

# Validity of Mid upper arm circumference for screening undernutrition among preschool children

Vijaykumar P Mane<sup>1,\*</sup>, Trupti B Naik<sup>2</sup>, Mallappa O<sup>3</sup>, Omprakash Ambure<sup>4</sup>

<sup>1</sup>Tutor, Dept. of Community Medicine, Karpaga Vinayaga Institute of Medical Sciences and Research Centre, Maduranthakam, Kanchipuram, Tamil Nadu

<sup>2</sup>Assistant Professor, Dept. of Microbiology, Subbaiah Institute of Medical Sciences and Research Centre, Shivamogga, Karnataka

<sup>3,4</sup>Post Graduate Student, Dept. of Community Medicine, Shivamogga Institute of Medical Sciences, Shivamogga, Karnataka

**\*Corresponding Author:**

E-mail: vijaymane01@gmail.com

## ABSTRACT

**Introduction:** Malnutrition is widely recognized as a major health problem in developing countries. For practical purposes, anthropometric measurements are the most useful tool for assessing the nutritional status of children. Mid upper arm circumference (MUAC) has been proposed as an alternative to weight-for-height (W/H) index as a measure of acute malnutrition because of its low cost and ease of performance, particularly for rapid field assessments of nutritional status in circumstances where resources and trained personnel are limited.

**Objectives:** Objectives: To estimate the validity of mid-upper-arm circumference (MUAC) measurement as a screening method in detection of wasting among preschool children

**Materials and methods:** A community based cross sectional study was done for a duration of 3 months in Bhadravati taluk, Shivamogga district, Karnataka state. 210 preschool children of either sex in the age group of 1-3 years (12- 36 months) were included in the study by cluster sampling technique. Anthropometric measurements were recorded using standard techniques.

**Results:** The prevalence of wasting and severe wasting was found to be in 21 (10%) and 2 (0.9%) of preschool children respectively using mid upper arm circumference against 28 (13.3%) and 6 (2.9%) respectively using Weight for Height index. The sensitivity of MUAC in detecting wasting was found to be around 35% in our study whereas the specificity was 95%.

**Conclusion:** MUAC could identify very few children as undernourished against W/H index. Further studies are needed to test the findings of our study.

**Keywords:** Cluster sampling, Mid upper arm circumference, Validity, Wasting

## INTRODUCTION

Malnutrition is widely recognized as a major health problem in developing countries. Growing children in particular are most vulnerable to its consequences. It is not only an important cause of childhood morbidity and mortality, but also leads to permanent impairment of physical and possibly, of mental growth of those who survive. The pre-school age mortality in India is as high as 4% of all deaths. Malnutrition was shown to be an underlying cause in 3.4% of all deaths in young children and associated cause in no less than 46%.<sup>1</sup>

It is widely accepted that, for practical purposes, anthropometry is the most useful tool for assessing the nutritional status of children. There are many anthropometric indicators in use such as weight-for-age, height-for-age, weight-for height, body mass index, mid upper arm circumference (MUAC) for age and MUAC. Most of these indicators need to be used along with specific reference tables for interpreting data.

As compared to other nutritional indices, weight-for-height is considered to be most responsive to recent and severe under-nutrition and is the most widely accepted measure of nutritional status during

emergencies, but it requires special equipment and is difficult to measure and interpret.<sup>2</sup> Mid upper arm circumference (MUAC) has been proposed as an alternative to weight-for-height (W/H) as a measure of acute malnutrition because of its low cost and ease of performance, particularly for rapid field assessments of nutritional status in circumstances where resources and trained personnel are limited.<sup>3</sup> When compared to standard anthropometry indices, MUAC is a valuable form of low technology applicable at village health worker level as it requires no scales, measuring devices or graph plotting.<sup>2</sup>

The following cross sectional study was conducted with the objective to estimate the validity (accuracy) of using mid-upper-arm circumference (MUAC) measurements as a screening method to detect wasting in preschool children.

## MATERIALS AND METHODS

A cross sectional study was done in Bhadravati taluk, Shivamogga district, Karnataka state for a duration of 3 months from August 2013 to October 2013. Cluster sampling technique was used for selection of study participants. All the villages and wards of Bhadravati taluk were considered as clusters

and 30 clusters were selected by population proportional to size sampling. In each of the cluster, house to house visit was done and 7 children of either sex in the age group of 12- 36 months were included, thus making a total of 210 children. Temporary visitors to the house and children not present in the house at the time of visit were excluded from the study. Assent of the child and consent of their parents was taken before taking anthropometric measurements and data was collected in a pretested and structured questionnaire.

Body weight was measured with minimal clothing and without footwear to the nearest 0.1 Kg using LED digital portable weighing scale. Child was weighed alone if the child was able to stand still on the weighing machine. If the child was unable to stand alone, mother was told to hold the baby and stand on the scale and the reading was recorded. Then the mother was told to stand alone keeping aside her baby and her weight was recorded. Child's weight was obtained by deducting her weight from the previous reading.

Length/ Height was measured using a standard metal tape to the nearest centimeters. For children aged between 12 – 24 months, recumbent length was measured. Child was made to lie on a firm flat surface, head was positioned firmly such that the eyes are looking vertically upwards (i.e. Frankfurt plane positioned vertically), knees extended by applying firm pressure and feet are flexed at right angles to the legs. Length was measured to the nearest centimeters. For those aged above 24 months, standing height was considered. Child was made to stand on flat floor with bare feet placed slightly apart and the back of the head, shoulder blades, buttocks, calves and heels touching the upright wall. The child's head is so positioned that a horizontal line drawn from the ear canal to the lower edge of the eye socket ran parallel to the floor (i.e., the Frankfurt plane positioned horizontally). The arms were made to hang at sides in

natural manner and the reading was taken to the nearest centimeters.

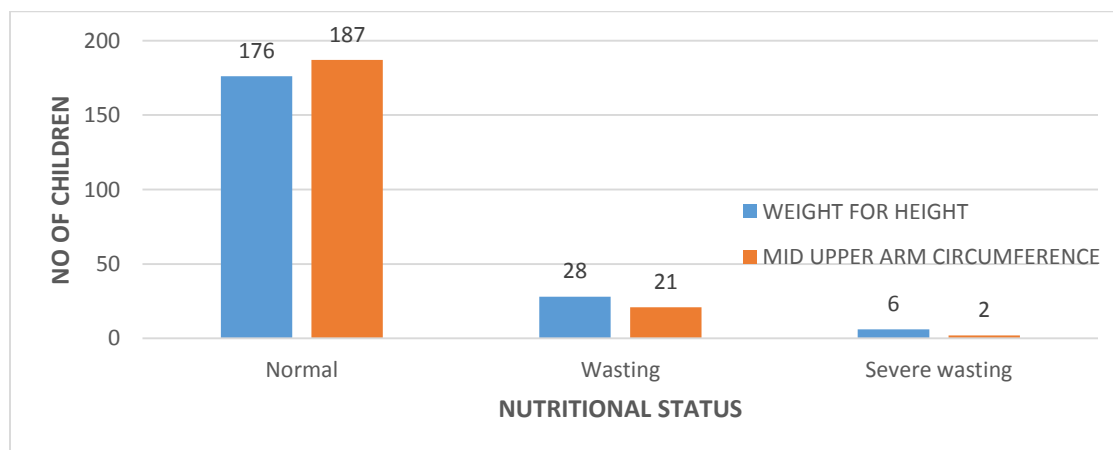
Mid upper arm circumference (MUAC) was measured using flexible measuring tape. The midpoint was assessed by measuring the distance between the acromial process of scapula and the olecranon process of ulna and taking the midpoint of that distance. Then the circumference of the left arm is measured at this point using the flexible measuring tape to the nearest 0.1 centimeter.

Data thus obtained was entered and analyzed using Epi Info version 3.5.4. According to WHO child growth standards 2006, children below two standard deviation of the reference median of weight-for-height index were considered as wasted and those below three standard deviation as severely wasted.<sup>4</sup> Mid upper arm circumference exceeding 125 mm was considered as satisfactory nutritional status and values below the cut-offs of 125 mm and 115 mm are used to define wasting and severe wasting respectively.<sup>5</sup>

## RESULTS

**FIGURE NO: 1** shows according to WHO child growth standards 2006, the prevalence of wasting and severe wasting in the study area was found to be 28 (13.3%) and 6 (2.9%) respectively using weight for height index. When mid upper arm circumference was used, the prevalence of wasting and severe wasting was found to be little lower in 21 (10%) and 2 (0.9%) of children respectively.

**TABLE NO. 1** shows the accuracy of MUAC in detecting wasting against weight for height. For moderate wasting, sensitivity of MUAC in detecting wasting was found out to be 35.7% and specificity was 95.5%. Percentage of false positives is 4.5% and that of false negatives is 64.3%. Similarly for severe wasting, sensitivity= 33.3%, specificity = 95.5%, false positives = 0% and false negatives = 16.7%.



**Figure 1: Comparison in prevalence of nutritional status among study participants using 2 indices – Weight for Height v/s Mid upper arm circumference**

**Table 1: Validity of Mid upper arm circumference in detection of wasting against Weight for Height.**

Nutritional Status Of Study Subjects		Weight for height			Total
		Normal	Wasting	Severe Wasting	
Mid Upper Arm Circumference	Normal	168(95.5)	18(64.3)	1(16.7)	187(89.04)
	Wasting	8(4.5)	10(35.7)	3(50)	21(10)
	Severe wasting	0(0)	0(0)	2(33.3)	2(0.9)
	<b>Total</b>	176 (100)	28(100)	6(100)	210(100)

Note: Figures in parenthesis indicate column percentages.

## DISCUSSION

The prevalence rates of wasting (both moderate and severe) as detected by Weight for height index and MUAC were different in our study, which confirms the findings by other studies.<sup>3, 6, 7</sup> On the contrary, a study by World Health Organization states that the prevalence of severe acute malnutrition (SAM) based on weight-for height below -3 SD of the WHO standards and those based on a MUAC cut-off of 115 mm, were very similar.<sup>5</sup>

The term validity refers to what extent the test accurately measures which it purports to measure. It has 2 components- sensitivity and specificity. When assessing the validity of a screening test, both the components should be considered.<sup>1</sup> Sensitivity of MUAC in detecting wasting (both moderate and severe) was found to be around 35% in our study, which is a little higher than those found in other studies.<sup>3, 7, 8, 9, 10</sup> It means that more than 60% of preschool children will be missed when MUAC alone will be used for screening low weight for height. In other words, MUAC yields too many “false negatives.” Since severe acute malnutrition carries a high risk of mortality among young children,<sup>11, 12, 13</sup> any test to screen the same with so much low values of sensitivity could be detrimental for any screening programs. MUAC was highly specific in our study, similar to the findings by other studies.<sup>3, 7, 8, 9, 10</sup> That is, the yield of false positives is not very high.

Our results indicate that different prevalence rates were obtained with the two measures at the cut-offs used, and that despite substantial overlap, MUAC could identify very few children as undernourished against W/H index. From the above findings it is clear that, nutritional status indicators like MUAC need to be used with caution, since these are not sensitive enough to detect all cases of malnutrition. Further studies are required to test the usefulness of MUAC in detection of undernutrition.

## LIMITATION OF THE STUDY

Even though the sample size was satisfactory to estimate the prevalence of wasting among preschool children, it was not enough for testing the accuracy of MUAC against W/H index, especially severe wasting. More studies with larger sample sizes are required to confirm the findings of our study.

## REFERENCES

1. Park K. Park's Text book of Preventive and Social Medicine. 22<sup>nd</sup> ed. Jabalpur: M/s Banarasidas Bhanot Publishers; 2013;508,130.
2. Kumar R, Aggrawal AK, Iyengar SD. Nutritional status of children: validity of mid-upper-arm circumference for screening undernutrition. *Indian Pediatr.* 1996;33:189-96.
3. Gayle HD, Binkin NJ, Staeling NW, Trowbridge FL. Arm circumference v/s Weight for Height in nutritional assessment: Are the findings comparable? *J Trop Pediatr* 1988;34(5): 213-217.
4. World Health organization, Department of Nutrition for Health and Development. WHO child growth standards: Training course on Child growth assessment. World health organization 2008.Module – C:22.
5. World Health Organization, United Nations Children's Fund. 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. WHO 2009.
6. Hop LT, Gross R, Sastroamidjojo S, Giay T, Schultink W. Mid- upper-arm circumference development and its validity in assessment of undernutrition. *Asia Pac J Clin Nutr* 1998;7(1):65-69.
7. Joseph B, Rebello A, Kullu P, Raj VD. Prevalence of Malnutrition in Rural Karnataka, South India: A comparison of Anthropometric indicators. *J Health Popul Nutr* 2002 Sep;20(3):239-244.
8. Fernandez MAL, Delchevalerie P, Herp MV. Accuracy of MUAC in the detection of severe wasting with the new WHO growth standards. *Pediatrics* 2010;126(1):e195- e201.
9. Dasgupta R, Sinha D, Jain SK, Prasad V. Screening for SAM in the Community: Is MUAC a 'Simple Tool'?. *Indian Pediatrics* 2013;50:154-155.
10. Diaro MD, Fatokun ME, Modupoelwa Kutu. 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):140-143.
11. WHO. Guideline: Updates on the management of severe acute malnutrition in infants and children. Geneva: World Health Organization; 2013.
12. Briend A, Collins S. Therapeutic Nutrition for children with severe acute malnutrition: Summary of African Experience. *Indian Pediatrics* 2010;47:655-659.
13. 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):s49-82.