Potentially modifiable micro-environmental and co-morbid factors associated with severe wasting and stunting in children below three years of age in Aligarh district

S Sachdeva, A Amir, S Alam, Z Khan, N Khalique

Citation

S Sachdeva, A Amir, S Alam, Z Khan, N Khalique. *Potentially modifiable micro-environmental and co-morbid factors associated with severe wasting and stunting in children below three years of age in Aligarh district*. The Internet Journal of Epidemiology. 2008 Volume 7 Number 2.

Abstract

Objective: To estimate the prevalence of wasting and stunting among children under three years of age and study variables associated with their severe forms. Methods: Cross sectional descriptive study done at the field practice areas of the urban and rural health training centres: 468 (245 boys and 223 girls) children aged 0-3 years were included. Height and weight were measured and the indices for wasting (weight for height) and stunting (height for age) calculated using z scores of standard deviation. Socio demographic, child care, feeding and morbidity related factors influencing wasting and stunting were analyzed using binary logistic regression analysis Results: Mean z scores for weight-for-height (WHZ) and height- for-age (HAZ) were less than the reference (CDC 2000) in both boys as well as girls. The overall age and sex combined prevalence of wasting and stunting were 37.6 % and 59.2 % respectively. Both sexes had comparable rates of wasting (boys=36.7%, girls=38.6%; p>0.05). However, there were significant sex differences in the frequencies of stunting (boys = 68.9%, girls = 48.4%; p<.01). The rates of severe wasting (8.3%) in both boys (9.1%) and girls (7.6%) were not as high as those of severe stunting (29.7%; 32.9% in boys and 26.2% in girls. Among variables in the child's microenvironment and co-morbidities; a lower socio economic status (Adjusted OR 1.7, 95% CI 1.1-2.6) , history of measles (Adjusted OR 5.2, 95%CI 1.4 to 19.3), inappropriate feeding (Adjusted OR 2.8, 95% CI 1.4 to 5.9) and presence of vitamin D deficiency (Adjusted OR 5.3, 95%CI 1.6 to 17.9) were associated significantly with the presence of severe wasting whereas pallor (Adjusted OR 1.7, 95%CI 1.1 to 2.6) had significant association with severe stunting. Conclusions: Intervention nutritional programmes and better regular immunization rates are needed for the most vulnerable groups to mitigate childhood morbidity and mortality.

Contribution: SS and AA are responsible for the concept, data collection, analysis and preparation of the manuscript. SA, ZK and NK were involved in data collection and preparation of manuscript.

INTRODUCTION

Undernutrition among children is a major public health problem in developing countries like India. Poor nutrition during childhood affects growth potential and risk of morbidity and mortality in later years of life. Malnourished children are more likely to grow into malnourished adults who face heightened risks of disease and death [1] . A number of factors affect child nutrition, either directly or indirectly. The most commonly cited factors are food availability and dietary intake, breastfeeding, prevalence of infectious and parasitic diseases, access to health care, immunization against major childhood diseases, vitamin A supplementation, maternal care during pregnancy, water supply and sanitation, socioeconomic status, and health-seeking behavior [1] . Children, especially the infants and toddlers constitute the most disadvantaged group. Severe acute and chronic malnutrition setting in at this stage could permanently impair the psychosocial development of the children [2] . The present study therefore attempts to investigate the potentially modifiable distal and proximal factors that cause severe malnutrition in children under three years of age and suggest ways to mould them to their advantage.

METHODOLOGY

STUDY AREAS AND SUBJECTS

This community based cross sectional study was conducted (during the period of August 2007 to June 2008) in the field practice areas of the Department of Community Medicine, J

N Medical College, Aligarh. The urban health training center (U.H.T.C) has four registered peri-urban localities with 1670 households and a registered population of 10,250. The rural health training center (R.H.T.C.) has seven registered villages having 2400 households with a registered population of 14,600. A community based household survey was conducted in the registered areas.

SAMPLE SIZE AND SAMPLING METHOD

The estimated sample size was calculated according to the formula: N=4pq/d^2 where p is the prevalence of malnutrition, q=1-p, and d is relative error. Taking the prevalence of malnutrition in children under three years of age as p=45.9% (NFHS-3) [3] and relative precision d as 10 % of p, the sample size was calculated to be 468. The sample was taken from children under three years of age present in the household and whose parents gave consent for the interview. The response rate was 96% and a total of 486 households (146 urban and 340 rural) were visited to attain the required sample. Systematic random sampling was done in the respective areas such that one eligible child from every tenth household (common sampling interval) was included randomly. For simplification, the lowest sampling interval of all localities (ten) was taken as the common interval applied to all. We drew 30 % and 70 % of the sample size from the urban population and rural population respectively [4] . Proportionate to population size we had a sample of 140 children from the UHTC and 328 children from the RHTC.

A preformed proforma (questionairre) was used for the study. The proforma was divided into two parts. First part of the proforma contained the identification data, socio demographic and environmental profile of the child's family. The social class of the child's family was determined using the Modified Prasad Scale [5] . A precise history of dietary intake of the child was elicited from the mother (recall of food items consumed in last 24 hours). Second part of the proforma included anthropometry and general physical examination of the child including signs of protein-calorie malnutrition and micronutrient deficiencies.

Height and weight measurements were recorded following the standard techniques. The spring balance with an infant tray was used for weighing children up to 10 kg and one with a floor dial for older children (more than 10 kg). The scales could easily be 'zeroed' without any weight on them. Further, daily calibration was enabled before survey. Weights were taken with the subjects wearing minimal clothing to the nearest 0.1 kg and 0.5 kg, in the infant and toddler scales, respectively. Supine length was recorded to the nearest of 0.1 cm using an infantometer for children up to two years of age .A portable stadiometer with a head piece was used to measure heights of older children. The exact age of the child was computed from the child's date of birth. When data on the exact date of birth was not available, the age as told by the mother was used, corrected to the nearest month. A regional local-events calendar was used to assist the mothers for better recall. Wasting and stunting were used to evaluate the nutritional status of the subjects as per Centre for disease 2000 norms. Age and sex specific – 2 z-scores were followed to define wasting and stunting.

Social classes I, II and III of the modified Prasad's classification were categorized as upper class and IV and V as lower class. Appropriate breast feeding was exclusive breast feeding for six months of age and continued up to two years along with semi solids. Appropriate feeding was as per the Integrated Management Neonatal Childhood Illness guidelines. The definitions for appropriate and inappropriate care utilized for the study were appropriate care sought from qualified medical professionals in government health facilities and private hospitals/clinics. Purchasing medicines from pharmacy, home remedies, visiting pharmacies, temples and traditional healers was defined as inappropriate care

STATISTICAL ANALYSIS

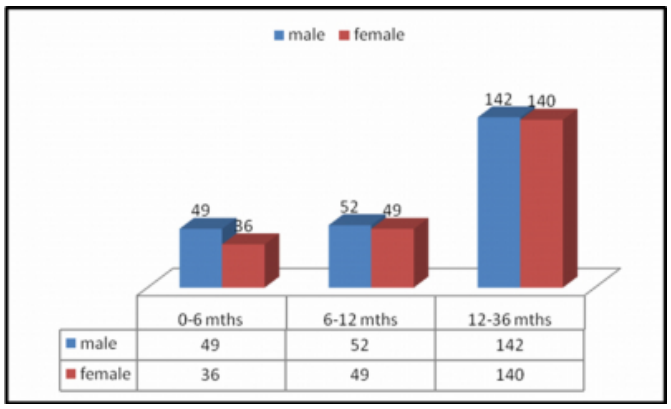
Analysis was performed using SPSS version 10.0 (SPSS, Chicago, IL). Continuous variables were expressed as mean ± standard deviation (Gaussian distribution) or range and qualitative data was expressed as percentage. Unpaired t test for independent samples was used in comparing continuous data between sexes. Chi square test and Fisher's exact test were used for univariate analysis. All p values were two tailed and values of <0.05 were considered to indicate statistical significance All confidence intervals were calculated at 95% level. Binary logistic regression was used to do the multivariate analysis.

RESULTS

The majority (282/ 60.25%) of children were seen in the 12-36 months age group and the least (101/18.16%) in the 0-6 months age group (Fig 1).

Figure 1

Fig 1: Bar chart representing age and gender distribution of the study population.



Female children constituted 48.08% of the study group. Almost half (51.46%) of the 486 children belonged to Muslim families and rest were from Hindu families. Sixty percent were living in nuclear families. Almost 83% were living in overcrowded dwellings and 76.5% belonged to the lower socio economic class. About 69.1% were practising open air defecation.

Mean (SD) z scores for height for age and weight for height of the study population were -2.93(1.07) and -1.46(1.34) respectively. The z scores for height for age in males (-2.52±1.02) and females (-2.25±1.12) were comparable (95% CI -0.13 to 0.46). Respectively the weight for height (-1.43±1.46 Vs -1.49±1.20, 95% CI-0.29 to 0.18) were comparable between the two genders in the study population (Fig 2 & 3).

Figure 2

Fig 2: Box-plots for z scores height for age (ZSCRHT) among boys and girls

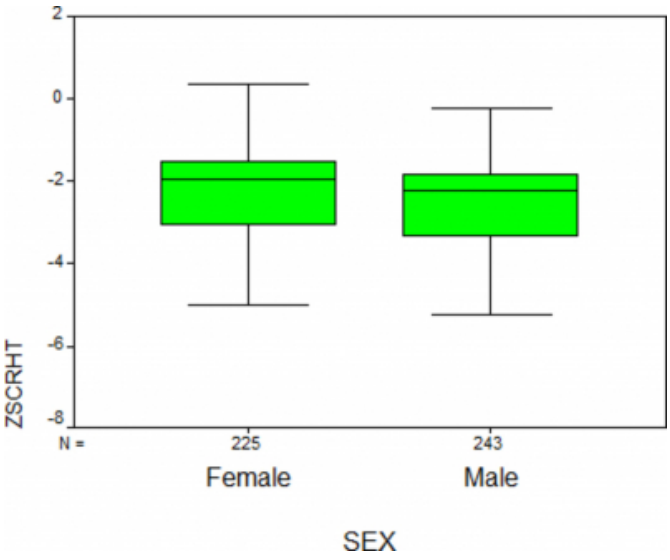
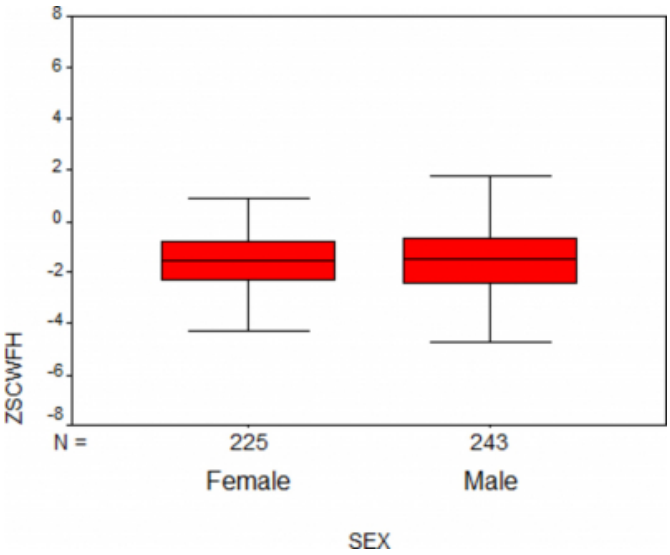


Figure 3

Fig 3: Box-plots for z scores weight for height (ZSCWFH) among boys and girls



The age-wise mean z scores for weight for height and height for age in both genders did not reveal any significant difference except in the age group 7-12 months wherein the mean height z scores was significantly (95% CI 0.33 to 1.08) lower among boys than girls. Males were more severely stunted than females in all age groups. Males were more wasted in the two younger age groups. All these differences did not reach the level of significance (Table 1).

Figure 4

Table 1: Mean age and gender specific z scores for height for age and weight for height.

Age group(months)	Gender		
	Male	Female	95% CI
0-6 months			
HAZ	-1.80±1.03	-1.40±0.77	-0.01 to 0.80
WHZ	-1.21±1.11	-1.06±0.76	-0.28 to 0.57
7-12 months			
HAZ	-2.61±0.93	-1.90±0.97	0.33 to 1.08
WHZ	-1.91±1.66	-1.83±1.29	-0.48 to 0.64
13-36 months			
HAZ	-2.72±0.92	-2.58±1.09	-0.09 to 0.38
WHZ	-1.33±1.45	-1.47±1.28	-0.46 to 0.17

HAZ: height for age, WHZ: weight for height

The overall age and gender combined rates of wasting (37.60%) and stunting (59.18%) were high. The overall prevalence of severe wasting and severe stunting were 8.33% and 30% respectively. Age combined rates of severe malnutrition (< -3 z scores) for height (28.8 % Vs 26.2 %) and weight for height (9.01% Vs 7.5%) were more common among males than for females.Social class (OR 2.3, 95% CI 1.0 to 5.1) and feeding practices (OR 2.6, 95% CI 1.3 to 5.1) were significant risk factors associated with wasting. However, only rural children were more likely to be stunted (OR 2.1, 95% CI 1.3 to 3.1) and none of the other socio demographic factors had significant association with stunting (Table 2).

Figure 5

Table 2: Univariate analysis of the demographic and child care related determinants of severe wasting and stunting.

S.No	Variable	Wasting			Stunting		
		Severe	Not Severe	OR(95% CI)	Severe	Not Severe	OR(95% CI)
1	Locality Urban Rural	6 30	135 297	0.4 (0.2 to 1.1)	57 82	84 245	2.1 (1.3 to 3.1)
2	Family Size ≤6 >6	19 17	172 260	1.28 (0.9 to 1.9)	51 88	140 189	0.6 (0.3 to 0.2)
3	Social class Lower Upper	28 8	263 169	2.3 (1.0 to 5.1)	89 50	202 127	1.1 (0.7 to 1.1)
4	Family Nuclear Joint	24 12	266 166	1.3 (0.6 to 2.6)	77 62	213 116	0.7 (0.5 to 1.1)
5	Dwellings Crowded Not crowded	28 8	360 72	1.4 (0.6 to 3.3)	118 21	270 59	0.8 (0.5 to 1.4)
6	Drainage Open Closed	32 4	354 78	1.8 (0.6 to 5.1)	116 23	270 59	1.1 (0.7 to 1.9)
7	Maternal age ≤ 20 >20	8 28	146 286	1.8 (0.8 to 4.1)	49 90	105 224	1.1 (0.8 to 1.5)
8	Mother Illiterate Literate	25 11	271 161	1.4 (0.6 to 2.8)	89 50	207 122	1.04 (0.7 to 1.6)
9	Father Illiterate Literate	13 23	142 290	1.2 (0.6 to 2.4)	42 97	113 216	0.8 (0.5 to 1.3)
10	Breastfeeding Appropriate Inappropriate	18 18	259 173	1.50 (0.8 to 2.9)	76 63	201 128	1.3 (0.9 to 1.9)
11	Bottle feeding Yes No	10 26	124 308	1.1 (0.5 to 2.2)	39 100	95 234	1.04 (0.7 to 1.6)
12	Feeding Appropriate Inappropriate	19 17	131 301	2.6 (1.3 to 5.1)	92 47	226 103	1.1(0.7 to 1.7)
13	Immunization Yes No	14 22	148 284	0.8 (0.4 to 1.7)	97 42	209 120	1.3 (0.9 to 2.0)
14	Care Seeking behavior Appropriate Inappropriate	2 34	17 415	0.7 (0.2 to 3.1)	3 136	16 313	2.3 (0.7 to 8.1)

Among the childhood morbidities presence of measles (Odd's ratio 3.9, 95% CI 1.4 to 11.3), vitamin A deficiency (OR 3, 95% CI 1.2 to 7.8), vitamin D deficiency (OR 6.7, 95% CI 2.5 to 17.8) and worm infestation (OR 3.3, 95% CI 1 to 10.3) were significantly associated with wasting. Pallor (OR 129.7, 95% CI 54.2 to 310.8) was found to be the most

significantly associated with stunting. Another factor that had a borderline association with stunting was the presence of vitamin D deficiency (OR 3.01, 95% CI 1.3 to 7.2) (Table 3).

Figure 6

Table 3: Univariate analysis of child morbidity related determinants of severe wasting and stunting

S.No	Variable	Wasting			Stunting		
		Severe	Not severe	O.R(95% C I)	Severe	Not severe	O.R(95% C I)
1	Measles Present Absent	5 31	17 415	3.9(1.4 to 11.3)	8 131	14 315	1.4 (0.6 to 3.4)
2	ARI* Present Absent	2 34	17 415	1.4 (0.3 to 6.5)	9 130	10 319	2.21 (0.9 to 5.6)
3	Pallor Present Absent	17 19	164 268	1.5 (0.7 to 2.9)	133 6	48 281	129.8 (54.2 to 310.8)
4	Vitamin A deficiency Present Absent	6 27	30 405	3 (1.2 to 7.8)	13 126	20 309	1.6 (0.8 to 3.3)
5	Vitamin D deficiency Present Absent	7 29	15 417	6.7 (2.5 to 17.8)	12 127	10 319	3.01 (1.3 to 7.2)
6	Diarrhea* Present Absent	3 33	20 412	1.9 (0.5 to 6.6)	10 129	13 316	1.9 (0.8 to 4.4)
7	Worms Yes No	4 32	16 416	3.3 (1 to 10.3)	9 130	11 318	2 (0.8 to 4.9)

*Had one or more episodes in the past one month

On binary logistic regression analysis social class (Adjusted OR 1.7, 95% CI 1.1 to 2.6), feeding practices (Adjusted OR 2.8, 95%CI 1.4 to 5.9), Measles (Adjusted OR 5.2, 95%CI 1.4 to 19.3), vitamin D deficiency (Adjusted OR 5.3, 95%CI 1.6 to 17.9) were the factors found significantly associated with wasting. On applying logistics regression analysis only pallor (Adjusted OR 1.7, 95%CI 1.1 to 2.6) was found significantly associated with stunting.

DISCUSSION

The two nutritional indices (wasting 37.6 %; stunting 59.2 %) were staggeringly higher in the present study as compared to the national (19 %; 38. %) (http://www.nfhsindia.org/pdf/IN.pdf) and state figures (14 %; 46 %) (http://www.nfhsindia.org/pdf/UP.pdf). Comparable rates were also observed in studies from Coimbatore [6] and Punjab [7] . Observed sex ratio of 0.93 corroborates the national (0.93) and state (0.90) figures (http://www.indiatogether.org/2004/apr/hlt-csratio.htm). Lower mean z scores for height and weight for height among boys as compared to girls in the present study are consistent with the observations of Dwivedi et al [8] from Madhya Pradesh. It has been suggested that growth in boys may be more sensitive to environmental insults such as infections and diseases [9] . .

An earlier study done in south Indian children revealed 8% and 21% severe wasting and severe stunting [6] . These figures are lower than that found in the present study specially in case of severe stunting. In some other better developed states of India (Haryana and Kerala) the surveys have not found children with severe malnutrition [10,11] . The pooled prevalence of severe wasting and severe stunting in Punjab districts were 2.8% and 38% [7] . The mean z scores for height among both the sexes declined as the child progressed from infancy through becoming a toddler. A largely similar trend was observed with the mean z scores for the weight for height. The better nutritional status of infants is probably due to their nutritional needs being met through breast milk and some complementary foods. However, after the first year of life, when breast feeding no longer meets their nutrient needs and complementary food is inadequate, there was an increase in the prevalence of under-nutrition. The findings are consistent with those of Benjamin and Zachariah [12] of Punjab who found that the highest proportion of malnourished children was in the second year of life. Better mean z scores during infancy further confirm the nutritional superiority of breastmilk and propose a case for exclusive breast feeding. The mean age and gender combined z scores for height and weight for height in the 0-6 months age group were -1.51± 0.96 and -1.12 ±0.98 respectively. Undernutrition and failure to thrive in this age group could be due to intra mural and neonatal events. However these factors have not been studied in the present work.

Children belonging to the lower social classes and where feeding was inappropriate were significantly more wasted than the rest. These results were confirmed by other workers [13] indicating that unavailability of food, insufficient purchasing power, inappropriate distribution and inadequate utilization might make the children vulnerable to malnutrition in a deprived community. Long duration of breastfeeding without introduction of appropriate complementary feeds may be associated with higher malnutrition because it reflects lack of resources to provide children with adequate nutrition [14] . It is also possible that children who are breastfed for a long time are more reluctant

to eat other foods, as was found in a study on a cohort of Ghanaian children [15] . Moreover the present study found measles an important co-morbidity associated with severe wasting which has been seen in a case control study of severely malnourished children with diarrhea in Bangladesh [16] . Whereas a Ugandan study found presence of fever in the preceding two week period as a risk factor for wasting [17] . Surprisingly we also found vitamin D deficiency significantly associated with wasting. This could be due to wasting and stunting present together in some children. Contrast to the present study which only found pallor as a risk factor for severe stunting, some workers from the developing world [18] have found family size, parental education [17,19] , poor breastfeeding pattern and inadequate complimentary feeding associated with chronic malnutrition. In a study done in Kerala anemia was seen to be significantly associated with mild and moderate malnutrition [11] .

There is a close positive link between the nutritional status of pre-school children and the stages of development of the states. Mothers' education and household conditions are important influences on children's health status irrespective of the stage of development [20] . Uttar Pradesh, where the present study was carried out, is one of the worst affected states in India. Focus, therefore should be on domiciliary management of severely malnourished children (without medical complications). The same can be achieved at primary health level with appropriate training of the anganwadis and auxillary nurse midwives. Intervention programmes for the most vulnerable groups should be planned to mitigate childhood morbidity and mortality. Micronutrient supplementation and health education of the caregivers through simple health packages would go a long way in alleviating the co-morbidities.

References

1. Sommerfelt, A. E. 1991. Comparative analysis of the determinants of children'snutritional status.Paper Presented at the Demographic and Health Surveys World Conference, Washington, D.C., August 5-7, 1991; 12 (9): 981-998.
2. Vazir S, Naidu AN, Vidyasagar P, Nutritional status, Psychosocial \Development and the Home Environment of Indian Rural Children. Indian Pediatr. 1998; 35: 959-966.
3. International Institute for Population Sciences (IIPS) and Macro International. 2007. National Family Health Survey (NFHS-3), 2005-06: India: Vol. 1. Mumbai: IIPS; 2007 (http://www.nfhsindia.org)
4. Blinkin N J, Sullivan K, Anderson JW, Johnstone BM, Remley DT Rapid nutrition surveys: How many clusters are enough? Disasters 1992; 16:97-103.
5. Kumar P. Social classification-need for constant updating. Ind. J. Comm Med 1993; 8(2): 59-61.
6. N Seetharaman,TV Chacko, SLR Shankar, AC Mathew. Measuring malnutrition-The role of z scores and the composite index of Anthropometric Failure. Indian Journal of Community Medicine January 2007; 32 (1): 35-39.
7. Laxmaiah A, Rao M K, Brahmam GNV, Kumar S, Ravindrenath M, Kasinah K et al. Diet and Nutritional Status of Rural Preschool Children in Punjab. Indian Pediatrics 2002; 39: 331-338.
8. Dwivedi SN, Banerjee N, Yadav OP. Malnutrition among children in an urban Indian slum and its associations. Indian Journal of Maternal and Child Health 1992; 3: 79-81.
9. Parraga IM, Assis AM, Prado MS, Barnetto ML, Reis MG, King CH & Blanto RE (1996): Gender differences in growth of school aged children with schistosomiasis and geohelminth infection. Am J Trop Med Hyg 1996; 55: 150–156.
10. Jood S, Bishnoi S, Sehgal S. Nutritional status of rural pre school children of Haryana state. Indian Journal of Pediatr 2000; 67 (3): 189-196
11. George KA, Kumar NS, Lal JJ,Sreedevi. Anemia and nutritional status of pre school children in Kerala. Indian J Pediatr 2000; 67 (8): 575-577.
12. Benjamin AI, Zachariah P. Nutritional status and feeding practices inunder three years old children in a rural community in Ludhiana, Punjab. Health and Population 1993;16 (192):3-21.
13. Martorell, R; Rivera, J; Kaplowitz, H; Pollitt, E. Long-term consequences of growth retardation during early childhood. In: Hernandez M, Argente J. , editor. Human growth: basic and clinical aspects. Amsterdam: Elsevier Science Publishers; 1992. pp. 143–149.
14. Hong, R. Effect of economic inequality on chronic childhood undernutrition in Ghana. Public Health Nutrition. 2006;10:371–378
15. Brakohiapa, LA; Yartey, J; Bille, A; Harrison, E; Quansah, E; Armar, MA; Kishi, K; Yamamato, S. Does prolonged breastfeeding adversely affect a child's nutritional status? Lancet. 1988;332:416–418
16. Chisti MJ, Hossain MI, Malek MA, Faruque AS, Ahmed T, Salam MA.Characteristics of severely malnourished under five children hospitalized with diarrhea,and their policy implications. Acta Paediatr. 2007 May; 96(5):693-6.
17. Wamani H, Astrom AN, Petersan S, Tumwine JK, Tylleskar T. Predictors of poor anthropometric status among children under two years of age in rural Uganda. Public Health Nutrition: 9(3);320-326.
18. Rahman A,Chowdhry S.Determinants of malnutrition among preschool children in Bangladesh. J Biosoc Sci. 2007 Mar; 39(2):161-73. Epub 2006 Mar 28.
19. Rayhan MI, Khan MSH. Factors causing malnutrition among under five children in Bangladesh. Pakistan Journal of Nutrition 5(6):558-562, 2006.
20. Som S, Pal M, Bharati P. Role of individual and household level factors on stunting: a comparative study in three Indian states. Ann Hum Biol.2007 Nov-Dec; 34(6):632-46.

Author Information

Sandeep Sachdeva, DCH,MD
Senior Resident, Department of Community Medicine, Jawaharlal Nehru Medical College (JNMC), Aligarh Muslim University (AMU), Aligarh

Ali Amir, MD
Senior Lecturer, Department of Community Medicine, Jawaharlal Nehru Medical College (JNMC), Aligarh Muslim University (AMU), Aligarh

Seema Alam, MD
Reader, Department of Pediatrics, Jawaharlal Nehru Medical College (JNMC), Aligarh Muslim University (AMU), Aligarh

Zulfia Khan, DCH, MD
Professor, Department of Community Medicine, Jawaharlal Nehru Medical College (JNMC), Aligarh Muslim University (AMU), Aligarh

Najam Khalique, MD
Reader, Department of Community Medicine, Jawaharlal Nehru Medical College (JNMC), Aligarh Muslim University (AMU), Aligarh