ISSN: 0975-833X

Available online at http://www.journalcra.com

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

International Journal of Current Research
Vol. 6, pp.039-044, July, 2010

RESEARCH ARTICLE

PREVALENCE OF UNDERWEIGHT, STUNTING AND WASTING AMONG URBAN POOR CHILDREN AGED 1- 5 YEARS OF WEST BENGAL, INDIA

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ARTICLE INFO

Article History:
Received 12th May, 2010
Received in revised form
27th May, 2010
Accepted 16th June, 2010
Published online 1st, July, 2010

Key words:
Urban,
Poor children,
Underweight,
Stunting,
Wasting.
Hindu,
Muslim,
Tribal.

ABSTRACT

To assess the nutritional status among urban poor children aged 1-5 years a cross sectional study was undertaken during February-June 2006 in three municipal wards of North 24-Parganas district, West Bengal, India. All information like age, sex, religion, caste, weight and height were collected from each subject through questionnaire following simple random sampling method. Nutritional status was assessed based on weight-for-age, height-for-age and weight-for-height z-score method. Undernutrition was defined as Z-score below -2.0 SD from the National Centre for Health Statistics (NCHS) reference population. A total of 899 children (boys=517; girls=382) aged 1-5 years were included in the present study. Overall, the prevalence of underweight, stunting and wasting was 63.6 (95% CI: 60.5 - 66.8) %, 52.7% (95% CI: 49.5-56.0) and 22.0% (95% CI: 19.6-25.1). Overall, 16.7 % (CI: 14.1-19.0), 25.1% (CI: 22.3-28.0) and 5.3% (CI: 4.0- 6.9) children were found to be severely underweight, stunted and wasted, respectively. Moreover, the prevalence of underweight was significantly higher among tribal (71.5%) children than Muslim (67.2%) and Hindu (57.6%) children. On the other hand, the prevalence of stunting and wasting was higher among Hindu and Muslim children, respectively.

In addition, according to WHO (1995) criteria for severity of malnutrition, the overall prevalence of underweight, stunting and wasting were very high indicating a critical situation. Therefore, appropriate health policies and measures must be implemented to reduce the burden imposed by poverty on childhood health and nutritional stress among these areas.

INTRODUCTION

The World Health Organization estimated that undernutrition is associated with about half of the child deaths among children under 5 years occurring each year in the developing world (WHO, 2003). The vast majority of undernourished children were found in Southern Asia including India. During the past two decades, the prevalence of undernutrition has expressively declined among children under 5 years worldwide (de Onis, 2000). It was noted that the prevalence rates of underweight children reduced from around 27.0 % in the 1990s to around 22.0 % in 2000 (de Onis, 2004). Similar trend has been observed in India. However, recent nationwide survey (IIPS 2007) showed that 42.5 %, 48.0 % and 19.8 % of children under 5 years of age still suffer underweight (low weight-for-age), chronic (low height for age) and acute (low weight for height) form of protein energy malnutrition, and many found in socially and economically vulnerable communities.

Anthropometry is widely acceptable as low-cost technique for defining the nutritional status of children (WHO, 1986; 1995; Waterlow, 1992).

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The WHO recommends to follow the National Centre for Health Statistics (NCHS) data (NCHS, 1977) as an international standard for the assessment of nutritional status during childhood (WHO, 1978; Waterlow, 1977; Sachdev, 1994). Therefore, results can be presented as nutritional indices in the form of Z-scores, percentiles or percentage of median. The uses of Z-scores have distinct statistical advantages, since it reflects the reference distribution and is comparable across ages and indicators (WHO, 1986; Waterlow, 1977; 1992).

In general, three internationally recommended nutritional indicators most commonly used are stunting (low height for-age), underweight (low weight-for-age) and wasting (low weight-for-height) (WHO, 1995). While stunting is an indicator of chronic undernutrition, the result of a failure to reach linear growth potential due to prolonged food deprivation, underweight reveals low body mass relative to chronological age, which is influenced by both, a child's height and weight. Thus, underweight cannot be distinguished between a child who is small in weight relative to his/her height and a child who is low in height relative to his/her age, but who may be normal in weight-for-height. Wasting as an indicator of acute

undernutrition, reflects more recent food deprivation or illness (WHO, 1995). However, there exists scanty information of the growth patterns and prevalence of undernutrition among urban poor children aged 1-5 years in West Bengal. In view of the strong association between socio-economic status and undernutrition observed worldwide (Sachs, 2005), the present study was conducted to report the prevalence of underweight, stunting and wasting among urban poor children based on Z scores.

MATERIALS AND METHODS

This cross-sectional study was undertaken in three municipal wards of Barasat and Madhyamgram municipality in North 24 Parganas district of West Bengal. The data was collected for the present study was done from February to June 2006. An estimated minimum sample size of 899 was calculated by using standard formula found elsewhere (Bisai, 2008), based on 31 % prevalence of underweight (Bose *et al.,* 2007), with relative precision of 3%. The study involved a random survey of children belonging to the lower socioeconomic class. The vast majority of the guardians of children were low-wage unskilled labourers. However, study area was selected purposively. Information on age, sex, ethnicity, religion, weight and height of all children were obtained by a trend investigator. Ages of children were noted from their parents or sometimes calculated using local events, which could be dated and linked to important life history. The study was approved by the respective institutional ethical committee and informed consent was obtained from the parents of each child.

The nutritional status of children was assessed by anthropometric measurements following standard techniques (Lohman *et al.,* 1988). Body weight measurements were taken, to the nearest 0.5kg, using a weighing scale. Recumbent length (for children below two years) and height (for children above two years) were measurements were taken, to the nearest 0.1cm, using locally made measuring board and anthropometric rod, respectively. The Z-scores for weight-for-age (WAZ), height-for-age (HAZ) and weight-for-height (WHZ) were calculated by using US National Centre for Health Statistics (NCHS) reference data as standard (NCHS, 1977). The children were classified as underweight, chronic (stunting) and acute (wasting) undernutrition if their WAZ, HAZ, WHZ Z-score less than -2.0 standard deviation. Severe and moderate undernutrition was classified as z-score <-3.0 and z-score between ≥-3.0 to < -2.0, respectively. All statistical analyses were made on EPI6 statistical software. One WAY-ANOVA was used to test age differences of mean weight and height. Odds ratio (OR) and 95% confidence interval (95% CI) measured by standard formula to compare the risk between groups as socio-religious and sex of the subject. The proportion test was employed to compare the prevalence of under nutrition in different groups. Moreover, p-value less than 0.05 were considered as statistically significant.

RESULTS

The present study comprised of 899 children, out of whom 517 and 382 were boys and girls aged 1–5 years. There existed significant ($p<0.001$) age differences in mean weight and height in boys (weight: F = 222.045 height: F=386.27) as well as girls (weight: F=190.16; height: F=290.25). The distribution of Z-scores for WAZ, HAZ and WHZ were presented in Figures 1, 2, 3, respectively. It was observed that mean z-scores for three nutritional indicators are between -1 to -2.5. It implied that average weight and height of children in the present study was lower than the reference median. The prevalence of underweight, stunting and wasting are presented in Table 1. It is important to note that boys were more malnourished in the form of underweight, stunted and wasted (65.5%; CI: 61.5-69.7, 53.5%; CI: 49.3-57.9, 23.8%; CI: 20.3-27.7) than the girls (60.9 %; CI: 56.1-65.9, 51.6%; CI: 46.6-56.6, 19.6%; CI: 16.1-24.2), but this was not statistically significant. However, prevalence of severe underweight was significantly higher among boys 19.3 % (CI: 15.9-22.7) than their girls 12.8% (CI: 9.5-16.2) counterpart ($X^2 = 5.845$, $p<0.05$). The boys were 1.5 (OR=1.59; CI: 1.08-2.34) times more likely to be severe underweight compared to girls. In the present study, overall (age and sex combined) prevalence of underweight, stunting and wasting were 63.6 (CI: 60.5 - 66.8) %, 52.7 (CI: 49.5-56.0) % and 22.0 (CI: 19.6-25.1) %, respectively. Overall, 16.7 (95% CI: 14.1-19.0) %, 25.1% (CI: 22.3-28.0) and 5.3% (CI: 4.0- 6.9) children were found to be severely underweight, stunted and wasted.

The distributions of malnutrition by different socio-religious groups are presented in Table 2. The prevalence of underweight, stunting and wasting among children from Hindu community was 57.6% (CI: 53.1-62.2), 60.5% (CI: 56.0-65.0) and 16.4% (CI: 13.2 - 20.3), respectively. There was no significant sex difference in underweight, stunting and wasting among Hindu children. Among Muslim community, 67.2% (CI: 60.6-73.8), 31.8% (CI: 25.3-38.3) and 34.9% (CI: 28.2-41.6) children were found to be underweight, stunted and wasted. It was observed that the rate of underweight and stunting were significantly higher among Muslim boys than the Muslim girls. Moreover, the prevalence of underweight, stunting and wasting among tribal children was 71.5% (CI: 66.0-77.1), 54.9% (CI: 48.8-61.1) and 22.1% (CI: 17.0-27.3), respectively. Figure 4 compares the odds ratio for nutritional status among different socio-religious groups. It was observed that the rate of underweight was significantly lower among Hindu children as compared to Muslim and tribal children. In contrast, the prevalence of stunting was significantly lower in Muslim children than the Hindu and tribal children. It was noteworthy to mention that the rate of severe stunting was more than 3 times and 4 times higher among Hindu and Tribal children than Muslim children. However, the rate of wasting was significantly lower among Hindu children than their Muslim counterparts. In general, it was observed that the chances of global acute malnutrition were higher among Muslim children than the other two groups, respectively.

DISCUSSION

Malnutrition is deeply rooted in poverty and underprivileged social environments (Singh *et al.,* 2009). Thus, undernutrition is a major health problem throughout the developing world including India, especially in underprivileged communities (Bose *et al.,* 2007; Kapur *et al.,* 2005; Nandy *et al.,* 2005; NFI, 1998). Several recent investigations from Africa (Abidoya and Ihebuzor, 2001; Waihenya, 1996) and Asia (Pryer *et al.,* 2004; Tada *et al.,*

2002) have studied the problem of child malnutrition. As found in many previous reports (Bisai *et al.,* 2009; Bisai and Mallick, 2010; Chakma *et al.,* 2009; Rao *et al.,* 2005; 2006; Mitra *et al.,* 2007), this study observed very high rates of child malnutrition in the form of underweight, stunting and wasting. It is well recognized that in both developed and developing countries, nutritional status is an indicator of living standards of a population (Nube *et al.,* 1998).

Table 1. Prevalence of underweight, stunting and wasting among preschool children of North 24 Parganas, West Bengal.

Age (years)	Sample (n)	Underweight (%)			Stunting (%)			Wasting (%)		
		S	M	T	S	M	T	S	M	T
Overall	**899**	**16.7**	**46.9**	**63.6**	**25.1**	**27.6**	**52.7**	**05.3**	**16.6**	**22.0**
Boys:										
1	54	37.0	35.2	72.2	18.5	18.5	37.0	24.1	25.9	50.0
2	100	23.0	42.0	65.0	22.0	20.0	42.0	07.0	18.0	25.0
3	92	25.0	42.4	67.4	27.2	23.9	51.1	07.6	18.5	26.1
4	114	07.8	51.8	59.6	32.5	31.5	64.0	00.0	14.9	14.9
5	157	15.9	51.0	66.9	27.4	33.1	60.5	02.5	16.6	19.1
Total	**517**	**19.3***	**46.2**	**65.5**	**26.5**	**27.0**	**53.5**	**06.0**	**17.8**	**23.8**
Girls:										
1	47	06.4	42.5	48.9	10.6	19.2	29.8	12.8	21.2	34.0
2	65	12.3	52.3	64.6	21.5	17.0	38.5	03.1	23.1	26.2
3	82	19.5	37.8	57.3	20.7	29.3	50.0	01.2	14.7	15.9
4	84	13.1	54.8	67.9	27.4	36.9	64.3	04.8	07.1	11.9
5	104	13.4	48.1	61.5	28.9	31.7	60.6	03.9	14.4	18.3
Total	**382**	**13.0***	**47.9**	**60.9**	**23.3**	**28.3**	**51.6**	**04.5**	**14.9**	**19.6**

S= Severe, M = Moderate, T = Total. * Sex difference: chi-square = 5.845, df =1, p<0.05.

Table 2. Prevalence of underweight, stunting and wasting among different socio-religious community of children of North 24 Parganas, West Bengal.

Religion / Community of children	Sample (n)	Underweight (%)			Stunting (%)			Wasting (%)		
		S	M	T	S	M	T	S	M	T
Total:										
Hindu	451	17.1	40.6	57.6**	28.6	31.9	60.5	2.9	13.5	16.4
Muslim	195	13.8	53.3	67.2	7.7	24.1	31.8**	10.3	24.6	34.9
Tribal	253	17.8	53.8	71.5	32.4	22.5	54.9	6.3	15.8	22.1
Boys:										
Hindu	239	20.1	38.1	58.2	30.5	32.2	62.8	2.9	14.3	17.2
Muslim	129	17.1	55.0	72.1*	9.3	28.7	38.0*	9.3	27.1	36.4
Tribal	149	20.1	51.7	71.8	34.9	17.4	52.3	8.1	15.4	23.5
Girls:										
Hindu	212	13.7	43.4	57.1	26.4	31.6	58.0	2.8	12.7	15.5
Muslim	66	7.6	50.0	57.6*	4.5	15.2	19.7*	12.1	19.7	31.8
Tribal	104	14.4	56.7	71.2	28.8	29.8	58.6	3.8	16.3	20.2

S= Severe, M = Moderate, T = Total. * Significant sex difference: p<0.05.

The overall finding of underweight (63.6%) in this study was much higher than the national and state figure of 42.5% and 38.7% (IIPS, 2007), but appeared similar to 63.7% previously reported in slum children of Midnapore town (Bisai *et al.,* 2009). However, the prevalence of stunting (52.7%) and wasting (22.0%) compared well with the national figure of 48.0% stunting and 19.8% wasting, but the proportion of stunting and wasting in this study was higher than the state figure of 44.6% stunting and 16.9% wasting (IIPS, 2008). Moreover, the finding of severe under nutrition in the form of severe underweight (16.7%), stunting (25.1%) and wasting (5.3%) compared well with the national figure of 15.8%, 23.7% and 6.4%, but these rates of severe underweight, stunting appeared higher than the West Bengal state findings of 11.1% and 17.8%, respectively.

It was important to note that the rate of severe underweight was significantly higher in boys than the girls. However, the prevalence of under nutrition in the form of underweight, stunting and wasting was slightly more in boys compared with girls, but these differences showed no statistical significance. Similar results were also reported in earlier studies worldwide (Marcoux, 2002, Bisai *et al.,* 2008; Bisai and Mallick, 2010).

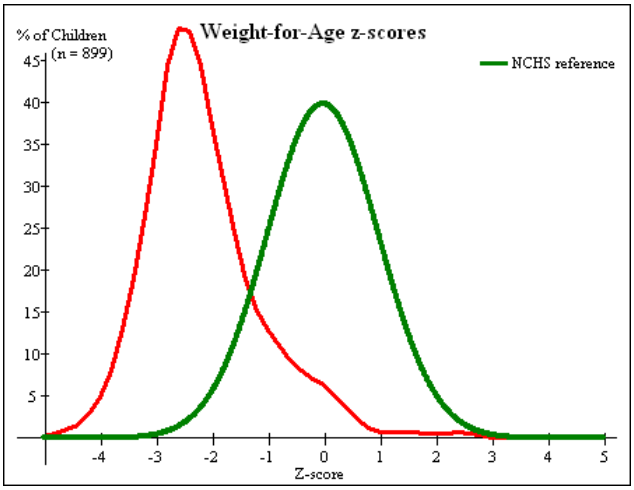

Figure 1. Distribution of WAZ scores

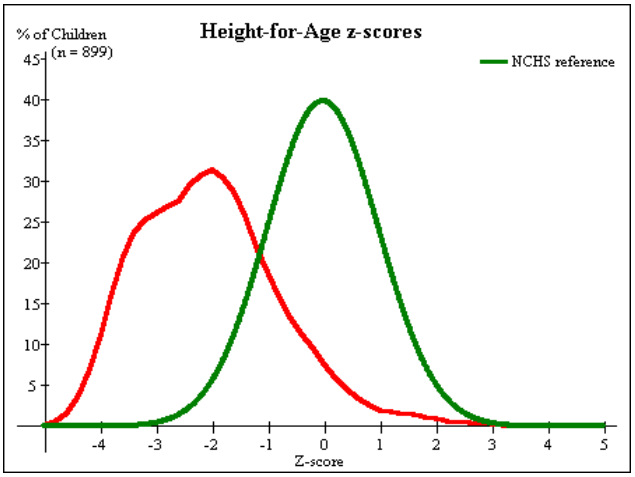

Figure 2. Distribution of HAZ scores

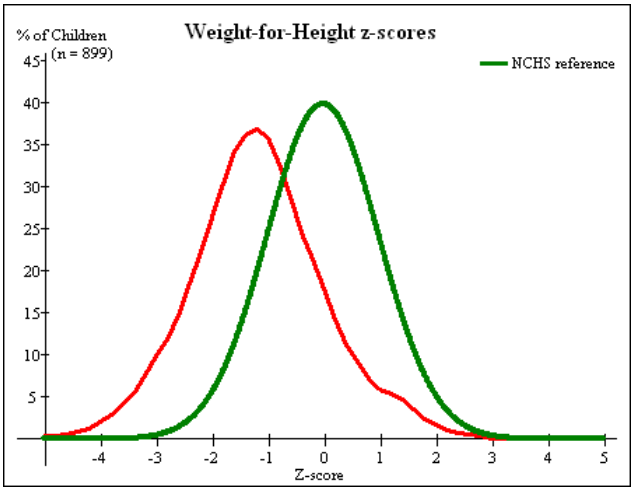

Figure 3. Distribution of WHZ scores

As found in the recent national survey (IIPS, 2007), the present study observed higher rate of underweight children in tribal (71.5%) community than Muslim and Hindu community, but the rate of underweight was higher than national and state figure of 54.5% and 59.7%, compared well with the finding of 72.1 % underweight among Saharia tribal children (Rao, *et al.,* 2006). The recent National Family Health Survey, India, revealed that the children belonging to tribal groups, schedule castes and other backward classes were found to have relatively higher rate of child under nutrition (IIPS, 2007). There is ample evidence that socio-economic status was significantly associated with nutritional status of children under five years of age. The prevalence of undernutrition significantly decreased with increased socio-economic status or wealth index (IIPS, 2007). Earlier studies worldwide showed that households with lower socio-economic status has a higher rate of undernourished

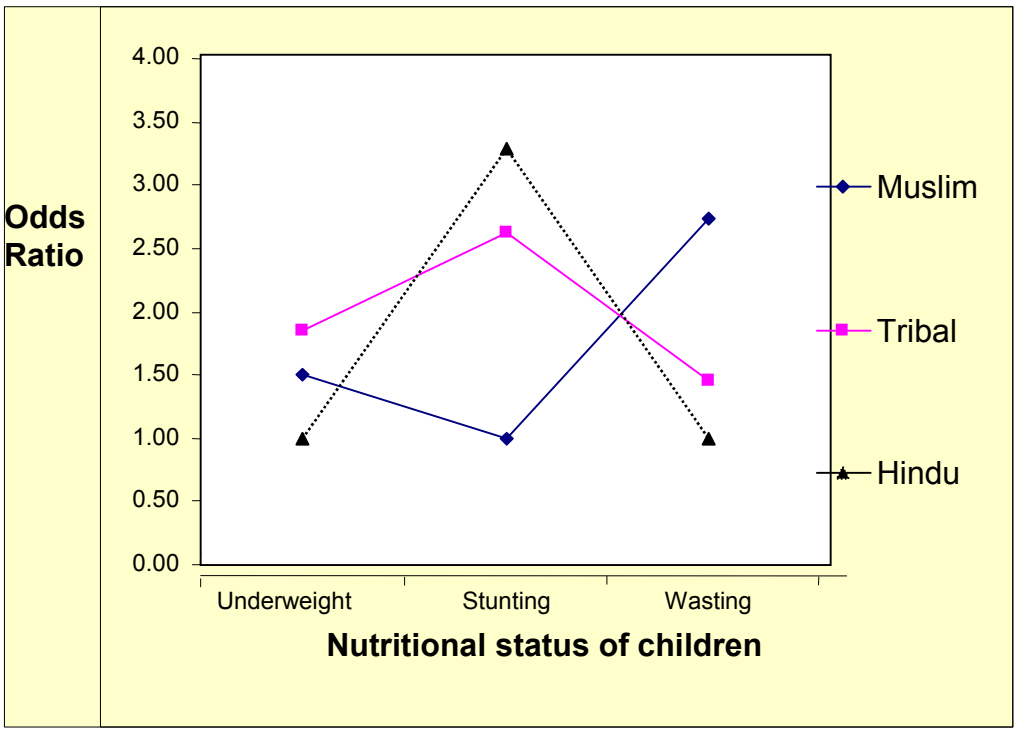

Figure 4. Odds ratio for undernutrition of children from different socio-religious groups.

children (UNICEF, 1990). These high rates of child under nutrition might be the result of dietary insufficiency and /or influences of early childhood illness (Bharati *et al.,* 2009). Moreover, high rate of low birth weight in addition with inadequate care and restricted access to health services translate into high rates of child under nutrition.

However, the rate of stunting was higher among Hindu children than Tribal and Muslim children and rate of wasting was higher among Muslim children than tribal and Hindu children. It implied that the Tribal and Muslim children were under both long and short term nutritional stress while the Hindu children suffer from long term nutritional stress. An earlier study reported that children from lower socio-economic status present short statures, probably as a result of poor nutritional conditions during growth. It is sometimes suggested that short stature is an adaptive response to years of under nutrition that allows children to preserve an adequate body weight under poor nutritional situation (Balam and Gurri, 1994).

This study observed that 63.6 %, 52.7 % and 22.0% children were found to be underweight, stunted and wasted, respectively. These rates were very high (underweight ≥ 30 %, stunting ≥ 40.0 % and wasting ≥ 15%) as per WHO (1995) recommended classification of severity of malnutrition, indicating a critical situation. Therefore, appropriate health policies and measures must be implemented to reduce the burden imposed by poverty on childhood health and under nutrition. Since, under nutrition among children under five years is prevalent in almost all the provinces in India (Som *et al.,* 2006). Thus, similar studies should be carried out among children of various ethnic groups residing in different towns of India to determine whether there is any ethnic variation in the proportion of under nutrition. Such studies should be of immense help to the policy makers in the formulation of effective nutritional intervention programmes to reduce the child under nutrition. Lastly, future investigations of child undernutrition among urban poor incorporating data on morbidity and mortality should be undertaken. These studies will assist in deciphering the association between undernutrition and health outcome.

Acknowledgement: The author expresses grateful thanks to the parents for their help and cooperation during study period. Data collection was done by Jayanta Chakraborty.

REFERENCES

Abidoya, RO., Ihebuzor, NN. 2001. Assessment of nutritional status using anthropometric methods on 1-4 year old children in an urban ghetto in Lagos, Nigeria. Nutr Health, 15 (1):29-39.

Balam, G. and Gurri, F. 1994. A physiological adaptation to undernutrition. Ann. Hum. Biol., 21:483–489.

Bharati, P., Bharati, S., Pal, M., Chakraborty, S., Som, S., Gupta, R. 2009. Growth and nutritional status of preschool children in India: rural urban and gender differences. Coll. Antropol. 33: 7-21.

Bisai, S. and Mallick, C. 2010. Prevalence of undernutrition among Kora-Mudi children aged 2-13years of Paschim Medinipur district, West Bengal, India. World J. Pediatr., (in press)

Bisai, S., Bose, K. and Dikshit, S. 2009. Undernutrition among slum children aged 3-6 years in Midnapore town, India. Intern. J. Biol. Anthropol., :vol-2: 2.

Bisai, S., Bose, K., Ghosh, A. 2008. Nutritional status of Lodha children in a village of Paschim Medinipur district, West Bengal, India. Indian J. Public Health, 52: 203-206.

Bisai, S. 2008. Nutritional status and growth pattern of urban infants in relation to birth weight. Curr. Sci., 95 (2): 175.

Bose, K., Biswas, S., Bisai, S., Ganguli, S., Khatun, A., Mukhopadhyay, A., Bhadra, M. 2007. Stunting, Underweight and Wasting among Integrated Child Development Services (ICDS) Scheme Children aged 3-5 years of Chapra, Nadia District, West Bengal, India. Mater. Child Nutr., 3(3): 216-221.

Chakma, T., Meshram, PK., Rao, PV., Singh, SB., Kavishwar, A. 2009. Nutritional Status of Baiga – A Primitive Tribe of Madhya Pradesh. Anthropologist, 11(1): 39-43.

De Onis, M., Blossner, M., Borghi, E., Morris, R., Frongillo, EA. 2004. Methodology for estimating regional and global trends of child malnutrition. Int. J. Epidemiol., 33:1260-1270.

De Onis, M., Frongillo, EA., Blossner, M. 2000. Is malnutrition declining? An analysis of changes in levels of child malnutrition since 1980. Bull. World Health Organ., 78: 1222-33.

Dibley, MJ., Goldsby, JB., Staehling, NW., Trowbridge, FL. 1987. Development of normalized curves for international growth reference: Historical and technical consideration. Am. J. Clin. Nutr., 46: 736-748.

Ghosh, S., Zaidi, I., Lakshmy, A., Choudhury, P., Bhargava, SK. 1979. Growth and development of children in different ecological settings. Indian J. Diet. Nutr., 16: 155-164.

International Institute for Population Sciences (IIPS) and Macro International. 2007. National Family Health Survey (NFHS-3), 2005–06: India: Volume I. Mumbai: IIPS.

International Institute for Population Sciences (IIPS) and ORC Macro. 2000. National Family HealthSurvey (NFHS-2), 1998-99. Mumbai, India: IIPS.

Kapur, D., Sharma, S., Agarwal, KN. 2005. Dietary Intake and growth pattern of children 9-36 months of age in an urban slum in Delhi. Indian Pediatr., 42(4): 351-356.

Lohman, TG., Roche, AF., Martorell, R. 1988. Anthropometric Standardization Reference Manual. Chicago: Human Kinetics Books.

Marcoux, A. 2002. Sex differentials in undernutrition: a look at survey evidence. Popul. Dev. Rev. 28: 275-284.

Mitra, M., Kumar, PV., Chakraborty, S., Bharati, P. 2007. Nutritional status of Kamar tribal children in Chhattisgarh. Indian J Pediatr., 74: 381-384.

Nandy, S., Irving, M., Gordon, D., Subramanian, SV., Davey, SG. 2005. Poverty, child undernutrition and morbidity: new evidence from India. Bull. World Health Organ. 83 (3): 210-216.

NCHS (National Centre for Health Statistics). 1977. NCHS growth curves for children. Birth to 18 years. Vital and Health Statistics Series 11, No 165 United States.

Nube, M., Asenso-Okyere, WK., Van den Boom, GJM. 1998. Body Mass Index as indicator of standard of

living in developing countries. Eur,.J. Clin. Nutr., 52: 136–144.

Nutrition Foundation of India (NFI). 1998. Profiles of Undernutrition and Underdevelopment: Studies of Poor Communities in Seven Regions of the Country, NFl Scientific Report 8. New Delhi: Media Workshop.

Pryer, JA., Rogers, S., Rahman, A. 2004. The epidemiology of good nutritional status among children from a population with a high prevalence of malnutrition. Public Health Nutr., 7:311-317.

Rao, KM., Kumar, RH., Venkaiah, K., Brahmam, GNV. 2006. Nutritional status of Saharia – a primitive tribe of Rajasthan. J. Hum. Ecol., 19(2): 117-123.

Rao, VG., Yadav, R., Dolla, CK., Kumar, S., Bhondeley, MK., Ukey, M. 2005. Undernutrition and childhood morbidities among tribal preschool children. Indian J. Med. Res., 122: 43-47.

Sachdev, HPS. 1994. Assessment of nutritional status. In: Nutrition in Children: Developing Country Concerns, 1st edn. Eds. Sachdev, HPS., Choudhury, P. New Delhi, National Update on Nutrition in Children, pp 171-196.

Sachs, JD. and McArthur, JW. 2005. The Millennium Project: a plan for meeting the Millennium Development Goals. Lancet, 365: 347-353.

Saxena, N., Nayar, D., Kapil, U. 1997. Prevalence of underweight, stunting and wasting. Indian Pediatr., 34: 627-631.

Singh, GCP., Nair, M., Grubesic, RB., Connell, FA. 2009. Factors Associated With Underweight and Stunting Among Children in Rural Terai of Eastern Nepal. Asia Pac. J. Public Health, 21; 144-152.

Som, S., Pal, M., Bhattacharya, B., Bharati, S., Bharati, P. 2006. Socioeconomic differentials in nutritional status of children in the states of West Bengal and Assam, India. J. Biosoc. Sci., 38 (5): 625-42.

Tada, Y., Keiwkarnka, B., Pancharuniti, N., Chamroonsawasdi, K. 2002. Nutritional status of the preschool children of the Klong Toey slum, Bangkok. Southeast Asian J. Trop. Med. Public Health, 33(3): 628-637.

UNICEF. 1990. Strategies of improving nutrition of children and women in developing countries. New York, USA.

Waihenya, EW., Kogi-Makau, W., Muita, JW. 1996. Maternal nutritional knowledge and the nutritional status of preschool children in a Nairobi slum. East Afr. Med. J. 73 (7): 419-423.

Waterlow, JC., Buzina, R., Keller, W., Lane, JM., Nichaman, MZ., Tanner, JM. 1977. The presentation and use of height and weight data for comparing the nutritional status of children under the age of 10 years. Bull. World Health Org., 55: 489-398.

Waterlow, JC. 1992. Assessment of nutritional status in the community. *In:* Protein Energy Malnutrition. London: Edward Arnold, pp 212-228.

World Health Organization Working Group. 1986. Use and interpretation of anthropometric indicators of nutritional status. Bull. World Health Org., 64: 929-941.

World Health Organization. 1978. A Growth chart for International Use in Maternal and Child Health Care: Guidelines for Primary Health Care Personnel. Geneva: World Health Organization.

World Health Organization. 2003. World Health Report: shaping the future. http://www.who.int/whr/2003/en/whr03_en.pdf, Last accessed on April 7, 2005.

World Health Organization. 1995. Physical Status: The Use and Interpretation of Anthropometry. Technical Report Series No. 854. Geneva: World Health Organization.

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