ORIGINAL ARTICLE

Mid-Upper Arm Circumference: Simplifying Maternal Nutritional Status Assessment - A Secondary Data Analysis from Nutrition Rehabilitation Centres

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ABSTRACT

Background: Maternal undernutrition is a major global public health issue, linked to increased morbidity and mortality for both mothers and children. It contributes to an intergenerational cycle of malnutrition, where maternal health directly affects child health. In India, Nutrition Rehabilitation Centres (NRCs) offer residential care for children with severe acute malnutrition (SAM) and also address maternal malnutrition, anaemia, and related co-morbidities. **Aims & Objectives:** 1. To assess the nutritional status of mothers of SAM children attending NRCs of Sambalpur district. 2. To evaluate MUAC as a simpler alternative tool to detect maternal malnutrition in comparison to BMI. **Methodology:** Retrospective Record-based study was conducted at NRCs of Sambalpur District. Data was collected from June to August 2023 at NRCs, documenting anthropometric details of mothers of SAM children at time of admission. Data was entered into MS Excel and analysed using SPSS version 21. **Results:** Out of the 935 mothers registered at NRC Burla and Sambalpur, 30.5% had short stature (<145 cm), while 34.0% and 49.7% were classified as thin based on BMI and MUAC, respectively. **Conclusion:** Over 60% of mothers of SAM children were malnourished, with 34% thin and 14.5% severely thin, underscoring the need for focused maternal nutrition support.

KEYWORDS

Body Mass Index, Maternal Health, Nutritional Status, Rehabilitation Centres, Severe Acute Malnutrition

INTRODUCTION

Maternal undernutrition has been a long-standing public health concern globally due to its adverse consequences on maternal and childhood mortality. (1) Assessment of nutritional status becomes of utmost importance for ensuring optimal health outcomes for both mother and child. In any Low-and-Middle-Income Countries (LMIC) like India, nutrition related facts and issues have not been adequately addressed.

As per NFHS-5 (2019–21), 18.7% of women aged 15–49(yrs) in India is undernourished, with a higher rate of 20.8% in Odisha. Undernutrition among children under five is reported at 7.7%. (2) The Government of India under the National Health Mission came up with 1151 NRCs established across the country to provide Facility-based Care for children with SAM. (3) In the NRC, the child is given treatment and management for medical complications, appropriate feeds based on locally available foods, and monitored round the clock. (3) BMI is the most commonly used method to assess maternal nutrition but requires trained personnel and equipment. Thus, MUAC may be proposed as a single step alternative if there is good conformity

with the nutritional status. It can help save time of field level health care personnel. While child malnutrition is discussed in several studies whereas limited literature exists on maternal malnutrition.

AIM: To highlight the nutritional status of mothers of SAM children at NRCs.

OBJECTIVES:

- To assess the nutritional status of mothers of SAM children attending Nutritional Rehabilitation Centres of Sambalpur district.
- To evaluate MUAC as a simpler alternative tool to detect maternal malnutrition in comparison to BMI.

MATERIAL & METHODS

Study Type & Study Design: This was a retrospective record-based study.

Study Setting: The study was conducted at Nutritional Rehabilitation Centres attached to District Headquarter Hospital, Sambalpur and Veer Surendra Sai Institute of Medical Sciences and Research (a teaching medical college hospital). Both the NRCs are in the district of Sambalpur in the state of Odisha in Eastern India.

Study Population: All 935 mothers of the admitted SAM children at the two selected NRCs during the period of April 2019 to March 2023 were enrolled as study subjects.

Study Duration: The project continued between June to August of 2023.

Strategy for Data Collection: Available Maternal Screening Registers for the financial years of 2019-2020, 2020-2021, 2021-2022 and 2022-2023 were scrutinised. The recorded data of the mothers were extracted using predesigned data extraction sheets. The data on anthropometric and biochemical measurements were obtained from the NRC records. Weight was measured using SECA weighing scales (model 874, Germany) with at least 100 g gradation. Height was recorded using UNICEF SECA stadiometer (model 216, Germany) with 0.1 cm gradation and MUAC using MUAC tape (procured from UNICEF supply department) with a gradation of 0.1 cm.

Recorded anthropometric data of the mothers like Weight, Height, MUAC were extracted. BMI was calculated from the recorded height and weight variables. The measurement of height, weight and MUAC was found to corroborate with standard procedures carried out by trained staff at the NRCs using standard tools.

Working Definitions: The reference normal for BMI in WHO ASIAN-PACIFIC guidelines i.e. 18.5-22.9 kg/m² was applied for analysis. (4) The mothers were categorized into the three categories as per UNICEF Guidelines on Maternal Nutrition Care at NRC, "Not at nutritional Risk" "At Some Nutritional Risk" "At Severe Nutritional Risk".(5)

Criteria	Not at nutritional Risk	At Some Nutritional Risk	At Severe Nutritional Risk
Age (years)	≥20	<20	
Height (cm)	≥145	<145	
BMI (kg/m2)	18.5-22.9	23-24.9(over-weight)	≥25 (0bese)
		16-<18.5(thin)	<16 (severe thin)
MUAC (in cm)	23-25.9	26-30	>30
		19-22.9	<19

Ethical Approval & informed consent: Ethical approval was obtained from Institute Ethics Committee (IEC) (Reference number 184-2022) before commencement of this study. Permission to access the records was obtained from the authorities prior to data collection.

Data Analysis: The data was entered in Microsoft Excel 2007 and analysed using IBM SPSS version 21(PASW statistics for Windows, Chicago, SPSS Inc.). Appropriate descriptive statistics like percentage, mean, standard deviation were calculated. The correlation between MUAC and BMI was determined using the Pearson Correlation and Simple Linear Regression. The diagnostic accuracy of the MUAC was determined using Receiver Operating Characteristic (ROC) Curve Analysis. Optimum cut off point of MUAC was determined using BMI as reference and ROC curve of MUAC was plotted against BMI cut off value of below 18.5 kg/m². The Area under curve (AUC), Positive Predictive Value (PPV) and Negative Predictive Value (NPV) were calculated

RESULTS

Table 1: Maternal demography and anthropometric profile (n= 935)

Variable	Mean ± SD	Category	Number	Percentage
Age (in year)	26.8 ± 4.3	<20	45	4.8
		21-30	755	78.6

		>30	145	16.6
Height (in cm)	148.5 ± 6.1	Short (<145)	285	30.5
		Normal (>145)	650	69.5
BMI (in kg/m2)	19.1 ±3.3	<16	136	14.5
		16-<18.5	318	34
		18.5-22.9	365	39
		23-24.9	61	6.5
		>=25	55	6
MUAC (in cm)	22.5 ±3.8	<19	90	9.6
		19-22.9	465	49.7
		23-25.9	263	28.1
		26-30	103	11.1
		>30	14	1.5

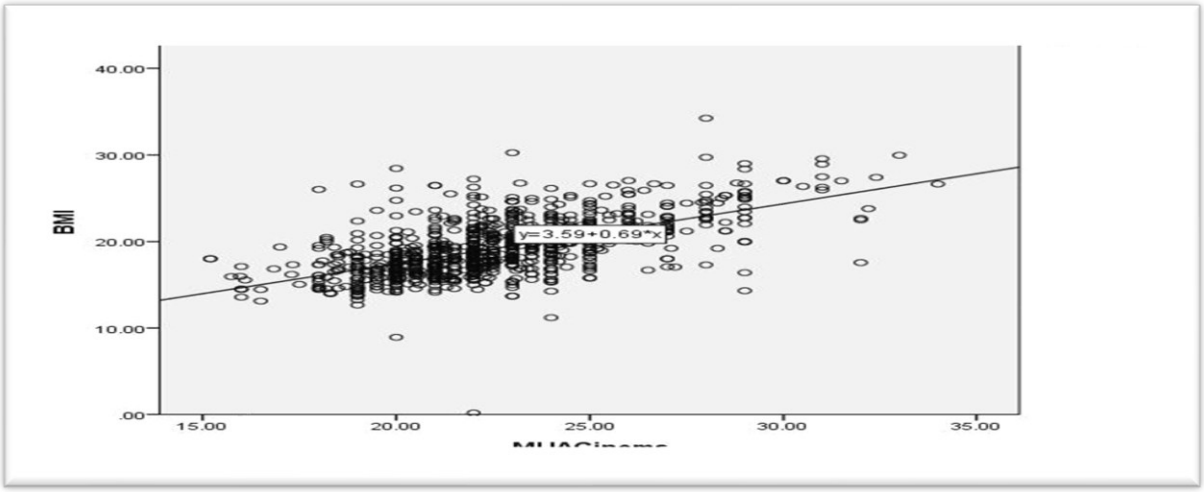
Anthropometric profile of 935 mothers registered for admission and care of their children at the two functional NRCs in the Sambalpur District in the state of Odisha is presented in table.1. The mean age of the enrolled mothers was 26.8 years. 51.7% belonged to 25-30 years age group. The mean height of the mothers was 148.5 cm. 30.5% were of short height (below 145cm) and were 'at nutritional risk' of developing malnutrition. By BMI 14.5% were severely thin (BMI<16 kg/m2) and 34% have BMI between 16-18.5 kg/m2 accounting for 48.5% of wasting out of the total. However, by MUAC, 49.7% were malnourished (MUAC <23cm) and 9.6 % were severely malnourished (MUAC <19cm). As per MUAC the burden of malnutrition is little higher compared to BMI i.e. 59.3%. Overweight and obesity was documented at around six percent with BMI> 23 kg/m2 and >25 kg/m2 respectively.

Table 2: Nutritional Risk assessment as per UNICEF Guidelines (n=935)

Criteria	Category	Percentage
	At risk	4.8
Age (years)	No risk	95.2
	At risk	30.5
Height (cm)	No risk	69.5
	At Severe nutritional risk	20.5
BMI (kg/m^2)	At Some nutritional risk	40.5
	No risk	39
	At Severe nutritional risk	11.1
MUAC (cm)	At Some nutritional risk	60.8
	No risk	28.1

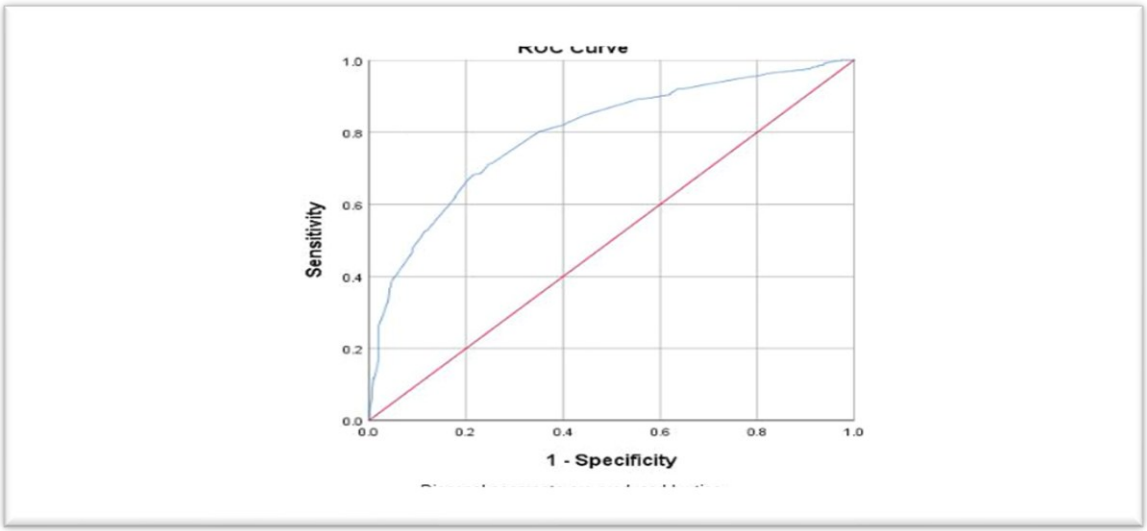
Table 2 shows the nutritional risk assessment of all study participants as per UNICEF. BMI wise 20.5% mothers were at severe nutritional risk and 40.5 % were 'at some nutritional risk'. Similarly, MUAC assessment classified 60.8 % mothers as 'at some nutritional risk' and 11.1% mothers as 'at severe nutritional risk'.

Figure 1. Graph showing correlation between MUAC and BMI using linear regression



The linear regression analysis between MUAC and BMI (as dependent variable) revealed significant positive correlation(r=0.60, p=0.000).The relationship between MUAC and BMI has been expressed using the equation 'BMI= 0.69 X MUAC +3.59'.In the present study, Receiver Operating Characteristics curve analysis was done using WHO BMI cut-offs and it was found to be 22.05cm with sensitivity of 74.4%, specificity 71.55%, PPV 70.8% and NPV=75.1% of with a good predictive value (AUROCC=0.79,CI=0.769-0.826)[Fig.2.]

Figure 2. ROC curve analysis showing performance of MUAC to detect maternal undernutrition



DISCUSSION

Data of 935 mothers of SAM children admitted at the two NRCs over a period of last 4 years were extracted from records and analysed. Applying the WHO BMI cut off, 61% of the mothers had malnutrition. Applying the MUAC cut off (below 23cm) 72% had malnutrition. Choedon et al in a study in New Delhi had reported 21% and 35% malnutrition prevalence amongst the mothers of SAM children attending NRC using BMI and MUAC criteria respectively.(6)Bhatia et al reported in NRC setting in Bhopal in 2018 reported that 57.7% of mothers were having BMI <18.5 kg/m^2 and 17% were severely thin.(7)Discordant finding in the studies quoted may be attributed to subtle variations in the sample size and sampling design applied.

Few community-based studies were referred to analyse the prevalence of maternal malnutrition. Findings from such a study by Bose et al in a tribal community revealed that 55.3% of the mothers to have BMI below 18.5 kg/m2 and 51.2% to have a MUAC below 22cm. (8) The mean BMI of the present maternal study population was found to be below normal range. Nguyen et al reported that 31.7% of the women having BMI below 18.5 with a mean MUAC value of 24.4±2.1.(9)Another study conducted at Sudan reported only 12.9% of the women were having BMI below normal range which is much less compared to our study.(10) The sizable variation in the prevalence rates in the studies quoted may be attributed to variations in terms of socioeconomic condition, genetics, ethnicity, and nutritional factors.

Our study showed a strong positive correlation between BMI and MUAC values with a correlation coefficient of 0.6(P value<0.001). Several other studies in India and abroad corroborate the present figures. (8-12

) MUAC is an easy, practicable, simple, easily portable, and inexpensive tool to assess adult nutritional status since it avoids calculations. BMI estimation costs about 1500 times that of MUAC measurement as reported from Ethiopia. (12) It needs more time for BMI estimation than for MUAC measurement in a mother. (13)A cut off value for MUAC of 22 cm corresponded with best trade-off between sensitivity (71.55%) and specificity (74.4%), which is like that suggested by WHO for Asian population. Nevertheless, Nguyen et al proposed a MUAC cut off 23.5 cm having 89% sensitivity and 71% specificity to differentiate normal population from those having undernutrition. (9)

CONCLUSION

Over two third of the mothers of NRC admitted children were found to be undernourished. There is significant positive correlation between MUAC and BMI values. We found a MUAC cut off of 22.05 cm

which aligns with WHO recommendation for maternal MUAC.

Recommendation

MUAC can be reliable, handy, and inexpensive tool that can be easily incorporated in primary care set up for evaluation for nutritional status. NRCs can be utilized to identify and correct maternal malnutrition as very high proportion of mothers were found to be undernourished amongst the NRC admitted children.

LIMITATION OF THE STUDY

Assumption of linearity in regression analysis may be a limitation as nonlinear relationship may exist between BMI and MUAC. A larger sample size from multiple NRCs will a more reliable result. The measurement method may not be used as a screening tool in the community since it has only been evaluated among the mothers of children admitted to NRCs.

RELEVANCE OF THE STUDY

There is a high prevalence of maternal undernutrition among the mothers of NRC attendees. Mid Upper Arm Circumference (MUAC) can be an alternative tool for measuring nutritional status among these women. Provision of Maternal nutritional intervention can also be programmed as an NRC activity.

AUTHORS CONTRIBUTION:

All authors have contributed equally.

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There are no conflict of Interest.

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