

Vol 46 (2) June , 2021

Print: ISSN 0304-4904  
Online: ISSN 2305-820X



# PAKISTAN PEDIATRIC JOURNAL



**A JOURNAL OF PAKISTAN PEDIATRIC ASSOCIATION**

Indexed in EMBASE/Excerpta Medica, Index Medicus WHO  
IMEMR & Global Health/CAB Abstracts and UDL-EDGE Products and Services

[www.pakpedsjournal.org.pk](http://www.pakpedsjournal.org.pk)

<http://www.pakmedinet.com/PPJ>

## ORIGINAL ARTICLE

# Relationship of Mid-Upper Arm Circumference and Body Mass Index for Assessing Maternal Nutritional Status

ATTIA BARI, AYESHA AYUB, MUHAMMAD MAHAD ALVI, Rashidah Javed, Muhammad Yasin Alvi

Pak Pediatr J 2021; 45(2): 186-91

### ABSTRACT

**Objective:** To determine the relationship of mid-upper arm circumference (MUAC) and body mass index (BMI) for assessing maternal nutrition of children under two years of age admitted with moderate and severe acute malnutrition.

**Study Design:** Descriptive cross-sectional study.

**Place and Duration of Study:** This study was conducted at the Stabilization Center for malnourished children of the Children's Hospital Lahore from June 2018 to December 2019.

**Material and Methods:** A total of 274 mothers accompanying their children admitted for nutritional rehabilitation were included. Demographics of participants along with MUAC and BMI of every mother were taken.

**Results:** Mean maternal age was  $28.14 \pm 5.29$  years. Mean MUAC of mothers was  $25.66 \pm 4.14$  and mean BMI was  $24.08 \pm 5.55$ . Majority {182 (66.4%)} of the mothers were illiterate. Moderate to severe maternal under-nutrition was identified in 36 (13%) and 37 (13.5%) mothers were obese based on MUAC. Similarly 33 (12%) mothers had low BMI of  $<18.5$  and 30 (10%) were obese. A significant positive correlation ( $r^2=0.857$ ) existed between BMI and MUAC values ( $p<0.001$ ).

**Conclusion:** In mothers of malnourished infants both under-nutrition and obesity are prevalent. Both BMI and MUAC showed comparable results in assessing maternal nutritional status.

**Key Words:** *Mid upper arm circumference, Body mass index, Maternal, Children, Nutrition, WHZ-score*

### Correspondence to:

**Attia Bari,**  
Department of Pediatric Medicine,  
The Children's Hospital and The  
Institute of Child Health, Lahore,  
Pakistan

**E-mail:** drattiabari@gmail.com

Received 31<sup>st</sup> December 2020;  
Accepted for publication  
5<sup>th</sup> May 2021

### INTRODUCTION

Good nutrition is considered as a key driver in achieving satisfactory human development.<sup>1</sup> A balanced nutrition is defined as the total amount of food intake in relation to the body's requirement. Malnutrition is a broad term used to define poor health conditions related to either deficiency or excess of one or more nutrients

encompassing under-nutrition at one end of the spectrum and obesity at the other end.<sup>2</sup> It is a problem that has affected the whole world's population especially children, where it constitutes one third of the total 9.7 million child deaths each year. In developing countries the prevalence of malnutrition in children and its associated morbidity and mortality is more as compared to

developed countries. About 26.6% of children are underweight and 32.5% are stunted throughout the world. Out of all the malnourished children, 70 percent belongs to Asia and this is due to combination of biological, cultural and socio-economic factors of this region.<sup>3</sup>

Studies have also shown the direct effect of maternal nutrition on intrauterine fetal growth, fetal outcome and growth of children afterwards because mother and child are considered as one unit.<sup>4</sup> The socio-economic background and education of mother is directly related to the health of under 5 aged children. It is a documented fact that women are more vulnerable to malnutrition as compared to males due to higher nutritional demands in pregnancy and lactation.<sup>5</sup>

There are many ways to assess malnutrition including dietary methods, laboratory methods, anthropometric methods, clinical methods and ecological methods.<sup>6</sup> Out of these, anthropometric methods are considered easy and useful to assess malnutrition and include basal body mass index (BMI), mid-upper-arm circumference (MUAC),<sup>7</sup> weight for age and height for age assessments.<sup>7</sup> For children under 5 years MUAC and assessment of weight for height are recommended by WHO to assess malnutrition.<sup>7</sup> BMI is used as a measure of malnutrition in adults but MUAC can be used both in pregnant and non-pregnant women but it is considered more accurate in pregnant ladies due to weight gain and edema.<sup>8</sup>

Researches from Pakistan on maternal nutritional status, association between maternal BMI and MUAC and especially the nutritional status of mothers having severely malnourished children appear to be scarce in the existing literature. So we planned our research to analyze the maternal nutritional status by using MUAC and BMI, to find correlation between these two parameter.

## MATERIAL AND METHODS

This was a cross-sectional descriptive study, conducted at the Children's Hospital Lahore from June 2018 to December 2019. The participants of the study were children aged 2 months to 2 years admitted for nutritional recovery in the Stabilization Center and their accompanying

mothers. Research project approval was obtained from the Institutional Review Board of the hospital and the parents also gave written informed consent for their participation in the research project. Height, weight, MUAC, and BMI for mothers were the anthropometric measurements of interest.

The categorization of malnutrition was done into severe acute malnutrition (MUAC; <11.5 cm, WHZ score; <-3SD) and moderate acute malnutrition (MUAC; 11.5-12.5 cm, WHZ score; <-2SD). Severe malnutrition <19 cm, moderate malnutrition ≥19 - <22 cm, mild ≥22 - 23 cm, normal 24-27 cm, overweight >27-30 and obese >30 cm are the cut off values for classifying nutritional status of mothers based on MUAC. According to the WHO classification the BMI was graded as: underweight (<18.5 kg/m<sup>2</sup>); normal (18.5-23 kg/m<sup>2</sup>); overweight (24-30 kg/m<sup>2</sup>) and obese (≥30kg/m<sup>2</sup>).<sup>9</sup> The weight of the child was measured on a digital scale (to the nearest 0.1 kg) with the child wearing only light clothing. The length of children with an "infantometer" was measured (to the nearest 0.1 cm). Our trained and experienced staff nurse took all the measurements to reduce the data collection error and the nutritionist conducted the BMI estimate. Using open epi an online statistical tool for sample size calculation and taking the prevalence of malnutrition in children as 23% with 95% confidence interval and a 5% error margin, sample size 274 was calculated.<sup>10,11</sup>

Information was collected about the socio-demographic profile of mother, her level of education and number of children under the age of five years. Sex, exclusive breast feeding until six months and forms of top feeding were included in the child's data. The data analysis was carried out using SPSS-22, Statistical tools. The quantitative variables like BMI, MUAC and age were expressed as mean and SD. Qualitative variables like child's gender; feeding practices and maternal education level were presented as frequency and percentages. Correlation was analyzed between BMI and MUAC and results presented as scatter plot graph. Chi-square test was used to find a meaningful association between the categorical variable and p-value of <0.05 was considered significant.

## RESULTS

The mean age of children admitted for nutritional rehabilitation was  $9.34 \pm 6.50$  months with a male preponderance {153 (56%)}. Exclusive breast feeding rates were very low {49 (18%)} and based on WHZ-score majority {200 (73%)} were in the category of severe acute malnutrition (table 1).

**TABLE 1: Demographic characteristics of children**

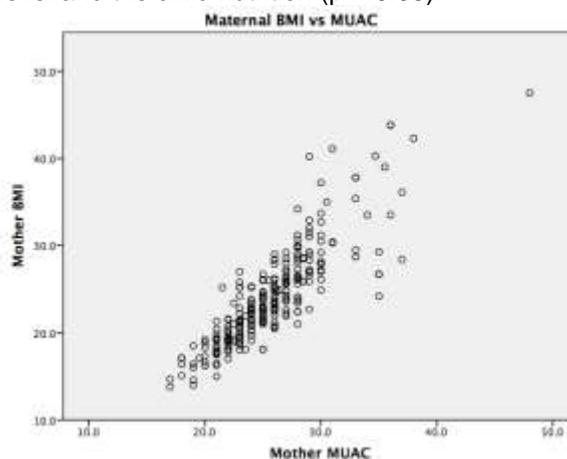
Characteristics	Number	Percentage
<b>Gender</b>		
Male	153	56
Female	121	44
<b>Child's Age (mean <math>\pm</math> SD) 9.34 <math>\pm</math> 6.50 months</b>		
< 6 months	103	38
6months-<1 year	75	27
1 year- 2 years	96	35
<b>Child's feeding</b>		
Breast Fed (BF)	49	18
Top fed only	116	42
B.F & Top	109	40
<b>Child's Nutritional Status based on WHZ score</b>		
<2 SD	74	27
<3 SD	74	27
<4 SD	126	46

**TABLE 2: Demographic characteristics of mothers**

Characteristics	Number	Percentage
<b>Maternal Age (mean 28.14 <math>\pm</math> 5.29 years)</b>		
<20 years	05	02
20-25 years	104	38
26-30	91	33
31-40 years	74	27
<b>Under five children</b>		
01	110	40
02	109	40
03	47	17
04	08	03
<b>Maternal Education</b>		
Primary	41	15.0
Secondary	35	13.0
Graduate	12	4.5
Masters	4	1.5
Illiterate	182	66.0
<b>Maternal MUAC (mean 25.66 <math>\pm</math> 4.14 cm)</b>		
Severe <19 cm	11	04
Moderate 19-21cm	25	09
Mild >21-23 cm	54	20
Normal >23-27 cm	87	32
Over-weight >27-30 cm	60	22
Obese >30 cm	37	13
<b>Maternal BMI (mean 24.08 <math>\pm</math> 5.55)</b>		
Under-weight <18.5	33	12
Normal 18.5-24.9	137	50
Over-weight 25-30	74	27
Obese >30	30	11

The mean age of the mothers was  $28.14 \pm 5.29$  years and majority were illiterate 182 (66%). Based on MUAC 36 (13%) were in the category of moderate to severe underweight as compared to BMI 33 (12%) were in under-weight category. Our 97 (35%) mothers were either overweight or obese based on MUAC as compared to 104 (38%) based on BMI (table 2).

A significant positive correlation ( $r^2=0.857$ ) existed between BMI and MUAC values ( $p<0.001$ ) fig 1. No association was found between maternal and child nutrition status and the maternal education level and the child nutrition ( $p=>0.05$ ).



$r^2: (0.857), (p<0.001)$

**Fig 1: Scatter plot showing correlation of MUAC and BMI**

## DISCUSSION

Malnutrition is a problem that has reported to affect nearly 50% of all the hospitalized children in the world and is a cause of death in 50-60% suffering from diarrhea, pneumonia and measles.<sup>3</sup> The Millennium Development Goals ended in 2015 without achieving the hunger mark as the progress in the battle against hunger has been slow over the years.<sup>2</sup> The prevalence of malnutrition in pediatric wards of England, USA, Germany and France varied from 6.1% to 14% while in Turkey it was reported to be 32%.<sup>12</sup> A study conducted in rural areas of Pakistan showed that 26% of total children were wasted, 55% were stunted and 15% were both stunted and wasted.<sup>13</sup> According to the results of our study majority (73%) children admitted for

nutritional rehabilitation were having severe malnutrition.

A study in different countries of South Asia showed that there is 25% to 50% association of maternal malnutrition with fetal growth retardation and fetal malnutrition, emphasizing the need of assessment and improvement of maternal nutrition for better outcomes.<sup>14</sup> The findings of our research have demonstrated maternal malnutrition in the form of both undernutrition, over-weight and obesity in mothers of malnourished children. Maternal stress, depression and iron deficiency anemia are significant contributing factors towards preterm birth, low birth weight babies and fetal distress in our country.<sup>15</sup>

Based on MUAC 48% of mothers had malnutrition (13% under-nutrition and 35% over weight) as compared to BMI, according to which 50% had malnutrition (12% under-nutrition and 38% over-weight or obese) in our study. Based on MUAC 24% of pregnant mothers were found to be suffering from malnutrition in Ethiopia.<sup>16</sup> Based on BMI more than 20% pregnant women in South Asia were found to be suffering from malnutrition.<sup>14</sup> A study on different groups of female patients showed that BMI is recommended for malnutrition assessment in young girls and lactating mothers but MUAC is considered much better in pregnant females for assessment of maternal malnutrition and subsequent fetal outcome.<sup>8</sup> BMI calculation also need more trained staff as it needs accurate estimation of weight and height and use of formula, as compared to MUAC, where the process and reporting of result is comparatively easy. MUAC is also considered better for nutritional assessment of mothers and children by UNICEF and WHO in emergency settings.<sup>7</sup>

Two third mothers of malnourished children admitted for nutritional rehabilitation were illiterate according to our study showing direct relation of maternal educational status with child health. A similar study from Pakistan also pointed that illiterate mothers have high percentage of stunted and wasted children.<sup>14</sup> A comparative study in Bangladesh and Indonesia showed that 50.7% of children in Bangladesh were stunted while 33.2% were stunted in Indonesia, and in Indonesia greater maternal education was found responsible

for a decrease of 4 to 5% odds of stunning in children.<sup>17</sup> Forty percent children in Nairobi were found stunted and maternal education was a strong predictor in the study along with socio-economic level and maternal health.<sup>18</sup> According to our study mere 18% of infants were exclusively breast fed. A study in Vietnam showed that improving breast feeding practices and maternal nutritional supplementation is directly associated with better child growth outcomes.<sup>19</sup>

A survey conducted by Mariyam revealed similar findings showing 31.8% of pregnant women were malnourished.<sup>20</sup> An Indian study also showed comparable results where one third of the women were underweight and about 18% were either overweight or obese, indicating both forms of malnutrition in pregnant women.<sup>21</sup> The type of food eaten in resource-poor countries is mainly carbohydrate leading to adult obesity patterns. In a study from Nepal the basic dietary ingredient was cereal intake and more than a quarter of the females were malnourished depicted by a low BMI < 18.5.<sup>22</sup>

**Limitations:** This was a single centered study conducted in a tertiary care hospital and all children were malnourished and majority patients belonged to low social class restricting the generalizability of our findings to other categories of the social class groups and children with normal nutritional status. By gathering data from mothers of normally nourished children, we are expanding our research.

## CONCLUSION

In mothers of malnourished infants both under-nutrition and obesity are prevalent. Both BMI and MUAC showed comparable results in assessing maternal nutritional status. MUAC is a much easy rapid diagnostic tool and a reliable anthropometric method to assess malnutrition in mothers as compared to BMI. This method should be adopted at the community level to assess and improve maternal and child nutrition in Pakistan.

**Conflict of interest:** Nil

## Authors' affiliation

**Attia Bari, Ayesha Ayub, Muhammad Mahad Alvi, Rashidah Javed, Prof. Muhammad Yasin Alvi**  
Department of Pediatric Medicine, The Children's

Hospital and The Institute of Child Health, Lahore, Pakistan

## REFERENCES

- Humbwavali JB, Giugliani C, Nunes LN, Dalcastagné S V, Duncan BB. Malnutrition and its associated factors: A cross-sectional study with children under 2 years in a suburban area in Angola. *BMC Public Health*; 2019; 19(1): 1–11.
- Arthur SS, Nyide B, Soura AB, Kahn K, Weston M, Sankoh O. Tackling malnutrition: A systematic review of 15-year research evidence from INDEPTH health and demographic surveillance systems. *Glob Health Action*. 2015; 8(1): 1–13.
- Khor GL. Update on the prevalence of malnutrition among children in Asia. *Nepal Med Coll J*. 2003; 5(2):113–22.
- Okubo H, Miyake Y, Sasaki S, Tanaka K, Murakami K, Hirota Y et al. Maternal dietary patterns in pregnancy and fetal growth in Japan: the Osaka Maternal and Child Health Study. *Br J Nutr*. 2012; 107 (10): 1526-33.
- Delisle HF. Poverty: The double burden of malnutrition in mothers and the intergenerational impact. *Annals of the New York Academy of Sciences*. 2008. p. 172–84.
- Barbosa-Silva MCG. Subjective and objective nutritional assessment methods: what do they really assess? *Curr Opin Clin Nutr Metab Care*. 2008; 11(3): 248–54.
- Sachdeva S, Dewan P, Shah D, Malhotra RK, Gupta P. Mid-upper arm circumference v. weight-for-height Z-score for predicting mortality in hospitalized children under 5 years of age. *Public Health Nutr*. 2016; 19(14): 2513–20.
- Fakier A, Petro G, Fawcus S. Mid-upper arm circumference: A surrogate for body mass index in pregnant women. *South African Med J*. 2017; 107(7): 606-10.
- Kumar P, Sareen N, Agrawal S, Kathuria N, Yadav S, Sethi V. Screening Maternal Acute Malnutrition Using Adult Mid-Upper Arm Circumference in Resource-Poor Settings. *Indian J Community Med*. 2018; 43(2): 132–134.
- Sullivan KM, Dean A, Soe MM. OPENEPI: A Web-based Epidemiologic and Statistical Calculator for Public Health. *Public Health Rep*. 2009;124 (3): 471-74.
- Asim M, Nawaz Y. Child Malnutrition in Pakistan: Evidence from Literature. *Children*. 2018; 5(60): 1-15.
- Joosten KF, Hulst JM. Prevalence of malnutrition in pediatric hospital patients. *Curr Opin in Pediatr*. 2008; 20(5): 590–6.
- Shah SM, Selwyn BJ, Luby S, Merchant A, Bano R. Prevalence and correlates of stunting among children in rural Pakistan. *Pediatr Int*. 2003; 45(1): 49–53.
- Bhutta ZA, Gupta I, de’Silva H, Manandhar D, Awasthi S, Hossain SMM, et al. Maternal and child health: is South Asia ready for change? *Bmj*. 2004; 328(7443): 816–9.
- Khalid N, Aslam Z, Kausar F, Irshad H, Anwar P. Maternal Malnutrition and Its Kick on Child Growth: An Alarming Trim for Pakistan. *J Food, Nutr Popul Heal*. 2017; 1(3:24): 1–7.
- Gebre B, Biadgilign S, Taddese Z, Legesse T, Letebo M. Determinants of malnutrition among pregnant and lactating women under humanitarian setting in Ethiopia. *BMC Nutr*. 2018; 4(1): 1–8.
- Semba RD, de Pee S, Sun K, Sari M, Akhter N, Bloem MW. Effect of parental formal education on risk of child stunting in Indonesia and Bangladesh: a cross-sectional study. *Lancet*. 2008; 371(9609): 322–8.
- Abuya BA, Ciera J, Kimani-Murage E. Effect of mother’s education on child’s nutritional status in the slums of Nairobi. *BMC Pediatr*. 2012; 12(80): 1-10.
- Huynh DTT, Tran NT, Nguyen LT, Berde Y, Low YL. Impact of maternal nutritional supplementation in conjunction with a breastfeeding support program on breastfeeding performance, birth, and growth outcomes in a Vietnamese population. *J Matern Neonatal Med*. 2018; 31(12): 1586–94.
- Mariyam AF, Dibaba B. Epidemiology of Malnutrition among Pregnant Women and Associated Factors in Central Refit Valley of Ethiopia, 2016. *J Nutr Disord Ther*. 2018; 8(1): 1–8.
- Mastiholi SC, Somannavar MS, Vernekar SS, Yogesh Kumar S, Dhaded SM, Herekar VR, et al. Food insecurity and nutritional status of preconception women in a rural population of North Karnataka, India. *Reprod Health*. 2018;15(1):101-26.
- Bhandari S, Sayami JT, Thapa PSayami M, Kandel BP, Banjara MR. Dietary intake patterns and nutritional status of women of reproductive age in Nepal: Findings from a health survey. *Arch Public Heal*. 2016; 74(1): 1–11.