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Prevalence of Undernutrition, Its Determinants, and Seasonal Variation Among Tribal Preschool Children of Odisha State, India

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Abstract

A community-based cross-sectional study was undertaken in the tribal areas of Odisha state, India, covering 1951 preschool children to assess their nutritional status in terms of underweight, stunting, and wasting; its correlates; and seasonal variation in nutritional status. χ^2 Test, one-way analysis of variance, and unadjusted and adjusted odds ratios were used for data analysis. The prevalence of underweight, stunting, and wasting was 58%, 65%, and 20%, respectively. The risk of underweight and stunting was, respectively, 1.9 and 2.4 times higher among children of illiterate mothers, whereas underweight and wasting was 1.4 times higher among children who had morbidities during the preceding fortnight. The prevalence of undernutrition was significantly ($P < .01$) higher during monsoon as compared with winter season. Undernutrition is an important public health problem and is associated with literacy of mother, morbidity, and season. Thus, improving socioeconomic condition, literacy, and sanitation along with insuring food security during monsoon season might improve nutritional status.

Keywords

child health, child survival, epidemiology, nutrition/dietetics, public health nutrition

Introduction

Despite rapid economic development and several nutritional intervention programs being in operation since the past 3 decades, childhood undernutrition remains an important public health problem in India. As reported by World Health Organization (WHO), more than half of the underweight children in the world live in Asian and African countries, including India.[1] The most vulnerable groups are children younger than 5 years and pregnant and lactating women.

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Nutritional status of preschool children is a sensitive indicator of community health and nutrition.[2] Undernutrition among children is mostly associated with food insecurity, inappropriate infant and young child-feeding practices, low quality of complementary foods, and high rates of gastrointestinal infections and parasitic infestations.[3]

Preschool children belonging to scheduled tribe are at higher risk of undernutrition as compared with their rural counterparts because of inadequate food intake coupled with traditional sociocultural taboos and limited access to health care services among tribal people.[4] National family health survey study in India reported that the prevalence of underweight, stunting, and wasting was 43%, 48%, and 20%, respectively, among children younger than 5 years in rural areas,[5] whereas the corresponding figures were much higher for tribal children (underweight 55%, stunting 54%, and wasting 28%).[5]

Apart from poverty, illiteracy of parents, infectious diseases, and seasonal and climatic changes also determine food availability, food security, and, thus, nutritional status of population.[6] The overwhelming influence of the season in rural/tribal areas extends beyond farmers and agricultural labor or those directly dependent on the land. It also affects food security and livelihood and much broader areas of rural/tribal life. In India, 3 main seasons are observed: winter (October–January), which is also the postharvest season as most of the crops are available at home during this period, summer (February–May), which is the preharvest season; and monsoon (June–September), during which harvesting takes place. During the harvesting season, most of the food stocks are used for sowing, and this may lead to food scarcity and food insecurity, resulting in increased rates of undernutrition.

Nutritional status and/or nutritional problems of the population are not uniformly distributed within the country and vary from state to state. Therefore, it is necessary to undertake statewise surveys with adequate sample size. This would facilitate state governments and international organizations such as WHO, United Nations Child Fund (UNICEF), and so on to focus on region-specific nutritional problems and initiate intervention measures to control the same.

National Nutritional Monitoring Bureau (NNMB) had carried out a survey on "diet and nutritional status of tribal population" during 2007-2008 as second repeat survey to study the diet and nutritional status of tribal population residing in the Integrated Tribal Development Agency (ITDA) areas. In this article, data pertaining to nutritional status of preschool children (1-5 years old) of Odisha state are analyzed and presented.

Method

Study Design and Study Area

It was a community-based cross-sectional study carried out during 2007-2008 in ITDA areas of Odisha state, India. ITDA operates in areas where the tribal population is more than 50%.

Selection of Villages

A total of 120 villages were covered. Of them, 90 villages were selected from the list of villages covered during first repeat survey (1998-1999), whereas the rest (30) of the villages were selected from the list provided by ITDA by random sampling procedure.

Selection of Households

From each of the selected villages, a total of 40 households (HHs) were covered. If more than 1 tribe was present in a village, total number of HHs in each tribe was enumerated first and then number of HHs required to be covered from each tribe was estimated by probability proportional

to size method. First, HHs were selected randomly, and then, required numbers of HHs were covered contiguously from each tribe.

Data Collection

Data were collected from the parents of selected children by trained investigators on various socioeconomic and demographic variables using pretested pro-forma. Anthropometric measurements such as weight and height/length, were carried out on all the 1- to 5-year-old children using standard equipment and procedures,[7] and they were examined clinically for the presence of signs of nutritional deficiency. Height was measured with an anthropometer in standing position, and in case of infants, reclining length was measured with an infantometer, whereas weight was measured with SECA weighing scale without footwear and with minimal clothes with accuracy of 0.1 kg. The survey was carried out over the year during the 3 seasons. For this purpose, villages to be covered in each selected districts were divided equally and were covered during different seasons to assess seasonal variation in anthropometric measurements and food and nutrient intakes. History of morbidities, such as fever, diarrhea, and acute respiratory infections (ARIs), if any, during the preceding fortnight was also collected from the mothers. Nutritional assessment was done using new WHO Child Growth Standards[8] according to standard deviation (SD) classification.[9] Children who were below 2SD values of the reference median (<median − 2SD) on the basis of weight-for-age, height-for-age, and weight-for-height indices were classified as "underweight," "stunted," and "wasted," respectively, whereas children who were below 3SD values of the reference median (<median − 3SD) were classified as "severe underweight," "severe stunting," and "severe wasting," respectively.

A 24-hour recall diet survey was carried out on every fourth HH covered for anthropometry to assess individual food and nutrient intakes.[10]

Ethical Clearance

The study was approved by the steering committee of NNMB and was also approved by the Scientific Advisory Committee of Indian Council of Medical Research, New Delhi. Ethical clearance was obtained from the institutional ethical review committee. Oral informed consent was obtained from the head of the selected HHs.

Training and Standardization

All the investigators were trained and standardized in the survey methodology at the National Institute of Nutrition (NIN), Hyderabad. Scientists from the NIN periodically supervised the field operations to ensure data quality.

Data Analysis

Data analysis was carried out using SPSS (Version 15.0). Test of proportion was used to study association between age-groups and undernutrition. Comparison of mean (SD) *z*-score values and median food and nutrient intakes with interquartile range (25th and 75th percentile) according to seasons were analyzed by using one-way ANOVA with post hoc test of least significant difference, and whenever the assumption of homogeneity of variance was violated, nonparametric test of Kruskal–Wallis one-way ANOVA was used. Association between undernutrition (dependent variable) and different socioeconomic and demographic factors (independent variables) were assessed by unadjusted odds ratio (OR). Stepwise logistic regression analysis was carried out to know the influence of individual factors on risk of undernutrition.

Household wealth index was developed by principal components analysis. The variables included in the factor analysis were HH sociodemographic factors such as type of house, occupation of head of the HH, per capita income, source of drinking water, type of fuel for cooking, availability of electricity, and sanitary latrine facilities. The first component explains most of the variance in the observed set of variables, including occupation of head of the HH, per capita income, and electricity. These weighed the heaviest (>0.5) and were in positive direction. This method was used as proxy for wealth assessment.[11,12] Each HH asset, about which information was collected, was assigned a weight or factor score generated through principal components analysis. The resulting asset scores were standardized in relation to a standard normal distribution with a mean of 0 and an SD of 1. The first component explained 22% of the variance. The regression score from the first component was used to create an index that was divided into tertiles as lowest, middle, and highest tertile.

Results

Coverage Particulars

A total of 1915 children were covered (boys 50%, mean age ± SD = 34.6 ± 13.6 months).

Nutritional Status of Preschool Children

Overall prevalence of underweight (weight for age <median − 2SD) was about 58%, whereas that of severe underweight (weight for age <median − 3SD) was 22%. The extent of overall stunting was 65%, and that of severe stunting was 30%. About 20% children had wasting, and of them, 5% had severe wasting (Table 1).

Seasonal Variation in Nutritional Status of Preschool Children

The prevalence of underweight, stunting, and wasting was significantly ($P < .01$) higher during monsoon (June–September) as compared with the prevalence of undernutrition during winter (October–January) and summer seasons (February–May; Figure 1).

Mean z-Score Values for Anthropometric Measurements According to Seasons

Significant ($P < .05$) difference was observed in the mean *z*-score values for weight-for-age, height-for-age, and weight-for-height and was lower during winter and summer seasons as compared with monsoon season (Table 2). Mean *z*-score values for weight-for-age, height-for-age, and weight-for-height during the winter season were −2.13, −2.29, and −1.33, respectively, whereas these were −2.15, −2.34, and −1.39, respectively, during the summer and −2.31, −2.52, and −1.51, during the monsoon season.

Mean Food and Median Nutrient Intake Among Preschool Children

Mean intake of foodstuffs, such as proteins, food fats, green leafy vegetables, and milk and milk products, was significantly higher during winter season as compared with monsoon season. Similarly, median intakes of all the nutrients were higher during the winter season and was significantly ($P < .01$) higher for vitamin A, iron, vitamin C, calcium, thiamine, riboflavin,

Table 1. Nutritional Status of Preschool Children According to Age by Standard Deviation Classification Using World Health Organization Child Growth Standards.

		Nutritional Grades		
Particulars	n	<Median − 3SD	<Median − 2SD to 3SD	≥Median − 2SD
Weight-for-age				
Age-groups (years)				
1-3	974	23.8	35.2	41.0
3-5	941	19.1	37.3	43.6
Pooled	1915	21.5	36.2	42.3
χ^2, *P* value			6.24, .04[a]	
Height-for-age				
Age-groups (years)				
1-3	974	34.3	33.7	32.0
3-5	941	25.5	35.6	38.9
Pooled	1915	30.0	34.6	35.4
χ^2, *P* value			19.2, .001[a]	
Weight-for-height				
Age-groups (years)				
1-3	974	6.7	16.3	77.0
3-5	941	3.2	13.4	83.4
Pooled	1915	5.0	14.9	80.1
χ^2, *P* value			17.0, .001[a]	

a. $P < .01$.

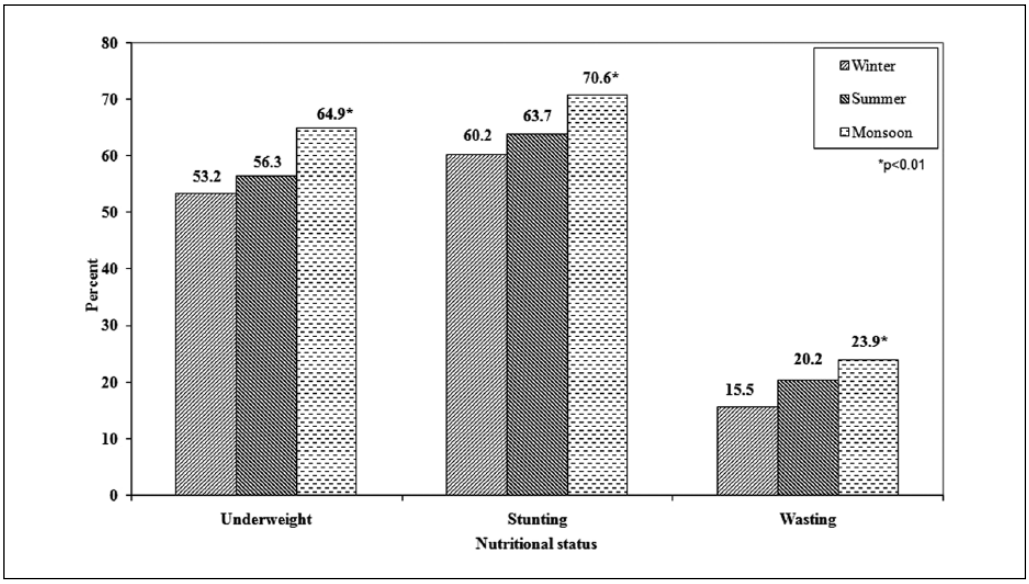

Figure 1. Prevalence of undernutrition according to different seasons among preschool children.

niacin, and free folic acid as compared with nutrient intakes during the monsoon seasons (Tables 3 and 4).

Table 2. Mean (SD) *z*-Score Values for Anthropometrics Measurements According to Survey Period.*

		Weight-for-Age		Height-for-Age		Weight-for-Height	
	n	Mean *z* Score	SD	Mean *z* Score	SD	Mean *z* Score	SD
Summer	833	−2.15[a]	1.18	−2.34[a]	0.90	−1.39[a]	0.93
Monsoon	527	−2.31[b]	1.19	−2.52[b]	0.90	−1.51[b]	0.87
Winter	555	−2.13[a]	1.12	−2.29[a]	0.85	−1.33[a]	0.86
F, P value		3.83, .02		10.2, .001		5.59, .004	

*Variations in superscripts indicate significant mean *z* score across seasons, $P < .01$.

Table 3. Mean Intake of Foodstuffs (IQR) Among 1- to 5-Year-Old Children According to Survey Period.

Age (Year)/ Foodstuffs	n	Cereals (g/d)	Pulses (g/d)	Food Fats (g/d)	GLV (g/d)	Root and Tubers (g/d)	Fruits (g/d)	Milk and Milk Products (g/d)
Summer	209	175 (140, 217)	15 (0, 25)	3.1 (0, 5)	31.4 (0, 61)	21.8 (0, 39)	12.8 (0, 19)	2.1 (0, 0)
Monsoon	163	163 (128, 207)	10.2 (0, 19)	3.1 (1, 5)	22.9 (0, 37)	23.8 (0, 42)	1.5 (0, 0)	2.3 (0, 0)
Winter	145	170 (126, 216)	11.9 (0, 21)	3.7 (2, 5)	39.8 (0, 64)	19.1 (0, 32)	7.5 (0, 1.1)	2.8 (0,0)
P value		0.13	0.01[a]	0.01[a]	0.00[a]	0.29	0.00[a]	0.69
RDI[b] 1-3 years		175	35	—	40	20	—	300
RDI 4-5 years		270	34	—	50	20	—	250

Abbreviations: IQR, interquartile range; GLV, green leafy vegetables; RDI, recommended dietary intakes.
a. $P < .01$.
b. From Nutritive Value of Indian Foods: National Institute of Nutrition, Indian Council of Medical Research, Hyderabad, India, 1990.

Table 4. Median (IQR) Intake Nutrients Among 1- to 5-Year-Old Children According to Survey Period.†

Seasons/ Nutrients	n	Energy (kcal/d)	Fats (g/d)	Proteins (g/d)	Vitamin A (µg/d)	Vitamin C (mg/d)	Iron (mg/d)
Summer	209	744 (580, 916)	4.4 (2.2, 6.9)	16.7 (13.1, 23.1)	65.2 (20.9, 609.5)	21.6 (10, 54.7)	4.3 (3.1, 6.1)
Monsoon	163	663 (560, 861)	4.9 (2.5, 7.6)	16.6 (12.7, 21.5)	24.3 (7.7, 503.4)[b]	12.9 (3, 50.7)[b]	4.0 (2.8, 5.8)[b]
Winter	145	778 (540, 933)	5.6 (3, 7.5)	17.9 (12.5, 22.7)	260 (29, 781.8)[a]	41.0 (13, 91)[a]	4.7 (3, 7.1)[a]
P value		.21	.11	.60	.01*	.01*	.05*
RDA[‡] 1-3 years		1060	27	16.7	400	40	09
RDA 4-5 years		1350	25	20.1	400	40	13

Seasons/ Nutrients	N	Calcium (mg/d)	Thiamine (mg/d)	Riboflavin (mg/d)	Niacin (mg/d)	Free Folate (µg/d)
Summer	209	156.5 (70.8, 270.9)	0.5 (0.3, 0.6)	0.2 (0.1, 0.3)	6.9 (5.3, 9.1)	23.8 (15.5, 31.8)
Monsoon	163	219 (68.3, 264.5)[b]	0.4 (0.3, 0.5)[b]	0.2 (0.1, 0.2)[b]	5.6 (3.9, 7.9)[b]	15.8 (11, 23.7)[b]
Winter	145	260 (29, 781.8)[a]	0.5 (0.3, 0.6)[a]	0.2 (0.1, 0.3)[a]	7.0 (4.7, 9.4)[a]	20.4 (12.6, 27)[a]
P value		.01*	.01*	.01*	.01	.01*
RDA[‡] 1-5 years		600	0.5	0.6	8	-

Abbreviations: IQR, interquartile range; RDA, recommended dietary allowances.
*Significant $P < .05$.
†Superscripts indicate significant variation in median intake of nutrients during different seasons.
‡From Expert Group of ICMR, Recommended Dietary Intakes for Indians, Indian Council of Medical Research, 2010.

Table 5. Baseline Characteristics and Unadjusted Odds Ratio (OR) With 95% Confidence Interval (95% CI) for Undernutrition Among Preschool Children.

Particulars	n	Underweight	Stunting	Wasting
Age (years)				
1-3	974	1.11 (0.92-1.33)	1.35 (1.12-1.63)[a]	1.50 (1.19-1.88)[a]
3-5	941	1.0	1.0	1.0
Gender				
Boys	966	1.07 (0.89-1.28)	1.13 (0.94-1.37)	1.13 (0.90-1.41)
Girls	949	1.0	1.0	1.0
Religion				
Hindu	1776	1.0	1.0	1.0
Christian	139	0.64 (0.45-0.90)[a]	0.55 (0.38-0.77)[a]	0.70 (0.43-1.13)
Literacy status of father				
Illiterate	1310	1.57 (1.19-2.08)[a]	1.66 (1.25-2.21)[a]	1.12 (0.79-1.61)
Classes 1 to 8	370	1.32 (0.95-1.84)	1.41 (1.01-1.96)[a]	1.07 (0.71-1.63)
Class 9 and above	234	1.0	1.0	1.0
Literacy status of mother				
Illiterate	1545	1.94 (1.37-2.74)[a]	2.43 (1.72-3.42)[a]	1.17 (0.75-1.84)
Classes 1 to 8	223	1.77 (1.16-2.70)[a]	1.80 (1.18-2.75)[a]	1.38 (0.81-2.36)
Class 9 and above	145	1.0	1.0	1.0
Possession of land				
No land	446	0.99 (0.80-1.23)	1.03 (0.83-1.29)	1.12 (0.86-1.46)
Possess land	1459	1.0	1.0	1.0
Household wealth index				
Lowest	779	1.39 (1.11-1.74)[a]	1.30 (1.04-1.64)[a]	1.54 (1.15-2.06)[a]
Middle	617	1.36 (1.07-1.73)[a]	1.41 (1.10-1.79)[a]	1.38 (1.02-1.89)[a]
Highest	519	1.0	1.0	1.0
Per capita income				
Below first tertile	638	1.21 (0.97-1.51)	1.14 (0.91-1.44)	0.98 (0.74-1.29)
First to second tertile	656	1.02 (0.82-1.27)	1.12 (0.89-1.41)	0.93 (0.70-1.23)
Above third tertile	621	1.0	1.0	
Morbidity (during preceding fortnight)				
Yes	224	1.43 (1.06-1.91)[a]	0.92 (0.69-1.23)	1.45 (1.04-1.99)[a]
No	1691	1.0	1.0	1.0

a. $P < .01$.

Nutritional Status by Socioeconomic and Demographic Variables

The baseline characteristics are presented in Table 5 with unadjusted OR with 95% confidence interval (CI) for dichotomized variables such as underweight (<median − 2SD), stunting (<median − 2SD), and wasting (<median − 2SD). The unadjusted factors significantly associated with underweight were religion, HH wealth index, literacy status of parents, and history of morbidities during the preceding fortnight.

The unadjusted factors associated with stunting were age-groups, religion, literacy status of parents, and HH wealth index.

Similarly wasting was observed to be significantly associated with age-groups, literacy status of father, HH wealth index, and history of morbidities during the preceding fortnight.

Table 6. Stepwise Logistic Regression Analysis for Undernutrition Among Preschool Children.

Outcome Variable	Underweight		Stunting		Wasting	
Independent Variable	OR	CI	OR	CI	OR	CI
Religion						
Hindu	1.0		1.0		—	—
Christian	0.66	0.49-0.94[a]	0.58	0.41-0.82[a]	—	—
Age-group (years)						
1-3	—	—	1.37	1.13-1.66[a]	1.51	1.19-1.89[a]
3-5	—	—	1.0		1.0	
Literacy status of mother						
Illiterate	1.89	1.34-2.67[a]	2.38	1.68-3.37[a]	—	—
Classes 1 to 8	1.74	1.14-2.66[a]	1.82	1.19-2.79[a]	—	—
Class 9 and above	1.0		1.0		—	—
Household wealth index						
Lowest	—	—	—	—	1.56	1.16-2.10[a]
Middle	—	—	—	—	1.42	1.04-1.94[a]
Highest	—	—	—	—	1.0	
History of morbidity (during preceding fortnight)						
Yes	1.42	1.05-1.90[a]	—	—	1.46	1.05-2.02[a]
No	1.0	—	—	—	1.0	

Abbreviations: OR, odds ratio; CI, confidence interval.
a. $P < .05$.

Prevalence of Morbidities

Fever was the commonest morbidity among the children (7.1%), followed by ARI (3.7%) and diarrhea (1.4%). The prevalence of underweight and wasting was significantly ($P < .01$) higher among children who had any of the morbidities during the preceding fortnight (Table 5).

Multivariate logistic regression analysis was performed to identify various socioeconomic and demographic variables associated with undernutrition (Table 6). Underweight was observed to be significantly ($P < .001$) associated with religion, age-groups, literacy status of mother, and morbidities during previous fortnight. The risk of underweight was 1.9 (95% CI = 1.34-2.67) and 1.7 (95% CI = 1.14-2.66) times higher among children whose mothers were illiterate or studied up to eighth standard as compared with children whose mothers had ≥9 years of schooling. History of morbidity during the preceding fortnight was significantly ($P < .001$) associated with underweight with risk of 1.4 (95% CI = 1.05-1.90).

Similarly, stunting was significantly associated with age-groups and literacy status of mother. The risk of stunting was 1.4 times (95% CI = 1.13-1.66) higher among 1- to 3-year-old children compared with 3- to 5-year-old children. There was 2-fold increase in the risk of stunting among children of illiterate mothers (OR = 2.4, 95% CI = 1.68-3.37) and those educated up to eighth standard (OR = 1.8, 95% CI = 1.19-2.79) as compared with children whose mothers had ≥9 years of schooling.

The risk of wasting was 1.5 times (95% CI = 1.19-1.89) higher among 1- to 3-year-old children compared with 3- to 5-year-old children. Children belonging to lowest and middle HH wealth index had 1.6 (95% CI = 1.16-2.10) and 1.4 times (95% CI = 1.04-1.94) higher risk as compared with children from highest HH wealth index. Any of the morbidity during the preceding fortnight had a risk of 1.4 times (95% CI = 1.05-2.02) compared with the children with no history of morbidities.

Discussion

Odisha state has the largest number of tribal population in India, comprising about 24% of the total population in the state. Tribals live in forest areas and engage in farming along with fishing, hunting, and food gathering for their daily subsistence. The study revealed that undernutrition is a major nutritional problem of public health significance among preschool children residing in the tribal areas of the State. The prevalence of underweight, stunting, and wasting was 58%, 65%, and 20%, respectively, which was lower than the previous survey carried out during 1998-1999.[13] Higher prevalence of underweight (61%) and wasting (21%) was also reported by the other study, whereas the prevalence of stunting (59%) was slightly lower.[14] Other studies carried out among tribal children also reported higher prevalence of undernutrition.[15-18] Sharma et al[19] reported that lower prevalence of underweight (37%) and stunting (46%) among tribal preschool children of Madhya Pradesh may be because of the small sample size (n = 123). The prevalence of undernutrition was significantly ($P < .05$) higher among 1- to 3-year-old children compared with 3- to 5-year-old children, which could be attributed to faulty feeding practices such as prolonged exclusive breastfeeding, delayed or early initiation and inappropriate complementary feeding, and higher rates of infection during this period. The prevalence of undernutrition was higher among boys than girls, which is similar with the findings reported by other studies.[20] Though the actual cause of this is not well established, it is presumed that boys are more influenced by environmental stress than girls.[21]

There is seasonal variation in anthropometric measurements and prevalence of undernutrition—that is, lower prevalence in undernutrition and significantly lower *z*-score values were observed during the winter and summer seasons. This might be because of higher intake of nutrients especially energy and fats because of easy availability and accessibility to food as this is postharvest period when the crop is available at home. Another reason may be higher prevalence of morbidities during monsoon season (14%) as compared with winter season (12%) as observed in this study. Also, monsoon season is the lean period when there is scarcity of food grains because harvesting took place during this period and food grains were not yet available at home. Ramachandran[6] also reported insufficiency of food grains during April to July and starvation during July to September in tribal areas of Odisha.

Logistic regression analysis showed that age of the child, religion, literacy status of parents, HH wealth index, and morbidity were significantly associated with undernutrition. Underweight and stunting was significantly higher among children of illiterate mothers or those educated up to eighth standard compared with children whose mothers had ≥9 years of schooling. Similar findings were also observed by other authors.[22-25] This may be because mother's education level is associated with higher efficient management of limited HH resources, greater utilization of health care services, better health-promoting behavior, lower fertility, and higher child-centered caring practices.[26,27] Higher socioeconomic status of parents are also associated with lower level of undernutrition as observed by other authors.[28] Presence of morbidity in the previous fortnight was significantly associated with underweight and wasting, indicating that morbidity plays significant role in nutritional status among these children.

In conclusion, the results of the study indicate that the prevalence of undernutrition is a major nutritional problem among the preschool children in tribal areas of Odisha and is associated with parent's education, socioeconomic status, morbidity, and season. Hence, encouraging maternal education along with maternal health promotion, improving socioeconomic condition of HHs by employment-generating activities, and personal hygiene might help in improving nutritional status. Food-for-work program needs to be strengthened for all people in tribal areas. Also, supply of additional food grains during lean periods (monsoon and winter season) through public distribution system to ensure HHs food security may help improve the nutritional status of children. Supplementary feeding programs under Integrated Child Development Services should be

continued even during summer season to overcome food inadequacies in diet among preschool children.

It should be mentioned that governments and nongovernmental organizations should initiate appropriate nutrition intervention measures, and nutrition supplementary feeding programs should be strengthened to control the problem of undernutrition among the children in tribal areas. These findings are of significant importance to develop appropriate strategies to implement the same to improve the nutritional status of children.

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