Research Article

Environmental determinants of underweight among pre-schoolchildren: A case control study

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ABSTRACT

Background: Underweight is a predisposing factor and a leading cause of mortality among pre-schoolchildren in low and middle income countries worldwide. Pre-schoolchildren require relatively higher nutritional requirements for their body weight compared to older children and adults which makes them vulnerable for underweight. According to the third National Family Health Survey-3 in which 42.5% of under 5 children are underweight. **Objective:** This study aims to study the selected environmental factors associated with underweight among pre-schoolchildren in a rural area. **Materials and Methods:** A community-based case control study was conducted in 10 villages of Kancheepuram District, Tamil Nadu. Sample size was calculated with two-sided confidence interval of 95%, power 90%, and ratio of cases to controls of 1. Taking the percent of exposure (lower socioeconomic status) in controls and cases as 22% and 43%, respectively, and an odds ratio of 2.6. The sample size calculated was 112 (cases-112 and controls 112). Chi-square test was applied to test the statistical difference in proportion and odds ratio was calculated. **Results:** The significant risk factors on univariate analysis for underweight were socioeconomic status (OR=5.16), inadequate ventilation (OR=1.8), presence of indoor pollution (OR=2.8), firewood used as fuel for cooking (OR=1.8), practice of open air defecation (OR=2.06). After adjusting for confounders using multivariate analysis the significant risk factors were socioeconomic status (OR=5.75), inadequate ventilation (OR=3.2). **Conclusion:** Poor socioeconomic status and inadequate ventilation were found to be associated with malnutrition in our study population.

KEY WORDS: Determinants, underweight, pre-school children

INTRODUCTION

In developing countries, 5.6 million children are dying due to under nutrition which means 10 children deaths per minute.[1] Poverty, food insecurity, heavy burden of infectious disease, lack of awareness regarding appropriate infant and young child feeding practices, and poor hygiene and sanitation are the direct and indirect causes of under nutrition among children and maternal population in developing countries.[2] Assessment of child growth is internationally recognized as an important public health indicator for monitoring nutritional status and health in populations.[3] The weight-for-age represents a convenient synthesis of both linear growth and body proportion.[4] Under five children require relatively higher nutritional requirements for their body weight compared to older children and adults which makes them vulnerable for underweight. Underweight is defined as percentage of under-5 children who are below minus two standard deviations from median weight-for-age of the WHO child growth standards. Millennium developmental goals have aimed to reduce the percentage of underweight children by one-half between 1990 and 2015. For India, this would imply a reduction in the child underweight rate from 54.8% in 1990 to 27.4% in 2015. However, so far we were able to bring

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it down only to 43% according to National Family Health Survey-3.[5] As underweight children pose a huge burden for nations as their future citizens will be neither healthy nor productive and thereby resulting in economic losses. Various epidemiological factors such as environmental, sociodemographic, housing condition, sanitation, child factors, maternal factors, and access to health-care services involves complex interaction with underweight. In this context, this study aims to measure the strength of association between the socioeconomic status, housing conditions and environmental factors associated with underweight among pre-schoolchildren in a rural area of Tamil Nadu.

MATERIALS AND METHODS

The community-based case control study was conducted among pre-schoolchildren of age group 2-5 years in a rural area of Kancheepuram District, Tamil Nadu. The study area is the field practice area of the Rural Health Training Center, Department of Community Medicine, located at Chunambedu of Kancheepuram District, Tamil Nadu.

Sample size was calculated using Epi info software version 7, with two-sided confidence interval of 95%, power 90%, and ratio of cases to controls of 1. Taking the percent of exposure[6] (lower socioeconomic status) in controls and cases as 22% and 43%, respectively, and an odds ratio of 2.6. The sample size calculated was 112 (cases-112 and controls 112). List of pre-schoolchildren and their residential address was obtained from the under-five register of each village available with the Anganwadi centers in the study area. House to house visit was made in all 10 villages of the study area using the address obtained from the under-five register. Using the WHO growth chart, underweight (<2 S.D) children were designated as cases and those who are in normal weight for age were designated as controls. Survey was conducted in all 10 villages till 112 cases achieved and equal number of neighboring controls was obtained from the same village. Data were collected using a pretested and predesigned questionnaire which included the following variables ventilation, overcrowding, toilet facility, and method of waste disposal. Weight of the child is measured using a validated weighing machine (dial type) recorded to nearest 100 g.

Overcrowding[7] is considered to exist >2 persons for 1 room, >3 persons for 2 rooms, >5 persons for 3 rooms and >7 persons for 4 rooms and additional 2 person for each further room.

Adequate ventilation[7] is considered when doors and windows combined should have 2/5th the floor area.

Mothers of the children were interviewed, in the absence of mother, either child's father or guardian was interviewed. Data were collected and analyzed using SPSS version 21.0. Chi-square test was used to verify the statistical significance of associations. $P < 0.5$ was considered as statistically significant. Odds ratio was calculated to measure the association between selected factors and underweight. Multivariate logistic regression was used to adjust for the confounding factors. Institute Ethics Committee clearance was obtained before starting the study.

RESULTS

The majority of the study participants (Table 1) considered for the study were males 117 (52.2%) and were in the age group of 36-47 months 82 (36.6%). Considering the socioeconomic status (Table 2), study participants belonging to class 4 socioeconomic status had higher risk of having underweight when compared with upper class with OR 5.16 [CI=1.89-14.06] which was statistically significant ($P < 0.05$). In housing conditions (Table 3), over-crowding and type of house of study participants did not have any significant association with underweight status of the children ($P > 0.05$). Inadequate ventilation in the house was found to be a risk factor for underweight with OR=1.8 (CI=1.05-3.06) and which was statistically significant ($P < 0.05$). Study participants living in house with indoor pollution were found to have 2.6 times more risk to be underweight (OR=2.6 [CI=1.5-4.7], $P < 0.05$) as compared to children living in houses without indoor air pollution. Children living in houses using firewood as cooking fuel were found to be at a higher risk to develop underweight when compared with children living in houses using gas for cooking (OR 1.86 [95% CI=1.02-3.38], $P = 0.04$). Waste disposal and presence of breeding site for mosquitoes were not significantly associated ($P > 0.05$). Underweight was high among the children who practiced open air defecation when compared to those who used sanitary latrine and open air defecation was associated with higher risk for underweight. (OR 2.06 [95% CI=1.21-3.51], $P < 0.05$). The significant risk factors associated with underweight after adjusting for confounders using multivariate regression (Table 4) were socioeconomic status (OR=5.75) and inadequate ventilation (OR=3.2).

DISCUSSION

A high number of underweight children were found among the families which belong to lower, upper lower,

Table 1: Distribution of study participants based on age and gender (*n*=224)

Age (in months)	Cases	Controls	Total
24-35	42 (37.5)	31 (27.6)	73 (32.6)
36-47	40 (35.7)	42 (37.6)	82 (36.6)
48-60	30 (26.8)	39 (34.8)	69 (30.8)
Gender			
Male	50 (44.6)	67 (59.8)	117 (52.2)
Female	62 (55.4)	45 (40.2)	107 (47.8)
Total	112 (100.0)	112 (100.0)	224 (100)

Table 2: Association between socioeconomic status of the study participant and underweight (*n*=224)

Social class	*n* (%)			Odds ratio (95% CI)	*P*
	Cases	Controls	Total		
1 (Upper)	11 (31.4)	24 (68.6)	35 (100.0)	Ref	
2 (Upper middle)	21 (33.9)	41 (66.1)	62 (100.0)	1.12 (0.46-2.712)	0.8
3 (Lower middle)	40 (58.0)	29 (42.0)	69 (100.0)	3.01 (1.28-7.1)	0.012
4 (Upper lower)	26 (70.3)	11 (29.7)	37 (100.0)	5.16 (1.89-14.06)	0.001
5 (Lower)	14 (66.7)	7 (33.3)	21 (100.0)	4.36 (1.38-13.84)	0.012
Total	112 (50.0)	112 (50.0)	224 (100.0)		

Modified BG Prasad classification (April 2014)[17]

Table 3: Determinants of household environment for underweight status of the child (*n*=224)

Environmental factors	*n* (%)			Odds ratio (95% CI)	*P*
	Cases	Controls	Total		
Type of house					
Pucca	50 (45.5)	60 (55.5)	110 (100.0)	Ref	
Semi-Pucca	39 (52.0)	36 (48.0)	75 (100.0)	1.3 (0.72-2.34)	0.38
Kutcha	23 (59.0)	16 (41.0)	39 (100.0)	1.72 (0.82-3.61)	0.14
Presence of overcrowding					
Yes	44 (48.4)	47 (51.6)	91 (100.0)	Ref	
No	68 (51.1)	65 (48.9)	133 (100.0)	0.89 (0.53-1.52)	0.68
Ventilation					
Adequate	41 (41.8)	57 (58.2)	98 (100.0)	Ref	
Inadequate	71 (56.3)	55 (43.7)	126 (100.0)	1.8 (1.05-3.06)	0.03
Presence of indoor air pollution					
Yes	85 (58.2)	61 (41.8)	146 (100.0)	2.6 (1.5-4.7)	0.001
No	27 (34.6)	51 (65.4)	78 (100.0)	Ref	
Type of fuel used for cooking					
Gas	65 (47.4)	72 (52.6)	137 (100.0)	Ref	
Kerosene	5 (25.0)	15 (75.0)	20 (100.0)	0.37 (0.12-1.07)	0.06
Firewood	42 (62.7)	25 (37.3)	67 (100.0)	1.86 (1.023-3.38)	0.04
Total	112 (50.0)	112 (50.0)	224 (100)		
Source of drinking water					
Dug well	9 (64.3)	5 (35.7)	14 (100.0)	Ref	
Public stand pipe	84 (53.8)	72 (46.2)	156 (100.0)	0.65 (0.2-2.02)	0.46
Piped water supply	2 (8.7)	21 (91.3)	23 (100.0)	0.05 (0.01-0.33)	0.002
Protected tube well	17 (54.8)	14 (45.2)	31 (100.0)	0.68 (0.18-2.48)	0.55
Place of waste disposal					
Collected by municipality	50 (43.1)	66 (56.9)	116 (100.0)	Ref	
Dumped into open ground	62 (57.4)	46 (42.6)	108 (100.0)	1.78 (1.04-3.02)	0.03
Presence of breeding site for mosquitoes					
Yes	45 (53.6)	39 (46.4)	84 (100.0)	Ref	
No	67 (47.9)	73 (52.1)	140 (100.0)	0.79 (0.46-1.37)	0.4
Practice of open air defecation					
Yes	63 (59.4)	43 (40.6)	106 (100.0)	2.06 (1.21-3.51)	0.005
No	49 (41.5)	69 (58.5)	118 (100.0)	Ref	
Total	112 (50.0)	112 (50.0)	224 (100)		

and lower middle class. This was found to be statistically significant and the strength of association of underweight and socioeconomic status was also high among these socioeconomic classes. Similar results were found in other

Table 4: Multivariate logistic regression analysis

Determinants	Adjusted OR	Confidence interval		*P*
		Upper	Lower	
Socioeconomic status (Class III)	3.5	1.01	11.19	0.03
Socioeconomic status (Class IV)	5.75	1.55	21.36	0.009
Inadequate ventilation	3.2	1.45	7.07	0.004
Indoor air pollution	1.7	0.72	3.96	0.22
Open air defecation	2.48	1.00	6.12	0.05
Fuel used for cooking (firewood)	1.27	0.49	3.26	0.61

studies done by Bharati et al.,[8] Chee et al.,[9] Kumar and Ram[10] and Kikafunda and Tumwine[11] which showed that lower socioeconomic status is an important risk factor for underweight.

Among housing conditions, ventilation, indoor air pollution, type of fuel used for cooking, source of drinking water, method of waste disposal and practice of open air defecation were found to be significantly associated with underweight among pre-schoolchildren whereas type of house, overcrowding and presence of breeding site had no significant association with underweight among pre-schoolchildren. The strength of association was found to be more for indoor air pollution, practice of open air defecation, use of fire wood for cooking and inadequate ventilation. Various studies by Pongou et al.[12] and Tamiru et al.[13] showed that similar association existed between source of drinking water and underweight. Studies done by Bhavsar et al.[14] and Sharma et al.[15] showed that open air defecation was a risk factor among under five children. In our study ventilation, indoor air pollution and type of fuel as determinants of underweight showed odds ratio of 1.8, 2.6, and 1.86, respectively, which was statistically significant. These three factors associated with underweight could be explained as follows, bio mass fuel used for cooking was found to be the likely risk factor for indoor air pollution in our study. Poorly ventilated (inadequate ventilation) dwellings will cause the indoor smoke to circulate within houses. The carbon particles in smoke can penetrate the respiratory epithelium and interferes with mucociliary defense of the respiratory system and also decreases the several antibacterial properties of lung macrophages which causes frequent acute respiratory tract infection which in turn predisposes to malnutrition. Infants and young children are more susceptible to these adverse effects because of the immaturity of respiratory defense system.[16] The findings of these studies were in concurrence with our study findings emphasizing that the above-mentioned housing conditions are significant risk factors of underweight.

Strengths

The community-based case control study and odds ratio estimation was obtained using multivariate analysis, and the possible confounders were adjusted during this process.

Limitations

Recall bias and social desirability.

CONCLUSION

The significant risk factors associated with the underweight after adjusting for confounders were socioeconomic status and inadequate ventilation.

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