

Maximum Thigh Circumference in the Surveillance of Protein-energy Malnutrition Among Young Children

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Summary

Ojofeitimi EO, Afolabi OA, Owolabi SP and Oguntade JO. Maximum Thigh Circumference in the Surveillance of Protein-energy Malnutrition among Young Children. *Nigerian Journal of Paediatrics* 1985; 12:37. The usefulness of maximum thigh circumference (MTC) as a potential tool to identify malnutrition was assessed in 700 children aged 7 to 36 months. The coefficients of correlation between MTC and middle upper arm circumference (MUAC) and the weight were 0.92 and 0.90 respectively. The mean MTC values showed no statistically significant sex differences. Based on the weights and MTC values, the children were categorised into four groups: well-fed, undernutrition, kwashiorkor and marasmus. Values obtained for each group were statistically significant. Our findings show that any child aged 7 months or more, whose MTC is below 18.3cm, should be regarded as suffering from occult malnutrition.

Introduction

ANTHROPOMETRY is the cheapest and simplest method of detecting early childhood malnutrition when compared to biochemical, clinical and morphological tests.¹⁻³ An ideal anthropometric measurement should be cheap, sex and age independent and easy to interpret by the auxiliary health workers with minimum education.⁴⁻⁶ Weight for age and middle upper arm circumference (MUAC) are two of the anthropometric

measurements which have been employed to detect occult childhood malnutrition for almost two and half decades.⁷ The former is dependent on age and sex, while the latter is age independent. In an attempt to make MUAC more sensitive, it has been combined with either head circumference or height measurement.³⁻¹⁰ A recent study has however, shown that the MUAC alone, is as sensitive as its combination with head circumference in assessing childhood malnutrition.⁶

The usefulness of the maximum thigh circumference (MTC) as another single anthropometric indicator in identifying hidden malnutrition has not been adequately examined. Maximum thigh circumference of preschool children has nevertheless, been shown to be sex independent, well correlated with MUAC and

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even more sensitive in identifying malnourished children than MUAC.^{5 11} In this study, we have employed MUAC and MTC techniques to detect latent malnutrition among children under the age of three years.

Subjects and Methods

The subjects consisted of 700 children, aged between 7 and 36 months. They were selected evenly from two population groups, namely: apparently healthy and malnourished children. The healthy subjects were randomly selected from among children of high income parents attending Day-Care Centres as well as from children brought to Infant Welfare Clinics for routine immunization. The malnourished group were children manifesting classical symptoms of kwashiorkor, marasmus or undernutrition and referred to the Nutrition Rehabilitation Clinic by paediatricians or health sisters.

Fifty children each, were chosen for both malnourished and well-fed nutritional categories at each age group as shown in Tables I & II. The middle upper arm circumference (MUAC) and weight measurements were carried out as recommended by Jelliffe,⁷ while the maximum thigh circumference (MTC) was measured as described by Zeitlin.¹¹

Data from the two groups were subjected to statistical analysis. Correlations between MTC and MUAC, and between MTC and weight for age were determined. In order to compare the MTC, MUAC and weight variables in the two groups, the MTC, MUAC and weight values observed were subjected to one-way analysis of variance (ANOVA). Also, the MTC values for well-fed children (normal values) and the three patterns of malnutrition (i.e. undernutrition, kwashiorkor and marasmus), which emerged from clinical observations were subjected to one way ANOVA, first within each age group and secondly, among the various age groups. The method used for one way ANOVA is as described by Hewlett-Packard HP67/HP97 Stat Pac 1 software for one way ANOVA.¹²

Results

Table I shows the mean values and standard deviations of MUAC, MTC and weights of both well-fed and malnourished children in defined age groups. The coefficient of correlations between MTC and MUAC, MTC and weight were 0.92 and 0.90 ($p < 0.001$) respectively. There were no significant sex differences for both MTC and MUAC. The MTC, MUAC and weights of well-fed children were regarded as the normal values. Statistical comparison of these values with the malnourished groups shows highly significant differences ($p < 0.001$) (Table I). The mean MTC values show higher absolute value difference between well-fed and malnourished children than the mean MUAC values. Based on our observations, the MTC values could be used to classify the children into four groups, namely: well-fed, undernutrition, kwashiorkor and marasmus. The respective values derived for various age groups between 7 and 36 months of age, are shown in Table II.

Discussion

The results of the present study have demonstrated that MTC is a potential tool for identifying covert childhood malnutrition before it is overt. It has a high correlation ($r = 0.92$) with MUAC. More importantly, it is sex-independent. Another vital advantage in favour of MTC is that it is a reliable indicator of hidden malnutrition as early as seven months among toddlers.⁵ This is a crucial period for infants in developing countries when poor weaning foods are being introduced. The observation that the mean MTC values showed higher absolute value difference between well-fed and malnourished children than the mean MUAC values, confirms an earlier finding by Zeitlin.⁵ The wider value differences of MTC for each age group should aid the community health workers with comparatively little formal education to detect occult malnutrition better than the narrower differences in MUAC values. The MTC for the well-fed group

Maximum Thigh Circumference

TABLE I

Means and Standard Deviations of MUAC, MTC and Weight in Well-fed and Malnourished Children

Age Group (mon)	Nutritional Status	Weight* (Kg)			MUAC* (cm)			MTC* (cm)		
		No of Subjects	Mean	SD	No of Subjects	Mean	SD	No of Subjects	Mean	SD
7-9	Well fed	50	8.25	0.66	50	14.01	0.69	50	24.29	1.34
	Malnourished	49	6.81	1.28	49	11.83	1.09	49	18.19	1.45
10-12	Well fed	49	9.42	0.55	49	14.87	0.63	49	24.10	0.53
	Malnourished	50	6.65	1.40	50	12.18	1.01	50	18.87	1.40
13-15	Well fed	50	10.79	0.81	50	15.10	0.43	49	24.67	0.64
	Malnourished	50	7.30	1.38	50	12.21	0.86	50	19.94	1.20
16-18	Well fed	50	11.05	0.89	50	15.05	0.40	50	25.32	1.19
	Malnourished	50	7.64	1.08	50	12.55	0.80	50	21.23	1.25
19-24	Well fed	50	11.18	0.59	50	15.09	0.36	50	26.03	1.24
	Malnourished	50	7.49	1.29	50	12.23	1.10	50	21.82	1.20
25-30	Well fed	50	11.66	0.55	50	15.28	0.38	50	27.88	1.43
	Malnourished	50	7.98	1.88	50	12.52	0.89	50	21.87	1.48
31-36	Well fed	50	13.62	0.86	49	15.75	0.32	50	28.65	1.11
	Malnourished	50	8.02	1.45	50	12.73	1.13	50	22.85	1.34

MUAC = Mid upper arm circumference

MTC=Mid thigh circumference

SD=Standard deviation

* Differences between mean values in each age group are significant at $p < 0.001$

TABLE II

Maximum Thigh Circumference Values and Classification of Nutritional Status

Age group (mon)	Well-fed			Undernutrition			Kwashiorkor			Marasmus			P
	No of Subjects	Mean (cm)	SD	No of Subjects	Mean (cm)	SD	No of Subjects	Mean (cm)	SD	No of Subjects	Mean (cm)	SD	
7-9	50	24.29	1.34	16	18.26	1.28	13	17.55	0.96	20	16.92	0.43	<0.01
10-12	50	24.10	0.53	20	19.42	0.62	15	18.90	0.77	15	16.92	0.37	<0.001
13-15	50	24.67	0.64	22	20.28	0.87	16	19.82	0.67	12	18.58	1.70	<0.001
16-18	50	25.32	1.19	17	22.26	0.54	18	21.14	0.68	15	19.20	1.27	<0.001
19-24	50	26.03	1.24	7	23.23	0.36	24	22.18	0.85	19	20.82	1.02	<0.001
25-30	50	27.88	1.43	14	21.88	1.08	16	22.30	0.81	20	20.63	0.83	<0.001
31-36	50	28.65	1.11	1	24.60	-	24	23.94	0.88	25	22.12	1.05	<0.001

SD= Standard Deviation

decreased around the 10th to 12th month and thereafter, increased steadily. This decrease suggests that the thigh is a fat storage depot which becomes an energy source when the toddlers start to walk.

As shown in the present study, MTC values for each age group can be used to classify infants into three degrees of malnutrition during the first three years of life which is a period of intensive growth. Unlike the other sex and age independent anthropometric techniques,⁴⁻⁶ which detect hidden infant malnutrition earliest at 12 months of age, MTC is unique in that it does so as early as 7 months. Thus, it can be inferred that any child from age 7 months, regardless of sex, whose MTC is below 18.3cm should be regarded as suffering from occult malnutrition. Therefore, he should be closely monitored for growth and development before his malnutrition becomes overt.

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