ORIGINAL RESEARCH

Assessment of accuracy of mid upper arm circumference with weight for length/height z score in malnourished children in Southern Kerala: A cross sectional study

[1]Axina Ali,[2]SBaburaj,[3]Geevarghese Prajit Prasad

[1,2,3]Department of Paediatrics, Dr.SMCSI Medical College, Karakonam, Thiruvanthapuram, Kerala, India

Corresponding Author
Axina Ali
Department of Paediatrics, Dr. SMCSI Medical College, Karakonam, Thiruvanthapuram, Kerala, India

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ABSTRACT

Introduction: Weight for Length/Height and Mid Upper arm circumference are two independent tools which are used to assess the severity of malnutrition. A study was conducted to assess the accuracy of Mid upper arm circumference in comparison to Weight for Length/Height in malnourished children between the age group of6-59 months.**Objective:** To assess the accuracy of Mid Upper arm Circumference (MUAC) in relation to Weight for Length/Height Z-score (WFL/WFH Z-score) in malnourished children. **Materials & Methods:** A Cross sectional Study was conducted at a tertiary care hospital with 302 (6m-59m) having diagnosis of malnutrition based on Moderate Acute Malnutrition (MAM) and Severe Acute Malnutrition (SAM) using the anthropometric age independent variables WHO growth Charts ofMUAC and WFL/WFH Z-score. **Results:**Out of the 302 children visited, the total number of malnourished children diagnosed on the basis of MAM and SAM was 72. The accuracy of MUAC in comparison to the WFL/WFH Z-score was found to be 83%.**Conclusion:** The Accuracy of MUAC was 83% in comparison to WFL/WFH Z score.

Key words: Undernutrition, malnutrition, mid upper arm circumference, weight for length/height z score

INTRODUCTION

stunting and undernutrition begins to increase after 4-6 months of age when solid foods (complementary feeding) are introduced. The proportion of children who are stunted or underweight increases rapidly with the child's age until about 18-24 months [4].

This study was conducted to know whether MUAC will be accurate enough to identify and estimate the Moderate and Severe Acute Malnutrition between the age group of 6-59 months in comparison to Weight for Height Z score. MUAC being more feasible can be easily used to diagnose malnutrition in rural areas, if the outcome is promising.

Materials and Methods

This cross-sectional study was conducted at the department of paediatrics of a tertiary care institute from March 2021 through August 2022. Children between the age group of 6m-59m with malnutrition based on MUAC and WFL/WFH Z-score were included. The sampling technique was convenience sampling which is a part of non-probability sampling.

The Mid Upper Arm Circumference (MAUC) measures mid-upper arm circumferential girth by using a non-stretchable measuring tape and the range between 12.5cm-13.5cm was considered as normal. The range between 11.5cm-12.5cm and less than 11.5 cm were considered as Moderate Acute Malnutrition (MAM) and Severe Acute Malnutrition (SAM) respectively.

Weight for Length (WFL)/Weight for Height (WFH) Z Scores (Z-score) compares the weight of the child and the expected mean weight of the child with the same height, following WHO growth standards. The Z score is the degree of deviation of the weight of a given child away from the mean value of the reference population, divided by the standard deviation for the reference population [5].

The study population was calculated using the formula:

$$n = 4pq/d2 = 4x25x75/(.2x25)2 = 300$$ [6].

Data were statistically analyzed using sensitivity, specificity, Positive predictive value, Negative predictive value and accuracy of the test

Inclusion criteria

1. Children between 6 months to 59 months attending the Paediatric OPD as patients/accompanying them/friends/relatives.
2. Preterm children with corrected gestational age.

Exclusion criteria

1. Children with chronic illness, congenital anomalies, neurologic problems, limb abnormalities
2. Parents of children who are not willing to participate in the study.

Results

The sensitivity, specificity, PPV, NPV and accuracy were 32.9%, 99.1%, 92%, 83% and 83% respectively (Tables 1, 2).

Out of the 302 children belonging to 6-59months, 72 children had malnutrition. 25 were detected malnourished using MUAC and 70 were detected malnourished using WFL/WFH Z score. Out of the 70 participants who were diagnosed with malnutrition by WFL/WFH Z score, only 32.9% (n=23) were correctly identified by MUAC. Here sensitivity of MUAC in detecting malnutrition was 32.9% when WFL/WFH Z score was taken as Gold standard. Out of the 232 participants who were diagnosed with no malnutrition by WFL/WFH Z score, 99.1% (n=230) were correctly identified by MUAC. Here specificity of MUAC in detecting no malnutrition was 99.1%.

Among the 25 participants who were detected to have malnutrition by MUAC, 92% (n=23) were already diagnosed with malnutrition by WFL/WFH Z score. MUAC has a positive predictive value of 92% in detecting malnutrition when compared to WFL/WFH Z score. Among the 277 participants who were detected to have no malnutrition by MUAC, 83% (n=230) were already diagnosed with no malnutrition by WFL/WFH Z score. MUAC has a negative predictive value of 83%.

Discussion

This study revealed MUAC has a sensitivity of 32.9% and specificity of 99.1% in detecting malnutrition when WHZ is used as reference standard.A cross sectional study in Primary Health Centres of Maharashtra in children between the ages of 6 to 59 months by Sougaijam*et al*.concluded that sensitivity of MUAC was 23.5% and specificity was 99.7% [7].The study in Nepal by Lamsal K P*et al*., concluded that sensitivity and specificity for SAM was 13.6% and 99.7% and that for MAM as 21.0% and 91.2% [8].

A similar study by Talapalliwar*et al*. got the sensitivity and specificity of MUAC <11.5cm(SAM by MUAC) as 13.6% and 99.3%, respectively and concluded a need to revise the cut off value of MUAC[9]. Thisstudy is also at par with the above studies, and can be concluded that to use MUAC as a screening tool in the community, requires a higher cut off value to increase the sensitivity of this tool.

This study reveals that the positive predictive value (PPV) of MUAC was 92% and the negative predictive value (NPV) was 83%. In a community based cross sectional study in Kolkata by Chaudhury*et al*., the PPV was 57.14% and NPV was 87.3% [6]. The PPV of this study was better than the reference study implying that MUAC can be used as a better predictor of malnutrition in our rural community.

The diagnostic accuracy of MUAC in comparison to WFL/WFH Z score from this study was found to be 83%. A study byKapil*et al*. found that the diagnostic test accuracy of MUAC for severe wasting was 93% (0·933 based on area under ROC curve) [10].

Table 1: Baseline characteristics of the study population

Study parameter	Mean(±SD)
Age(m)	30.96(±16.336)
Sex (M:F)	1.08:1
Weight (Kg)	12.496(±4.392)
Length/Height (cm)	89.947(±13.124)
WFL/WFH (%)	95.152(±13.612)
MUAC (cm)	14.284(±1.313)

Table 2: Sensitivity, Specificity, PPV, NPV and Diagnostic accuracy of MUAC in relation to WFL/WFH Z score

Malnutrition on MUAC	Malnutrition on WFL/WFH Z score		Total	Sensitivity & specificity of MUAC	PPV & NPV	Accuracy
	Yes	No				
Yes	23	2	25	Sensitivity=23/70=33.95%	PPV=23/25=92%	Diagnostic Accuracy 23+230/302 = 83%
No	47	230	277			
Total	70	232	302	Specificity=230/232=99.1%	NPV=230/277 =83%	

Conclusion

The sensitivity, specificity, PPV, NPV of MUAC in comparison to WFL/WFH Z score were 32.9%, 99.1%, 92%, 83%respectively The Accuracy of MUAC was 83% in comparison to WFL/WFH Z score. The Accuracy may be increased by increasing the cut off value of malnutrition, but it need multicentre studies with large number of samples.

References

1. Laillou A, Prak S, Groot R de, Whitney S, Conkle J, Horton L, *et al*.Optimal Screening of Children with Acute Malnutrition Requires a Change in Current WHO Guidelines as MUAC and WHZ Identify Different Patient Groups. PLOS ONE. 2014 Jul 1; 9(7):e101-159.
2. Management of severe malnutrition: a manual for physicians and other senior health workers. RevPanamSaludPública. 1999 Aug;6(2):146-7.
3. Shekhar S, Shah D. Validation of mid upper arm circumference cut offs to diagnose severe wasting in Indian children. Indian Pediatr. 2012 Jun 1;49(6):496-7.
4. Ghai OP, Paul VK, BaggaA.Ghai essential Paediatrics (9th ed.).New Delhi, India: CBS Publishers and distributors; 2019.
5. Mei Z. Standard deviation of anthropometric Z-scores as a data quality assessment tool using the 2006 WHO growth standards: a cross country analysis. Bull World Health Organ. 2007 Jun 1;85(6):441–8.
6. Chowdhury R, Mukherjee A, Naskar S, Lahiri SK. A study on relationship between various anthropometric measurements used as indicators of acute malnutrition in a slum of Kolkata. 2012;3(2):9.
7. Sougaijam R, Gupta SS, Raut AV, Bharambe MS, Garg BS. Validating the MUAC (Mid-upper arm circumference) Cut-off for Detection of Severe Acute Malnutrition in Children Aged 6-59 Months in Rural Maharashtra. Indian Pediatr. 2019 Mar 15; 56(3):209-12.
8. Lamsal KP, Parajuli KR, Pun BK, Adhikari RP, Bashyal M, Dangol B, *et al*.Accuracy of Using Mid-Upper Arm Circumference to Detect Wasting Among Children Aged 6-59 Months in Nepal. Glob Health Sci Pract. 2021 Dec 31; 9(4):881-9.
9. Talapalliwar M, Garg B. Diagnostic accuracy of mid-upper arm circumference (MUAC) for detection of severe and moderate acute malnutrition among tribal children in central India. Int J Med Sci Public Health. 2015 Jan 1; 1.
10. Kapil U, Pandey RM, Bansal R, Pant B, Varshney AM, Yadav CP, Sinha S, Sareen N, Sachdev HS. Mid-upper arm circumference in detection of weight-for-height Z-score below-3 in children aged 6-59 months. Public Health Nutrition. 2018 Jul; 21(10):1794-9.