Living Environs and Nutritional Status of Children from an Urban Indian Slum: An Analysis of Associative Factors

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Abstract: Growing urbanization gives rise to slums, which are densely populated peri-urban areas housing underprivileged populations. The nutritional status of children in slum areas can be compromised due to poor living environs despite availability of many urban health care facilities. The present cross- sectional study was undertaken to determine the nutritional status of children residing in slum and analyze the various associative factors. The study area was Ghousianagar, a slum in city of Mysore from South India. A sample of 676 children (2-11 years of age, males, 310 and females, 366) from two schools was chosen for detailed anthropometry. Data were also collected on living conditions, economic and literacy levels of parents and nutritional status of mothers (n=200) through standard techniques. The results revealed that the living conditions of children were highly unhygienic. Only in 36% of families both parents were literate. Children from all age groups exhibited different degrees of malnutrition which worsened with increasing age. Only 8% of children were normal and the rest suffered with different degrees of undernutrition. Stunting and wasting were significantly influenced by age and gender of children. Under associative factors studied, weight for age of children was significantly associated with economic status of family and maternal BMI. Weight for height was associated with economic status, family size and maternal BMI. Height for age exhibited marginal association with family size. It can be said that adverse living environment and limited resources influenced the nutritional status of children adversely.

Keywords: Anthropometry, body mass index, gender, literacy level, economic level, family size.

INTRODUCTION

Slums in urban areas of India are growing at an alarming pace due to migration of masses either in search of employment or better living conditions. In India, 28% of population was living in urban areas in the year 2001 with future projections of 50% growth with 605-618 millions by the year 2021-2025 [1]. Of this, around 1/3rd were living in poverty stricken slum areas. Slums are usually settled on low-lying areas not used by others for any regular purposes. The sustenance and recognition of slum residents for receiving the basic amenities as safe drinking water, safe drainage, proper housing, excreta disposal, access to health care, transport facility, etc. are not met and they are forced to reside in inhuman condition. Slums adjacent to waste disposal sites face several hazards of degraded environment as polluted water and air. This adverse environment has deleterious repercussions on health and nutrition of vulnerable sections of population, especially children.

Malnutrition is a part of vicious cycle that also includes poverty and disease, the three components being interrelated and each contributing to the occurrence and persistence of the other. Anthropometric deficits may therefore act through the other two components of the cycle and lead to further malnutrition. Of the major determinants leading to malnutrition, the proximal factors are inadequate food intake and disease. The distal factors do not directly influence somatic status but do so through intermediate and proximal determinants *via* a number of pathways. For example, poverty can lead to low levels of parental education, poor water supply and sanitation, low purchasing power and inadequate health care, all of which contribute to low food security at the community level leading to poor nutritional status of children. Cultural factors influenced by social and economic levels such as gender and food insecurity are also found to affect the nutritional status of children [2]. However, the extent of these influences on the anthropometric indices varies by the study set up and the age group included, hence the present study is an attempt to explore these angles in selected population.

A recent review by Best *et al.,* [3] on the need to care for children states that malnutrition is a public health issue in school aged children in developing countries and there is a need for high quality research as well as nutrition interventions. National level nutrition surveys conducted in rural areas of eight Indian states indicated that 40-50 and 6-8.6% of school children respectively were moderately and severely malnourished [4]. However, no such nationally representative information on nutritional status of children of slum areas is available. Research studies undertaken in slum areas of different parts of the

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country have been mostly cross-sectional and focused on preschoolers and adolescents [5]. Few reports do suggest that the nutritional status of children residing in slum areas is far below the developing country standards [6, 7]. The present study was undertaken with the objective of determining the nutritional status of children residing in slum and analyzing the various associative factors.

METHODS

Study Area and Subjects

The study was conducted in an urban slum of Mysore city situated in South India, by name 'Ghousianagar'. It is a densely populated area with compact houses, narrow approach mud roads and no drainage facilities. The slum had a school and a day care center for preschool children run by a voluntary organization. Appropriate approvals from the concerned authorities for conducting the study and informed consent from the parents of children was obtained. The mode of data collection was cross sectional. It comprised of development of questionnaires, collection of baseline data, anthropometric measurements, detailed collection of information regarding maternal characteristics, and analysis of associative factors. All the children between the age of 2-11 years attending the school and preschool numbering 676 (males, 310 and females 366) were enrolled for the study. Data were collected from their parents (a total of 200 families, as most of the families had 2-4 children enrolled in the school).

Tools and Techniques

Baseline Survey

The mothers of the selected children (n=200) were interviewed with an open-ended questionnaire and information on demography, literacy and economic status, mode of occupation, housing conditions, hygiene in and around the houses, availability of basic amenities at household and community level, existence of welfare organizations, ongoing activities, recreational activities and access to health facilities were elicited. Information on personal hygiene, their participation in social, educational and health camps etc, were recorded on observational basis.

Categorization of Families Based on Different Criteria

Economic Status

Food expenditure was considered as the index of economic status as majority of the families belonged to labor class and their monthly income was not stable. A large percentage of the family income was spent on food stuffs in these families. This is supported by studies involving low socio-economic groups wherein food expenditure is considered an index of economic status or household economic position [8]. The food expenditure pattern was computed with the help of a questionnaire. Based on the food expenditure, [amount in Rs./consumption unit/month] the selected families were categorized into three categories as low, [< 450] Medium, [451-900)] and high [901-1200].

Literacy Status

Based on the literacy levels or years of formal schooling received, the mothers were categorized into three groups as level -0 (illiterate), level - I (5-7 years of schooling) and level - II (8-10 years of schooling).

Family Size

Based on the number of members, the families were categorized into three groups as small (3-5 members), medium (6-8 members) and large (>9 members).

Assessment of Nutritional Status

The nutritional status of children was assessed by recording their age, weight, height, mid upper arm circumference (MUAC) and skinfold thickness (SFT). Exact age was ascertained by referring to school records and validated with parents on house visits. Weights of the children were recorded using an electronic balance (EssaeDigi Scale, Model D-20), to the nearest of 0.1 kg following standard procedures. Heights of all the children were recorded with the aid of a non-stretchable fiberglass tape fixed to a straight wall to the nearest of 1.0 mm. The weight and height data of children was analyzed using Gomez and Z score classification to determine their nutritional status, details of which are included below [9]. Based on weight for age of children, they were divided into different grade of malnutrition as per Gomez classification as normal [>90%], grade I or mild undernutrition [76-89%], grade 2 or moderate undernutrition [60-75%], grade III or severe undernutrition [<60%]. Weights and heights of the children were compared with 50th percentile of NCHS standards [10] and the degree of nutritional status was computed using 'Z' scores or standard deviation classification as normal [median to –1sd]; mild [-1sd to –2sd]; moderate [-2sd to -3sd] and severe [<-3sd]. Based on the results, the children were classified into

different grades of malnutrition as underweight [low weight for age]; stunting [low height for age] and wasting [low weight for height]. Weights and heights of the mothers of the selected children were recorded and body mass index was computed and the nutritional status of mothers was coded as per the classification of BMI suggested for Asian populations [11].

MUAC and SFT (fat folds at triceps) were measured using a non-stretchable fiber glass tape and Harpenden's skin fold calipers respectively by standard techniques. The recorded measurements were compared with the standards [12] and children categorized into different grades of malnutrition.

Statistical Analysis

Mean and SD of all the anthropometric indices were calculated in relation to age and sex. Children were classified into three age groups for analysis as advised by statistician. Suitable statistical tests were adopted to test the various factors associated with the nutritional status of the children. The maternal factors were literacy status, economic status and nutritional status and the child factors were age and gender. Analysis of variance and chi-squares were applied appropriately. Probability level was fixed to $P < 0.05$ for all analysis. The level of significance indicated for the data is as follows; ns: not significant, *: $P \leq 0.05$, **: $P \leq 0.01$ and ***: $P \leq 0.001$.

RESULTS AND DISCUSSION

Living Environs and Differential Vulnerability Index

The existing conditions in the slum area can be assessed scientifically using different criteria and expressing in terms of differential vulnerability as adopted by USAID/India [13]. The status of slum area chosen for the study is given in Table **1**. The occurrence of open drains in the areas is graded under 'extremely' vulnerable category indicative of a risk for morbidity and mortality. The residents were housed in single room mud and brick small dwellings without any running water, drainage or toilet facilities. Around half of the selected families owned a house while the remaining rented dwellings. Four public taps and six borewells were catering to the needs of the population. Only $1/4^{th}$ of the households had electrical connections, while the rest did not utilize electrical facilities due to financial constraints. There were few small shops located in the area for purchasing foods. The quality of food stuffs available was very poor. The perishables as cut fruits, meat, sweet meats were placed in open containers beside roads compromising the hygienic quality. For health care facility, there were only two health clinics present in the study area. Public transport facilities were available to residents.

Most of the residents had radio sets and few had televisions in their homes. There were no parks/ other recreational activities of any kind. However, cinema theaters were approachable through public transport system. A voluntary organization was offering education to the school children, running a daycare centre for preschool children and worked for the welfare of children, nursing and expectant mothers. It was providing supplementary foods, nutrient supplements, medicines for minor ailments and a female doctor's service periodically. Health and nutrition camps and referral services for severely malnourished children were also offered. Employment status received a low score indicating the low economic position of the population. Thus assessing the differential vulnerability of area indicated the prevailing

Table 1: Differential Vulnerability of Slums for Various Criteria

Category	Criteria	Degree of vulnerability	Category	Criteria	Degree of vulnerability
Land/house	Land status	Moderate	Services	Toilet	Moderate
	House			Water	
Employment	Pattern	Extreme		Drains	Extreme
	Occupational hazards	Moderate		Electricity	Moderate to extreme
	Credit	Extreme	Health status	Health facility	Moderate
Education	Children and adults	Moderate		Service	
	Gender status			Morbidity	Extreme
	Identity proofs		Support	Govern-ment/NGO	Moderate

[Ref.: 13].

situation to assist in identification of health and nutritional status of the community and associated factors to certain extent.

Literacy and Occupational Status

The literacy and occupational status of selected families is presented in Table **2**. As can be seen, around half of the mothers were illiterate, 38% had 5-7 years of formal schooling and 13% had studied up to high school. Around 44% of the fathers of study children were illiterate, one third had received 5-7 years and one fifth had received 8-10 years of schooling. In 30% of families both parents were illiterate and in another 1/3rd of the families, one of the parents had received formal education. A good body of evidence suggest that health and nutritional status of the children and survival rates of infants were enhanced by educational attainments of the parents especially that of the mothers. Better education is associated with better information, capabilities as well as eagerness to try alternative approaches of earnings.

Around 1/4th of the men in the selected families were engaged in vending vegetables and fruits for earning their livelihood, another 20% were drivers for private vehicles. Around 20 and 30% were involved in unskilled and skilled labour. Around 3/4th of the women were involved in income generation for their family, of which most were involved in '*Beedi'* rolling (a local version of cigarette, i.e. tobacco rolled in a dried leaf). Both literacy and occupational status shows that the study population were deprived of a better socio-economic status.

Nutritional Status

Nutritional Anthropometry

Children form an important segment of the society; their physical growth and nutritional status deserve to receive utmost priority as it reflects the general health and nutritional status of the society and nation as a whole. Literature survey suggests that malnutrition still continues to be a public health problem and is a cause of mortality. India consists of diverse agro-climatic regions and ethnic multiplicities. The socio-cultural practices, lifestyles and food habits influencing the nutritional status are known to vary to a large extent. As seen from Figure **1**, 20% of the children had normal weight, while 31 and 6% suffered with moderate and severe degrees of underweight respectively. When height for age was taken into consideration, it was surprising to observe that 9% of the children had attained height which was above normal and 16% had normal height/age. Seventeen and 37% were subjected to moderate and severe degree of stunting

Table 2: Educational and Occupation Status of Selected Families

Educational Level				
Literacy level	**Mothers (%)**	**Fathers (%)**	**Educational pattern**	**No.**
'O' Level (Illiterates) (n=187)	49	44	Both parents literate	72
Level '1' (5-7th std) (n=143)	38	34	Both parents illiterate	60
Level '2' (8≥10th std) (n=70)	13	22	One parent literate	68
Occupation				
Fathers		**No.**	**Mothers**	**No.**
Vendors		48	*Beedi* rolling	146
Drivers		41	*Agarbatti* rolling	6
Unskilled labourers (coolie, butcher, hotel attender, *beedi* rolling, *agarbathi* rolling)		41	Tailoring	2
Skilled workers (carpenter, painter, iron smith, tailor, welder, cobbler, mechanic)		57	Not working	46
Shop keepers		5		
Others		4		
Not working		4		

Beedi: Local form of cigarette wherein tobacco is rolled in a leaf for smoking.
Agarbatti: Incense sticks.

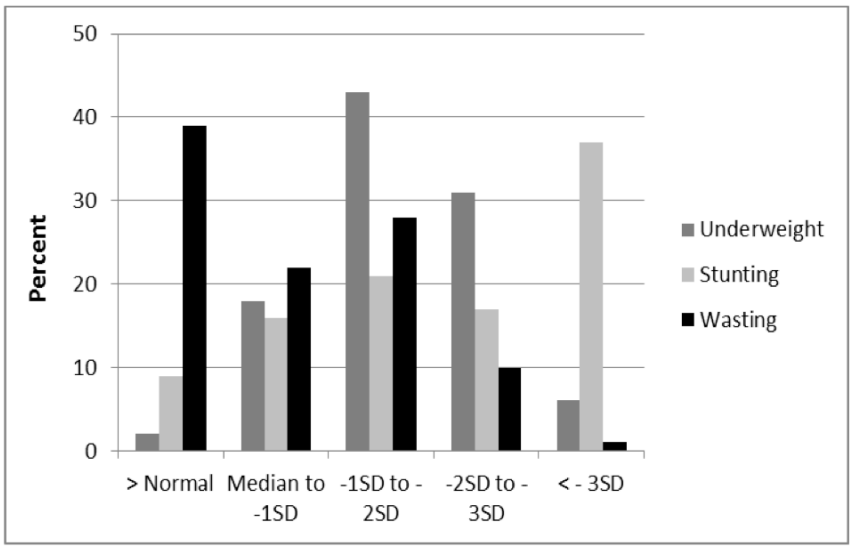

Figure 1: Percent prevalence of malnutrition in selected children.

respectively. Weight/height ratio, an age independent index suggested that 39 and 22% had normal ratio, while only 11% exhibited wasting.

Anthropometric indices are one of the best indicators for assessing nutritional status as it indicates the onset of 'mild malnutrition' in children or those falling in '<-1SD' as per Z scores (Table **3**). Around 1/10th of children had attained normal weight and height/age and exhibited normal weight/height ratios or were free from anthropometric failure. A little more than 1/3rd of the selected children exhibited mild forms of undernutrition or one or more forms of anthropometric failure. Mild forms of undernutrition have not received much biological/clinical significance, though it needs attention. This is the initial stage which on negligence might progress or advance to further stage pushing the children from 'at risk' to 'risky' zone of undernutrition and making them vulnerable to morbidity and mortality. A little more than half of the children were subjected to moderate and severe forms of undernutrition. A small proportion of them were underweight and wasted, while 17% were stunted. Around 1/5th of the children were subjected to both underweight and stunting indicating that they were suffering from both long term and current nutrient deprivation. A small proportion of 5%

Table 3: Anthropometric Profile of Children (No. of Subjects)

Indicator	Male	Female	Total	Male	Female	Total
Normal	26 (51)	29 (49)	55 (8)	-	-	-
	Undernourished < - 1SD			Undernourished < - 2SD		
Underweight	5 (16)	27 (84)	32 (5)	18 (51)	17 (49)	35 (5)
Stunting	7 (44)	9 (56)	16 (2)	55 (48)	60 (52)	115 (17)
Wasting	12 (55)	10 (45)	22 (3)	14 (52)	13 (48)	27 (4)
Underweight & stunting	33 (49)	34 (51)	67 (10)	71 (50)	72 (50)	143 (21)
Underweight & wasting	26 (43)	35 (57)	61 (9)	15 (50)	15 (50)	30 (5)
Multiple failure	21 (39)	33 (61)	54 (8)	7 (37)	12 (63)	19 (3)

Figures in parenthesis indicate percentages.

exhibited underweight and wasting indicative of acute and current undernutrition. The current way of representation gives a better picture or severity of undernutrition over the conventional method of reporting the prevalence of each form of undernutrition independently. This method also implicates the level of risk and exact situation of children's nutritional status. The differences in the pattern of undernutrition between the male and female children were found to be non-significant as per F test (F=0.9479 ns).

The proportion of multiple anthropometric failure though looks small, cannot be overlooked as the associated consequences on health and well being of children are detrimental. It has been shown that failure of number of anthropometric indices increased as the mean standard of living scores decreased. Several studies have consistently showed that children with multiple failure were at a higher risk for diarrhea and acute respiratory infections [14, 15].

MUAC, an indicator of protein status and an age independent criteria, is a simple and inexpensive measurement which is quick and easy to undertake for minimally trained workers in door-to-door screening in comparison to any other indicators tested. One way to ensure the age-independence is to adjust indicators that account for age of the subject as weight/age or height/age [16]. Contradicting this, several others have reported that MUAC for age in comparison to other anthropometric indices was a superior indicator with good predictive power of mortality and high specificity in underfives [17]. In present study MUAC was found to be >90% of standard in around 80% of children in 2-5 year old group, and the remaining had a MUAC between 80-90% of standard (Table **4**). In 6-8 year old group, though a similar proportion had MUAC >90% of standard, a small proportion of children showed a 10% downward shift in the measurement. In the 9-11 year old group a negative shift was seen in a higher proportion from '>90%' category to '81-90%' group. The differences between the age groups were found to be highly significant as per chi-square analysis.

Skinfold measurements assess the thickness of subcutaneous tissue and indicate fat status. As can be seen in Table **4** children with SFT >90% of standard reduced to almost half with increasing age. The proportion of children with SFT between '60-80%' of standard reduced from younger to older age group. In the group with <60% of standard SFT, a higher proportion was from older age group. The differences in the pattern of distribution of SFT among the children between the various categories of percentage of standard was found to be highly significant as per chi-square analysis.

Nutritional Status in Relation to Age and Gender

Weight/age of the children above the 50th percentile NCHS of standard was observed in a small proportion of the children, however it reduced with age (Table **5**). The proportion of children with ≥ normal decreased with age while those with <-2 SD increased with age. It implies that the overall nutritional profile deteriorated

Table 4: Distribution of Children Based on Mid Upper Arm Circumference and Skinfold Thickness in Relation to Age (% of Subjects)

Age group (years)	No.	Percent of standard			
		61-70	71-80	81-90	>90
Mid upper arm circumference					
2-5	221	0	0	22	78
6-8	336	0	5	17	78
9-11	119	0	5	50	45
Total	676	0	3	27	70
X^2 = 46.358***					
Skinfold thickness					
2-5	221	25	48	13	14
6-8	336	18	38	34	10
9-11	119	47	41	5	7
Total	676	34	44.5	10.5	11
X^2 = 64.850***					

with age. The proportion of children with height/age above the expected values was observed in 17% of children below 5 years. It drastically reduced by 50% and 5% in 6-8 and 9-11 year groups of that prevalent in younger ages. Moderate degree of stunting was almost comparable in all three age groups but severe form increased by around 2 to 3.5 times with every three year increase in age. The extent of deterioration of linear growth with age was found to be extremely significant. The weight for height ratio of the children above the expected values were found to increase with age, it increased by almost two to three times with a corresponding decrease in moderate degree of wasting in the 9-11 year group compared to younger age groups. The differences in the pattern was found to be highly significant.

The proportion of children with normal weight for age or the degree of underweight were found to be comparable between the genders (Table **5**). This was confirmed by chi-square analysis. This pattern is similar to that reported for preschool and school children of rural origin reported by National Nutrition Monitoring Bureau [4]. Height/age of children was found to be normal in a higher proportion of females than males; moderate degree of stunting was more in females while

Table 5: Nutritional Status of Children in Relation to Age and Gender (% of Subjects)

Indicator	> Normal	Median To -1SD	-1SD to -2SD	-2SD to -3SD	< - 3SD
Age group (years)					
Underweight					
2-5	4	16	46	24	10
6-8	3	17	40	32	8
9-11	1	15	43	36	5
$X^2 = 8.985^{ns}$					
Stunting					
2-5	17	18	30	17	18
6-8	9	18	25	16	32
9-11	1	12	9	15	63
$X^2 = 76.131^{***}$					
Wasting					
2-5	25	35	25	14	1
6-8	31	24	33	12	-
9-11	71	8	15	5	1
$X^2 = 28.379^{**}$					
Gender					
Underweight					
Male	3	16	44	32	5
Female	2	20	42	29	7
$X^2 = 2.25^{ns}$					
Stunting					
Male	8	18	21	12	41
Female	10	14	22	21	33
$X^2 = 12.987^{**}$					
Wasting					
Male	42	18	28	12	0
Female	35	26	29	8	2
$X^2 = 8.746^{*}$					

severe form was seen in males. These differences were found to be highly significant as per chi-square analysis. The prevalence rates were similar to those reported for preschoolers by NNMB [4] but no such differences in the trend existed between the genders. Weight/height ratios of a higher proportion of males were above the standard value, however, moderate wasting was comparatively lower in females. These differences proved to be statistically significant. In contrast no such gender differences were observed in rural subjects from eight states [4]. Dutta *et al.,* [18] studied the prevalence of undernutrition among children in Himalayan region and found a very high degree of stunting and wasting in children. The incidence was higher in girls than in boys and was higher in rural children than in urban.

Associative Factors

Research has shown that factors as maternal literacy status, family structure, nutrition knowledge, dietary adequacy, maternal nutritional status etc. affect the nutritional status of the children. Since women are the primary caregivers of the children, their health and nutritional status is also known to influence the growth and development of children irrespective of other socio-cultural factors. Hence these factors were also studied in the present investigation.

Economic Status Versus Nutritional Status

Higher levels of income are correlated with better housing conditions; houses with piped water, toilet facilities and electricity have lower contaminant levels than households without such amenities. More money can be spent on nutritious food, medicine and health care that can directly impact on children's health. Better economic status facilitates mother's learning opportunities on health seeking, nutritional requirements, better selection of foods for their children and better health and nutritional status.

Weight for age of the children in relation to economic status (Table **6**) showed that the proportion of children with normal weights, were comparatively higher in the 'middle' income group. Proportion of underweight (<-2SD) declined by more than three times from low to high economic group but severe form increased at the same rate. On the whole <-2SD and <-3SD together was found to reduce by 7% and 15%, in high than low and medium income groups respectively and the differences were extremely significant.

The results of present study confirm the findings of other investigations conducted in different parts of country in children of 6-16 years. The pattern is consistently evident among children in all South Asian countries [19-21].

Proportion of children with normal height for age increased with an increase in the income level. It was found to double from 'low' to 'high' level, prevalence of stunting (<-2SD) was lower in 'high' and least in 'middle' income groups. Severe degree of stunting was lower in 'high' and 'low' income groups. A linear decrease in the prevalence of stunting (i.e. both <- 2SD and <- 3SD together) with an increase in the economic status, though non-significant, was evident. Similar pattern was reported for preschoolers of rural areas of Mysore city [20]. Height attainment or linear growth is the outcome of long-term effect of economic status.

Since the study group comprised of both preschool and school aged children and height velocity being age specific, the effect of economic status was not significantly evident in these children. In contrast several other studies from South Asian countries have shown that occupations reflecting the economic status were found to influence nutritional status of its family members especially of growing children. Prevalence of stunting was higher among children of laborers and unskilled workers than those of landlords or servicemen [21,22].

Proportion of children with normal weight/height ratio decreased with improvement in economic levels. Moderate degree of wasting (<-2SD) was lower and severe form was higher in high income group. Prevalence of wasting i.e. both 'moderate' and 'severe' forms summed up together was found to be higher among 'high' income group. An inverse relationship is clearly evident between the extent of wasting and their economic status. One possible reason for such a pattern is the lowest prevalence of stunting or attainment of normal height in a higher proportion of children in 'high' income groups. The attainment of linear growth and failure to increase weight in the same proportion would be graded as "wasted". The differences in the prevalence of wasting between the economic groups were found to be significant at 0.1% level.

Family Size Versus Nutritional Status

Family size and structure is known to influence the quality of life of its members which can be measured in

Table 6: Nutritional Status of Children in Relation to Economic Status, Family Size, Literacy Level and BMI of Mothers (% of Subjects)

Criteria	Factor	No.	Normal	1st grade	2nd grade	3rd grade	Significance
Economic level							
Weight for age	Low	181	8	31	51	10	X^2=40.069***
	Medium	433	12	31	50	7	
	High	62	8	48	15	29	
Height for age	Low	181	11	26	36	27	X^2=10.063 ns
	Medium	433	18	23	26	33	
	High	62	23	25	29	23	
Weight for height	Low	181	56	27	7	10	X^2=73.315***
	Medium	433	50	35	15	1	
	High	62	42	25	4	29	
Family size							
Weight for age	Small	374	21	45	29	5	X^2=4.330 ns
	Medium	279	21	40	30	9	
	Large	23	17	50	22	11	
Height for age	Small	374	30	21	20	29	X^2=12.592*
	Medium	279	24	23	17	36	
	Large	23	28	16	-	56	
Weight for height	Small	374	62	30	7	-	X^2=17.275***
	Medium	279	60	26	12	2	
	Large	23	55	11	28	6	
Literacy level of mothers							
Weight for age	Level 0	318	10	36	47	7	X^2=8.486 ns
	Level I	243	9	27	53	11	
	Level II	115	6	39	51	4	
Height for age	Level 0	318	19	25	29	27	X^2=7.502 ns
	Level I	243	17	21	25	37	
	Level II	115	12	28	32	28	
Weight for height	Level 0	318	47	36	15	2	X^2=10.054ns
	Level I	243	48	35	15	2	
	Level II	115	62	30	8	-	
Maternal BMI							
Weight for age	Normal	202	3	31	57	8	X^2=21.750***
	CED	56	-	25	55	20	
	Overweight	56	2	36	45	10	
	Obese	24	12	42	46	0	
Height for age	Normal	202	17	31	32	20	X^2=7.572 ns
	CED	56	13	27	41	20	
	Overweight	56	9	34	27	30	
	Obese	24	17	29	25	29	
Weight for height	Normal	202	42	37	16	5	X^2=16.350**
	CED	56	34	50	13	4	
	Overweight	56	55	23	21	-	
	Obese	24	54	42	4	-	

terms of health and nutritional status. The impact can be better visualized in infants and children who are vulnerable to growth deficits by age. Large size families are usually seen with low income with less number of

earners and more number of dependents. People of low socio economic background believe that children are the future earners of the family and opt for more children thus causing distribution of the limited resources among the children, making them food insecure leading to undernutrition. Research has shown that children of nuclear families and those with lower birth rate were nutritionally stronger than their counterparts from joint families and those with higher birth order [23].

Nutritional status of children in relation to family size is presented in Table **6**. The proportion of children with 'normal' weight/age and prevalence of underweight (<-2SD) was similar in 'small' and 'medium' sized families but lower in 'large' families. Severe form of underweight increased with increase in family size. The pattern on the whole did not show significant differences between the groups compared. This observation is similar to that reported from a study conducted in Garhwal district [23] and in Pakistan [2]. Contrary to this, a positive association between family size and nutritional status of school children has also been shown [24]. Hence, it can be said that current nutritional status was not affected by family size.

Children with normal height/age were comparatively higher among 'small' families. Moderate degree of stunting reduced while severe form showed an increase with the family size, it was two fold higher among children of large families compared to 'small' families. Prevalence of stunting on the whole, paralleled with that of the family size. The differences in height attainment showed significant differences between different sized families. It implies that long-term deprivation of essential nutrients in adequate quantities to the children of larger families definitely leads to linear growth retardation.

The proportion of children with normal weight/height ratios showed slight decrease with a corresponding increase in the prevalence of severe form of wasting, was 'nil' in 'small' sized families and formed a small proportion in 'medium' families. The proportion of moderately wasted children quadrupled in 'large' families compared to that of 'small' sized families. Chi-square analysis revealed the differences in the pattern to be extremely significant. The extent of differences between the groups are quiet obvious as increase in the family size leads to qualitative and quantitative liquefaction of nutrients for all household members. From the above observations it can be said that 'large' family size in low socio-economic groups is definitely a cause of chronic as well as acute forms of malnutrition in the growing age children.

Maternal Literacy Versus Nutritional Status

Women generally are the primary caregivers, devoting more time to the care and protection of their children. Educated mothers feel personally responsible for the overall growth and development. Maternal education is a transformer of attitudes from traditional fatalistic health care to acceptance and utilization of modern health care. The possible mechanisms that relate mother's education and child's nutritional status are – education creates better economic opportunities, better understanding of child's sickness, seeking of medical aids, encourages social mobility of women which exposes her to modern society and better health care than deferring to traditional practices. Communities with higher proportion of educated women are more likely to provide better sanitation, medical services, sharing of health knowledge and thereby influence the child's nutritional status. An association between maternal literacy status and nutritional status of under fives is widely researched, but the same relationship is scanty among older children. The present study is an attempt to see, if the effect continues up to late childhood (Table **6**). The proportion of children with normal weight/age reduced with increasing literacy levels. Moderate underweight (<-2SD) was comparatively higher among those of literate mothers (level I) but severe form was lower among those of literate mothers (level II). The differences in the pattern of underweight between different groups were found to be non-significant. Proportion of children with normal height/age decreased with increase in maternal literacy levels. Moderate degree of stunting (<-2SD) was comparatively lower in children of literate (level I) mothers than those of other categories. Severe stunting (<-3SD) was higher among those of literate (level I) mothers. Prevalence of stunting (both forms together) was observed to be slightly higher among children of literate mothers (level II). However, the differences between the groups were statistically non-significant.

Proportion of children with normal weight/height was found to be higher by 15% among the highly literate mothers of the study group. Moderate wasting was lower and severe wasting was found to be nil among children of literate mothers (level II). The association between weight/height ratio and maternal literacy status was not significant as per chi-square analysis.

Highest prevalence of stunting among children of literate mothers would have masked wasting, i.e. when the children's height/age is compromised, wasting cannot be evidenced or the ratio fails to identify the prevailing form of undernutrition.

Either long-term, current or acute forms of undernutrition was found to be influenced by maternal education levels. Though literature has shown a strong association between child nutritional status and maternal education, lack of such a association in the study population could be explained as follows – in areas of adverse environmental conditions with low income, bigger family size and low position of women, their existing level of education might fail to influence the nutritional status of the children. These results confirm the findings of earlier workers who have stated that basic facilities and personality characteristics of the mother influence child health outcomes independent of education or economic wealth [25]. Additionally decision making power or autonomy would better influence the health outcome and stunting in children. The attempt of Frost *et al.* [26] in finding the link between maternal education and child stunting has shown that education co-efficient reduced almost by 50% after controlling for socio-economic, knowledge, reproductive, autonomy and geographic variables. But education is definitely a part of socio-economic factors which on empowerment of women will be fully expressed and the impact of which can be definitely evidenced in the better health and nutritional status of the future generation.

Mother's BMI Versus Nutritional Status

The biological link between the 'mother' and her child that begins on conception 'in-utero' continuing during infancy till oral feeding is initiated is well established. However, the nutrition link or dependency of the child on the mother continues for $1/4^{th}$ or $1/5^{th}$ of the life span of the child. For a woman to successfully perform the child rearing task, her health and nutritional status should be sound. In developing countries like India, especially among the low socio-economic groups, health and nutritional status of the women are far from satisfactory. Women's health and nutritional status are inextricably bound up with socio-cultural and economic factors which severely constrain their ability to acquire good health services [27]. In low socio-economic families women would be performing multiple roles as procuring food, preparing, child bearing and rearing activities and all of these are known to be influenced by the health and nutritional status of the mother. Limited paternal involvement in child rearing has also been termed a cause for child malnutrition, thus increasing the burden of work for women [28].

Table **6** presents the nutritional status of children in relation to that of their mothers. Of the children with normal weight/age around 2 and 3% belong to 'normal' and 'overweight' mothers, while 12% of normal children's mothers were obese. No child of CED mothers had normal weight/age. Moderate and severe underweight was lower by 10% and 18-20% among children of overweight and obese mothers. The overall prevalence of under-weight was higher among children of 'CED' mothers. The nutritional status of the children paralleled that of their mothers. The association between weight/age of children and nutritional status of their mothers was found to highly significant. Several reports have consistently shown a positive association between weights of infants, preschoolers and their mothers [20]. However it was surprising to observe that maternal nutritional status continues to have a bearing even during school age. This shows that school going children also need attention of their care givers for their nutritional needs and hence the effect on nutritional status. Height/age of children was found to be slightly higher and similar among children of 'normal' and 'obese' mothers. Moderate underweight was found to be higher among those of 'CED' mothers and severe underweight among children of 'overweight' and 'obese' mothers. Overall prevalence of stunting was found to be comparatively lower among children of 'normal' and 'obese' mothers compared to those of 'overweight' and 'CED' mothers. The association between stunting of children and BMI of their mothers was found to be non-significant as per chi-square analysis.

Reports of 42 demographic surveys from Asia, Africa and Latin America i.e. countries that are undergoing nutrition transition showed that in 10% of households overweight mothers and stunted children pairs were found which was attributed to economic development [29]. A similar trend evident in the present study shows that though the selected population belongs to a slum area of low socio-economic status, they had access to food, though it may be limited, resulting in overweight mothers. In other words linear growth is the outcome of growth over long-period, its association with the current nutritional status of mothers may not give a true estimate as the high parity of mothers would definitely fluctuate their nutritional status.

Forty two percent of children belonging to mothers with normal BMI exhibited normal weight/height ratios, while 16 and 5% exhibited moderate and severe degrees of wasting respectively. The proportion of children with normal weight/height ratios was comparatively lower among children of CED mothers. Moderate wasting was higher among children of overweight and least among children of obese mothers. Severe wasting was absolutely nil among children of obese and overweight mothers. Chi-square analysis revealed the association between maternal nutritional status and degree of wasting to be highly significant. A positive association between weight/age and weight/height ratios with that of maternal nutritional status shows that maternal nutritional status is definitely a factor determining the nutritional status of school children. Similarities in the nutritional status of mothers and children may also reflect the availability of resources at the family level.

It can be concluded from the results of the study that the living conditions of children from an Indian urban slum was very poor. The living environment affected the nutritional status of children of all ages adversely as determined through anthropometry. It was influenced by the age and gender of children. The poor nutritional status was associated with poor economic conditions of families, family size and maternal undernutrition.

AUTHORS CONTRIBUTIONS

Dr. Asma Kulsum was responsible for all data collection and field work [E-mail: asmakulsum@gmail.com].

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REFERENCES

[1] Planning Commission. Ninth five year plan. New Delhi, Government of India 2002; Vol 2.

[2] Ansari NB, Rahbar MH, Bhutta ZA, Badruddin, SH. Child's gender and household food insecurity are associated with stunting among young Pakistani children residing in urban squatter settlements. Food Nutr Bull 2006; 27: 114-27.

[3] Best C, Neufingerl N, Geel LV, Briel TD, Osendarp S. The nutritional status of school aged children: Why should we care. Food Nutr Bull 2010; 31: 400-17.

[4] NNMB. Diet and nutritional status of rural population. Technical reports No. 21. National Nutrition Monitoring Bureau, National Institute of Nutrition. Hyderabad, India 2002.

[5] Ghosh S, Shah D. Nutritional problems in urban slum children. Ind Paed 2004; 41: 682-96.

[6] Kaul KK. Nutritional status of children. In, Profile of undernutrition and underdevelopment. Nutritional Foundation of India, Scientific report No. 8 New Delhi 1988; 55-58.

[7] Rao VK, Balakrishna N, Adinarayan K. Critical limits of some anthropometric measurements and indices for the assessment of nutritional status. Ind J Nutr Dietet 1986; 23: 88-86.

[8] Lakshmi JA, Begum K, Saraswathi G, Prakash J. Dietary adequacy of Indian rural pre-school children – influencing factors. J Trop Pedia 2005; 51: 39-44. http://dx.doi.org/10.1093/tropej/fmh072

[9] Rao DH, Vijayaraghavan K, Rao KM. Anthropometry in the assessment of nutritional status. In: Text book of Human nutrition. Bamji, MS, Krishnaswami K, Brahmam GNV, Eds., Oxford and IBH Publishing Co. New Delhi, 2009; 142-153.

[10] WHO, Measuring change in nutritional status. Anne. 3, Research data for weight and height of children. World Health Organization, Geneva. 1983.

[11] IOTF/WHO. The Asia pacific perspective : redefining obesity and its treatment. International Diabetic Institute. Caulfield, Victoria 2000.

[12] Gopaldas T, Seshadri S. Nutrition monitoring and assessment, Oxford University Press, New Delhi 1987.

[13] USAID. Urban child health – Urban theme paper. (cited 25th August 2010), Available from URL: http://www.makingcities-work.org/urbanthemes/ urbanhealth/urban_child_health# water. 2004.

[14] Nandy S, Irving M, Gordon D, Subramanian SV, Smith GD. Poverty, undernutrition and morbidity: new evidence from India. Bull WHO 2005; 83: 210-16.

[15] Rice A, Sacco L, Hyder A, Black RE. Malnutrition as an underlying cause of childhood deaths associated with infectious diseases in developing countries. Bull WHO 2000; 78: 1207-21.

[16] Myatt M, Khara F, Collins S. A review of methods to detect cases of severely malnourished children in the community for their admission into community-based therapeutic care programs. Technical background paper for an informal consultation held at Geneva, World Health Organization, UNICEF and the Standing Committee on Nutrition of the United Nations, 21-23 Nov. 2005.

[17] Alam N, Wojtyniak B, Rahaman MM. Anthropometric indicators and risk of death. Am J Clin Nutr 1989; 49: 884-88.

[18] Dutta A, Pant K, Puthia R, Sah A. Prevalence of undernutrition among children in the Garhwal Himalayas. Food Nutr Bull 2009; 30: 77-81.

[19] Laxmaiah A, Rao MK, Brahmam GNV, Kumar SM, Ravindranath K, Kashinath G, *et al*. Diet and nutritional status of preschool children in Punjab. Ind Pedia 2002; 39: 331-38.

[20] Lakshmi JA, Begum K, Saraswathi G, Prakash J. Nutritional status of rural pre-school children - mediating factors. J Fam Welfare 2003; 49: 45-56.

[21] Khuwaja S, Selwyn BJ, Shah SM. Prevalence and correlates of stunting among primary school children in rural areas of south. Pak J Trop Pedia 2005; 51: 72-77. http://dx.doi.org/10.1093/tropej/fmh067

[22] Osei A, Houser R, Bulusu S, Joshi T, Hamer D. Nutritional status of primary school children in Garhwali Himalayan villages of India. Food Nutr Bull 2010; 31: 221-33.

[23] Dutta A, Kumar J. Impact of sex and family size on the nutritional status of Hill children of Uttar Pradesh. Ind J Nutr Dietet 1997; 34: 121-26.

[24] Mian RMA, Ali M, Ferroni PA, Underwood P. The nutritional status of school aged children in an urban squatter settlement in Pakistan. Pak J Nutr 2002; 1: 121-23. http://dx.doi.org/10.3923/pjn.2002.121.123

[25] Dasgupta M. Death clustering, mother's education and determinants of child mortality in rural Punjab, India. Population studies 1990; 44: 489-505. http://dx.doi.org/10.1080/0032472031000144866

[26] Frost MB, Forste R, Haas DW. Maternal education and child nutritional status in Bolivia: finding the links. Soc Sci Med 2005; 60: 395-407. http://dx.doi.org/10.1016/j.socscimed.2004.05.010

[27] Shettar SC. Health status of women in Karnataka: problems and future needs. J Family Welfare 2004; 50: 48-54.

[28] Tran BH. Relationship between paternal involvement and child malnutrition in a rural area of Vietnam. Food Nutr Bull 2008; 29: 59-66.

[29] Garret LJ, Ruel MT. Stunted child overweight mother pairs: Prevalence and association with economic development and urbanization. Food Nutr Bull 2005; 26: 209-16.

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