ORIGINAL ARTICLE

MID UPPER ARM CIRCUMFERENCE AND WEIGHT FOR HEIGHT Z-SCORE AS SCREENING TOOLS FOR ACUTE MALNUTRITION IN UNDERWEIGHT CHILDREN <5 YEARS OF AGE

Mujeeb ur Rehman, Saima Bibi*, Imran, Hamayun Anwar***, Tariq Alam†, Khyal Muhammad***

Department of Paediatrics, King Abdullah Teaching Hospital, Mansehra, *Ayub Teaching Hospital, Abbottabad, **Department of Gastroenterology, Children Hospital, Lahore, ***Department of Paediatrics, Frontier Medical College, Abbottabad, †District Head Quarter Hospital, Tank, Pakistan

Background: Malnutrition is a major risk factor for childhood morbidity and mortality. Mid upper arm circumference (MUAC) is a simple and easy to perform method and now it is considered as a surrogate marker of malnutrition. The objective of this study was to assess the utility of MUAC in detecting acute malnutrition in comparison to weight for height Z-score (WHZ) in underweight children below 5 years of age. **Methods:** This cross-sectional study was conducted in Paediatrics Department, Ayub Teaching Hospital, Abbottabad. A total of 200 underweight patients aged 6 months to 5 years were included in the study. Weight for height Z-score and weight for age were determined using WHO child standard growth charts after documenting their growth parameters. The data was analyzed using SPSS-22. **Result:** Out of 200 patients, 104 (52%) were male and 96 (48%) were female. The mean age was 24.37±16.55 months. Overall 66% children had MUAC below 12.5 Cm while 34% children had MUAC above 12.5 Cm. A total of 116 (58%) children were less than -2SD for WHZ and 84 (42%) were above -2SD WHZ. **Conclusion:** MUAC is a simple, cheap and easy to perform method to quickly screen children with acute malnutrition and it is more specific then WHZ using the cut-off point of <12.5 Cm. MUAC is more specific in detecting acute malnutrition in younger infants as compared to older children.

Keywords: Mid Upper Arm Circumference, Weight for height Z-score, malnutrition

Pak J Physiol 2020;16(1):6–9

INTRODUCTION

Under nutrition is one of the major risk factor and contributor to morbidity and mortality in children under 5 years of age especially in developing countries. Severe acute malnutrition (SAM) is also one of the main public health problems in children because the risk of mortality and morbidity is nine times more in these children as compared to normal well-nourished children.[1] About 165 million children around the world are malnourished and malnutrition contribute to more than 50% of the childhood mortality worldwide.[2]

Severe acute malnutrition (SAM) in children aged 6–59 months is diagnosed by either of the following parameters. Weight for height Z-score (WHZ) < -3SD or Mid Upper Arm Circumference (MUAC) <115 mm or presence of oedema feet. There are subcutaneous fats and muscle bulk in the human arm. When there is decreased food intake for a long period of time due to any reason then it leads to decreased levels of subcutaneous fat and also reduced muscle mass which causes a decrease in the MUAC which can be used to identify children with acute malnutrition.[3–5] MUAC is a simple, quick and rapid method of detecting malnutrition and there is a need of minimal supervision and training of the health care workers and also of materials.[6]

Initially the World Health Organization (WHO) recommendations for the management of SAM were confined mainly to patients who were admitted in hospital,[5] but currently the new WHO guidelines emphasize, that Community Management of Acute Malnutrition (CMAM) is the standard of care for children with SAM.[7] In primary health care facilities weight-for-height Z-score (WHZ) has long been the method of choice for identifying children with SAM but use of WHZ has some technical and clinical restrictions especially in infants and preschool children by the community health workers. Therefore, in the community setting and field, for the management of children with SAM, a two-stage referral and admission system was developed. The community healthcare providers detect and diagnose children with SAM using MUAC as a screening tool and they then refer these patients for further inpatient management and the program staff in the hospital admit these children to Outpatient Therapeutic Program (OTP) using WHZ as a diagnostic tool.[8] In these two-stage referral system many children who were detected with SAM and referred using MUAC as a diagnostic tool were refused inpatient management because they were not diagnosed as SAM using WHZ. So this problem was identified and removed by also considering MUAC as a strong alternative method for both admission and referral to OTP.[8,9] Since MUAC can predict the risk of morbidity and mortality in children with SAM more than WHZ, it is a better screening tool to use for referral and

admission to OTP.[10–12] In contrast to WHZ, MUAC is a cheap, quick, simple and low-cost method[7] which can be used easily by healthcare workers in the community with minimal expertise[8] and it is less prone to measurement error as compared to WHZ[9].

The recent WHO guidelines suggest that MUAC should be used as screening tool for malnutrition in the community setting while in the inpatient and healthcare facility WHZ or MUAC or bilateral oedema can be used as a diagnostic criteria for the identification, admission and management of children with SAM.[4] In many studies it has been demonstrated that MUAC is a superior tool to identify and detect children at higher risk of mortality and morbidity[5–10] and this could be due to the reason that MUAC detects infants and younger children with SAM as compared to WHZ which detects older children with SAM than younger ones.[11] In the community setting it is very difficult to obtain accurate weight and height measurements as compared to MUAC which can easily be documented by healthcare workers.[9,13]

Since MUAC has many advantages as compared to WHZ, it can be used very easily in the community-based TFPs, including some emergency situations, when the aim is to detect large number of children with severe acute malnutrition especially in developing countries and in situations and regions where resources are limited, and closed supervision is not possible.[6]

This study aimed to determine clinical correlation between mid-upper arm circumference and weight for height Z-score in underweight children.

MATERIAL AND METHODS

This cross-sectional study was conducted in the Paediatrics Department, Ayub Teaching Hospital, Abbottabad from October 2017 to March 2018, after approval from Hospital Ethical Committee. Sample size of 200 was calculated using WHO software for sample size determination in health studies by keeping confidence level of 95%, anticipated prevalence of 38.5%[14] and Absolute Precision of 10%.

Children of either gender aged 6 months to 5 years admitted in ward fulfilling the inclusion criteria of underweight (weight for age less than -2SD on WHO child standard growth charts) were included in this study in a consecutive manner. Children having generalized oedema, cellulitis or abscess of the arm were excluded from this study. Children under 6 months were also excluded from study.

A written informed consent was obtained from the caregivers of the participants. A structured questionnaire was used for data collection that included parameters like age, sex, weight, length/height, and MUAC. Mid upper arm circumference, height and weight were recorded using measuring tape, stadiometer/measuring tape and weighing scale respectively.

All growth parameters were plotted on the WHO child standard growth chart. Weight for height Z-score and weight for age were determined using WHO standard growth charts. Chi-square test was applied to evaluate the association between categorical variables, and $p<0.05$ was considered statistically significant.

RESULTS

A total of 200 patients who fulfilled the inclusion criteria were enrolled in this study. Of these, 104 (52%) were male and 96 (48%) were female. The mean age was 24.57±16.62 months. Mean weight of the participants was 7.88±2.6 Kg. Children were divided in three age groups 6–12 months, >12–24 months and >24–60 months. A total of 79 (39.5%) patients were 6–12 months old, 50 (25%) patients were >12–24 months old and 71 (35.5%) were >24–60 months old (Table-1). A total of 116 (58%) children were less than and 84 (42%) were above -2SD for WHZ. Among male participants, 64 children were less than and 40 children were above -2SD WHZ. Among female children, 52 were less than and 44 were above -2SD WHZ (p=0.291) (Table-2).

Of the total study population, 84 (42%) patients had MUAC <11.5 Cm, 48 (24%) had MUAC 11.5−12.5 Cm and 68 (34%) children had MUAC >12.5 Cm. Among male patients, 37 children had MUAC <11.5 Cm, 24 had MUAC 11.5−12.5 Cm and 43 had MUAC >12.5 Cm. Among female patients, 47 children had MUAC <11.5 Cm, 24 had MUAC 11.5−12.5 Cm and 25 had MUAC >12.5 Cm (Table-3). Overall 132 (66%) children had MUAC up to 12.5 Cm while 68 (34%) had MUAC >12.5 Cm (Table-4).

Among those children who had WHZ < -2SD, 51 (44%) had MUAC <11.5 Cm, 29 (25%) had 11.5−12.5 Cm, and 36 (31%) had MUAC >12.5 Cm. Among those children whose WHZ was above -2SD, 33 (39%) had MUAC <11.5 Cm, 19 (23%) had 11.5−12.5 Cm and 32 (38%) had >12.5 Cm (p=0.582) (Table-5). The MUAC groups based on cut-off value of 12.5 Cm were analyzed with respect to age groups which was statistically significant (p=0.000) (Table-6).

Table-1: Gender-wise distribution of the patients in age groups

Age (Months)	Male	Female	Total
6–12	39	40	79
12–24	28	22	50
24–60	37	34	71
Total	104	96	200

Table-2: Gender-wise frequency of the patients in WHZ groups

WHZ	Male	Female	Total	*p*
< -2SD	64	52	116	0.291
> -2SD	40	44	84	
Total	104	96	200	

Table-3: Gender-wise frequency of the patients in MUAC groups

MUAC groups	Male	Female	Total
< 11.5 Cm	37	47	84
11.5–12.5 Cm	24	24	48
> 12.5 Cm	43	25	68
Total	104	96	200

p=0.059

Table-4: Frequency of patients based on MUAC cut-off value of 12.5 Cm

MUAC	Number	Percentage
Up to 12.5 Cm	132	66%
>12.5 Cm	68	34%
Total	200	100%

Table-5: Frequency of patients in MUAC groups with WHZ

	WHZ		
MUAC	< -2SD	> -2SD	Total
<11.5 Cm	51	33	84
11.5–12.5 Cm	29	19	48
>12.5 Cm	36	32	68
Total	116	84	200

p=0.582

Table-6: MUAC of the patients in different age groups

Age (Months)	MUAC		Total
	Up to 12.5 Cm	>12.5 Cm	
6–12	66	13	79
>12–24	31	19	50
>24–60	35	36	71
Total	132	68	200

p=0.000

DISCUSSION

Owing to a high prevalence of malnutrition in children, it is imperative to identify and utilize those diagnostic tools that would identify at risk population more effectively.[14] A study conducted by Velzeboer and colleagues, comparing WFH and MUAC in Guatemala children showed that preschool children tend to become irritable and disturbed while measuring height and weight while no such disturbance is reported when measuring MUAC and in this same study it was also reported that it can be performed quickly and also by minimally trained health workers.[13] In our study the frequency of severe acute malnutrition (SAM) was 58% as determined by Weight for Height among undernourished children. While the frequency of severe acute malnutrition was 66% when taking MUAC of 12.5 Cm as a cut-off point for acute malnutrition while it decreased to 42% when the cut-off point was taken as 11.5 Cm.

Worldwide studies reported that WHZ and MUAC criteria detect children with acute malnutrition in different rate and proportion. Grellety and Golden, in a multicounty study, reported that the number of children detected by one method differs significantly from the other one. They reported that MUAC is more specific in detecting acute malnutrition in younger children while WHZ ratio is more specific in detecting acute malnutrition in older children. This same study also reported that the frequency of SAM with WHZ is 84.5% while with MUAC it is 38.5%.[15] Another study in India showed that more than 95% children were diagnosed with moderate to severe acute malnutrition with WHZ while only 33% of the children were diagnosed using MUAC.[16] However there are other studies which show that MUAC is superior to WHZ in detecting malnourished children who are at higher risk for mortality and need immediate treatment.[17]

In our study MUAC was more useful for detecting acute malnutrition in younger children as compared to older age groups. In the age groups of 6−12 months, >12 to 24 months and >24 to 60 months, 66 (50%), 31 (23.4%) and 35 (26.5%) children had a MUAC less than 12.5 Cm respectively. Similar finding was reported in an Indian study which shows that MUAC detect slightly higher percentage of children with acute malnutrition who are younger and females.[16]

There is strong evidence that shows MUAC as better screening tool for assessing mortality and morbidity as compared to WHZ in undernourished children.[18] In a Nigerian study, the sensitivity and specificity of MUAC in detecting under-nutrition was 20% and 95.3% at a cut-off point of <13.5 Cm while in detecting underweight it was 25.7%and 96.8% and for the detection of stunting its sensitivity and specificity was 30.4% and 96.6%.[19] In a study in India, 8.9% of the children had WHZ less than -3SD while in the same population the frequency of SAM by MUAC was 4.9% using a cut-off point <11.5 Cm. In the same study the frequency of severe stunting detected by WHZ was 26% while it was 60.9% by MUAC at cut-off level of <11.5 Cm.[20]

Further studies incorporating the parameters of aforementioned studies and including bigger sample sizes are need to be carried out to better define the utility of MUAC in our settings.

CONCLUSION

In conclusion MUAC is a simple, cheap and easy to perform method to quickly screen children with acute malnutrition and its yield is better than WHZ when the cut-off value of <12.5 Cm is used to define acute malnutrition. Mid upper arm circumference better identifies acute malnutrition in younger infants as compared to older children so this method should be preferably used by health care workers especially in community care settings.

REFRENCES

1. Black RE, Allen LH, Bhutta ZA, Caulfield LE, de Onis M, Ezzati M, *et al*. Maternal and child Undernutrtion: Global and regional exposures and health consequences. Lancet 2008;371:243–60.

2. Black RE, Victora CG, Walker SP, Bhutta ZA, Christian P, De Onis M, *et al*. Maternal and child Undernutrition and overweight in low-income and middle-income countries. Lancet 2013:382:427–51.
3. Bray GA, Greenway FL, Molitch ME, Dahms WT, Atkinson RL, Hamilton K. Use of anthropometric measures to assess weight loss. Am J Clin Nutr 1978;31(5):769–73.
4. Harries AD, Jones LA, Heatley RV, Newcombe RG, Rhodes J. Precision of anthropometric measurements: the value of mid-arm circumference. Clin Nutr 1984;2(3–4):193–6.
5. Ross DA, Taylor N, Hayes R, McLean M. Measuring malnutrition in famines: are weight-for-height and arm circumference interchangeable? Int J Epidemiol 1990;19(3):636–45.
6. Goossens S, Bekele Y, Yun O, Harczi G, Ouannes M, Shepherd S. Mid-upper arm circumference based nutrition programming: evidence for a new approach in regions with high burden of acute malnutrition. PloS One 2012;7(11):e49320.
7. Collins S, Sadler K, Dent N, Khara T, Guerrero S, Myatt M, *et al*. Key issues in the success of community based management of severe malnutrition. Food Nutr Bull 2006;27(3 Suppl):S49–82.
8. Myatt M, Khara T, Collins S. A review of methods to detect cases of severely malnourished children in the community for their admission into community-based therapeutic care programs. Food Nutr Bull 2006;27(3 Suppl):S7–23.
9. Mwangome MK, Fegan G, Mbunya R, Prentice AM, Berkley JA. Reliability and accuracy of anthropometry performed by community health workers among infants under 6 months in rural Kenya. Trop Med Int Health 2012;17(5):622–9.
10. Briend A, Maire B, Fontaine O, Garenne M. Mid-upper arm circumference and weight-for-height to identify high-risk malnourished under-five children. Matern Child Nutr 2012;8:130–3.
11. Briend A, Garenne M, Maire B, Fontaine O, Dieng K. Nutritional status, age and survival: The muscle mass hypothesis. Eur J Clin Nutr 1989;43:715–26.
12. Vella V, Tomkins A, Ndiku J, Marshal T, Cortinovis I. Anthropometry as a predictor for mortality among Ugandan children, allowing for socio-economic variables. Eur J Clin Nutr 1994;48:189–97.
13. Velzeboer MI, Selwyn BJ, Sargent F 2nd, Pollitt E, Delgado H. The use of arm circumference in simplified screening for acute malnutrition by minimally trained health workers. J Trop Pediatr 1983;29(3):159–66.
14. 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;35(2):337–41.
15. 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;2:10. DOI 10.1186/s40795-016-0049-7
16. 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 district in India. Indian J Community Med 2018;43(3):190–4.
17. Briend A, Alvarez JL, Avril N, Bahwere P, Bailey J, Berkley JA, *et al*. Low mid-upper arm circumference identifies children with a high risk of death who should be the priority target for treatment. BMC Nutr 2016;2:63.
18. Tadesse AW, Tadesse E, Berhane Y, Ekstrom EC. Comparison of mid-upper arm circumference and weight-for-height to diagnose severe acute malnutrition: A study in Southern Ethiopia. Nutrients 2017;9(3): E267.
19. 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(2):140–3.
20. Dasgupta R, Sinha D, Jain SK, Prasad V. Screening for SAM in the community: is MUAC a simple tool? Indian Pediatr 2013;50(1)154–5.

Address for Correspondence:

Dr Saima Bibi, Assistant Professor, Department of Paediatrics, Ayub Teaching Hospital, Abbottabad-22040, Pakistan.
Cell: +92-300-5635010
Email: drsaima79@yahoo.com

Received: 31 May 2019 **Reviewed: 27 Mar 2020** **Accepted: 28 Mar 2020**

Contribution of Authors:

MuR: Concept, literature search, study design, data acquisition, manuscript writing
SB: Statistical analysis and interpretation, manuscript writing, formulation of tables, bibliography, review and approval of final manuscript
I: Data entry, proof reading
HA: Data entry, proof reading
TA: Data entry
KM: Data acquisition, proof reading

Funding source: None
Conflict of interest: None