 Anthropologist, 7(2): 99-103 (2005)

Nutritional Status : Anthropometric Perspective of Pre-School Children

Ginjinder Kaur, Harmander Singh Kang, Pushpa Singal and S.P. Singh

Department of Human Biology, Punjabi University, Patiala 147 002, Punjab, India

KEYWORDS Malnutrition. Punjabi Children. Underweight. Stunted. Wasted. BMI

ABSTRACT A total of 6531 Punjabi children (3720 males and 2811 females) in the age range of 1 to 5 years were measured in this cross-sectional study during the months of October to December, 2001 inhabiting different parts of Punjab for assessing malnutrition using the criteria of weight-for-age, height-for-age, MUAC-for age (WHO, 1983), weight-for-height (WHO, 1995) and BMI (Rolland-Cachera et al., 1984). The percentage of children who were underweight, stunted, wasted and having low MUAC/age (having Z-scores of –2 SD or more below the reference mean or median value) was 15.04%, 11.42%, 10.76% and 38.52% respectively.

INTRODUCTION

Growth assessment best defines the health and nutritional status of children, because disturbances in health and nutrition, regardless of their etiology, invariably affect child growth and hence provide an indirect measurement of the quality of life of an entire population (De Onis et al., 1993).

Anthropometry is widely recognized as one of the useful techniques to assess the growth and nutritional status of an individual or population (Gorstein et al., 1994; Jelliffe, 1966; Rao et al., 1986). One of the basic reasons is that anthropometry is highly sensitive to undernutrition (Martorell, 1984). Malnutrition is frequently part of a vicious cycle that includes poverty and disease. The 3 factors, viz., malnutrition, poverty and disease are interlinked in such a way that each contributes to the presence and permanence of the others. Malnutrition makes its principal impact on young children in developing countries. These nations are facing great difficulties in uplifting the standards of living of its population because of unequal distribution of its resources. The result is widespread malnutrition.

While malnutrition manifests its diverse forms, protein energy malnutrition (PEM) ranks foremost in terms of socioeconomic consequences and the enormity of its effects. Numerous criteria have been suggested for the assessment of PEM in a population group. Nutritional anthropometric (body measure) parameters such as weight-for-age (W/A), height-for-age (H/A), weight-for-height (W/H), mid upper arm circumference-for-age (MUAC/A) and body mass index (BMI) are commonly used for assessing malnutrition and evaluating the effects of dietary treatment on children.

The designation of a child as having impaired growth implies some means of comparison with a "reference" child of the same age and sex. Thus, in practical terms, anthropometric values need to be compared across individuals or populations in relation to an acceptable set of reference values. Controversy arises over the use of an international population both as "reference" and "standard", which has given rise to the emergence of two groups of experts – one is influenced by the Genetic Potential Theory or Deprivation Theory and the other by Heretic Views (Osmani, 1992). According to Genetic Potential Theory, each individual is endowed with a maximum potential of growth, especially in the case of children below 5 years of age. The failure to achieve the maximum genetic potential is believed to be affected by the environmental factors like nutrition, socio-economic condition, etc., thereby resulting in growth retardation. The exponents of the Heretic View, on the other hand argue that deviation from genetic potential does not entail any functional impairment. Instead, children or adults may be "small but healthy" (Seckler, 1982).

Of the various anthropometric indices that can be used to assess child growth status, the following provide a comprehensive description, height-for-age portrays performance in terms of linear growth, and essentially measures long-term growth faltering; weight-for-height reflects body proportion or the harmony of growth, and is particularly sensitive to acute growth disturbance and weight-for-age represents a convenient synthesis of both linear growth and body

proportion (WHO, 1986), mid-upper arm circumference has been proposed as an alternative index of nutritional status. However, for proper interpretation of MUAC with regard to nutritional status or to its etiological relationship to functional outcomes, the application of a MUAC-for-age reference is indicated. The body build of an individual can be more accurately assessed through body mass index (BMI) (Bhalla, 2002). On the basis of this, the relative proportion of children who need special attention can be assessed.

The prevalence of PEM in Asia is highest in the world. The surveillance of the large population of the region imply that more than half of all malnourished children in the world are found in this region (WHO, 1999). Keeping this in mind, this paper attempts to utilize various criteria for their effectiveness in quantifying childhood malnutrition. The criteria employed are height-for-age, weight-for-age, MUAC-for-age, weight-for-height and BMI.

MATERIAL AND METHODS

The present cross-sectional study has been conducted on 6531 children (3720 males and 2811 females) in the age range of 1-5 years inhabiting different parts of Punjab. The data was drawn from cretches, child day care centers, preparatory schools and home to home visits. Weight, length/height and mid-upper arm circumference were measured using standard techniques (Tanner et al., 1969). Date of birth of children were noted from birth certificates, vaccination certificates and school registers, maintaining fairly accurate records. To estimate child's age, a decimal age calendar was used. Body mass index (BMI) has been calculated as :

$$BMI = \text{Weight (kg)} / \text{Height}^2\text{(m)}$$

For analysis, the children were grouped into 9 groups with half yearly class intervals so that the mean value of the group came out to be half year or whole year value.

At the individual level, however, there is a substantial recognition that Z-score is the most appropriate descriptor of malnutrition. The Z-score system expresses the anthropometric values in terms of standard deviations or Z-scores below or above the reference mean or median value of the requisite parameter at a given age or to a relative parameter.

The WHO/NCHS data was used for assessing malnutrition through weight-for-age, height-for-age, mid-upper arm circumference-for-age (WHO, 1983); Epi Info Programme for weight-for-height (WHO, 1995) and BMI growth charts for BMI (Rolland-Cachera et al., 1984).

RESULTS

Weight, height and mid upper arm circumference for age are the percentages of adequacy of each of these measurements based on the respective standards for the child's chronological age. Anthropometric indicators for malnutrition are W/A, H/A, W/H and MUAC/A standardized Z-scores 2 or more deviations below reference.

Table 1(a): Prevalence of malnutrition in 1-5 year old Punjabi children

Age (yrs)	*Total No. N*	*Weight/Height (Wasted)*	
		n	*%*
1	193	41	21.24
1.5	319	91	28.52
2	350	82	23.42
2.5	404	56	13.86
3	742	97	13.07
3.5	862	86	9.97
4	1497	83	5.54
4.5	1176	82	6.97
5	988	85	8.60

Table1(a) and 1(b) represents the proportional distribution of malnourished Punjabi children according to various criteria. The prevalence of malnutrition seems to decrease with increase in age, with few exceptions.

The highest percentage of malnourished children according to W/H criterion are observed at the age of 1.5 years, followed by those of 2 and 1 years. There is an initial increase and further decrease in the prevalence of malnutrition. Out of the total sample, 10.76% of the children are malnourished.

There is a trend of decrease in underweight subjects (low W/A) from 1 to 4 years with an increase in later years. About 15.04% of the present sample are underweight. The 1 year age group has maximum number of such subjects followed by 1.5, 5 and 2 years.

The frequency of stunting in children (low H/A) also follows the above trend. Age groups of 1.5, 1, 2 and 5 years have a higher prevalence of stunted subjects with a decreasing trend. Out

Table 1(b): Prevalence of malnutrition in 1-5 year old Punjabi children

Age (yrs)	Total N	Males						Females					
		Under-weight (W/A)		Stunted (H/A)		MUAC/ Age		Under-weight (W/A)		Stunted (H/A)		MUAC/ Age	
		n	%	n	%	n	%	n	%	n	%	n	%
1	193	24	24	19	19	54	54	34	36.6	23	24.7	46	49.5
1.5	319	42	22.3	37	19.7	102	54.3	30	22.9	33	25.2	80	61.1
2	350	37	20.6	29	16.1	81	45	31	18.2	21	12.4	78	45.9
2.5	404	24	12.3	12	6.2	147	75.4	34	16.3	20	9.6	96	46
3	742	27	7	26	6.8	161	41.8	53	14.8	25	7	164	46
3.5	862	41	8.1	37	7.3	155	30.5	55	15.8	41	11.6	140	39.7
4	1497	81	7.7	68	6.5	256	24.5	85	18.9	74	16.4	196	43.5
4.5	1176	115	17.1	76	11.3	227	33.7	69	13.7	66	13.1	195	38.8
5	988	136	23.5	79	13.6	192	33.2	64	15.6	60	14.7	146	35.7

Table 2: Distribution of BMI according to age on BMI Charts

Age (yrs)	Males		Females	
	BMI Mean	Position on BMI Chart*	BMI Mean	Position on BMI Chart*
1	16.40	Below 25th percentile	15.80	Below 10th percentile
1.5	15.40	Below 10th percentile	15.03	Below 10th percentile
2	15.18	Below 25th percentile	14.95	Below 25th percentile
2.5	14.50	Below 10th percentile	14.62	Below 25th percentile
3	14.52	Below 10th percentile	14.51	Below 25th percentile
3.5	14.59	Below 25th percentile	14.38	Below 25th percentile
4	14.59	Below 25th percentile	14.50	Below 25th percentile
4.5	14.58	Below 25th percentile	14.30	Below 25th percentile
5	14.44	Below 25th percentile	14.29	Below 25th percentile

*The charts of Rolland Cachera et al. (1984) were used for comparison.

of the total subjects, 11.42% show low height for age values.

Data on mid upper arm circumference (MUAC) represents that a large percentage (38.52%) of the sample are malnourished according to MUAC/A criterion. Approximately half of the subjects in the respective age groups of 1, 1.5, 2, 2.5 and 3 years suffer from malnutrition.

The comparison of the body mass index values of the present sample has been made with the standards of BMI prepared by Rolland-Cachera et al. (1984). The findings of this analysis show that males in the age groups of 1.5, 2.5 and 3 years and females in the age group of 1 and 1.5 years have BMI values below the 10th percentile on the BMI charts given by Rolland-Cachera et al. (1984) (Table 2).

DISCUSSION

A low weight-for-age (W/A) is considered to indicate underweight and, in the absence of significant wasting in a community, like low height-for-age (H/A), reflects sub-optimal long term health and nutritional conditions. A low height-for-age (H/A) indicates stunting, and reflects a process of failure to reach linear growth potential as a result of sub-optimal health and/ or nutritional conditions. A low weight-for-height (W/H) indicates wasting or thinness, and reflects in most cases a recent and severe process of weight loss, which is associated with acute starvation and/or severe disease.

The main findings of the analysis are furnished in Tables 1(a), 1(b) and 2, comparing the proportion of children with varying rates of malnutrition using 5 criteria.

A prevalence exceeding 5% (low W/H) is alarming given a parallel increase in mortality that soon becomes apparent (Toole and Malkki, 1992). Out of the present sample, 10.76% are wasted, 15.04% are underweight, 11.42% are stunted and 38.52% of the subjects have MUAC representing malnutrition. For children in the age group below 2 years, low values of H/A probably reflect a continuing process of "failing to grow".

Table 3: Comparison of percentage of underweight, stunted and wasted subjects of present study with Punjab and Indian sample.

Age	*Present Study*			*Punjab Sample(1998-99)[b]*			*Indian Sample(1992-93)[a]*			*Indian Sample(1998-99)[b]*		
(yrs)	*Under-* weight*	*Stun-ted**	*Was-ted***	*Under-weight**	*Stun ted**	*Was-ted***	*Under-weight**	*Stun-ted**	*Was-ted***	*Under-weight**	*Stun-ted**	*Was-ted**
3	16.7	12.2	18.2	28.7	39.2	7.1	51.5	47.1	19.3	47	45.5	15.5

a – National Family Health Survey (NFHS-1). (1992-93)
b – National Family Health Survey (NFHS-2). (1998-99)
* – WHO Recommendation. (1983)
** - Epi-Info Programme (WHO, 1995)

A quick and reliable method for screening children to identify those who are seriously malnourished is the measurement of mid-upper arm circumference. A healthy child between the ages of 1 and 5 years should have a minimal MUAC of 13.5 cm. If it is between 12.5 and 13.5 cm, special attention is to be given. When it is less than 12.5 cm, there is a marked wasting of underlying muscle and fat. Large studies in Latin America and South Asia have clearly established the reliability of arm circumference screening as a method of identifying malnourished children (Ebrahim, 1983).

The Punjabi children are healthier than the subjects of earlier studies done in Punjab and India in the age group upto 3 years (Table 3). In the present study 16.7% of the subjects are underweight compared to 28.7% of Punjab sample (1998-1999), 51.5% of Indian sample (1992-93) and 47% of 1998-1999 Indian sample. Height deficit is prevalent in 12.2% subjects of present study against 39.2% (Punjab, 1998-1999), 47.1% (India, 1992-93) and 45.5% (India, 1998-1999). Wasting is significant in the present subjects (18.2%) while earlier Punjab sample had less percentage (7.1%) and approximately significant values in Indian samples (1992-93 and 1998-1999). In the age groups of 1, 1.5 and 2 years, more children are vulnerable to malnutrition according to W/H, W/A, H/A and MUAC/A. This is also in accordance to the studies done by Waterlow (1973).

Overweight or underweight status cannot be appreciated by body weight measurement only, as height must also be taken into account. As it is weakly correlated with height and strongly correlated with weight, the W/H^2 index assesses corpulence (Total Body Mass, independent of height) and predicts the degree of adiposity (Rolland-Cachera et al., 1984). It can therefore be used as an indicator of nutritional status. This method, which makes simultaneous use of 3 parameters (weight, height and age) reveals ascending and descending phases. Children below the 10th percentile of BMI on BMI growth charts need special attention. Males in the age groups of 1.5, 2.5, 3 years and females in the age groups of 1 and 1.5 years are the requisite group.

There is a consensus that are wide variety of (instead of just a few) biological, behavioural and socio-economic variables influence the health status of young children in developing countries (Rutstein, 2000). The causes of growth retardation are deeply rooted in poverty and lack of education. To continue to allow underprivileged environments to affect child's development not only perpetuates the vicious cycle of under development but also leads to an enormous waste of human potential. Child health results from many factors, such as the availability of health facilities, good nutrition, parents' awareness of the need for regular immunizations and treatment of disease. In 1995, nearly half of the under 5 children of South Asia were underweight. Prevalence of undernutrition in South Asia is declining faster in the recent decades compared to other developing regions. (Sen and Sengupta, 1983). The prevalence of malnutrition in this part of country is also less owing to marked advancement, modernized outlook and greater acknowledgement of the diet of the mother and child in the Punjabi population.

REFERENCES

Alderman, H., Hoddinott, J. and Kinsey, B.: Long term consequences of early children malnutrition. *Paper presented at Ist International Conference on Economics and Human Biology. Tubingen,* July 11-14, 2002 (2002).

Bhalla, A.K.: The relevance of selected anthropometric techniques in clinical pediatrics. *Human Growth and*

Development: Issues and Applications, 16-35 (2002).

De Onis, M., Monteiro, C., Akre, J. and Clugston, G.: The worldwide magnitude of protein- energy malnutrition : an overview from the WHO Global Database on child growth. *Bulletin of the World Health Organization*, **71:** 703-712 (1993).

Ebrahim, G.J.: *Nutrition in Mother and Child Health. Child Health in a Changing Environment.* Macmillan Press Ltd., London, p. 48 (1983).

Ferro-Luzzi, A., Sette, S., Franklin, M.F. and James, W.P.T.: A simplified approach to assessing adult chronic energy deficiency. *Eur. J. Clin. Nutr.*, **46:** 173-186 (1992).

Gorstein, J., Sullivan, K., Yip, R., de Onis, M., Trowbridge, F. and Fajans, P.: Issues in assessment of nutritional status using anthropometry. *Bulletin of WHO*, **72:** 272-283 (1994).

Jelliffe, D.B.: Assessment of the nutritional status of the community. *Monograph, Series No. 53.* WHO, Geneva (1966).

Martorell, R. and Ho, T.J.: Malnutrition, morbidity and mortality. *Popul. Dev. Rev*., **10 (Suppl.):** 49-68 (1984).

Osmani, S.R.: Some controversies in the measurement of undernutrition. In: S. R. Osmani (Ed.): *Nutrition and Poverty.* Clarendon Press, Oxford, 49-96 (1992).

Rao, K.V., Balakrishna, N. and Adinarayana, K.: Critical limits of some anthropometric measurements and indices for the assessment of nutritional status. *J. Nutr. Dietet*., **23:** 88-99 (1986).

Rolland – Cachera, M.F., Deheeger, M., Bellisle, F., Sempe, M., Guilloud-Bataille, M., and Patois, E.: Adiposity rebound in children : a simple indicator for predicting obesity. *Am. J. Clin. Nutr*., **39:** 129-135 (1984).

Rutstein, S.O.: Factors associated with trends in infant and child mortality in developing countries during the 1990s, Bulletin of the World Health Organization, **78:** 1256-1270 (2000).

Seckler, D.: Small but healthy : A basic hypothesis in the theory, measurement and policy of malnutrition. In : P. V. Sukhatme (Ed.): *Newer Concepts in Nutrition and Their Implications for Policy.* Maharashtra Association for the Cultivation of Science, Pune pp. 68-72 (1982).

Sen, A. and Sengupta, S.: Malnutrition of rural children and the sex bias. *Economic and Political Weekly,* 19 (Annual Number) (1983).

Tanner, J.M., Hiernaux, J. and Jarman, S.: Growth and physique studies. In: *Human Biology – A Guide to Field Methods.* J.S. Weiner and J.A. Lourie (Eds.). Blackwell Scientific Publications, Oxford (1969).

Toole, M.J. and Malkki, R.M.: Famine – affected refugee and displaced populations: Recommendations for public health issues. *Morbidity and Mortality Weekly Report*, **41:** 1-25 (1992).

Waterlow, J.C.: *Bibl. Nutr. Diet.*, **18:** 6. Quoted by McLaren, D.S. and Read (1973).

W.W.C.: Assessment of nutritional status in early childhood. *Lancet*, **II:** 146 (1973).

WHO.: *Measuring Change in Nutritional Status.* WHO, Geneva (1983).

WHO.: Epi Info: *Field Guide on Rapid Nutritional Assessment in Emergencies.* WHO, Geneva (1995).

WHO.: Physical status : The use and interpretation of Anthropometry. *WHO Tech. Rep. Ser.* No. 854. WHO, Geneva (1995).

WHO.: *Health Situation in the South-east Asia Region 1994-1997.* WHO Regional office for South-East Asia, New Delhi (1999).

WHO Working Group: Use and interpretation of anthropometric indicators of nutritional status. *Bulletin of the World Health Organization*, **64:** 924-941(1986).