Journal of Population Therapeutics & Clinical Pharmacology

RESEARCH ARTICLE
DOI: 10.53555/29ykts90

A COMPARISON BETWEEN MID UPPER ARM CIRCUMFERENCE AND WEIGHT FOR HEIGHT Z-SCORE FOR ASSESSMENT OF NUTRITIONAL STATUS IN CHILDREN 6 MONTHS TO 5-YEAR-OLD AGE GROUP.

Dr. Nisha Upadhyay[1*], Dr. Divya Gohel[2], Dr. Gaurav Desai[3], Dr. Chintan Upadhyay[4]

[1*]Professor (H.G.), Department of Pediatrics, GMERS Medical College, Gandhinagar, Gujarat,India
[2]DNB Resident, Department of Pediatrics, GMERS Medical College, Gandhinagar, Gujarat, India
[3]Associate Professor, Department of Community Medicine, GMERS Medical College, Gandhinagar, Gujarat, India
[4]Professor & Head of Obstetrics and Gynecology Department, Dr. N. D. Desai faculty of Medical Science and Research, Dharmsinh Desai University, Nadiad, Gujarat, India

***Corresponding Author:** Dr. Nisha Upadhyay
Email ID: drnishaupadhyay@gmail.com

ABSTRACT

Background: The World Health Organization (WHO) defines severe acute malnutrition (SAM) in children aged 6–60 months as weight-for-height below –3 standard deviations (severe wasting) of the reference population. The preference for using the weight-for-height Z-score (WHZ) over other anthropometric measures, such as weight-for-age (WAZ) or height-for-age (HAZ), is due to its ability to indicate both current nutritional status and, indirectly, past growth patterns through height measurement.

Objective: To compare MUAC and Z-SCORE for assessment of nutritional status in children 6 months to 5 years of age.

Materials and Methods: This hospital-based cross-sectional analytical study was conducted among 300 children at the tertiary care centre in Gujarat from November 2022 to May 2023. WHZ scoring was done and compared with MUAC.

Results: According to Z-score criteria, the prevalence of SAM was 8.7% and the prevalence of MAM was 20% in the present study. According to MUAC criteria, the prevalence of SAM was 6% and the prevalence of MAM was 16%. The Sensitivity and Specificity of the MUAC criteria for SAM patients were 42.3% and 97.4%, respectively. The Sensitivity and Specificity of the MUAC criteria for MAM patients were 35% and 88.7%, respectively.

Conclusion: With the use of the currently recommended WHO cut-off for MUAC, a considerable number of children would not have been identified as either severely or moderately malnourished compared to the number detected if the WHZ criteria had been used. A higher cut-off value is therefore recommended for screening acute malnutrition, thereby increasing sensitivity.

Keywords: Malnutrition, Mid upper arm circumference, Under five children, WHZ score.

INTRODUCTION

Malnutrition is responsible for nearly two-thirds of child deaths worldwide, either directly or through its contribution to illnesses such as diarrhoea, pneumonia, and measles in children under five years of age.[1] In Indian hospitals, children suffering from malnutrition have been reported to face up to a sixfold higher risk of death when affected by diarrhoeal disease or acute respiratory infections.[2,3] According to the National Family Health Survey (NFHS-5, 2019–21), around 19.3% of children below five years are wasted, while the prevalence of underweight and stunting continues to remain alarmingly high.[4]

The World Health Organization (WHO) defines severe acute malnutrition (SAM) in children aged 6–60 months as weight-for-height below –3 standard deviations (severe wasting) of the reference population. The preference for using the weight-for-height Z-score (WHZ) over other anthropometric measures, such as weight-for-age (WAZ) or height-for-age (HAZ), is due to its ability to indicate both current nutritional status and, indirectly, past growth patterns through height measurement.[5]

Evidence from a multi-district survey showed that WHZ identified 96% of global acute malnutrition (GAM) cases compared to 28.4% detected by mid-upper arm circumference (MUAC). For SAM, WHZ captured 95.1% of cases, while MUAC identified only 30%, with merely one-fourth of cases overlapping.[6] In Jabalpur district, malnutrition prevalence was found to be higher using WHZ (rural: 19.7%, urban: 18.9%) than MUAC (rural: 14.3%, urban: 14.4%), indicating that MUAC may underestimate cases at current cut-offs.[7] Similarly, a Gujarat hospital-based study suggested age-specific MUAC thresholds (e.g., <120 mm for 6–24 months, <135 mm for older children) to improve case detection.[8] A cross-sectional study in Vadodara reported only 40% overlap between SAM identified by WHZ and MUAC, but increasing the MUAC cut-off to 13.5 cm significantly improved sensitivity for both moderate and severe acute malnutrition, though specificity declined.[9]

These differences highlight that the choice of indicator affects the perceived severity of malnutrition in a population and, consequently, the scale of interventions required. If both WHZ and MUAC are used simultaneously, programme costs and workload may increase disproportionately, with limited added benefit in mortality reduction. On the contrary, relying on a single measure may fail to detect many at-risk children, thereby excluding them from treatment. [10] Therefore, this study aims to compare MUAC and Z-scores for assessing the nutritional status of children aged 6 months to 5 years.

MATERIALS AND METHODS

Study Setting

This hospital-based cross-sectional analytical study was conducted among 300 children at a tertiary care centre in Gujarat from November 2022 to May 2023. The hospital is a tertiary care centre catering to patients from diverse socio-economic backgrounds of Gandhinagar and neighboring districts.

Inclusion Criteria

- Children aged 6 months to 5 years admitted to the Paediatric Ward, PICU, or NRC during the study period were included.
- Children whose parents/guardians provided written informed consent.

Exclusion Criteria

- Children with congenital chest wall deformities, spinal deformities, skeletal or cartilage dysplasia.
- Children with chronic illnesses, malignancy, HIV infection, or other immunodeficiency disorders.

Data Collection and Methodology

Eligible children were enrolled consecutively during the study period. Demographic details and relevant clinical history were recorded in a pre-designed proforma. Nutritional assessment was conducted using standardized anthropometric methods in accordance with WHO guidelines (2006).

Anthropometric Measurements

Weight was measured using an electronic digital weighing scale to the nearest 0.005 kg. Length (for children <24 months) was measured in recumbent position using an infantometer, to the nearest 0.1 cm. Height (for children ≥24 months) was measured in the standing position using a stadiometer, to the nearest 0.1 cm. The mid-upper arm circumference (MUAC) was measured on the left arm at the midpoint between the acromion and olecranon using a non-stretchable measuring tape, and recorded to the nearest millimeter.

Nutritional Classification

Weight-for-Height Z-Score (WHZ): Calculated using WHO growth standards (2006).

Data Analysis

Data were entered into Microsoft Excel and analyzed using Epi Info CDC 7. Descriptive statistics, including mean, standard deviation, and percentages, were applied. Agreement between MUAC and WHZ in identifying malnutrition was assessed using sensitivity, specificity, and Cohen's kappa statistics. A p-value <0.05 was considered statistically significant.

RESULTS

Table 1: Socio-demographic Characteristics of study participants [N=300]

Parameter	**Number**	**%**
Age		
6 months to 2 years	183	61
2 years to 5 years	117	39
Gender		
Female	136	45.3
Male	164	54.7
Resident		
Rural	97	32.3
Urban	203	67.7
Socio-economic Class		
Upper	15	5
Upper Middle	35	11.7
Upper Lower	16	5.3
Lower Middle	55	18.3
Lower	179	59.7
Housing condition (n=86)		
Kachcha	40	46.5
Pakka	46	53.5

Table 1 and Figure 1 show that 61.0% & 39.0% of study participants belonged to the age groups 6 months to 2 years & 2 years to 5 years, respectively. Additionally, 45.3% & 54.7% of participants were male & female, respectively. Almost 32.3% & 67.7% study participants resided in rural & urban areas, respectively. Nearly 5%, 11.7%, 5.3%, 18.3%, and 59.7% of the study participants belonged to the Upper, Upper Middle, Upper Lower, Lower Middle, and Lower S-E classes, respectively. Around 46.5% & 53.5% of study participants lived in kachcha houses and pakka houses, respectively.

Table 2: Distribution of patients according to Z-score and MUAC [N=300]

Method	**SAM**	**MAM**	**Normal**
Z-Score	26 (8.7%)	60 (20.0%)	214 (71.3%)
MUAC	18 (6%)	48 (16%)	234 (78%)

Table 2 shows that 8.7% & 20% of study participants were classified as SAM & MAM children, respectively, according to Z-score criteria, and 6% & 16% of study participants were classified as SAM & MAM children, respectively, according to MUAC criteria.

Table 3: Comparison between Z-score & MUAC Criteria for SAM [N=300]

SAM by MUAC	SAM by Z-score		Total
	Yes	No	
Yes	11	7	18
No	15	267	282
Total	26	274	300

Table 3 shows that the sensitivity, specificity, PPV, and NPV of the MUAC criteria for the SAM patients were 42.3%, 97.4%, 61.1% & 94.6% respectively.

Table 4: Comparison between Z-score & MUAC Criteria for MAM [N=300]

SAM by MUAC	MAM by Z-score		Total
	Yes	No	
Yes	21	27	48
No	39	213	252
Total	60	240	300

Table 4 shows that the sensitivity, specificity, PPV, and NPV of the MUAC criteria for the MAM patients were 35%, 88.7%, 43.7% & 84.5% respectively.

DISCUSSION

Under-nutrition in children requires instant nutrition rehabilitation and medical attention as it can be a lethal condition if not timely diagnosed. Therefore, it is essential to identify these fragile and vulnerable children at the earliest opportunity to provide them with nutritional support.[11]

In the present study, the majority of patients (54.7%) were male, and the remaining 45.3% were female. Bari A et al.[12] also showed predominance of males (52.5%) over females (47.5%). No significant differences in the proportion of MAM and SAM cases were found across different genders when WHZ was used as an identification criterion. A similar finding was observed by Kumar P et al.[13]

The majority of patients were in the 6 months to 2 years age group (61%), and the remaining 39% were in the 2 to 5 years age group. In the study by Abitew DB et al.,[4] the mean age of the children in months was 23.2±9.7, and approximately half (49%) were in the 12–23-month age range, with 54% being male children. In Bari A et al.[12], the majority of children were in the 6-11 month age group (50.5%), followed by the 12-23 month age group (37.4%). A study from India by Sachdeva et al.15 showed that 24.5% were in the age range of 6–11 months, but a study published in Nutrients depicted more children in the age range of 36-59 months (50%). Shukla N et al.[16] observed that the highest number of children was found in the 25-36 month age group.

The majority of patients (67.7%) resided in urban areas, and the remaining 32.3% lived in rural areas. In patients from rural areas, the majority belonged to lower-middle and lower socio-economic classes. Patients belonging to the upper and upper-middle socio-economic classes were more prevalent among patients from urban areas. In Shukla N et al.,[16] comprising 41.8% children from rural area and 58.2% were from urban area; with regards to socio-economic status, in rural area, the majority (44.1%) of children belonged to class V according to modified BG Prasad's classification[17]; while in urban area, the majority belonged to class I-IV. In the present study, according to the W/H, the majority of the SAM patients (53.8%) were from rural areas. Similarly, in Shukla et al.16, the prevalence of severe malnutrition was higher in rural areas (6.2%) compared to urban areas (5.1%). Underlying determinant factors may include a lack of resources for food security, care, and health due to poverty.

According to the Z-score criteria, the prevalence of SAM was 8.7% and the prevalence of MAM was 20% in the present study. According to MUAC criteria, the prevalence of SAM was 6% and the prevalence of MAM was 16%. According to this study, the detection of malnutrition by W/H criteria is more effective than by MUAC. According to Shukla et al.,[16] the prevalence of malnutrition, as measured by W/H, is 38.6%, with 11.3% experiencing severe malnutrition. According to MUAC, the prevalence is 28.7%, with 7.9% having severe malnutrition.

In our study, The Sensitivity and Specificity of the MUAC criteria for SAM patients were 42.3% and 97.4%, respectively. The Sensitivity and Specificity of the MUAC criteria for MAM patients were 35% and 88.7%, respectively. In 2022, Lambebo A et al.[18] concluded that the sensitivity of MUAC is lower compared to specificity, and varies from area to area. A study done by Dukhi N et al.[19] found W/H to be a more sensitive measure. Bilukha O et al.[20] also found that the prevalence of wasting by WHZ exceeded that by MUAC in 74.1% of surveys, and the median prevalence by WHZ was greater in 73.17% of countries. Findings of this study are also consistent with the study done by Hossain M et al.[21] who observed that with the use of the currently recommended WHO cut-off for MUAC, a significant number of children would not have been identified as either severely or moderately malnourished compared with the number who would have been identified if the WHZ cut-off was used. Similarly, Dairo et al.22 observed that MUAC was a poorly sensitive indicator of undernutrition at a cut-off below 13.5 cm but highly sensitive at 15.5 cm. A higher cut-off value is therefore recommended for screening children for acute malnutrition. Experience from Goossens et al.23 suggests that, as an admission criterion for SAM, using a cut-off of 118 mm for MUAC is a valuable alternative to the WHZ.

CONCLUSION

MUAC has clear advantages for the screening of nutritional status in large numbers of children. MUAC is being used as a rapid diagnostic tool for the quick assessment and referral of malnourished children for nutritional rehabilitation. Our findings suggested that, with the use of the currently recommended WHO cut-off for MUAC, a considerable number of children would not have been identified as either severely or moderately malnourished compared to the number detected if the WHZ criteria had been used. A higher cut-off value is therefore recommended for screening acute malnutrition, thereby increasing sensitivity. In the Indian context, WHZ and/or MUAC criteria should be used together to identify all cases of acute malnutrition. WHZ score assessment training should be provided to nurses or anganwadi workers at peripheral and referring centres to detect all malnourished children.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

REFERENCES

1. The Child Health Epidemiology Reference Group: Definitive global childhood causes of death estimates released by CHERG. Not on track to meet Millennium Development Goal 4. 2012.
2. Behera SK, Mohapatra SS, Kar S, Das D, Panda C. Incidence and mortality of hospitalized diarrhea cases. Part III. Indian Pediatr. 1980;17:607-12.
3. Sehgal V, Sethi GR, Sachdev HP, Satyanarayana L. Predictors of mortality in subjects hospitalized with acute lower respiratory tract infections. Indian Pediatr. 1997;34:213-9.
4. National Family Health Survey (NFHS-5). rchiips.org. Archived from the original on 24 November 2021. Retrieved 19 August 2022.
5. World Health Organization: WHO Child Growth Standards and the Identification of Severe Acute Malnutrition in Infants and Children: A Joint Statement by the World Health Organization and the United Nations Children's Fund. Geneva: WHO. 2009.

6. Kumar P, Bijalwan V, Patil N, Daniel A, Sinha R, Dua R, et al. Comparison between Weight-for-Height Z-Score and Mid Upper Arm Circumference to Diagnose Children with Acute Malnutrition in five Districts in India. Indian J Community Med. 2018 Jul-Sep;43(3):190-194.
7. Shukla N, Toppo NA, Thakur A, Kasar PK, Sharma B.Mid-upper arm circumference versus weight for height Z-score for detecting malnutrition in children aged 06-59 months in rural and urban areas of Jabalpur district, Madhya Pradesh, India. Int J Community Med Public Health2020;7:1794-8.
8. MehtaN,BhattRG, VoraH, ParmarB.Comparison of midupperarm circumference and weight-for-height z score for assessing acute malnutrition in children aged6-60 months: an analytical study. Int J Contemp Pediatr 2019;6:522-6.
9. KananiSM, BharaniSN. A comparison of mid-upper arm circumference and weight-for-height z score of world health organization growth standards in detecting moderate and severe acute malnutrition in children aged 6-60 months. Int J Contemp Pediatr 2024;11:38-44.
10. Grellety E, Golden MH. Weight-for-height and mid-upper-arm circumference should be used independently to diagnose acute malnutrition: policy implications. BMC Nutr. 2016;2(1):10.
11. Bhan MK, Bhandari N, Bahl R. Management of the severely malnourished child: perspective from developing countries. BMJ. 2003 Jan 18;326(7381):146–151.
12. 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. Pak J Med Sci 2019 Mar-Apr;35(2)337-341.
13. Kumar P, Bijalwan V, Patil N, Daniel A, Sinha R, Dua R, Seth A. Comparison between Weight-for-Height Z-Score and Mid Upper Arm Circumference to Diagnose Children with Acute Malnutrition in five Districts in India. Indian J Community Med. 2018 Jul-Sep;43(3):190-194.
14. 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. J Nutr Metab 2021 May 5;20218830494.
15. Sachdeva S, Dewan P, Shah D, Kumar R, Malhotra RK, Gupta P. Mid-upper arm circumference v. weight-for-height Z-score for predicting mortality in hospitalized children under 5 years of age. Public Health Nutrit. 2016;19(14):2513-20.
16. Shukla N, Toppo NA, Thakur A, Kasar PK, Sharma B. Mid-upper arm circumference versus weight for height Z-score for detecting malnutrition in children aged 06-59 months in rural and urban areas of Jabalpur district, Madhya Pradesh, India. Int J Community Med Public Heal 2020;71794-8.
17. Shaikh Z, Pathak R. Revised Kuppuswamy and BG Prasad socio-economic scales for 2016. Int J Community Med Public Health. 2017;4(4):997-9.
18. Lambebo A, Mezemir Y, Tamiru D, Belachew T. Sensitivity and specificity of mid-upper arm circumference for assessment of severe acute malnutrition among children aged 6-59 months. Systematic review and meta-analysis. Nutrition. 2023 Mar:107:111918.
19. Dukhi N, Sartorius B, Taylor M. Mid-upper arm circumference (MUAC) performance versus weight for height in South African children (0–59 months) with acute malnutrition. South Af J Clin Nutr 2017;30(2)49-54
20. Bilukha O, Leidman E. Concordance between the estimates of wasting measured by weight-for-height and by mid-upper arm circumference for classification of severity of nutrition crisis: analysis of population-representative surveys from humanitarian setting. BMC Nutr 2018;4(1)24
21. Hossain M, Ahmed T, Arifeen S, Billah S, Faruque A, Islam M, et al. Comparison of midupper arm circumference and weight-for-height z score for assessing acute malnutrition in Bangladeshi children aged 6-60 month: an analytical study. Am J Clin Nutrit. 201.
22. Dairo MD, Fatokun ME, Kuti M. Reliability of the mid upper arm circumference for the assessment of wasting among children aged 12-59 months in urban Ibadan, Nigeria. Int J Biomed Sci. 2012;8:140-3.

23. Goossens S, Bekele Y, Yun O, Harczi G, Ouannes M, Shepherd S. Midupper arm circumference based nutrition programming: evidence for a new approach in regions with high burden of acute malnutrition. PLoS One. 2012;7:e49320.