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A Hospital Based Bivariate Analysis of Nutritional Status and its Determinants among the Children Aged 2 to 12 Years in an Indian Island

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Abstract

Background: Malnutrition in children is a major public health problem in developing countries and is one of the common causes of mortality and morbidity in children. We aimed to determine the nutritional status of children aged 2-12 years of age using World Health Organisation (WHO) Z score for Weight for age (WFA)/Body Mass Index (BMI) for age (for children above 108 months), and to evaluate association between underweight and various socio-demographic factors.

Materials and Methods: A total of 444 children aged 2-12 years (24-144 months) were enrolled in the study. The children's anthropometric measurements were taken using the standard operating procedures; the socio-demographic particulars were obtained using a pretested validated questionnaire, after obtaining written consent from their parents. The anthropometric data was analyzed using WHO Anthro and Anthro plus Softwares. Underweight and severe underweight was diagnosed if WFA Z score <= -2 standard deviation [SD] and <-3 SD (for children from 108 months to 144 months, thinness and severe thinness if BMI for age Z score <=-2 SD and <-3 SD).

Results: Overall prevalence of under nutrition among the children 24-144 months of age was 30.8%. Among children in the age groups of 24-59 months, 60-119 months and 120-144 months, the prevalence of underweight/thinness was 27.9%, 31.3% and 26.4%, respectively. Severe underweight/thinness in the same age groups was 7.1%, 10.7%, and 11.3%, respectively. The socio-demographic factors significantly associated with underweight were education status of mother, occupation of father, number of siblings, type of family and religion ($p<0.05$).

Conclusion: Mild to moderate under nutrition was common among the children of the island and affects boys slightly more than girls, however, severe underweight is more prevalent in girls.

Key Words: Children, India, Nutritional status, Underweight.

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1- INTRODUCTION

Undernutrition contributes to nearly half of all deaths in children under 5 years old and is widespread in Asia and Africa (1). This translates into unnecessary loss of about 3 million young lives in a year. Undernutrition puts children at higher risk of dying from common infections, increases the frequency and severity of such infections, and contributes to delayed recovery. In addition, the interaction between undernutrition and infection can create a potentially lethal cycle of worsening illness and deteriorating nutritional status. Poor nutrition in the first 1000 days of a child's life can also lead to stunted growth, which is irreversible and associated with impaired cognitive ability and reduced school and work performance (1). In the post-2015 development era, estimates of child malnutrition will help determine whether the world is on track to achieve the United Nations Sustainable Development Goals-particularly goal2 –to "end hunger, achieve food security and improved nutrition, and promote sustainable agriculture"(1).

In India, the proportion of under 5 years children who are underweight and stunted has gone down from 42.5%,48% (as per National Family Health Survey [NFHS]-3, 2005-2006 (2) to 35.7% and 38.4%, respectively (NFHS-4, 2015-2016)(3). However, the proportion of children who exhibit wasting has increased from 19.8 percent to 21.0 percent between the two surveys. Similarly severe wasting has increased from 6.4% to 7.5%, during the same period. There had been few studies on nutritional status of children from Andaman and Nicobar Islands, mostly on the indigenous tribes in the late 1990s (4-7), and on the settler groups in early 1990s (8). Also, there was a study on the tsunami affected population of these islands staying in relief camps, which showed a high prevalence of underweight, wasting and stunting (48%, 16% and 37% respectively) (9). It was only in NFHS-4 (2015-2016) survey that Andaman and Nicobar Islands was included and it showed the prevalence of undernutrition, wasting and stunting in under 5 years children as 21.6%, 23.3% and 18.9%, respectively (3). In this background, this study was designed to estimate the prevalence and factors associated with undernutrition in both preschool and school children, attending one tertiary care hospital of Port Blair, Andaman and Nicobar Islands, India.

2- MATERIALS AND METHODS

The present prospective study was conducted after obtaining the approval from the Institute Ethical Committee. This study was conducted in the paediatrics outpatient department (OPD) of a teaching hospital located in a remote island of India over a period of 6 months (Aug. 2015 to Jan. 2016). The children (24-144 months age group), and their parents, who attended the OPD, were informed about the purpose and the method of the research and the voluntary nature of participation in the study verbally and in written form. The children who returned after recovery from minor illness, for enrolment in the study were included. Informed written consent were obtained from the parents of each child after the study objective was explained. Information of socio-demographic particulars were obtained from the subject's mother using a pretested validated questionnaire

Details regarding social class, family income, and occupation, education of the parents, birth order, birth interval and number of siblings was collected. The socio- economic status was evaluated using Modified Kuppuswamy scale. The children who suffered from metabolic disorders, chronic illnesses, children from indigenous tribal community, those with congenital anomalies and those below 2 years and above 12 years were excluded from the study. A total of 444 children of

either sex were included. The age of the children was determined using school records or birth certificate. A complete general physical examination followed by anthropometric assessment was done using standards methods as described in training manual of World Health Organization (WHO) Growth Standards. We first calculated unadjusted, age and sex disaggregated descriptive statistics for weight, height, Body mass index (BMI), weight for age Z score (WAZ) and BMI for age Z score (BMZ). Computation of individual Z scores was done using WHO Anthro and Antho-Plus software (10, 11) in comparison to WHO child growth standards which were based on WHO Multicentre Growth Reference Study Group (12).

Since the indicator weight for age is recommended only up to the age of 9 years, we calculated that particular indicator only for the recommended age group. Beyond that age and up to 12 years (144 months) of age, BMI for age Z score was used**.** According to WHO 2007 Z score charts; WAZ < –3 SD implies severe underweight, –2 to –3 standard deviation (SD) implies mild to moderate underweight and >- 2 SD implies normal/ healthy status. In case of children more than 9 years (108 months) of age, BMZ < –3 SD implies severe thinness, –2 to –3 SD implies mild to moderate thinness, > – 2 SD was normal. WAZ/BMZ> 1 SD was overweight and >2SD implies obesity.

Data was entered and analysed by IBM Statistical Package for Social Sciences (SPSS) Statistics 23.0 software. In order to study the association between underweight/thinness and various socio demographic variables, Chi square test was applied. Bivariate logistic regression analysis was used to quantify the magnitude of association between different factors and undernutrition. A P-value less than 0.05 was considered as statistically significant.

3- RESULTS

A total of 444 children in the age group of 24-144 months were included in the study. The study population was fairly distributed with males being 213 (47.97%) and females 231 (52.02%). The distribution of children according to age and sex is as shown in **Table.1**. Mean age of the children was 76.51(33.89) months. Likewise, mean weight and height were 18.65 (7.02) Kg, and 110.57(17.77) cm, respectively. Majority of the children were in the 60-119 months group 223 (50%), of female sex 231(52%), Hindu (82.65%), belonged to nuclear family (75%), had a household family size of 4-8 (79.72%), were from lower/upper lower socioeconomic status (55.1%), and 290 (65.3%) attended public school.

Out of all children, 371 (83.5%) were delivered vaginally, 313 (70.4%) had a normal birth weight, 237 (53.3%) were first order babies, 251(56.5%) had 1 sibling, and 304 (68.46%) had no sibling < 5yrs of age. Regarding education status of parents, 9.2% of fathers and 10.1% of mothers were illiterate; 70% of fathers were middle school or higher educated and similar percent was engaged as semiskilled or skilled worker. Similarly, majority of subjects' mothers (69%) in our study, were middle school or higher qualified. The household income per month was Rs10024-14995, in 143 (32.2%).

Tables 1 to 3 describe nutritional status of children according to socio-demographic profile with Chi-square analysis. **Table.4** describes the grading of family income according to Kuppuswamy classification. **Table.5** describes the Binary Logistic Regression analysis of various variables and underweight/thinness in children. The overall prevalence of under nutrition/thinness in the 24-144 months age group was 30.8%. We observed a prevalence of 27.97%, 38%, and 10.71% for underweight, stunting (Height for Age Z score, HAZ< -2 SD), and wasting

(Weight for height Z score, WFH<-2 SD), respectively, in the 24-59 months age group. The prevalence of severe underweight, stunting and wasting in the same age group was 7.14%, 10.11% (HAZ<-3 SD) and 10.71% (WFH <-3 SD), respectively. In the 60-119 months age group, the prevalence of mild to moderate underweight was 31.39% and severe underweight was 10.76% whereas in the 120-144mths age groups, thinness and severe thinness was found in 26.41% and 11.32%, respectively. The prevalence of overweight-obesity, in the 60-144 months group was 4.1%. Of the total 18 children, who were overweight or obese, 8 subject were boys (3.8%) and 10 were girls (4.3%), and the difference was not statistically significant. Regarding sex distribution of under nutrition, 67 (31.5%) boys and 70 (30.2%) girls were found to be mild to moderately undernourished (**Table.2**). However, severe underweight/thinness was higher in girls (12.1%) than boys (6.6%), and the difference was significant (p= 0.0482). The socio- demographic factors significantly associated with underweight were education status of mother (chi-square=15.206, p=0.004), occupation of father (chi-square = 12.676, p =0.048), number of siblings (chi-square =12.634, p=0.027), type of family (chi-square =5.26, p=0.022), and religion (chi-square =10.567, p=0.005). However, other demographic variables including age, sex birth order, birth weight, type of delivery, presence of any one sibling <5 years of age, education of father, socioeconomic status, type of school attended and family income, had no significant association. Odds ratio of being undernourished were higher among children with lower socio-economic status (Adjusted Odds ratio, AOR=1.793, 95% confidence interval [CI]=1.028-3.126, p=0.040), more than or equal to two siblings (AOR=1.837, CI=1.040-3.248, p=0.036), less educated mother (AOR=1.739, 95%CI-1.035-2.920, p=0.037), and father occupied as skilled worker or above (AOR=0.527,95%CI=0.321-0.866, and p=0.011).

Table-1: The Demographic Variables of the Children Studied, India

Variables	Nutritional status						Total		Chi-square	P-value
	Normal		Mild to moderate underweight		Severe underweight					
	n	%	n	%	n	%	n	%		
Gender										
Male	138	67.3	53	25.9	14	6.8	205	48.1	0.05	0.824
Female	151	68.3	42	19.0	28	12.7	221	51.9		
Age, Months										
24-35	40	71.4	12	21.4	4	7.1	56	13.1	6.207	0.719
36-47	37	71.2	11	21.2	4	7.7	52	12.2		
48-59	40	71.4	12	21.4	4	7.1	56	13.1		
60-71	31	64.6	9	18.8	8	16.7	48	11.3		
72-83	30	66.7	11	24.4	4	8.9	45	10.6		
84-95	28	66.7	9	21.4	5	11.9	42	9.9		
96-107	31	75.6	6	14.6	4	9.8	41	9.6		
108-119	21	60.0	11	31.4	3	8.6	35	8.2		
120-131	6	46.2	5	38.5	2	15.4	13	3.1		
132-144	25	65.8	9	23.7	4	10.5	38	8.9		

N: number.

Table-2: The Parental Variables of the Children Studied, India

Variables	Nutritional status						Total		Chi-square	P-value
	Normal		Mild to moderate underweight		Severe underweight					
	n	%	n	%	n	%	n	%		
Education of mother										
Graduate/Post Graduate	37	90.2	3	7.3	1	2.4	41	9.6	15.206	0.004
Intermediate	89	67.9	34	26.0	8	6.1	131	30.8		
Middle School	82	70.7	19	16.4	15	12.9	116	27.2		
Primary School	54	58.1	27	29.0	12	12.9	93	21.8		
Illiterate	27	60.0	12	26.7	6	13.3	45	10.6		
Occupation of father										
Profession	3	100.0	0	0.0	0	0.0	3	0.7	12.676	0.048
Semi-profession	9	60.0	6	40.0	0	0.0	15	3.5		
Clerical, Shop-owner, Farmer	22	78.6	4	14.3	2	7.1	28	6.6		
Skilled Worker	87	60.4	44	30.6	13	9.0	144	33.8		
Semi-skilled Worker	120	74.5	24	14.9	17	10.6	161	37.8		
Un-skilled worker	48	64.9	16	21.6	10	13.5	74	17.4		
Unemployed	0	0.0	1	100.0	0	0.0	1	0.2		

Table-3: The Family Variables of the Children Studied, India

Variables	Nutritional status						Total		Chi-square	P-value
	Normal		Mild to moderate underweight		Severe underweight					
	n	%	n	%	n	%	n	%		
No. of siblings										
0	71	64.5	30	27.3	9	8.2	110	25.8	12.634	0.027
1	178	73.3	44	18.1	21	8.6	243	57.0		
2	33	56.9	17	29.3	8	13.8	58	13.6		
3	5	62.5	1	12.5	2	25.0	8	1.9		
4	1	20.0	2	40.0	2	40.0	5	1.2		
5	1	50.0	1	50.0	0	0.0	2	0.5		
Socio-economic status										
Upper	2	100.0	0	0.0	0	0.0	2	0.5	4.566	0.335
Upper Middle	55	73.3	17	22.7	3	4.0	75	17.6		
Middle/Lower Middle	79	71.8	23	20.9	8	7.3	110	25.8		
Lower/Upper Lower	152	64.1	54	22.8	31	13.1	237	55.6		
Lower	1	50.0	1	50.0	0	0.0	2	0.5		
Family Type										
Nuclear	226	70.8	61	19.1	32	10.0	319	74.9	5.26	0.022
Joint/Extended	63	58.9	34	31.8	10	9.3	107	25.1		
Unemployed	0	0.0	1	100.0	0	0.0	1	0.2		
Religion										
Hindu	243	69.2	72	20.5	36	10.3	351	82.4	10.567	0.005
Muslim	32	53.3	23	38.3	5	8.3	60	14.1		
Christian	14	93.3	0	0.0	1	6.7	15	3.5		

Table-4: Gradation of Families Income for Kuppuswamy Classification

Variables	Nutritional status						Total		Chi-square	P-value
	Normal		Mild to moderate underweight		Severe underweight					
	N	%	n	%	n	%	n	%		
Family Income, Rupee										
40095	16	80.0	3	15.0	1	5.0	20	4.7	3.779	0.052
20047-40092	49	67.1	16	21.9	8	11.0	73	17.1		
14998-20044	28	51.9	20	37.0	6	11.1	54	12.7		
10024-14995	95	66.4	31	21.7	17	11.9	143	33.6		
6014-10021	98	73.7	25	18.8	10	7.5	133	31.2		
2008-6011	1	100.0	0	0.0	0	0.0	1	0.2		
< 2005	2	100.0	0	0.0	0	0.0	2	0.5		

For children between 108-144mths, BMZ<-2 and <-3 was calculated to define thinness and severe thinness respectively; BMZ: BMI for age Z score.

Table-5: Binary Logistic Regression Analysis of the Children Studied, India

Variables	B	S.E.	Wald	df	Sig.	Exp (B)	95% CI. for EXP(B)	
							Lower	Upper
Age	-.001	.003	.177	1	.674	.999	.992	1.005
Gender	.039	.226	.030	1	.862	1.040	.668	1.620
Mother Education	.553	.265	4.370	1	.037*	1.739	1.035	2.920
Father Education	-.272	.283	.924	1	.336	.762	.438	1.326
Occupation of Father	-.640	.253	6.397	1	.011*	.527	.321	.866
Siblings	.608	.291	4.382	1	.036*	1.837	1.040	3.248
SE Status	.584	.284	4.238	1	.040*	1.793	1.028	3.126
Family Size	.027	.093	.083	1	.773	1.027	.856	1.233
Family Type	.212	.335	.400	1	.527	1.236	.641	2.383
Child below 5years	.112	.253	.197	1	.657	1.119	.681	1.838
Birth order	.134	.241	.310	1	.578	1.144	.713	1.835
Type of delivery	-.164	.296	.306	1	.580	0.849	.476	1.516
Birth weight, gr	.119	.253	.223	1	.637	1.127	.686	1.850
Religion	.481	.286	2.832	1	.092	1.618	.924	2.835
Type of school	.446	.238	3.512	1	.061	1.562	.980	2.491
Family income	-.412	.246	2.807	1	.094	.662	.409	1.073
Constant	-1.204	.587	4.208	1	.040	.300		

Significant; 95% CI: 95% confidence interval; SE: standard error; df: degrees of freedom; Exp (B): the exponentiation of the B coefficient.

4- DISCUSSION

In our study, the overall prevalence of under nutrition in the 2-12 years (24-144months) aged children was 30.8%. The prevalence of underweight in the 24-59 months age group was 27.97%. This matches well with the value of 27% reported by Manimunda et al. (9). Nearly similar prevalence of 21.6% was reported in less than 5 years children in NFHS-4 survey for Andaman and Nicobar Islands (3). The slight increased prevalence in the present study as compared to NFHS-4 was probably, the present study was hospital based study where absolutely healthy children don't attend. However, it was much low compared to all India prevalence of underweight of 42.5%, in the same survey. Our findings indicate that the prevalence of mild to moderate underweight was slightly more among males (31.45%) than females (30.3%),

although statistically insignificant. This finding is similar to study by Mukherjee et al. (13) who reported a higher prevalence of 10.97% among males and 8.63% in females. Also, we found a higher prevalence of severe underweight in females than males in all age groups but more so in the 120-144 months age group. The possible explanation for this could be the loss of biological advantage in these girls as they grow and gender discrimination they face in the form of inadequate diet, inappropriate health care practices, inconsistent treatment seeking and the increased energy and other nutrient requirement during the pubertal spurt.

Our study showed a significantly association between mother's education and nutritional status of children (p = 0.004). On applying multiple logistic regression analysis, illiterate or primary school educated mothers had AOR1=739 (95%CI: 1.035-2.920), and p- value of 0.037 indicating a higher risk of their children, being underweight. Similar findings have been reported from many other studies conducted elsewhere. (13-30). Literate women, due to their exposure to the outside world, develop a change in their traditional beliefs and attitude towards health of children. They become more aware of personal hygiene and of promotive and curative health care. An educated mother is more capable to take independent decisions and can smartly utilise even meagre household resources to ensure that their children remain healthy.

Occupation of father but not education of father was significantly associated with the risk of underweight in children in this study. There was a lower risk of underweight children whose fathers' were semiskilled workers or below (p= 0.011), on binary logistic regression analysis. In contrast to our findings, Gupta et al. (20) found occupation of father significantly but positively correlated with nutritional status of children. Prior study from Nepal (26), Ludhiana (15), and eastern India (29), revealed that father's unemployment was negatively correlated with the probability of under nutrition in children. These contrary findings could be explained by the fact that almost 48% fathers were primary/middle school literate, 55% were semiskilled/unskilled workers and almost 33% had a monthly income of Rs 10000-15000 (in Rupees). Also, free health care services are provided in these islands, which could have enabled these fathers with a small family, to contribute a reasonably good proportion towards the nutritional care of their children. Also the representation of fathers from higher level of occupation (as per Kuppuswamy scale), is relatively low in our study.

The number of siblings in the family was another variable significantly associated with nutritional status in children (p=0.027). Those children with 2 or more siblings had a disadvantage in terms of risk for underweight (p= 0.036), as computed from Binary logistic regression analysis. Many other studies also revealed the fact that under nutrition is linked to more number of siblings (14, 22, 29). Children from nuclear family had an advantage in nutritional status compared to joint/extended family status (p=0.022). However, this variable lost significance on binary logistic regression analysis (p= 0.527). In the study by Srivastava et al. (23), joint family type was significantly associated with all three indices of malnutrition. Similar results have been reported in another study at Karnataka (30). This could be attributed to the inability of mothers to provide adequate care for their young children, especially where there was more than one under five siblings in the family. Also, the distribution of food in the family could be inappropriate, with older family members receiving the largest share. We found that the children who belonged to Hindu family were better nourished compared to others

(p=0.005), but this difference was not significant on binary logistic regression analysis (p=0.092). The above finding was similar to the previously conducted studies (21, 22, 24 28, 29). Also, some research has revealed that Muslim children are more vulnerable, due to inadequate immunization, differentials in childcare practices, lack of nutrient-rich diet, poor utilization of healthcare services, inappropriate hygiene and sanitation, etc.
We found that, there was a significant and positive association of under nutrition with socio-economic status. Children from lower socioeconomic status were found more vulnerable on binary logistic regression analysis (p=0.04). Since socio-economic status is a composite index of father's education, occupation and per capita income, the correlation becomes more relevant. Similar research conducted in Nepal (26) showed that poor socio-economic status was found as the risk factor for both stunting and being underweight. Similar findings have been demonstrated in other studies in India too (13, 27). Socio-economic status might play important role as many practices, seeking and access to health care might be dependent on it.

The current study has certain limitations. Firstly, being a hospital based study, it only included the children who attended the Pediatric OPD during the study period and whose parents gave consent to be included in the study. Secondly, it is difficult to compare the different age group of children as a whole which might be the limitation of the study but the use of WHO Anthro and Anthro Plus software, for the assessment of the underweight, wasting and thinness among study population is an advantage in deriving those criteria. Thirdly, different factors affecting children's nutritional status were studied; however, some potential confounders, such as the physical activity of the study participants, age of the mother at first birth, mother's BMI, preceding birth interval, diarrhea episode, and prevalence of various parasitic infestation, type of food consumed, hygiene and sanitary practices were not studied. Lastly, since it was a cross-sectional study, it suffered from temporal ambiguity, as both malnutrition and their predictors were assessed at the same time. Hence we could only measure the correlations but interpretations supporting direct causal association were not possible. Also due to the cross-sectional design, we could not measure or compare current versus past burden of under-nutrition among these children.

5- CONCLUSION

The present study was probably the first of its kind in Port Blair, Andaman and Nicobar Islands, to assess the nutritional status amongst the children aged 24 to 144 months of age using the WHO Child Growth Standards (Z score). It estimated the prevalence of under nutrition as 30.8%, affecting boys slightly more than girls in all age groups. However, severe underweight was more prevalent in girls than boys. The prevalence of overweight-obesity, another aspect of malnutrition was 4.1% in the 60-144mths age group. It was also concluded that undernourishment was significantly associated with education of mother, occupation of father, number of siblings, socioeconomic status, religion and type of family. We conclude that, to combat the problem of malnutrition, health education focussing on nutrition should be given to school children as well as their mother.

6- CONTRIBUTORS

RS, NR: Planned the study; RS, NR: Wrote the study protocol; RS: collected the data; PV, SR: Analyzed and interpreted the data; NR, RS: wrote first draft of the manuscript. All authors approved the final draft.

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8- CONFLICT OF INTEREST: None.

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