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Original Research Article

Accuracy of Mid-Upper Arm Circumference (MUAC) to Detect Wasting in Children Aged 6-59 Months in Central India: A Cross-sectional Study

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Abstract

Background: Children with wasting need to be screened promptly and accurately in countries with a high prevalence of undernutrition. The World Health Organization recommends using WHZ and MUAC to identify children with acute malnutrition for treatment.

Aim: To compare WHZ and MUAC cut-offs to identify wasting among children aged 6–59 months.

Setting and design: A hospital based cross-sectional study among under-five children visiting Paediatric OPD at RIMS, Raipur Chhattisgarh from January 2022 to June 2022 was conducted.

Methods and Material: Children in the age group 6-59 months with consent of guardians collected sociodemographic data and anthropometric measurements. Anthropometric measurements were transformed into z-scores with the aid of WHO Anthropometric calculator software version 3.2.

Statistical Analysis: To compare the use of MUAC and WHZ to identify wasting, we used descriptive statistics and Kappa statistics to compare the use of MUAC and WHZ to identify wasting. SPSS was used for data analysis.

Results: The prevalence of severe wasting was 3.4% and 10.5% using MUAC and WHZ, respectively, while moderate wasting as 8.1% and 13.4%. We found 5.88% sensitivity for SAM and 6.97% sensitivity for MAM, with specificity of 96.87% and 91.75%, respectively. The kappa values for SAM and MAM are 0.037 and -0.015 respectively.

Conclusions: Although MUAC can be used as a rapid screening tool to detect wasting in children aged 6–59 months, using the recommended MUAC cut-offs captures only a small proportion of the total number of wasted children. The poor sensitivity of MUAC compared to WHZ as well as kappa values suggests no agreement between MUAC and WHZ need to refine admission and discharge criteria for malnutrition management programs.

Keywords: MUAC and WHZ, SAM and MAM.

Introduction

The prevalence of paediatric malnutrition is high worldwide, but it remains underdiagnosed or underestimated in clinical practice because of diagnostic difficulties. Furthermore, Pediatrics malnutrition is associated with numerous short and long-term consequences such as cognitive and behavioural impairments, growth retardation, and increased mortality. Early detection and treatment of paediatric malnutrition is essential to reduce these consequences.[1-4]According to the National Family Health Survey-5, 19.3% of under-five children in India are undernourished and 7.7% of them are severely undernourished. Chhattisgarh state in India has an 18.9% rate of wasted children and a 7.5% rate of severely wasted children. This is indicative of the fact that the state of Chhattisgarh has a much higher undernourishment rate. Poor nutrition education, limited access to nutritious food, or poverty-driven resource shortages may cause this.[5, 6]

The monitoring of nutrition in the community helps to deliver a clearer vision of the nature, extent and distribution of nutritional problems occurring in different parts of the community as well as in different geographical areas. Such data is essential to formulate policies, devise pertinent programmes and carry out these programmes to prevent and control nutritional deficiency disorders.[7] In order to detect malnutrition in the community, one needs to use a method that is easy, acceptable, low cost, precise, accurate, sensitive, specific, and predictive, as well as both objective and quantitative. [8]MUAC is widely used in low and middle income countries,

particularly to screening nutritional status and determining mortality risks in children. The WHO urges that wasting i.e. Z score for Weight for Height or MUAC as well as nutritional edema be used to estimate the prevalence of acute malnutrition. It is also used for admission criteria for further management. Various studies concluded that MUAC as a simple tool for easy recognition of muscle wasting in under-five children.[9-15]

According to World Health Organization, under-five children with a mid-upper arm circumference (MUAC) of <11.5 cm, had z-score for weight-for-height (WHZ) <–3 standard deviation (SD) as compared to that of normal population are having Severe Acute malnutrition (SAM). Similarly, WHZ <–2 to ≥–3 SD along with MUAC ≥11.5 cm to <12.5 cm are with Moderate Acute Malnutrition (MAM).[1]

By considering WHZ as the gold standard, we intended to determine the magnitude of difference in the determining of malnourished children by MUAC and Weight for Height Z score.

Subjects and Methods

A cross-sectional study among under-five children visiting Paediatric OPD at Raipur Institute of Medical Sciences, Raipur Chhattisgarh from January 2022 to June 2022 was conducted.

Inclusion Criteria

Apparently healthy children, residing in the adjacent villages of the study area, with age between 6 months to 59 months and whose parents or guardian were willing for participation.

Exclusion Criteria

Following children are excluded from the study:

- Age less than 6 months and more than 5 years
- Critical or any chronic illness,
- Not cooperative and
- Those who not willing to participate.

Sociodemographic data and anthropometric measurements were collected from the eligible children. Anthropometric measurements like weight, height, and MUAC measured two times and the average of readings was taken. All the anthropometric measurements were measured by trained nursing staff with the aid of calibrated instruments. After removing the shoes, heavy clothing and objects from their pockets, the participants were then weighed (to the nearest 10.0 g). The standing height was measured (to the nearest 1 mm) by a stadiometer with their feet positioned together at the heels with the back of the heels. MUAC was measured (to the nearest 1 mm) in sitting or standing posture using a Shakir's tape which was placed at mid between the olecranon process of the left ulna and the acromion process of the left scapula. Weight for height z-scores were calculated with the help of WHO Anthropometric calculator software version 3.2.

Statistical analysis used: Data were analyzed using IBM SPSS version 25. In order to compare the use of MUAC and WHZ to identify wasting, we used descriptive statistics and Kappa statistics to compare the use of MUAC and WHZ to identify wasting.

Results: Total 322 children were participated in the study in the age group 6-59 months. Out of these 184 were males while138 female children. Table 1 depicts age and gender distribution of study participants. Figure 1 & 2 shows the gender distribution of study participants with MUAC & WFH respectively. Number of malnourished participants identified are more as per WFH Z score. Table 2 indicates comparison of MUAC and Z score system (WFH) for malnutrition. It is obvious from the table 2 that 23.9% children are wasted as per Z score system for WFH as compared to 11.5% malnourished children as per MUAC classification. Figure 3 reveals that MUAC identifies more Normal children while Z score system identifies more malnourished children. Table 3 demonstrates the sensitivity and specificity for both moderate and severe malnutrition and also exhibits the level of agreement between MUAC and Z score system for WFH. It reveals that for diagnosing SAM at cut-off value 11.5 cm, sensitivity is 5.88% and specificity is 96.87%. Similarly for MAM at cut-off 12.5 cm sensitivity and specificity are 6.97% and 91.75% respectively. The values of Cohen's Kappa indicates no level of agreement between MUAC and Z score system WFH for SAM (k value=0.037) as well as MAM (k value=-0.015).

Table 1: Age and gender distribution of the study population

Age group	Male	Female	Total
6-12 months	22	30	52
13-24 months	47	31	78
25-36 months	51	27	78
37-48 months	33	21	54
49-59 months	31	29	60
Total	184	138	322

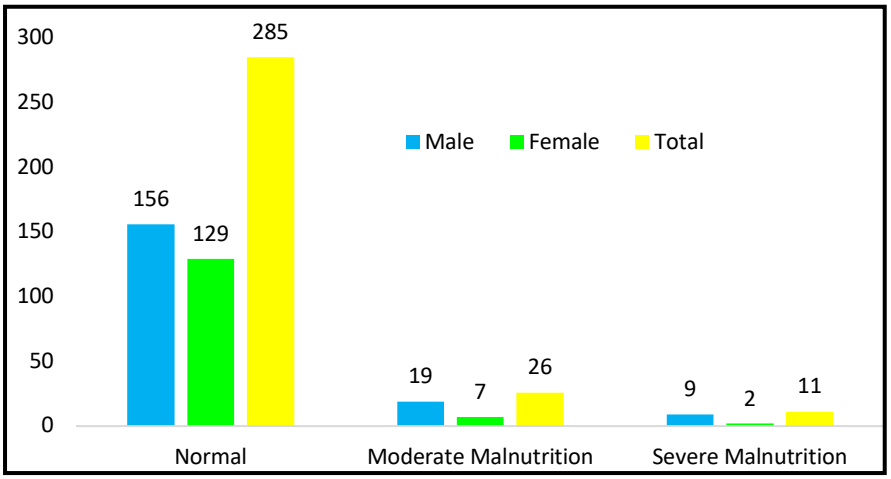

Figure 1: Distribution of study population as per MUAC and Gender

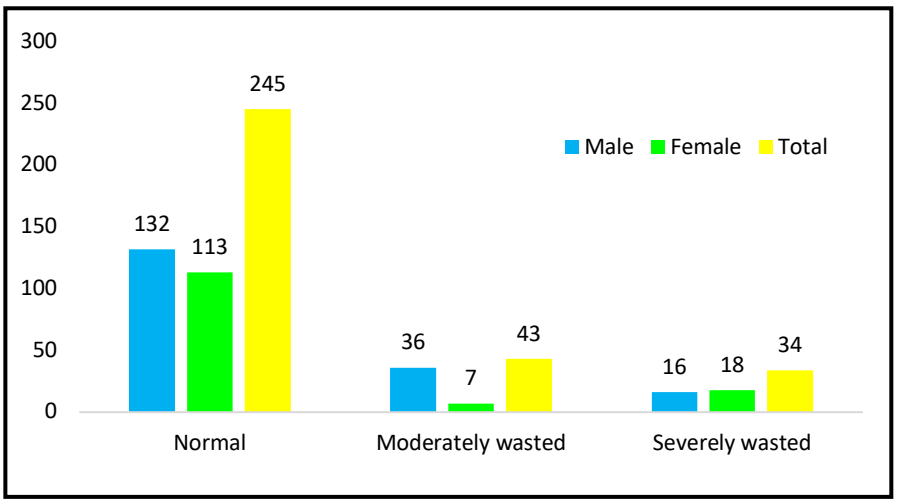

Figure 2: Distribution of study population as per WFH and Gender

Table 2: Comparison of MUAC and Z-Score system (WFH) for malnutrition

Mid Upper Arm Circumference	Z Score System (WFH)			
	Normal	Moderately Wasted (<-2SD)	Severely Wasted (<-3SD)	Total
Normal	219	37	29	285 (88.5)
Moderate Malnutrition	20	03	03	26 (8.1)
Severe Malnutrition	06	03	02	11 (3.4)
Total	245 (76.1)	43 (13.4)	34 (10.5)	322 (100)

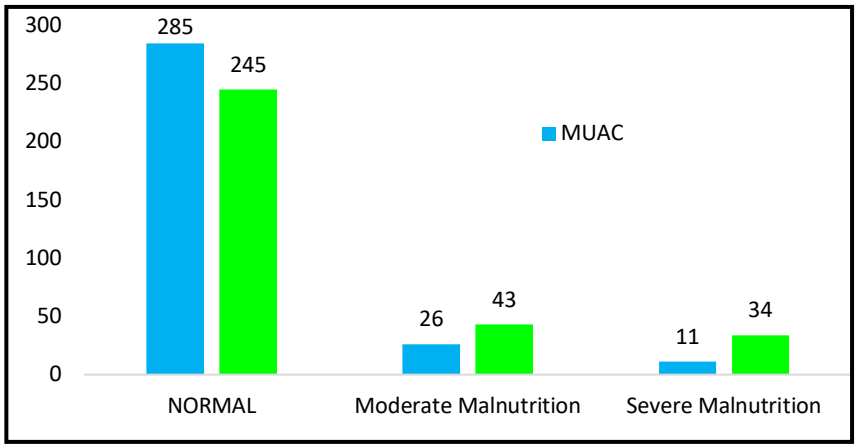

Figure 3: Distribution of study population as per MUAC & WFH

Table 3: Level of agreement for SAM & MAM between MUAC & WFH

Sr. No.	Variables	Moderate Malnutrition	Severe Malnutrition
1	Sensitivity	6.97%	5.88%
2	Specificity	91.75%	96.87%
3	Cohen's Kappa	-0.015	0.037

Discussion

This study compares the sensitivity and specificity of MUAC with WHZ to identify wasting in underfive children in Chhattisgarh, to recommend how to intervene timely and diagnose wasting accurately, required to identify and treat undernourished children worldwide. The purpose of this study was to identify differences in the MUAC and WHZ measurements to detect wasting among children in Chhattisgarh. The percentage of wasting, as measured by WHZ, was almost the same as the national prevalence reported in the recent NFHS-5 (23.9% vs. 27%). Out of these wasted children, we found that 10.5% were SAMs and 13.4% were MAMs, but when using MUAC, we found only 3.4% SAMs and 8.1% MAMs. A similar finding was found by Lamsal KP et al in children aged 6-59 months, 10.5% of children shows (2.1% SAM while 8.5% MAM) as measured by WFH Z score, but when using MUAC 0.4% were SAM and 2.7% MAM.[16] When comparing the 2 methods for identification and using WFH Z score as the reference standard, Cohen's Kappa value for both SAM and MAM showed 0.037 and -0.015 respectively. This suggests that the current MUAC cut-offs are poor tools for detecting wasting. With WHZ as the reference standard, we found MUAC only had 5.88% sensitivity for SAM (MUAC <115 mm) and 6.97% sensitivity for MAM (MUAC ≥115 mm to <125 mm), with a specificity of 96.87% and 91.75%, respectively. Various studies that have reported a very wide range of sensitivity of MUAC, ranging from 13.6% to 43.5% and consistently higher specificity.[16-22] In a study, Berkley J et al. observed that there was a 42% sensitivity and 92% specificity in patients with WHZ with severe wasting. Our study showed a similar specificity but very low sensitivity.[17] MUAC detects undernutrition with a sensitivity of 20 percent and wasting with a specificity of 95.3% at a cutoff level of 13.5 cm. MUAC and malnutrition assessment have poor agreement. This study indicates the need for different cut-off criteria for acute malnutrition (wasting).We found this study to be consistent with our findings.[18] This study recommends increasing the MUAC cutoff value to 115 mm. The likelihood of diagnosing severe wasting increases by 12% and false-negative results are reduced by 16% when sensitivity is increased by 5 mm. This leads to earlier intervention and better treatment outcomes.[19] The study by Grellety E et.al. observed that the MUAC-115 mm can be used to evaluate the severity of malnutrition with higher mortality rates in children. Unfortunately, due to its low sensitivity, a third of the children malnourished children went unidentified.[20] The results of a similar study conducted among tribal children in India by Tallapalliwar et al. indicated that the WHO's recommended cutoff of 11 cm MUAC had a 99.3% specificity and a 13.6% sensitivity.[21]

Conclusion

This study corroborate that MUAC detect wasting substantially in small proportion when WHZ as the reference standard, leading to most of the children undetected or undiagnosed eventually untreated. MUAC's poor performance in terms of sensitivity and specificity suggests that health facilities and acute malnutrition management programs should either increase the MUAC cut-off values or implement both MUAC and WHZ to diagnose and treat wasting early, rapidly, and accurately. Even though MUAC is an effective screening tool for detecting wasting in children between 6 and 59 months of age, the recommendation cut-offs capture only a small proportion of the total number of wasted children. As a result of MUAC's low sensitivity in comparison to WHZ, as well as its kappa values, it is evident that MUAC and WHZ need to refine their admission and discharge criteria for malnutrition management programs.

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