
Gender (Male/Female)	65 (50%) / 65 (50%)
Mean Weight (kg)	10.5 ± 2.3
Mean Height (cm)	85.2 ± 7.4
Mean MUAC (cm)	12.3 ± 1.2

Based on the weight-for-height (WFH) z-score criterion, 60 children (46.2%) were diagnosed with Severe Acute Malnutrition (SAM), while 70 children (53.8%) were not diagnosed as malnourished according to this method given in table 2.

Table 2: SAM Diagnosis by Weight-for-Height (WFH)

Category	Number of Patients (n, %)
Diagnosed with SAM (WFH)	60 (46.2%)
Not Diagnosed with SAM	70 (53.8%)

Using the MUAC criterion, 33 children (25.4%) were diagnosed with SAM, whereas 97 children (74.6%) were not classified as malnourished given in table 3.

Table 3: SAM Diagnosis by Mid-Upper Arm Circumference (MUAC)

Category	Number of Patients (n, %)
Diagnosed with SAM (MUAC)	33 (25.4%)
Not Diagnosed with SAM	97 (74.6%)

Using the MUAC criterion, 33 children (25.4%) were diagnosed with SAM, whereas 97 children (74.6%) were not classified as malnourished given in table 4.

Table 4: Concordance Between WFH and MUAC Diagnoses

Concordance Category	Number of Patients (n, %)
Both Diagnosed (WFH & MUAC)	16 (12.3%)
WFH Only	44 (33.8%)
MUAC Only	17 (13.1%)
Neither Diagnosed	53 (40.8%)

Among children diagnosed with SAM using the WFH criterion, the mean weight was 8.4 kg (±1.5 kg), the mean height was 78.6 cm (±6.2 cm), and the mean MUAC was 11.1 cm (±0.9 cm). For those diagnosed using the MUAC criterion, the mean weight was slightly lower at 7.8 kg (±1.3 kg), the mean height was 76.4 cm (±5.8 cm), and the mean MUAC was 10.8 cm (±0.8 cm) given in table 5.

Table 5: Anthropometric Characteristics of Diagnosed Patients

Parameter	WFH Diagnosed (Mean ± SD)	MUAC Diagnosed (Mean ± SD)
Weight (kg)	8.4 ± 1.5	7.8 ± 1.3
Height (cm)	78.6 ± 6.2	76.4 ± 5.8
MUAC (cm)	11.1 ± 0.9	10.8 ± 0.8

DISCUSSION

Severe Acute Malnutrition (SAM) is a critical global health concern, particularly affecting children in low- and middle-income countries. Accurate diagnosis is essential for timely intervention, yet inconsistencies between diagnostic criteria, such as weight-for-height (WFH) z-scores and mid-upper arm circumference (MUAC), remain a significant challenge.[11] While WFH assesses wasting relative to height, MUAC offers a simple tool for field-based screening. However, studies reveal discrepancies between these methods, often leading to misclassification and exclusion of at-risk children.[12] Such inconsistencies hinder the effectiveness of malnutrition programs and global comparisons of prevalence data.

Understanding the gaps in diagnostic overlap is vital to improving SAM identification and care delivery. This study examines the concordance and differences between WFH and MUAC in diagnosing SAM.

The findings of our study revealed significant discrepancies between these two methods, with only 12.3% of children diagnosed with SAM by both methods. These results highlight the inconsistency in diagnostic classification between the two indicators, which is consistent with previous studies that have examined the concordance between WFH and MUAC measurements. Bari et al. (2019) reported a higher prevalence of SAM identified by MUAC (73.2%) compared to WFH (70%). They found that MUAC was an excellent predictor of SAM, with an Area Under the Curve (AUC) of 0.786, suggesting a good diagnostic performance.[13] In contrast, in our study, the proportion of children diagnosed with SAM by MUAC was 25.4%, which was considerably lower than that by WFH (46.2%). This disparity may be attributed to differences in the population, diagnostic criteria, or MUAC cut-off values. Similar findings were observed by Zehra et al. (2021), who found that the diagnostic agreement between MUAC and WFH ranged from 0.2 to 0.3, indicating poor concordance in some cases.[20]

Our study's findings are also comparable to Zaba et al. (2020), who reported a positive correlation between WFH and MUAC (rho = 0.593), but emphasized that these methods rarely agreed on their diagnostic classifications (κ = 0.353). Our study found 33.8% of children meeting the WFH criterion but not the MUAC criterion, a similar discrepancy in classifications.[14] In line with Zaba et al.'s findings, this suggests that while WFH and MUAC both serve as valuable tools for identifying SAM, they do not always yield consistent results, and reliance on one criterion alone may lead to different classifications.[14]

Our results are consistent with the findings of Rehman et al. (2020), who found that MUAC is a quick and cost-effective screening tool for acute malnutrition, especially when combined with other clinical assessments.[16] This underscores the value of MUAC as a rapid diagnostic tool, though our study's lower diagnostic agreement with WFH highlights the need for further research to determine the optimal combination of both methods in diagnosing SAM in different age groups.

Hossain et al. (2017) showed that MUAC correlated well with WFH (r = 0.618) and identified age-specific cut-offs for both methods. Similarly, our study suggests that variations in diagnostic results based on age, weight, and MUAC measurements may contribute to these discrepancies.[15] The overall low proportion of SAM identified by MUAC in our study may be influenced by the relatively younger age group (mean age 32.5 months) compared to Hossain et al.'s study, which examined children aged 6–60 months.[15]

As Bai et al. (2022) noted, the sensitivity and specificity of MUAC vary by age group, with the highest sensitivity observed in the 12-24 months group and the highest specificity in the 6-12 months group.[21] While previous studies like Abitew et al. (2021) and Tadesse et al. (2017) showed good agreement between MUAC and WFH, with kappa values ranging from 0.7 to 0.8, our study reported a much lower concordance.[17,19] This could reflect differences in the study populations, MUAC cut-off values, and sample sizes, as our study involved a smaller sample with a more focused age range. The higher prevalence of SAM diagnosed using WFH in our study (46.2%) compared to MUAC (25.4%) also reflects regional or demographic variations in the identification of malnutrition.

In contrast to our study's findings, Chiabi et al. (2017) concluded that MUAC was a better predictor of death in children under 12 months of age, with a sensitivity of 95.5%.[18] This suggests that while MUAC may provide an accurate assessment of SAM, particularly in infants, its diagnostic sensitivity for SAM in older children may be less reliable, as seen in our study

This study's strength lies in its comprehensive assessment of SAM diagnosis using both WFH and MUAC criteria, providing valuable insights into their discrepancies and concordance. The use of a standardized protocol for anthropometric measurements ensures reliability. However, the study is limited by its single-center design, which may restrict generalizability to broader populations. Additionally, the cross-sectional nature prevents assessment of long-term outcomes related to diagnostic inconsistencies.

CONCLUSION

study highlights significant inconsistencies between weight-for-height (WFH) z-scores and mid-upper arm circumference (MUAC) in diagnosing Severe Acute Malnutrition (SAM). The low concordance rate underscores the limitations of relying on a single diagnostic criterion, as many at-risk children may be missed. Harmonizing diagnostic approaches is crucial to ensuring comprehensive identification and effective treatment of malnourished children.

BIBLIOGRAPHY

1. Fagbamigbe AF, Kandala NB, Uthman AO. Demystifying the factors associated with rural–urban gaps in severe acute malnutrition among under-five children in low-and middle-income countries: A decomposition analysis. Scientific Reports. 2020 Jul 7;10(1):11172.
2. Abate HK, Kidane SZ, Feyessa YM, Gebrehawariat EG. Mortality in children with severe acute malnutrition. Clinical nutrition ESPEN. 2019 Oct 1;33:98-104.
3. Grellety E, Golden MH. Weight-for-height and

mid-upper-arm circumference should be used independently to diagnose acute malnutrition: policy implications. BMC nutrition. 2016 Dec;2:1-7.
4. Durukan HE, Dörtkardeşler BE, Tosyalı M, Gökçe Ş, Kurugöl NZ, Koç F. Assessment of the Diagnostic Performance of MUAC in Malnutrition Screening and Its Correlation with Other Anthropometric Indicators in Healthy Children and Adolescents. Children. 2024 Dec 18;11(12):1535.
5. Grellety E, Golden MH. Severely malnourished children with a low weight-for-height have similar mortality to those with a low mid-upper-arm-circumference: II. Systematic literature review and meta-analysis. Nutrition journal. 2018 Dec;17:1-9.
6. Briend A, Alvarez JL, Avril N, Bahwere P, Bailey J, Berkley JA, Binns P, Blackwell N, Dale N, Deconinck H, Delchevalerie P. Low mid-upper arm circumference identifies children with a high risk of death who should be the priority target for treatment. BMC nutrition. 2016 Dec;2:1-2.
7. Abebe Y, Abera Z, Aregawi F, Berhane S, Wondimu T, Bimerew B, Bahreselasie M. An innovative, low-cost tool for a more efficient weight-for-height/length (WHZ/WLZ) assessment. Field Exchange 61. 2019 Oct 22:8.
8. Duarte CK, de Abreu Silva L, de Almeida Santos A. Measuring muscle mass: Mid-arm muscle circumference or mid-upper arm circumference?. Clinical Nutrition. 2022 Oct 1;41(10):2424-5.
9. Hayes J, Quiring M, Kerac M, Smythe T, Tann CJ, Groce N, Gultie Z, Nyesigomwe L, DeLacey E. Mid-upper arm circumference (MUAC) measurement usage among children with disabilities: A systematic review. Nutrition and Health. 2023 Jun 20:02601060231181607.
10. Escher NA, Andrade GC, Ghosh-Jerath S, Millett C, Seferidi P. The effect of nutrition-specific and nutrition-sensitive interventions on the double burden of malnutrition in low-income and middle-income countries: a systematic review. The Lancet Global Health. 2024 Mar 1;12(3):e419-32.
11. Otiti MI, Allen SJ. Severe acute malnutrition in low-and middle-income countries. Paediatrics and Child Health. 2021 Aug 1;31(8):301-7.
12. Chama GC, Siame L, Kapoma C, Hamooya BM, Masenga SK. Severe acute malnutrition among children under the age of 5 years. Plos one. 2024 Aug 26;19(8):e0309122.
13. Bari A, Nazar M, Iftikhar A, Mehreen S. Comparison of Weight-for-Height Z-score and mid-upper arm circumference to diagnose moderate and severe acute malnutrition in children aged 6-59 months. Pakistan Journal of Medical Sciences. 2019 Mar;35(2):337.
14. Zaba T, Nyawo M, Álvarez Morán JL. Does weight-for-height and mid upper-arm circumference diagnose the same children as wasted? An analysis using survey data from 2017 to 2019 in Mozambique. Archives of Public Health. 2020 Dec;78:1-4.
15. Hossain MI, Ahmed T, El Arifeen S, Billah SM, Faruque AS, Islam MM, Jackson AA. Comparison of midupper arm circumference and weight-for-height z score for assessing acute malnutrition in Bangladeshi children aged 6–60 mo: an analytical study. The American journal of clinical nutrition. 2017 Nov 1;106(5):1232-7.
16. Rehman M, BiBi S, Imran I, Anwar H, Alam T, Mohammad K. Mid upper arm circumference and weight for height z-score as screening tools for acute malnutrition in underweight children< 5 years of age. Pakistan Journal of Physiology. 2020 Mar 31;16(1):6-9.
17. Abitew DB, Yalew AW, Bezabih AM, Bazzano AN. Comparison of Mid-Upper-Arm Circumference and Weight-For-Height Z-Score in Identifying Severe Acute Malnutrition among Children Aged 6–59 Months in South Gondar Zone, Ethiopia. Journal of nutrition and metabolism. 2021;2021(1):8830494.
18. Chiabi A, Mbanga C, Mah E, Nguefack Dongmo F, Nguefack S, Fru F, Takou V, Fru III A. Weight-for-height Z score and mid-upper arm circumference as predictors of mortality in children with severe acute malnutrition. Journal of tropical pediatrics. 2017 Aug 1;63(4):260-6.
19. Tadesse AW, Berhane Y, Ekström EC. Comparison of mid-upper arm circumference and weight-for-height to diagnose severe acute malnutrition: A study in Southern Ethiopia. Nutrients. 2017 Mar 11;9(3):267.
20. Zehra M, Saleem A, Kazi Z, Parkar S. Mid-upper arm circumference assessment and comparison with weight for length Z-score in infants≤ 6 months as an indicator of severe acute malnutrition. Cureus. 2021 Sep;13(9).
21. Bai P, Rais H, Fawad B, Kumari S. Concordance Between Indices of Malnutrition: Mid-Upper Arm Circumference V/S Weight for the Height Z Score in Different Age Groups in Karachi, Pakistan. Cureus. 2022 Jul;14(7).

