Original Research Article

Assessment and comparison of nutritional status in children aged 0-5 years based on WHO and IAP growth charts

Perumalpillai Santhakumaran, Srinivasan Govindaraj*, Sivaraman Thirumalaikumarasamy

Department of Paediatrics, Institute of Child Health and Hospital for Children, Egmore, Chennai, Tamil Nadu, India

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*Correspondence:

Dr. Srinivasan Govindaraj,
E-mail: sppillai26@yahoo.in

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ABSTRACT

Background: The problems of malnutrition among under five children can be used to conclude the necessity for nutritional care, surveillance, or appropriate intervention of nutritional programmes in a community. The objective of the present study was to assess the nutritional status in under 5 children and to compare the nutritional status with WHO and IAP Growth curves and to evaluate the relationship of same with variables like literacy, income of parents, order of birth, sex of the child, birth weight and breast feeding.

Methods: This was a cross-sectional study was carried out in 1052 children aged under 0-5 years hailing from middle and low socio-economic class of an urban population attended to out-patient department and ward in Government Royapettah Hospital and Anaganwadi centres in and around Royapettah during the period of November 2006 to October 2007. Anthropometric measurements such as weight, height/length, middle arm circumference (MAC) were taken for all the children and all the measurements were plotted in the IAP growth chart, WHO growth chart (Z score - 2006), BMI - WHO standards and compared.

Results: Out of 1052 children, majority of the subjects were male children 535 (50.9%). As per IAP guidelines, majority of the children 513 (48.8%) were under normal weight, 5 (0.5%) of them were with very severe malnutrition. According to WHO standards most of the children 623 (59.2%) were under weight and 135 (12.8%) were under severe malnutrition. Positive correlation was observed between the nutritional status of the children with educational and employment status of parents, increasing birth weight and family income. Increasing birth order has a negative influence on nutritional status of the child. Optimally breast-fed babies (Exclusively breast fed for 6 months with appropriate complementary feeds thereafter) have better nutritional status.

Conclusions: The study concludes that utmost care and attention must be focused on child's nutrition by giving priority to education for poor community especially for women, creating awareness regarding benefits of early initiation of breastfeeding and limiting family size.

Keywords: Anthropometric indices, IAP growth charts, Malnutrition, WHO standards

INTRODUCTION

Malnutrition among under five children has been identified as a major health and nutrition problem in India.¹ It occurs particularly in weaklings and children in the first years of life. It is not only an important cause of

childhood morbidity and mortality, but leads also to permanent impairment of physical and possibly, of mental growth of those who survive.^{2,3}

The incidence of malnutrition in India in preschool age children is 1 to 2 percent.² The great majority of cases of malnutrition, nearly 80 percent, are the "intermediate"

ones, that is the mild and moderate cases which frequently go unrecognized. This is primarily due to an inadequate intake of food (food gap) both in quantity and quality and infections, notably diarrhea, respiratory infections, measles and intestinal worms which, increase requirements for calories, protein and other nutrients, while decreasing their absorption and utilization.⁴

The nutritional status of the child can be measured by using anthropometry, a simple valuable tool and the gold standard for evaluating the nutritional status.⁵ In children the three most commonly used anthropometric indices to assess their growth status are weight-for-height, height-for-age and weight-for-age. By using these measurements, growth charts were made for monitoring the children's health and nutritional status.

In 2006, WHO released new standards for assessing the growth and development of children from birth to 5 years of age. The Nutrition foundation of India concluded that the WHO standard is applicable to Indian children.⁶ Deviations of Z-scores less than - 2 SD from the international reference population were used to classify children as moderately low weight for age⁶. Deviation of Z scores less than - 3SD put children in the severe under nutrition category. In the ICDS programme, Harvard unisex growth standards for weight for age modified by the IAP are used for detection of under nutrition in preschool children.

The present study was undertaken to assess the nutritional status in under 5 children, to compare the nutritional status with WHO and IAP Growth curves and to evaluate the relationship of nutritional status with variables like literacy and income of parents, order of birth, sex of the child, birth weight, breast feeding and adequacy of diet.

METHODS

The present cross-sectional study was carried out in children aged under 0-5 years hailing from middle and low socio-economic class of an urban population attended to out-patient department and ward in Government Royapettah Hospital and Anaganwadi centres in and around Royapettah. The study was carried out during the period of November 2006 to October 2007.

1052 children from age group 0 - 5 years were enrolled for the study. The age of the children 0 - 5 years was assessed and confirmed from records. Children who have been registered in the anganwadi and attending the center regularly were included. The study was approved by the Institutional ethics committee. Written consent from the parents of all children. Detailed history of the children was noted in predesigned proforma. Educational status of the parents, income, birth order, birth weight, breast feeding and history of past illness of the child from the mother were also recorded. Anthropometric measurements such as weight, height/length, middle arm circumference (MAC) were taken for all the children and

all the measurements were plotted in the IAP growth chart, WHO growth chart (Z score, 2006) and BMI - WHO standards.

Weight was measured by personal weighting balance with minimum clothing. Children up to 10 kg were weighed by infant weighting scale.¹⁴ Height was calculated by using the tape of non-stretchable fibre glass type. For children between 0-2 years recumbent length was taken by fixing a wooden scale of 1-meter length to the edge of wooden table and a vertical plywood was permanently attached to the edge of a table which was used as the head piece. Another plywood was used for the leg. Children above 2 years were asked to stand on the flat floor, with feet parallel and with heels, buttocks, shoulder and back of the head touching the wall. The head was held erect with eyes in the horizontal plane and arms hanging by the sides, the head piece was brought to the top of the head, with the vertical piece flat against the wall and the horizontal piece crusting the hair and making contact with top of head. Measurements taken nearer 1cm.

MAC is measured by non-stretchable elastic tape. Reading below 12.5 cm indicates severe PEM, 12.5 - 13.5 cm moderate PEM and above 13.5 cm is normal. BMI is calculated by the formulae: weight (kg)/height² (m).

RESULTS

A total of 1052 children were included in the study. Of them most of the children were under the age group of 2-3 years. Majority of the study subjects were male children 535 (50.9%) as shown in Table 1.

Table 1: Age and sex wise distribution of the children's participated in the study.

Age	Sex		Total
	Male children (N)	Female children (N)	
0-6 months	36	30	66
7-12 months	54	56	110
1-2 years	121	90	211
2-3 years	157	159	316
3-4 years	106	118	224
4-5 years	61	64	125
Total N (%)	535 (50.9%)	517 (49.1%)	1052 (100%)

Table 2 shows the distribution of children according to weight for age as per IAP guidelines. Majority of the children 513 (48.8%) were under normal weight. 5 (0.5%) of them were suffering with very severe malnutrition.

Table 3 presents the nutritional status of according to weight for age as per WHO standards (2006). Most of the

children 623 (59.2%) were under weight and 135 (12.8%) were under severe malnutrition.

Table 2: Weight for age according to IAP category.

Grading	% Weight for age	Number of children	%
Normal	>80	513	48.8
Mild malnutrition	71-80	352	33.5
Moderate malnutrition	61-70	162	15.4
Severe malnutrition	51-60	20	1.9
Very severe malnutrition	<50	5	0.5
Total		1052	100

Table 3: Weight for age according to WHO category.

Grading	SD (Z Score)	Number of children	%
Normal	+2SD to -2SD	623	59.2
Moderate malnutrition	-2SD to -3SD	294	27.9
Severe malnutrition	<-3SD	135	12.8
Total		1052	100

Table 4 presents the distribution of children according to MAC category. 558 (63.7%) of children are having normal MAC. About 288 (32.9%) children were under moderate and 30 (3.4%) were under severe malnutritional status. WHO BMI chart was taken as the criteria for assessing nutritional status as given in Table 5. Our study shows that 765 (72.7%) as normal, 192 (18.3%) were

with moderate BMI, and 87 (8.3%) were in the low category. Surprisingly 2 children were overweight and 6 were obese.

Table 4: Distribution of children according to MAC category.

Grading	MAC (cm)	Number of children	%
Normal	13.5	558	63.7
Moderate malnutrition	12.5 - 13.5	288	32.9
Severe malnutrition	<12.5	30	3.4
Total		1052	100

Table 5: BMI status of children according to WHO.

Grading	SD (Z Score)	Frequency	%
Severe malnutrition	<-3SD	87	8.3
Moderate malnutrition	-3SD to -2SD	192	18.3
Normal	-2SD to 2SD	765	72.7
Over Weight	2SD to 3SD	2	0.2
Obese	>3SD	6	0.6
Total		1052	100

Table 6 presents the nutritional status of the children according to fathers and mothers occupation. In the study, about 1001 fathers were employed. Of them 481 children were under normal and 25 children were with severe malnutrition. 121 (11.5%) of the total mothers were employed and 913 were unemployed. Only 15 (12.3%) children of employed mothers and 172 (18%) children of unemployed mothers were moderately and severely malnourished.

Table 6: Nutritional status of the children according to parent's occupation.

Grade	Occupational status of father		Occupational status of mother	
	Employed	Unemployed	Employed	Unemployed
Normal	481	32	63	450
Mild malnutrition	340	10	43	309
Moderate malnutrition	155	5	14	148
Severe malnutrition	20	0	1	19
Very severe malnutrition	5	0	0	5
Total	1001	47	121	931

Table 7: Nutritional status of the children according to parent's educational status.

Educational status of parents	Father (n=1048)		Mother (n=1052)	
	High school and above (n=513)	Primary and below (n=535)	High school and above (n=441)	Primary and below (n=611)
Malnourished	224	311	245	343
Severe malnutrition	1	4	-	-

Out of 1048 children (4 fathers expired) 513 fathers have acquired high school and above qualification. 224 of 513 children (43.7%) were malnourished. But when the father's educational status was primary (535 fathers) 311 children (58%) were malnourished. Out of 5 children with very severe malnutrition, 4 were children of fathers with poor literacy. Regarding maternal education 441 mothers have obtained high school and above qualification and the prevalence of malnutrition among these literate mothers was 44.4% (245 children out of 441). But when the mother's educational status was primary or less the prevalence of malnutrition was 56% (343 out of 611 children).

Nutritional status of children in relation to family income was given in Table 8.

Majority of children 720 (46.2%) participated in the study were under the group of family income <2000 per month. Of them 333 were in normal status and 17 were under severe and very severe malnutrition. Most of the children 180 (54.2%) who are under the group of family income >2000 were in normal and 7 were under severe malnutrition status.

Table 8: Nutritional status of the children according to family income.

Grade	Family income	
	< Rs.2000	> Rs.2000
Normal	333	180
Mild malnutrition	250	102
Moderate malnutrition	119	43
Severe malnutrition	13	7
Very severe malnutrition	5	0
Total	720	332

51.1% of first born babies and 49.8% of 2nd born babies were having normal weight, but only 38% of higher order birth (3 and above) were in the normal category.

The prevalence of mild and moderate malnutrition was 61% in the higher order birth group, in contrast the prevalence of mild and moderate malnutrition was 46.8 and 47.2% respectively in the 1st and 2nd order birth group (Table 9).

Table 9: Nutritional status of the children in relation to birth order.

Grade	Birth order in %		
	1	2	3+
Normal	51.1	49.7	38
Mild malnutrition	34.1	29.7	43.6
Moderate malnutrition	12.7	17	16.9
Severe and very severe malnutrition	2.1	2.9	1.4
Total percentage (number of children)	100 (440)	100 (470)	100 (142)

In our study when the birth weight was more than 2.5 kg 54.6% of Children were in the normal weight category with progressive decline in the birth weight, the percentage of children in the normal weight category also declined to 39% (Table 10).

Table 10: Nutritional status of the children in relation to birth weight.

Grade	Birth weight (kg) in %		
	< 2	2-2.5	>2.5
Normal	39	40.1	54.6
Mild malnutrition	51.2	37.5	29.9
Moderate malnutrition	9.8	20.3	12.8
Severe malnutrition	0.0	2.1	1.9
Very severe malnutrition	0.0	0.0	0.8
Total percentage (number of children)	100 (41)	100 (379)	100 (632)

Babies who were less than 6 months of age were excluded from the analysis for calculating duration of expressed breast milk (EBM). Out of the remaining 986, 391 babies (39.6%) have received optimum 6 months exclusive breast feeding. Only 109 (27.8%) children were malnourished with ideal 6 months EBM. Only 2 children (0.5%) were severely malnourished and none were very severely malnourished. With inadequate breast feeding (EBM <3 months) the prevalence of malnutrition was 68% (32 out of 47 children), severe malnutrition was 19% and very severe malnutrition was 6%. With prolonged breast feeding (EBM >8 months) and delayed complementary feeding the prevalence of malnutrition was 50%, severe and very severe malnutrition was 7% and 1.7% respectively as given in Table 11.

Table 11: Nutritional status of the children in relation with duration of exclusive breast feeds.

Grade	Duration of exclusive breast feeds in months					
	3 and less	4-6	6	7	8 and above	Total
Normal (%)	15 (31.9)	73 (29)	282 (72.3)	64(26)	28 (50)	462 (46.8)
Mild malnutrition (%)	13 (27)	127 (50.5)	70 (18)	122(50.6)	13 (23)	345 (34.9)
Moderate malnutrition (%)	7 (15.3)	49 (19.5)	37 (9)	54 (22)	10 (17)	157 (15.9)
Severe malnutrition (%)	9 (19)	1 (0.4)	2 (0.5)	1 (0.4)	4 (7)	17 (1.7)
Very severe malnutrition (%)	3 (6)	1 (0.4)	0 (0)	0 (0)	1 (1.7)	5 (0.5)
Total no. (%)	47 (100)	251 (100)	391 (100)	241(100)	56 (100)	986 (100)

Figure 1 presents the percentage difference of malnutrition in children according to IAP and WHO classification. The percentage of moderate malnutrition, was 15.4% and the percentage of severe malnutrition was 2.4% (25 children), as per IAP classification. The percentage of moderate malnutrition and severe malnutrition according to WHO's SD score were 27.9% and 12.8% respectively.

Figure 1: IAP/WHO malnutrition percentages.

DISCUSSION

In our study, a total of 1052 children were enrolled. Of them 535 (50.9%) were males and 517 (49.1%) were females. Male preponderance was observed in the study. This was similar to the studies of Singh et al.⁷

In the present study, the prevalence of malnutrition according to Indian Academy of Pediatrics (IAP) classification observed in 539 (51.2%) children. Ghosh et al, in their study of urban slum children in Calcutta (1994) reported a similar value of 51% prevalence of malnutrition.⁸

Using WHO growth reference (2006) the percentage of malnourished children in our study was 40.8% (429 children). Bhandari et al, in their study using WHO standards the prevalence of underweight was noticed in 43.67% which closely correlates with our study.⁹ Other authors Sachdev et al., in their survey of under 5 children in 1995 has reported percentage of malnourished as 61.2%.¹⁰ Rama Rao et al in their study of nutritional status of children in north east India has reported the prevalence of underweight as 37%.¹¹

In this study, the nutritional status of children was also assessed using MAC as criteria and revealed 63.7% (558 children) were in the normal category (MAC >13.5 cm), 228 children (32.9%) were moderately malnourished (MAC 12.5-13.5 cm) and 30 children (3.4%) were severe malnourished (MAC < 12.5 cm). Similar observation was made by Gunasekaran et al in their study in which 66% were normal Children, 32% were moderate malnourished and 2% were severely malnourished.¹²

By using body mass index (BMI), WHO BMI chart as the criteria for assessing nutritional status, our study shows 72.7% (765 children) as normal. 18.3% (192 children) and 8.3% (87 children) were in the low (<-2SD to -3SD) and very low category (<3SD). Surprisingly 2 children were overweight and 6 were obese. Gunasekaran et al in their study has reported 57% children were moderately under nourished and 31% as severely under nourished using BMI as criteria.¹²

In our study only 47 fathers were unemployed and we couldn't find any statistically significant relations between nutritional status of the child and father's employment. Rama Rao et al observed that father's background seems to have little impact on the nutritional status of children.¹¹ 121 (11.5%) of the total mothers were employed. Only 15 (12.3%) children were moderately and severely malnourished. But 172 (18%) children of the 931 unemployed mothers were moderate and severely malnourished. This determines that mother unemployment had shown an impact on nutritional status of the children.

Parent's educational status also plays a very important role in the development of healthy child. In the present study, 224 out of 513 children (43.7%) of whose fathers having high class and above education qualification were malnourished and 311 children (58%) out of 535 fathers with primary educations status were malnourished. Ray et al reported substantial differences in the prevalence of malnutrition among children belonging to illiterate fathers (74.76%) and literate fathers (57.28%).¹³

Mothers education was found to have strong impact on child's nutritional status. 441 mothers have obtained high school and above qualification and the prevalence of malnutrition among these literate mothers was 44.4% (245 children out of 441). Children's of illiterate and poor educational status mothers were more malnourished 56% (343 out of 611 children) compared to the above. This might be due to the reason that higher educated women can take independent decisions and more aware about proper nutrition, maintenance of hygiene, and various health issues as compared to illiterate or less educated women. Earlier studies have also documented the same on children's health status.¹⁴⁻¹⁶

In our series, 720 children were under the lesser income group. Of them 387 (53.7%) were malnourished and all the 5 children with very severe malnutrition were also in the same income group. Similar association of socio economic status and malnutrition was observed in the study of Bhandari et al.⁹

In this study, the prevalence of mild and moderate malnutrition was 61% in the higher order birth group, in contrast the prevalence of mild and moderate malnutrition was 46.8 and 47.2% respectively in the 1st and 2nd order birth group. This might be due to the

reason that children with higher birth order get lesser attention and care compared to children of first order. This observation was in accordance with the studies of Elkholy et al.¹⁷

In our study, it was noticed that 45.4% of children were malnourished, in relation to the birth weight less than 2.5 kg. With progressive decline in the birth weight, the percentage of children with malnutrition was also increased to 61% in comparison with overall 51.2% of our study. Rama Rao et al in his study noticed that Babies who were small at birth, tended to have a lower nutritional status.¹¹

Prema et al studied the relation between prevalence of under nutrition and infant feeding practices.¹⁸ Too early introduction of milk substitutes (in the 3-5-month age group) and too late introduction of complementary feeds (in the 6-8-month age group) are associated with lower mean weight. Ghosh et al also reported lack of introduction of semi solids and lack of EBM in the first 6 months as possible etiological factors for malnutrition.⁸ The results of our study corroborate with the above statements. With prolonged breast-feeding EBM >8 months and delayed complementary feeding the prevalence of malnourished observed was 50%. The percentage of children with severe and very severe malnutrition was 7 % and 1.7% respectively.

The estimates of the total number of malnourished children based on weight for age was marginally higher with IAP standard than with WHO – SD ('Z' Score) approach. The prevalence of malnutrition as per IAP was 51.2% in comparison with 40.8 % malnutrition by WHO standards. Sachdev et al reported 65.4 % and 61.2 % malnutrition using IAP and WHO standards respectively, IAP standard showing more malnutrition than WHO standards.¹⁰

The estimates of moderate and severe malnutrition based on weight for age were consistently significantly higher with SD/Z score approach than with the percentage of median approach of IAP. The percentage of moderate and severe malnutrition according to IAP was 15.4% and 2.5% respectively. The percentage of moderate malnutrition and severe malnutrition according to WHO's SD score were 27.9% and 12.8% respectively. Similar observations were made by Sach Dev et al in which the percentage of severe malnutrition was 33.3% and 17.1% with WHO SD and IAP standards respectively.¹⁰ Prema Ramachandran et al also in their study reported the prevalence of moderate and severe under nutrition is lowest by IAP standards and higher with WHO standards (2006).¹⁹

CONCLUSION

The study shows that the prevalence of malnutrition was highest for the age group 4 to 5 years and lowest for the age group 0 to 6 months and more prevalent among

female children. Educational status and employment status of parents have positive impact on nutritional status of the child. Birth weight and family income also found to have great impact on nutritional status of the children. Thus, utmost care and attention must be focused on child's nutrition with multipronged approach such as giving priority to education for slum community especially for women, creating awareness regarding benefits of early initiation of breastfeeding and limiting family size.

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