Original Research Article

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

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ABSTRACT

Background: WHO and UNICEF propose two independent criteria for diagnosing malnutrition in children aged 6-60 months, viz. mid upper arm circumference and weight-for-height. However, both these criteria do not identify same set of children as having malnutrition, and using only one of the diagnostic criteria proposed by WHO may potentially leave some high-risk children untreated. Therefore, the purpose of this study was to determine the prevalence of malnutrition by using both mid-upper arm circumference (MUAC) and weight for height (W/H) and their differences among children.
Methods: Cross sectional study carried out in rural and urban areas of Jabalpur district among 1237 children of age group 06-59 months in randomly selected eight ward and two blocks of Jabalpur district. Where 720 children were from urban wards and 517 from rural villages. Multistage random sampling technique was used for the selection of study subjects. Pre-designed and pretested questionnaire was used for interview, Salter's Scale for weighing, non-stretchable Measuring Tape for measuring height and Shakir's tape for mid upper arm circumference.
Results: In rural area, prevalence of malnutrition according to MUAC is 74 (14.3%) while according to w/h is 102 (19.7%). While in urban, prevalence according to MUAC is 104 (14.4%) while according to w/h is 136 (18.9%).
Conclusions: The findings are clear that, prevalence of wasting by W/H is more than by MUAC. With the use of the currently recommended WHO cut-off for MUAC, a significant number of children would not have been identified. A higher cut off value, therefore recommended for screening.

Keywords: Malnutrition, Mid-upper arm circumference, Rural, Urban, Weight for height

INTRODUCTION

The World Health Organization (WHO) and UNICEF propose to use two independent criteria for diagnosing malnutrition in children aged 6-60 months, viz. WHZ and mid-upper arm circumference (MUAC), weight-for-length/height z-score (WHZ) has been used for years in clinical settings for diagnosing SAM (WHO 1999), but

the use of MUAC was introduced more recently with the development of community-based management of severe acute malnutrition (SAM) (WHO and UNICEF 2007).[1-3]

Practically, MUAC is used as diagnostic criteria at community level because it is easy to implement after minimum training to health workers, while w/h is difficult to implement in resource-poor settings including

difficulties in accurately weighing and measuring length in sick children; unavailability of calibrated weighing scales and height boards; the need for reference charts; and the complex calculations to derive and interpret WHZ.

Recognizing these operational difficulties, MUAC <11.5 cm is recognized internationally as an age- and sex-independent diagnostic criterion for SAM, alongside WHZ <-3.

However, MUAC and WHZ do not identify the same set of children as having malnutrition and use of only one the criteria leave some high-risk children untreated. In addition, very few studies have directly compared MUAC <11.5 cm with WHZ <-3. The purpose of this study was to determine the prevalence of malnutrition by using both MUAC and WHZ and their differences among children.

Objectives

To estimate the prevalence of malnutrition by using MUAC as well as W/H among children of age 06-59 months in rural and urban areas of Jabalpur district, Madhya Pradesh, India and to assess whether there were any differences in the children identified by MUAC versus WHZ.

METHODS

It was a cross sectional study conducted among children of age group 06-59 months in rural and urban areas of Jabalpur district, Madhya Pradesh, India.

Sample size for rural area was calculated separately according to the formula:

$$N = \frac{Z^2 pq}{d^2}$$

According to NFHS-4 MP, the prevalence of malnutrition among children under five years of age in rural area of Madhya Pradesh was 45%, taking it as prevalence, with the relative error (d) as 10% of prevalence (P) and Z as 1.96, the sample size for rural area was calculated as 470. After adding 10% non-respondents, the final sample size came out to be 517.[4]

Multistage random sampling technique was used for the selection of study subjects. In rural area, there are 7 blocks, two out of seven blocks were selected randomly. From each block, five-gram panchayats were selected using random table and then from each gram panchayat 52 children were selected using lottery method.

While for urban area, according to NFHS-4 MP, the prevalence of malnutrition among children under five years of age was 37%, taking it as prevalence, with the relative error (d) as 10% of prevalence (P) and Z as 1.96, the sample size was calculated as 654.[4] After adding 10%

non-respondents, the final sample size came out to be 720.

Multistage random sampling technique was used for the selection of study subjects. In the first stage 79 wards under the Jabalpur municipal corporation were listed. 8 out of the total 79 wards were randomly selected. From each of the 8 wards three anganwadi centres were selected randomly. All the children in the age group 06-59 months from each anganwadi centre were enlisted. Using lottery method 30 children were selected randomly from each anganwadi centre. Pre-designed and pretested questionnaire was used for interview, Salter's Scale for weighing, non-stretchable measuring tape for measuring height and Shakir's tape for mid upper arm circumference.

Data collection technique

Face to face interview of the mothers or the primary care giver of the child was conducted after explaining the objectives of the study and obtaining the informed consent. Then clinical examination of the child was carried out followed by anthropometric examination. Height and weight measurements were recorded following the standard techniques. The weight was measured using Salter's scale with light clothing and without shoes. Zero error was checked and adjusted before measurements.

The height of the child was recorded with the help of non-stretchable measuring tape. If the child was less than 2 years old recumbent length was recorded and for the child aged 2 years or older or able to stand, standing height was recorded. If a child was less than 2 years old and did not lie down for length measurement, then his/her standing height was measured and 0.7 cm was added to convert it into length. In general, standing height is about 0.7 cm less than recumbent length. If a child aged 2 years or older cannot stand, then their recumbent length measured and 0.7 cm were subtracted to convert it to length.

The new WHO child growth standards for children under 5 years (WHO 2006) were used as reference for median.[5] Nutritional status of children were assessed according to weight for age, height for age, weight for height and BMI for age and sex by standard deviation classification recommended by WHO, as given below:

As per WHO classification undernutrition/malnutrition was given as Cut-off level= Weight for height, ≥ Median -2SD= Normal, <Median -2SD to Median -3SD= Moderate wasting, <Median -3SD= Severe wasting.[5]

Mid upper arm circumference

The MUAC was recorded using Shakir's Tape. Children with MUAC 11.5 cm to 12.4 cm were considered as mildly malnourished and those less than 11.5 cms were considered as severely malnourished.[5] MUAC was

compared with WHZ based on the 2006 WHO growth standards for predicting the outcome. Severely ill children and whose parents were not willing to participate in the study were excluded from the study.

Data thus obtained was coded and entered into Microsoft excel worksheet. This was analyzed using Epi Info™ 7.1.5 and SPSS 20.0 (free trial version). For determining the association Chi-square test, odds ratio was applied for each of the factor. The statistical significance was evaluated at 5% level of significance. p value less than 0.05 was considered as statistically significant. Microsoft office word 2007 and Microsoft office excel 2007 were used to generate tables.

RESULTS

In the present study comprising of 517 children aged 06-59 months from rural area, 273 (52.8%) were males and 244 (47.2%) were female children while in urban area out of 720 children 351(48.7%) were male and 369 (51.3%)

were female. With regards to age distribution it was observed that highest children were found in 25-36 months in both rural and urban area. Majority of the children were Hindu by religion followed by Muslims and Christians. With regards to socio-economic status, in rural area, majority 228 (44.1%) of children belonged to class V according to modified BG Prasad's classification.[6] While in urban area, majority belongs to class I-IV.

In this study, in rural area, prevalence of malnutrition according to MUAC is 74 (14.3%) of which 17 had severe malnutrition (3.2%) while malnutrition according to w/h is 102 (19.7%) of which 32 (6.2%) had severe malnutrition.

While in urban, prevalence of malnutrition according to MUAC is 104 (14.4%) of which 34 had severe malnutrition (4.7%) while malnutrition according to w/h is 136 (18.9%) of which 37 (5.1%) had severe malnutrition.

Table 1: Socio-demographic characteristics of the study population.

Socio-demographic characteristics	Rural (n=517)	Urban (n=720)	Total (n=1237)
	N (%)	N (%)	N (%)
Gender			
Male	273 (52.8)	351 (48.7)	624 (50.4)
Female	244 (47.2)	369 (51.3)	613 (49.5)
Total	517 (100)	720 (100)	1237 (100)
Age (in months)			
06 to 12	61 (11.8)	95 (13.2)	156 (12.6)
13-24	102 (19.7)	149 (20.7)	251 (20.3)
25-36	126 (24.4)	191 (26.6)	317 (25.6)
37-48	123 (23.8)	158 (21.9)	281 (22.7)
49-59	105 (20.3)	127 (17.6)	232 (18.8)
Total	517 (100)	720 (100)	1237 (100)
Religion			
Hindu	500 (96.7)	691 (96)	1191 (96.3)
Muslim	17 (3.3)	28 (3.9)	45 (3.6)
Christian	0 (0.0)	1 (0.1)	1 (0.1)
Sikh	0 (0.0)	0 (0.0)	0 (0.0)
Total	517 (100)	720 (100)	1237 (100)
Socio-economic class (monthly per capita income)			
Upper class (Rs. 6346 and above)	7 (1.4)	14 (1.9)	21 (1.7)
Upper middle class (Rs. 3173-6345)	11 (2.1)	32 (4.5)	43 (3.5)
Middle class (Rs. 1904-3172)	54 (10.4)	135 (18.8)	189 (15.3)
Lower middle class (Rs. 952-1903)	217(42)	333 (46.2)	550 (44.5)
Lower class (≤951)	228(44.1)	206 (28.6)	434 (35)
Total	517 (100)	720 (100)	1237 (100)

Table 2: Distribution of study population according to W/H criteria of WHO classification of malnutrition in rural and urban area.

Indices	Area	Undernourished (<-2 SD to -3 SD score), N (%)	Severe undernourished (< -3SD score), N (%)	Total, N (%)
Wasting (weight for height)	Rural	70 (13.5)	32 (6.2)	102 (19.7)
	Urban	99 (13.7)	37 (5.1)	136 (18.9)

Table 3: Distribution of study population according to MUAC criteria of WHO classification of malnutrition in rural and urban area.

Indices	Area	Undernourished (11.5 cm to 12.4 cm), N (%)	Severe undernourished (<11.5 cm), N (%)	Total N (%)
MUAC	Rural	57 (11)	17 (3.2)	74 (14.3)
	Urban	70 (9.7)	34 (4.7)	104 (14.4)

Table 4: Sensitivity and specificity of different cut off value for MUAC in rural and urban area.

S. no.	MUAC (cm)	Sensitivity (%)	Specificity (%)	PPV (%)	NPV (%)	Positive likelihood ratio	Negative likelihood ratio
Rural							
1	<11.5	10.8	98	65	82	7.5	0.90
2	<12.5	20.6	87	28	82	1.6	0.91
3	<13.5	73	46	25	88	1.4	0.57
Urban							
1	<11.5	25	100	100	85	Undefined	0.75
2	<12.5	75	99	98	94	219	0.25
3	<13.5	98	45	29	98	1.79	0.04

The median MUAC was 13·56 of rural area and 13.21 of urban area.

In rural area, MUAC <11.5cm was seen in 17 (3.2%) children; of these, 11 (2.1%) had MUAC <11.5 cm but WHZ ≥-3, while 6 children (1.2%) had both WHZ<-3 and UAC <11.5 cm.

A total 26 (5.02%) of children with WHZ <-3 had MUAC ≥11.5 cm.

While in urban area, MUAC <11.5 cm was seen in 34 (4.7%) children of these 3 (0.4%) children have WHZ <-3 and MUAC ≥11.5 cm and 34 children (2.1%) had both WHZ <-3 and MUAC <11.5 cm. It is clearly observed that percentage of malnutrition according to w/h is more than MUAC.

Table is showing that sensitivity of higher cut off value is higher as compare to lower cut off value for MUAC in both rural and urban area.

DISCUSSION

In this study, in rural area, prevalence of malnutrition according to w/h is 102 (19.7%) of which 32 (6.2%) had severe malnutrition while according to MUAC is 74 (14.3%) of which 17 had severe malnutrition (3.2%).

In urban, prevalence of malnutrition according to MUAC is 104 (14.4%) of which 34 had severe malnutrition (4.7%) while according to w/h is 136 (18.9%) of which 37 (5.1%) had severe malnutrition.

So according to this study, detection of malnutrition by W/H criteria is more than MUAC which is in concordance with other studies. And by comparing

different cut off value for MUAC alone we have found that sensitivity of higher cut off value of MUAC is higher as compare to lower cut off value for MUAC in both rural and urban area which is also in concordance with other studies.

A study done by Dukhi et al, found W/H to be a more sensitive measure.[7] At a facility level W/H is considered the anthropometric measure of choice in children aged 0-59 months as nurses are trained in obtaining this measure. At the household level MUAC is preferred as a quick and easy measuring tool. This further suggests that the use of MUAC alone can possibly mask malnutrition problems in children. Therefore, use of both anthropometric indices is recommended to ensure all age groups are correctly identified for malnutrition.

Oleg B et al, also found prevalence of wasting by WHZ exceeded prevalence by MUAC in 543 (74.1%) surveys and median prevalence by WHZ was greater in 30 (73.17%) countries.[8]

Findings of this study are also collaborated with the study done by Hossain IM et al, who observed that with the use of the currently recommended WHO cutoff 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 cutoff was used.[9] According to study done by Sachdeva S et al, the findings are clear that, MUAC was found to be a significantly better predictor of mortality compared with WHZ<-3.[10] WAZ was also identified as an independent predictor of mortality. MUAC <11.5 cm and WHZ <-3 identify different sets of children with only partial overlap; using MUAC <11.5 cm as the sole criterion missed one third of

children at risk of dying but identified those at higher risk of mortality.

Similarly, Dairo et al, observed that MUAC was a poorly sensitive indicator of under nutrition at a cut-off below 13.5 cm but highly sensitive at 15.5 cm.[11] A higher cut off value is therefore for recommended for screening for acute malnutrition among under five children. Experience from Faso B, has suggested that, as an admission criterion for SAM, the use of a cutoff of 118 mm for MUAC was a useful alternative to the WHZ.[12]

A study done by Kumar et al, also concluded in his study that optimum cut off level of MUAC in their setting were higher than the conventional cut off points for detection of undernutrition among children.[13]

Study by Fernandez et al, confirms the need to change the MUAC cutoff value from <110 mm to <115 mm.[14] This increase of 5 mm produces a large change in sensitivity (from 16% to 25%) with little loss in specificity, improves the probability of diagnosing severe wasting, and reduces false-negative results by 12%.

CONCLUSION

The findings are clear that, prevalence of malnutrition by W/H is more than prevalence of malnutrition by MUAC and 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. A higher cut off value is therefore recommended for screening acute malnutrition among under five children.

ACKNOWLEDGEMENTS

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