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Prevalence and predictors of undernutrition in children aged 0-59 months in the slums of Hyderabad, India

Rajini Peter [1], K Anil Kumar [2]

Tata Institute of Social Sciences, Mumbai. 1- MSc. (Community Health Nursing), PhD Scholar. 2- PhD, Professor, School of Health Systems Studies

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Corresponding Author:

Rajini Peter, TISS, Deonar, Mumbai, India. E-mail: rajinimathew.in@gmail.com

Abstract:

Background: Overcrowding, unsanitary environment, inaccessible health facilities and poverty predispose slum children to ill-health and undernutrition. Purpose of this paper is to describe the prevalence and examine the predictors of undernutrition among children under five in the slums of Hyderabad, India. **Materials and Methods:** A cross-sectional survey was conducted in ten slums of Hyderabad, to appraise care giving practices and health and nutritional status of children under five. Data were collected from 506 slum households, selected through multistage stratified random sampling. Height-for-age and weight-for-age Z scores were computed after anthropometric measurements. Stunting and Underweight prevalence levels were estimated and role of child, mother and household factors was examined using bivariate as well as multivariate logistic regression analyses. **Results**: Prevalence of stunting and underweight was 39.8% and 33.5% respectively. Child's age (OR-1.03; CI-1.02-1.05), birth weight (OR-1.96; CI-1.11 -3.48), birth interval (OR-1.82; CI 1.03-3.21), mother's BMI (OR-1.99; CI-1.26-3.14), and household wealth index (OR-2.06; CI-1.07-3.96; OR-2.28; CI- 1.04-4.99) were the significant predictors of stunting. The predictors of underweight were child's age (OR-1.04; CI-1.03-1.05), birth weight (OR-2.63; 95%CI-1.47 -4.7), sex (OR-1.54; CI-1.01-2.35), hygienic care (OR-2.06; CI-1.31-3.23), and mother's age at child birth (OR-2.01; CI-1.12-3.62). Apart from these, mother's feeding response (OR-2.04; CI-1.01-4.14) was an important factor for children aged 6-23 months. **Conclusion**: Reassessment of slum health and development measures and intensified IEC programmes on maternal nutrition, hazards of early pregnancy, birth spacing, hygiene and appropriate feeding responses are necessary to improve nutrition of slum children.

Key words: Children; Slum; Stunting; Undernutrition; Underweight

Introduction

India is not an exception to the global phenomenon of remarkable growth of urban population. The country will have 41 percent population living in cities and towns by 2030[1]. The growth of urban population has led to 'Urbanisation of Poverty' as poor migrate in large numbers searching for livelihood and poverty figures of several states bear this out. The urban poor are over 25 percent [2] of the urban population.

Inadequate urban infrastructure and high land and house prices have forced many urban poor into shanty slum settlements. According to census 2011[3], the state of Maharashtra has the highest

slum population (11.8 million) and is immediately followed by united Andhra Pradesh (10.1million). The growth of slum population in Andhra Pradesh has been unprecedented in the last decade from 5.2 million in 2001 to 10.1 million in 2011 (15.6% of India total). It is the state with highest proportion of slum households to urban households (35.7%). Hyderabad has 31.9 percent households living in slums.

Slums are characterised by overcrowding, polluted environments and lack basic services like drinking water, toilet, drainage systems and waste disposal mechanisms. Lack of sanitation, inaccessible health facilities and poverty exposes slum population to various stressful conditions of ill health and malnutrition [4]. The health and nutrition indicators of the urban poor children are as bad as or even worse than in rural areas. When mortality rates of children under five are higher among rural population than urban poor in India, undernutrition levels are high among urban poor; stunting 54.2 against 50.7 percent and underweight 47.1 against 45.6 percent of rural children. Anaemia is 71.4 percent in the urban poor children [5]. More than three out of five children in urban slums [6] do not receive all childhood vaccinations. The accessibility and utilization of primary health services are also poor in slum communities.

Undernutrition in early childhood has serious, long-term consequences. It impedes motor, sensory, cognitive, social and emotional development. Malnourished children are less likely to perform well in school and more likely to grow into malnourished adults, at greater risk of disease and early death. Undernutrition is the underlying cause of at least 50 per cent deaths in children under five in India. Even if it does not lead to death; malnutrition, including micronutrient deficiencies, often leads to permanent damage, including impairment of physical growth and mental development [7].

Segregate slum statistics are necessary for planning comprehensive interventions for improvement of child nutrition in slums. Studies on slum population of Hyderabad are limited. Hence a cross sectional survey was done to assess the caregiving practices and health status of children under five living in the slums of Hyderabad. The aim of this paper is to describe the prevalence and predictors of undernutrition in children aged 0-59 months in slums of Hyderabad.

Materials and Methods:

A cross-sectional survey was conducted in ten slums of Hyderabad, from December 2012 to April 2013 to appraise the caregiving practices and health and nutritional status of children under five. Data were collected from 506 households with at least one child aged 0-59 months. Oral informed consent was taken from child's mother. Permission for the study was obtained from the University and the Municipal Corporation.

Sample size for the study was estimated as 506 based on the 32.4% [8] prevalence of stunting in Hyderabad slum population in NFHS-3, with confidence level at 95%, 5% margin of error and a design effect of 1.5. Multistage stratified random sampling was done ensuring a proportional representation of population from central as well as peripheral area of the city and slums from the government list and slums not listed anywhere. Households were selected from 10 randomly selected slums, out of which six (4 listed, 2 unlisted) were from central area and four (3 listed, 1 unlisted) were from peripheral areas of the city. For selecting mother-child dyads from the slums, the lane to begin the survey was randomly selected and households with under-fives were enrolled. Once first lane was surveyed eligible households from the adjacent lane were approached and so on until the required number for each slum was reached. Only one married woman with a child under five was included from each household. When a mother had more than one child under five, the youngest child was selected for data collection. Children whose mothers were married and living with their husbands were included for the survey. Children who were acutely ill or having congenital defects, and whose mothers migrated to the city in the last 6 months, or not willing to participate in the study were excluded.

The details of household, child and mother characteristics were obtained by anthropometric measurements, observation and personal interviews with mothers. A semi-structured interview schedule was developed based on the caregiver and household determinants of child health and nutrition reported in the literature and pretested on 25 mother-child pairs. All interviews were conducted in local languages.

Weight and height/length measurements of children and mothers were made following standard techniques [9], using SECA digital weighing scale and anthropometer rod to the precision of 0.1 kg and 0.1cm. For younger children, combined weight of the mother and child were recorded and mother's weight

was subtracted from total. Recumbent length was measured for children younger than 24 months using a standard measuring board while others were measured standing. The nutritional status of children was determined by the height/length for age Z scores (HAZ) and weight for age Z scores (WAZ). These scores were generated against the WHO growth standards (2006), using WHO Anthropac software version 3.2.2. Undernutrition measured as Stunting and Underweight in children were defined as HAZ scores and WAZ scores below minus 2 standard deviations from the WHO reference population median, respectively.

The independent variables considered for analysis included the socio economic and demographic factors of child, mother and household; and important child care factors namely hygienic care, meal frequency, dietary diversity and mother's feeding response. The household wealth index was calculated by principal component analysis taking into account data on water source, toilet facility, electricity, type of cooking fuel; main material of construction for floor, roof and wall; type of windows, members per sleeping room; member having a bank or post-office account and house ownership and household possession of various assets like bicycle, electric fan, pressure cooker, chair etc. Food security was assessed by asking selected questions from the Household Food Insecurity (Access) scale on food situation of last one month. Media exposure of mothers was decided by asking how often they read a newspaper/magazine, listened to radio, watched TV and cinema. Hygienic care was assessed by a spot check observation of 13 hygiene aspects, namely, cleanliness of mother, child's hands and body, child's bottom, child's play area, house, compound, cooking and serving vessels; observation of whether child has an underwear, drinking water is kept covered, any stagnant water in and around house, soap near hand washing area, detergent near utensil washing area; and asking how stool last passed by the child was disposed of.

Minimum meal frequency and dietary diversity are two of the many indicators proposed by World Health Organization to assess Infant and Young Child Feeding for children aged 6 to 23 months [10]. For assessing these feeding practices, mother was asked to list all foods and liquids child consumed in the previous 24 hours. For breastfed children a meal frequency of 2 times if 6–8 months and 3 times if 9–23 months, and for non-breast fed children a frequency of 4 times for all was considered minimum needed for that age group. Dietary diversity is adequate if the child had consumed items from at least 4 of the 7 different groups of food. The 7 food groups are grains, roots, tubers; legumes and nuts; dairy products; flesh foods; eggs; vitamin-A rich fruits and vegetables and other fruits and vegetables. Mother's feeding response was also assessed by asking what measures she will take if the child refuses food. Appropriate responses were encouraging eating; playing with the child and making to eat and giving something else after sometime. Inappropriate responses were stopping feeding and doing nothing and forceful feeding. These feeding indicators were estimated for 248 children aged 6 to 23 months.

Binomial logistic regression analysis was employed to establish the predictors of undernutrition. The role of various background factors was tested using bivariate and multivariate logistic regression. In bivariate analysis, the associations of all mother and child factors with each dependent variable were separately assessed. All variables of interest with a probability value less than 0.15 on bivariate analysis were included in multivariate analysis. Variables that were expected to have biological and logical association with the dependent variables were also considered, even if they did not meet the above criteria. Odds ratios with 95% confidence interval were generated. The analyses were done using SPSS version 15.

Results

Descriptive statistics

Table 1: Socio-economic and demographic characteristics of children (0-59 months) and their mothers of the slums of Hyderabad, India

Child's age	**No.**	**Percentage**
0-23 months	303	59.9
24-60 months	203	40.1
Birth weight		
Average/more	440	87
Smaller than average	66	13
Sex		
Female	212	41.9
Male	294	58.1
Birth interval - preceding		
24+ months	276	54.5
First born	152	30.1

< 24 months	78	15.4
Hygienic care		
Satisfactory	300	59.3
Unsatisfactory	206	40.7
Mother's age at childbirth		
≥ 20 years	427	84.4
<20 years	79	15.6
BMI		
≥ 18.5 kg/m^2	382	75.5
< 18. 5 kg/m^2	124	24.5
Literacy		
Literate	296	58.5
Illiterate	210	41.5
Media exposure		
Good	170	33.6
Poor	336	66.4
Husband's occupation		
Service/Skilled work	318	62.8
Unskilled laborer	188	37.2
Husband drinks alcohol		
No	244	48.2
Yes	262	51.8
Household food security		
Satisfactory	253	50
Poor	253	50
Wealth index		
Highest quintile	101	20
Second/third quintile	203	40.1
Fourth/lowest quintile	202	39.9
Toilet facilities		
Improved	366	72.3
Open field	140	27.7
Source of drinking water		
Piped into the house/yard	148	29.2
Public tap/tanker truck	358	70.8
Crowding		
2-3 persons/sleeping room	174	34.4
4+ persons/sleeping room	332	65.6

Out of 506, 303 (59.9%) children were aged 0 to 23 months, 294 (58.1%) were male, 66 (13%) were smaller than average in birth weight, 78 (15.4%) had less than 24 months of preceding birth interval and 206 (40.7%) had unsatisfactory hygienic care. 79 (15.6%) mothers were less than 20 years old when they delivered, 124 (24.5) were undernourished with BMI less than 18.5 kg/m^2, 210 (41.5%) were illiterates and 336 (66.4%) had poor mass media exposure. About 37 percent (188) husbands were unskilled labourers and 52 percent (262) consumed alcohol. The food security of 253 households (50%) was doubtful and 140 households (27.7%) did not have any toilet facilities. 358 (70.8%) households were depending on public tap/trucks for drinking water and 332 (65.6%) households were crowded, and had to accommodate 4 or more persons in a sleeping room (table 1).The feeding characteristics of children (6-23 months) are depicted in the following figure.

Figure 1: Distribution of children aged 6-23 months according to their feeding pattern

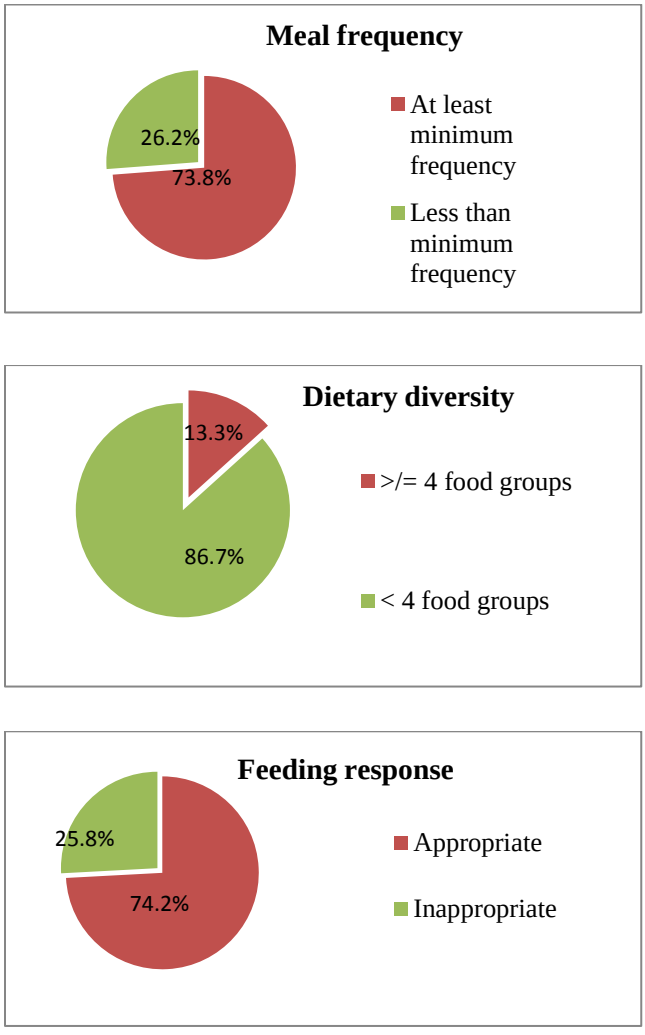

Table 2: Levels of undernutrition in children aged 0- 59 months in slums of Hyderabad, India						
Age in months	**N**	**Severely stunted [% HAZ < -3SD]****	**Stunted [%HAZ < -2SD]**	**N**	**Severely underweight [% WAZ < -3SD]****	**Underweight [%WAZ < -2SD]**
Total:	**503***	**18.5**	**39.8**	**505***	**10.9**	**33.5**
(0-5)	55	3.6	10.9	55	3.6	12.7
(6-11)	89	10.1	27	88	4.5	25
(12-23)	158	17.7	44.3	159	9.4	31.4
(24-35)	86	26.7	50	87	17.2	37.9
(36-47)	71	32.4	53.5	72	15.3	48.6
(48-59)	44	18.2	43.2	44	18.2	50

* Three cases in stunting and one case in underweight omitted due to extreme observation
** (%< -2SD includes %< -3SD)

The prevalence of undernutrition measured as stunting and underweight is described in table two. 39.8 percent children were stunted, and 18.5 percent of all children were severely stunted. 10.9 percent children were severely underweight and 33.5 percent of all children were underweight. Both stunting and underweight were lowest in children aged 0-5 months and then in 6-11 months aged.

Table 3: Association of socio-economic and demographic characteristics of children (0-59 months) with stunting and underweight – results of bivariate logistic regression						
Socio-economic and demographic characteristics	**Stunting**			**Underweight**		
	No. (%) stunted	**Odds Ratio**	**95% CI**	**No. (%) underweight**	**Odds Ratio**	**95% CI**
Child's age[†]		1.026***	1.014-1.039		1.033***	1.020-1.046
Birth weight ® Average/more	166 (38)			135 (30.8)		
Smaller than average	34 (51.5)	1.735**	1.031-2.917	34 (51.5)	2.393***	1.417-4.039
Sex ®Female	73 (34.8)			58 (27.4)		
Male	127 (43.3)	1.436*	0.996-2.071	111 (37.9)	1.619**	1.104-2.376
Birth interval ®24+m	107 (39.1)			91 (33)		
First born	53 (35.1)	0.844	0.558-1.276	45 (29.6)	0.855	0.557-1.313
< 24 months	40 (51.3)	1.643*	0.991-2.275	33 (42.9)	1.525	0.910-2.555
Hygienic care ®Satisfactory	101 (33.9)			76 (25.3)		
Unsatisfactory	99 (48.3)	1.822***	1.266-2.622	93 (45.4)	2.447***	1.676-3.574
Mother's age at childbirth ®>/= 20	159 (37.5)			132 (31)		
<20 years	41 (51.9)	2.290***	1.583-3.315	37 (46.8)	2.080***	1.418-3.051
BMI®>/= 18.5 kg/m^2	139 (36.5)			122 (31.9)		
< 18. 5 kg/m^2	61 (50)	1.741***	1.154-2.628	47 (38.2)	1.318	0.864-2.011
Literacy® Literate	102 (34.6)			90 (30.5)		
Illiterate	98 (47.1)	1.686***	1.173-2.423	79 (37.6)	1.374*	0.946-1.995

Husband's occupation ® Service/Skilled	109 (34.4)			94 (29.7)		
Unskilled laborer	91 (48.9)	1.828***	1.264-2.644	75 (39.9)	1.575**	1.078-2.299
Husband drinks® No	81 (33.6)			73 (29.9)		
Yes	119 (45.4)	1.644***	1.145-2.359	96 (36.8)	1.363	0.940-1.977
Wealth index ® Highest quintile	20 (19.8)			22 (21.8)		
2nd /3rd quintile	81 (40.3)	2.734***	1.554-4.809	71 (35)	1.931**	1.110-3.360
4th/lowest quintile	99 (49.3)	3.931***	2.241-6.896	76 (37.8)	2.183***	1.257-3.791
Food security ® Good	88 (34.9)			72 (28.6)		
Poor	112 (44.6)	1.502**	1.049-2.151	97 (38.3)	1.554**	1.071-2.257
Toilet facilities ® Improved	128 (35.2)			110 (30.1)		
Open field	72 (51.8)	1.981***	1.333-2.945	59 (42.1)	1.689**	1.128-2.527
Drinking water ® Piped into the yard	40 (27.2)			37 (25)		
Public tap/truck	160 (44.9)	2.184***	1.436-3.320	132 (37)	1.760***	1.145-2.705
Crowding® 2-3/room	57 (32.9)			52 (29.9)		
4+ persons/ room	143 (43.3)	1.556**	1.059-2.286	117 (35.3)	1.283	0.864-1.904

*** - P $\leq$ 0.01; ** - P $\leq$ 0.05; * P $\leq$ 0.10; † - Continuous variable

Bivariate analysis

Tables 3 and 4 presents the results of bivariate analysis where the associations of background variables with prevalence of stunting and underweight were individually examined.

Almost all variables were significantly associated with stunting and underweight in children aged 0-59 months. Child's sex and preceding birth interval were the only exception in stunting where the association was only at 10 percent level (P $\leq$ 0.1). For child underweight, preceding birth interval; mother's BMI and literacy; husband's alcohol consumption and crowding did not demonstrate significant associations.

With respect to children aged 6-23 months, (Table 4) child's age, hygienic care, mother's age at childbirth, BMI, husband's occupation, wealth index of the household, food security and source of drinking water demonstrated statistically significant associations (P $\leq$ 0.05) with stunting. Child's age, birth weight, hygienic care, mother's age at childbirth, and household food security were the factors which demonstrated statistically significant associations (P $\leq$ 0.05) with child underweight.

Table 4: Association of socio-economic and demographic characteristics of children (6-23 months) with stunting and underweight – results of bivariate logistic regression

Socio-economic and demographic characteristics	Stunting			Underweight		
	No. (%) stunted	Odds Ratio	95% CI	No. (%) underweight	Odds Ratio	95% CI
Meal frequency ® minimum	73 (39.9)			50 (27.3)		
Less than minimum	21 (32.8)	0.736	0.404-1.341	22 (34.4)	1.393	0.757-2.564
Dietary diversity ® ≥ 4 food groups	9 (28.1)			8 (24.2)		
Less than 4 groups	85 (39.5)	1.671	0.738-3.785	64 (29.9)	1.333	0.571-3.114
Feeding response ® appropriate	64 (36.6)			46 (26.3)		
Inappropriate	29 (48.3)	1.622	0.897-2.934	24 (39.3)	1.819*	0.984-3.362
Child's age†		1.096***	1.037-1.157		1.066**	1.007-1.129
Birth weight ®Average	78 (36.3)			55 (25.6)		
Smaller than average	16 (50)	1.756	0.832-3.706	17 (15.3)	3.297***	1.544-7.042
Sex ®Female	35 (35.7)			24 (24.2)		
Male	59 (39.6)	1.180	0.696-2.000	48 (32.4)	1.500	0.845-2.664
Birth interval ®24+m	46 (37.1)			37 (29.6)		
First born	40 (35.3)	0.925	0.520-1.644	23 (27.1)	0.882	0.478-1.630
< 24 months	18 (47.4)	1.526	0.733-3.178	12 (32.4)	1.142	0.519-2.511
Hygiene ®Satisfactory	46 (32.2)			30 (21		
Unsatisfactory	48 (46.2)	1.807**	1.073-3.044	42 (40.4)	2.552***	1.455-4.474
Mother's age at childbirth ® ≥ 20	71 (35.1)			46 (26.3)		
<20 years	23 (51.1)	2.068***	1.224-3.494	24 (39.3)	1.979**	1.128-3.473
BMI ® ≥ 18.5 kg/m^2	57 (32.2)			47 (26.4)		
< 18. 5 kg/m^2	37 (52.9)	2.360***	1.341-4.155	25 (36.2)	1.584	0.875-2.866
Media exposure®Good	27 (31.4)			20 (23.5)		
Poor	67 (41.6)	1.558	0.896-2.707	52 (32.1)	1.536	0.843-2.799
Husband's occupation ®Service/Skilled	49 (31.6)			40 (26)		
Unskilled laborer	45 (48.9)	2.071***	1.218-3.522	32 (34.4)	1.495	0.855-2.615
Husband drinks® No	42 (33.9)			34 (27.2)		
Yes	52 (42.3)	1.430	0.853-2.396	38 (31.1)	1.211	0.699-2.098
Wealth index®Highest	7 (13.5)			9 (17.3)		
2nd /3rd quintile	44 (43.1)	4.877***	2.008-11.85	33 (32)	2.252*	0.983-5.161
4th/lowest quintile	43 (46.2)	2.260***	2.260-13.53	30 (32.6)	2.312*	0.998-5.357
Food security ® Good	43 (32.2)			31 (23.3)		
Poor	51 (44.7)	1.694**	1.009-2.844	41 (36)	1.848**	1.061-3.219
Toilet ® Improved	63 (34.8)			49 (27.1)		
Open field	31 (47)	1.659*	0.936-2.939	23 (34.8)	1.441	0.788-2.634
Drinking water	20 (25.5)			18 (22.5)		

® Piped into the yard						
Public tap/truck	74 (44)	2.322***	1.285-4.196	54 (32.3)	1.646	0.88-3.050
Crowding® 2-3/room	31 (35.6)			22 (25.3)		
4+ persons/ room	63 (39.4)	1.173	0.683-2.016	50 (31.3)	1.343	0.746-2.417

*** - P ≤= 0.01; ** - P ≤ 0.05; * P ≤ 0.10; † - Continuous variable

Multivariate analysis

Table 5: Predictors of undernutrition in children aged 0-59 months in the slums of Hyderabad, India - results of multivariate logistic regression

Child mother and household characteristics	Odds ratios for Stunting			Odds ratios for Underweight		
	OR	95% CI	P value	OR	95% CI	P value
Child's age†	1.033	1.019-1.047	**0.000**	1.039	1.025-1.053	**0.000**
Birth weight ® Average/more						
Smaller than average	1.964	1.109-3.479	**0.021**	2.627	1.469-4.698	**0.001**
Sex ®Female						
Male	1.421	0.948-2.129	**0.089**	1.542	1.012-2.351	**0.044**
Birth interval ®24+m						
First born	1.084	0.599-1.962	0.789	0.86	0.51-1.45	0.571
< 24 months	1.818	1.031-3.208	**0.039**	1.561	0.875-2.786	0.132
Hygienic care ®Satisfactory						
Unsatisfactory	1.162	0.751-1.796	0.50	2.056	1.308-3.232	**0.002**
Mother's age at childbirth ®≥ 20 years						
<20 years	1.752	0.988-3.107	**0.055**	2.014	1.119-3.623	**0.019**
BMI®>/= 18.5 kg/m^2						
< 18. 5 kg/m^2	1.993	1.264-3.143	**0.003**	1.535	0.958-2.458	**0.075**
Literacy® Literate						
Illiterate	1.044	0.676-1.614	0.846	0.904	0.572-1.429	0.666
Husband's occupation ® Service/Skilled						
Unskilled laborer	1.317	0.85-2.041	0.218	1.196	0.755-1.896	0.445
Husband drinks ® No						
Yes	1.473	0.976-2.223	**0.065**	1.296	0.844-1.989	0.236
Wealth index ® Highest quintile						
2^{nd} /3^{rd} quintile	2.061	1.072-3.963	**0.030**	1.432	0.741-2.767	0.285
4^{th}/lowest quintile	2.282	1.043-4.993	**0.039**	1.038	0.462-2.332	0.927
Food security ® Good						
Poor	0.935	0.604-1.449	0.764	1.014	0.642-1.602	0.952
Toilet ® Improved						
Open field	1.197	0.695-2.064	0.517	1.422	0.799-2.531	0.232
Drinking water source ® Piped into the yard						
Public tap/truck	1.306	0.785-2.172	0.305	1.147	0.676-1.946	0.61
Crowding® 2-3 persons						
4+ persons/ room	1.311	0.782-2.197	0.305	--	---	--

† - Included in the model as a continuous variable

Table 5 displays the results of multivariate logistic regression on the data of children aged 0-59 months where all significant child, maternal and household variables were included in the regression model adjusting for their combined effects on child stunting and underweight. The factors proved as predictors of stunting are child's age (OR-1.033; 95% CI-1.019-1.047), birth weight (OR-1.964; 95% CI-1.109 -3.479), birth interval (OR-1.818; 95% CI 1.031-3.208), mother's BMI (OR-1.993; 95%CI-1.264-3.143), and household wealth index (OR-2.061; 95% CI-1.072-3.963; OR-2.282; 95% CI- 1.043-4.993). For child underweight, child's age (OR-1.039; 95% CI-1.025-1.053), birth weight (OR-2.627; 95%CI-1.469 -4.698), sex (OR-1.542; 95% CI-1.012-2.351), hygienic care (OR-2.056; 95% CI-1.308-3.232), and mother's age at child birth (OR-2.014; 95%CI-1.119-3.623) were the significant predictors.

As for the children aged 6-23 months, child's age (OR-1.12; 95% CI-1.047-1.198), mother's age at child birth (OR 2.273; 95%CI-1.053-4.908), BMI (OR-2.553; 95%CI-1.33 - 4.9), and household wealth index (OR-3.838; 95% CI-1.356-10.863; OR-3.58; 95% CI- 1.056-12.141) were the significant predictors for stunting. However, predictors of underweight in children (6-23m) were child's age (OR-1.088; 95% CI-1.015-1.166), birth weight (OR-3.267; 95%CI-1.365 -7.82), mother's feeding response (OR-2.043; 95% CI-1.009-4.135), and age at child birth (OR-2.332; 95%CI-1.061-5.126) (Table 6).

Table 6: Predictors of undernutrition in children aged 6-23 months in the slums of Hyderabad, India - results of multivariate logistic regression

Child mother and household characteristics	Odds ratios for Stunting			Odds ratios for Underweight		
	OR	95% CI	P value	OR	95% CI	P value
Meal frequency ®minimum						
Less than minimum	1.242	0.592-2.608	0.566	1.65	0.785-3.467	0.186
Dietary diversity ® ≥ 4 groups						
Less than 4 groups	1.196	0.442-3.24	0.725	0.897	0.327-2.458	0.832
Feeding response ® appropriate						
Inappropriate	1.331	0.667-2.656	0.417	2.043	1.009-4.135	**0.047**
Child's age†	1.12	1.047-1.198	**0.001**	1.088	1.015-1.166	**0.017**
Birth weight ®Average/more						
Smaller than average	1.783	0.748-4.251	0.192	3.267	1.365-7.82	**0.008**
Sex ®Female						
Male	---	----	---	1.811	0.923-3.553	**0.084**
Hygienic care ®Satisfactory						
Unsatisfactory	1.145	0.599-2.187	0.682	1.874	0.956-3.674	**0.067**
Mother's age at childbirth ®≥ 20 years						
<20 years	2.273	1.053-4.908	**0.037**	2.332	1.061-5.126	**0.035**
BMI®>/= 18.5 kg/m^2						
< 18. 5 kg/m^2	2.553	1.33-4.9	**0.005**	1.863	0.952-3.646	**0.069**
Media exposure® Good						
Poor	1.632	0.814-3.272	0.167	1.356	0.658-2.797	0.409
Husband's occupation ® Service/Skilled						
Unskilled laborer	1.43	0.753-2.714	0.274	1.222	0.626-2.384	0.557
Wealth index ® Highest quintile						
2^{nd} /3^{rd} quintile	3.838	1.356-10.863	**0.011**	1.284	0.451-3.653	0.64

4th/lowest quintile	3.58	1.056-12.141	**0.041**	1.034	0.302-3.533	0.958
Food security ® Good						
Poor	1.088	0.57-2.074	0.799	1.261	0.635-2.505	0.508
Toilet ® Improved						
Open field	1.088	0.477-2.479	0.841	---	----	---
Drinking water ® Piped						
Public tap/truck	1.246	0.57-2.725	0.581	1.174	0.514-2.682	0.703

† - Included in the model as a continuous variable

Discussion:

The purpose of this paper was to describe the prevalence of stunting and underweight in children aged 0-59 months residing in the slums of Hyderabad and to identify the predictors of the same. The nationwide NFHS-3 survey has indicated that nutritional deficiencies in India are evident right from the time of birth, and stunting and underweight rise rapidly in the first two years of life. At national level, the first peak levels were seen at 20 months of age (stunting-59%, underweight-47%) [11] and thereafter the proportions fluctuating between 48 and 60 percent for stunting and about 42 and 50 percent for underweight. The present study demonstrated a similar pattern in slum children too as evident from figure 2; the first peak levels at 18- 24 months of age (stunting-51%, underweight-40%). The prevalence levels were quite high around 30 to 42 months. Age showed a significant association in the regression analysis too; for every one month increase in child's age, the odds of a child (0-59m) being stunted was 1.03 times and that of being underweight was 1.39 times (Table 5). The overall prevalence of stunting at 39.8 percent and underweight at 33.5 percent were higher than the NFHS-3 data for Hyderabad slums (32% & 26% respectively) [8]. The rapid growth of slum population in the recent years might offer a possible explanation.

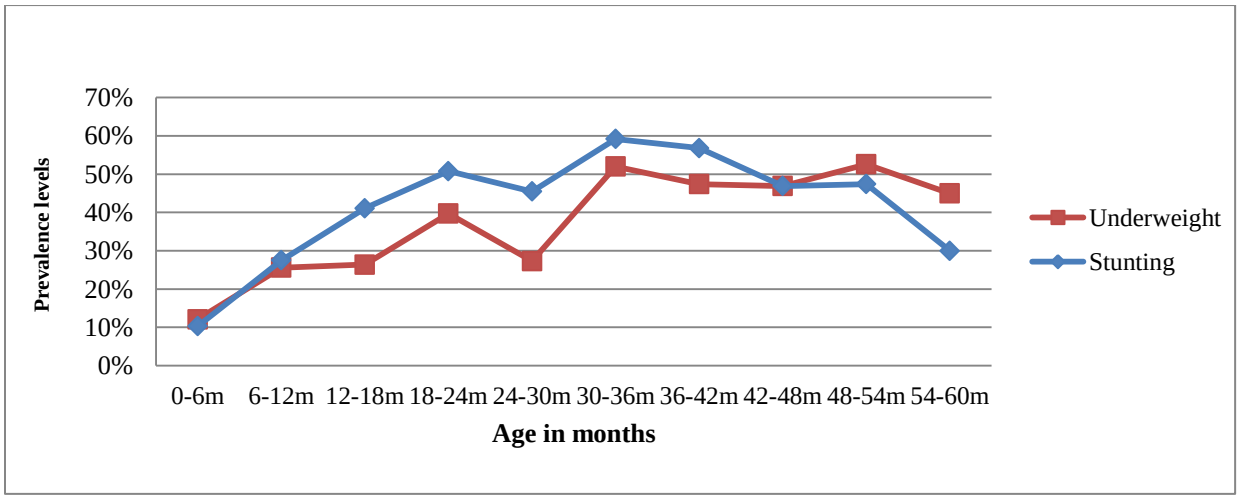

Figure 2: Stunting and underweight levels in children by age in the slums of Hyderabad, India

Birth weights below the average and birth interval less than 2 years too have raised the odds for stunting in children. Birth weight was significant for underweight too. The effects of these factors are highly researched and many studies [12; 13; 14] prove them to be instrumental in causing undernutrition in children.

Children with well-nourished mothers (BMI >/= 18 kg/m^2) and good household wealth were protected from stunting. Maternal health and child nutrition are directly related. Malnourished mothers are less alert to children's needs and have reduced ability to carry out the necessary tasks in child care. Analysis of Bangladesh DHS (1999-2000) data [12] has shown mother's BMI at childbirth as a determinant of malnutrition in children under the age of five. Another study in India [15] too observed maternal BMI to be significantly related to malnutrition in children under age three. Household wealth and poverty have very strong associations with child nutrition and is evidenced across the world [16]. Although the study population belonged to the

poorest section of the society, the minimal wealth differentials too demonstrated association with stunting.

Underweight was predicted by sex of the child, hygienic care and mother's age at childbirth. Most of the studies in Southeast Asia corroborate female children to be more prone to undernutrition than male children. However the NFHS-1[17] did not show any sex-differential in child undernutrition; whereas in NFHS-3[11] differential was negligible (1%). Present study demonstrated the odds of male children being underweight to be 1.5 times as that of females, which need to be explored further. Unhygienic practices can compromise nutrition by increased morbidity in children. Study in Ghana [18] established good household and personal hygiene to be associated with good nutrition in young children. Pregnancy and delivery before the age of 20 put women at high risk for obstetric complications and force them with responsibilities of child care when they are not ready. Studies confirm that adolescent mothers lack good parenting skills [19].

For children aged 6-23 months, apart from the above factors mother's feeding response also emerged significant. The amount of food that children consume may depend as much on the caregivers' active encouragement of eating as the amount offered [20]. The Ghana study [18] proved caregiver's responsiveness to be affecting good nutrition. None of the environmental factors showed any relation with child nutrition, the reason for which might be the homogenic nature of the sample.

Conclusion:

The predictors of undernutrition discerned in this study are not anything new. The fact that these well-established factors are still relevant should be a cause for concern, since it reflects the inefficiency or inaccessibility of the interventions combating undernutrition over the years. These insufficiencies are acutely manifested in slums where ignorance, deprivation, and official neglect prevail. A re-examination of existing slum health and development measures is required. Comprehensive slum specific interventions including IEC activities emphasising on maternal nutrition, hazards of early pregnancy, birth spacing, hygienic care and appropriate feeding responses for children, should be employed if changes in the nutritional scenario of slum children are expected.

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Abbreviations:

NFHS – National Family Health Survey
WHO – World Health Organization
HAZ – Height for Age Z scores
WAZ – Weight for Age Z scores
PCA – Principal Component Analysis
BMI – Body Mass Index
OR – Odds Ratio
IEC – Information, Education and Communication