

Original Article

Trends in the prevalence of undernutrition, nutrient & food intake and predictors of undernutrition among under five year tribal children in India

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Undernutrition among children under five year is a significant public health problem in India. The present study was carried out to assess trends in nutritional status, nutrient and food intake among children under five year over two time periods. It was a community-based cross-sectional study, carried out in tribal areas of India. A total of 14,587 children, 0-5 years old were covered for nutritional assessment in terms of underweight, stunting and wasting. A 24 hour diet survey was carried out in a sub-sample of households surveyed. Wealth index was constructed using principle component analysis. The prevalence of underweight and stunting had declined significantly over the periods (49% vs 57%, 51% vs 58%, respectively), while the prevalence of wasting remained similar (22% vs 23%). There was marginal decrease in the intake of foods and nutrients over the periods, and was below recommended levels. Stepwise regression showed that the risk of underweight and stunting was significantly ($p < 0.01$) higher among children of illiterate mothers and children from lowest and middle households wealth index. Morbidities during preceding fortnight had 1.3 times higher risk of underweight and wasting. In conclusion, undernutrition is a significant health problem among tribal children and is associated with literacy status of mothers, household wealth index and morbidities. Therefore implementation of appropriate nutritional intervention strategies and improvement in households food security through public distribution systems, food intakes, socio-economic condition, literacy of parents and personal hygiene may help in improving the nutritional status of tribal children.

Key Words: underweight, stunting, wasting, Households wealth index, nutrient intakes

INTRODUCTION

Despite rapid economic development along with increase in food production in recent decades and several nutritional intervention programmes in operation since the last three decades, childhood undernutrition remains an important public health problem in India. It is one of the important reasons for ill health and child mortality.¹ Globally undernutrition is an underlying cause in at least half of all childhood deaths.² Undernutrition contributes to the death of 5.6 million children under five years in the developing world each year- the equivalent of 10 children a minute.³ Thus children under five year constitute the most vulnerable segment of any community and their nutritional status is a sensitive indicator of community health and nutrition.⁴

Undernutrition among children has been mostly associated with higher family food insecurity, low quality of complementary foods and high burdens of intestinal parasitic and other infections, poor socio-economic background, low birth weight (LBW) and intra-uterine growth retardation (related to maternal malnutrition), and has persisted despite improvement in economic conditions over recent years.⁵ The burden of undernutrition appears

particularly high among rural and Indigenous tribal populations.

Underweight, stunting and wasting are each associated with synergistic increases in mortality from diarrhoea, respiratory diseases and infections such as measles. Consequences of stunting manifest throughout childhood and includes delayed attainment of motor milestones such as walking⁶ and reduced school performance, resulting in fewer years of education and therefore reduced productivity and work capacity - which impacts economic productivity at a national level. A stunted child may have an increased risk of developing chronic diseases such as obesity, impaired glucose tolerance and hypertension during adulthood.^{7,8}

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As per 2001 census, tribal population constitute about 8.1% of total population (74.6 million) in India. Some of the major tribe includes Gonds from Madhya Pradesh, Chenchus in Andhra Pradesh, Paniyan and Kanikkar in Kerala, Santhals in Orissa and West Bengal, Khond in Orissa, Angamis in Nagaland, Bhils in Maharashtra and Gujarat, Bhutias in Tibet and Great Andamanese in Andaman and Nicobar. The largest number of tribal are in Madhya Pradesh (12.23 million), Orissa (8.1 million) and Jharkhand (7.0 million), followed by Gujarat, Chhattisgarh, Andhra Pradesh, Kerala, and West Bengal.⁹ These tribal people are the poorest in the country, mostly depends on hunting, agriculture and fishing for their livelihood, and hence they are at higher risk of undernutrition.

National Nutritional Monitoring Bureau (NNMB) had carried out a survey on 'Diet and nutritional status of tribal population during 2007-08, as a second repeat survey in nine States of India to study changes in the diet and nutritional status of tribal population residing in the Integrated Tribal Development Agency (ITDA) Areas. ITDA operates in areas where the tribal population is more than 50% in that particular area. Trends in nutritional status and nutrient intake among children under five years are presented in this communication.

METHODS

Study design and study areas

A community based cross-sectional study was carried out in ITDA Areas in nine States of India (Andhra Pradesh, Gujarat, Kerala, Karnataka, Maharashtra, Madhya Pradesh, Orissa, Tamil Nadu and West Bengal) during 2007-08. These States constitute about two thirds of the total tribal population in India.

Selection of villages

In each State, a total of 120 villages were selected, of them, 90 villages were selected from the list of villages covered during first repeat survey (1998-1999), while the remaining (30) villages were selected from the list provided by ITDA by adopting random sampling procedure. The sampling method used is described in details elsewhere.¹⁰

Selection of households

From each selected village, a total of 40 households (HHs) were covered. For this purpose, the total number of tribal HHs in a village was enumerated and then 40 HHs were covered contiguously by selecting a random start from north east corner of the village. In case where the number of tribal HHs were less than 40, a nearby tribal village was covered for the remaining HHs.

Collection of data

Data on various socio-economic and demographic variables was collected from the parents using pre-tested questionnaire. Anthropometric measurements (weight up to nearest 100 g and height up to nearest 1 mm) were carried out on all available 0-5 years old children using standard equipment and procedures,¹¹ and were examined clinically for presence of signs of nutritional deficiency. Morbidities, if any, during the preceding fortnight such as fever, diarrhoea, and acute respiratory infections (ARIs),

etc. were also obtained from the mother. Nutritional assessment was carried out using WHO Child Growth Standards¹² according to standard deviation (SD) classification (WHO 1983).¹³ Children who were below two SD values of the reference median ($<\text{median} - 2 \text{ SD}$) on the basis of 'weight-for-age', 'height-for-age' and 'weight-for-height' indices were classified as under-weight, stunting and wasting respectively, while children who were below three SD values of the reference median ($<\text{median} - 3 \text{ SD}$) were classified as 'severe under-weight', 'severe stunting' and 'severe wasting' respectively.

The diet survey was carried out by using the 24 hour dietary recall method in every fourth HHs selected for anthropometry. Mean intake of food stuffs was measured in grams/Consumption Unit, one consumption unit (CU) is defined as the energy requirement for a adult reference man, weighing 60 kg and age between 18-39 yrs. Median nutrients intake per day was estimated from each individual dietary intake by a computer programme developed by National Institute of Nutrition (NIN), Hyderabad.

Ethical clearance

Ethical clearance was obtained from the Institutional Ethical Review Committee of NIN, Hyderabad. Oral informed consent was obtained from the mothers/parents involved in the study.

Definitions

'Pucca' house means walls made up of cement and bricks or stones and reinforced cement concrete roof (RCC), while 'semi pucca house' is one that has brick or stone wall and tiled or asbestos roof, 'kutcha' house had mud or thatched walls and thatched or tiled/asbestos roof.

Training and standardization: All the field investigators were trained and standardized in the survey methodology at NIN, Hyderabad. Scientists from NIN periodically supervised the field operation to ensure data quality.

Data analysis

Data analysis was carried out using SPSS (15.0 Version). Test of proportion was used to study the association between age groups and undernutrition. Association between dependant variable (undernutrition) and its determinants were assessed by unadjusted odds ratio (OR). Stepwise logistic regression analysis was also carried out to determine the influence of individual factors on undernutrition.

Household wealth was assessed by principal components analysis. The variables included in the factor analysis were household socio-demographic variables such as type of house, occupation of head of household, source of drinking water, type of fuel for cooking, electricity, sanitary latrine and landholding that are related to wealth status. The three components which explain most of the variance in the observed variables included: type of house, occupation of head of household, per capita income, electricity and sanitary latrine. This weighed the heaviest (>0.5) and was shown to be in the positive direction. This method was established in epidemiology during the 1990s and has been used as a proxy for wealth assessment in the literature.^{14,15} Each household asset for which information is collected was assigned a weight or factor score gener-

ated through principal components analysis. The resulting asset scores are standardized in relation to a standard normal distribution with a mean of zero and a standard deviation of one. The first three components explained 51% of the variance. The regression scores from the first component were used to create an index that was divided into tertiles as: lowest, middle and highest.

RESULTS

Coverage particulars and socio-demographic profile of study subjects

A total of 14,587 children were covered, of which 18% were below 1 year and 42% were 1-3 years of age. Boys and girls were distributed equally. Age of the children ranged from 0 to 59 months (mean 29.1, SD±16.3).

The majority (94%) of the HHs were Hindus, and about two thirds (67%) of HHs were living in *semi pucca* houses, while 28% were living in *kutcha* houses. About 63% of the HHs were nuclear families, while 18% were joint families. The average family size was 5.5 (±1.9). About 58% of fathers and 64% of mothers of the children were illiterate. About 39% of HHs does not possess agriculture land. About 66% of fathers and 45% of mothers were engaged in either agriculture or non agriculture labour. About 40% of the HHs had household's wealth index below the 3rd tertile (Table 1). Safe water (Tap) for drinking was accessible to only 17% of the HHs and nearly all the HHs were using firewood (99%) for cooking. Sanitary latrine was present only in 11%, while electricity in 51% of the HHs.

Nutritional status of children under 5 years

In general, the overall prevalence of underweight was about 49%, of which 19% were severely underweight. The extent of overall stunting was about 51%, and of them, about 24% were severely stunted. About 22% of children had wasting, of which 7% had severe wasting. The prevalence of severe underweight and stunting was significantly ($p<0.01$) higher among 1-3 year old children, as compared to infants; while the prevalence of severe wasting was higher among 0-1 year old children as compared to 1-5 year old children (Table 2).

Changes in the prevalence of undernutrition over two time periods

The prevalence of underweight and stunting (1-3 and 3-5 year children) had significantly ($p<0.01$) declined over the period (49% vs 57%, 51% vs 58%, respectively) during 1998-99 and 2008-09, while the prevalence of wasting remained similar (22% and 23%) (Table 3).

Food and nutrient intake among children

Intakes of all the major nutrients especially energy, calcium, Iron, Vitamin A and Vitamin C have declined over the periods and were below the recommended dietary allowances (RDA), while intake of proteins and thiamine was similar to RDA. Similarly, the intake of all foods except roots and tubers have declined over the periods, and were below recommended dietary intakes (RDI) among 1-3 year old children; while there was marginal change in the intake of food stuffs among 4-5 years old children, although it was below RDI (Table 4).

Table 1. Household socio-demographic characteristics of study subjects

Characteristics	n	%
Religion		
Hindu	10518	93.5
Others	733	6.5
Type of House		
Kutcha	3141	27.9
Semi Pucca	7533	67.0
Pucca	577	5.1
Type of family		
Nuclear	7059	62.7
Ext. Nuclear	2099	18.7
Joint	2093	18.6
Family size		
1-4	4170	37.1
5-9	6694	59.5
≥10	387	3.4
Literacy status of father		
Illiterate	6539	58.2
1 st -8 th standard	3323	29.5
SSC & above	1385	12.3
Literacy status of mother		
Illiterate	7183	63.8
1 st to 8 th class	2990	26.6
9 th & above	1076	9.6
Land (Acres)		
Nil	4397	39.1
<2.5	4669	41.5
2.5-<5	1424	12.7
≥ 5	763	6.8
Occupation of father		
Labour	7427	66.0
Cultivators	2927	26.0
Service	405	3.6
Others	494	4.4
Occupation of mother		
Labour	5045	44.8
Cultivators	2764	24.6
Service	212	1.9
Housewife	3232	28.7
Households Wealth Index		
Lowest	4505	40.1
Middle	4456	39.6
Highest	2286	20.3

Nutritional status by age groups, gender and socio-economic and demographic variables

The risk of underweight and stunting was significantly ($p<0.01$) higher among children of 1-3 years and 3-5 years, as compared to those less than 1 year of age. The prevalence of under-weight, stunting and wasting was significantly ($p<0.01$) higher among boys compared to girls. The unadjusted factors significantly ($p<0.01$) associated with underweight and stunting were: literacy status of parents, households wealth index, per capita income, family size and history of morbidity (fever, diarrhoea and acute respiratory infections) during the preceding fortnight among children below five years of age (Table 5).

Similarly wasting was observed to be significantly associated with the literacy status of parents, household wealth index, family size and history of morbidity (fever and diarrhoea) during the preceding fortnight (Table 5).

Logistic regression analysis was used to identify various socio-economic and demographic variables associated with undernutrition revealed that age and gender of

Table 2. Nutritional status of children under 5 year according to age by SD classification using WHO Child Growth Standards

Age groups (y)	Nutritional Grades			
	n	< Median - 3 SD	≥ Median - 3 SD to < Median - 2 SD	≥ Median - 2 SD
WEIGHT FOR AGE				
<1	2629	14.5	21.2	64.3
1-3	6057	21.6	29.8	48.6
3-5	5899	18.3	34.1	47.6
Pooled	14585	19.0	30.0	51.0
χ^2, p value			261.6, 0.001*	
HEIGHT FOR AGE				
<1	2629	16.4	18.2	65.4
1-3	6056	29.0	28.1	42.9
3-5	5902	22.3	29.9	47.8
Pooled	14587	24.0	27.1	48.9
χ^2, p value			420.8, 0.001*	
WEIGHT FOR HEIGHT				
< 1	2621	11.0	13.1	75.9
1-3	5056	7.2	16.9	75.9
3-5	5891	4.2	15.4	80.4
Pooled	14568	6.7	15.6	77.7
χ^2, p value			152.6, 0.001*	

*Significant.

Table 3. Trends in the prevalence of undernutrition among 1-5 years old children, during 1998-99 and 2008-09

Age Groups (yrs)	Year of survey	n	<Median - 3 SD	≥ Median - 3 SD to <Median - 2 SD	≥Median - 2 SD
Underweight					
1-3	1998-99	5902	24.6	32.8	42.6
	2008-09	6057	21.6	29.8	48.6
χ^2, p value				44.0, 0.001*	
3-5	1998-99	5927	21.2	35.2	43.6
	2008-09	5899	18.3	34.1	47.6
χ^2, p value				24.0, 0.001*	
Pooled	1998-99	11829	22.9	34.0	43.1
	2008-09	11956	20.0	31.9	48.1
Stunting					
1-3	1998-99	5903	33.8	27.2	39.0
	2008-09	6056	29.0	28.1	42.9
χ^2, p value				33.9, 0.001*	
3-5	1998-99	5927	27.8	27.5	44.7
	2008-09	5902	22.3	29.9	47.8
χ^2, p value				47.5, 0.001*	
Pooled	1998-99	11830	30.8	27.3	41.9
	2008-09	11958	25.7	29.0	45.3
Wasting					
1-3	1998-99	5899	8.9	17.3	73.8
	2008-09	5056	7.2	16.9	75.9
χ^2, p value				11.6, 0.003	
3-5	1998-99	5897	4.5	15.2	80.3
	2008-09	5891	4.2	15.4	80.4
χ^2, p value				0.79, 0.67	
Pooled	1998-99	11796	6.7	16.2	77.1
	2008-09	11947	5.7	16.2	78.1

* $p < 0.01$

the child, literacy status of parents, household wealth index, family size, and morbidity were significantly ($p < 0.01$) associated with undernutrition. Risk of underweight was 1.9 times higher among 1-3 and 3-5 year children as compared to infants, and among boys as compared to girls. Children living in overcrowded families (family size ≥ 10) had a risk of 1.3 (CI=1.07-1.52) of being underweight as compared to children with family size

of ≤ 4 . Risk of underweight was 1.6 (CI=1.32-1.83) and 1.5 (CI=1.28-1.76) times higher among children of illiterate mothers and those educated up to 8th standards, as compared to children whose mothers were educated to the level of higher secondary and above. Children belonging to lowest and middle wealth index had 1.4 (CI=1.28-1.51) and 1.2 (CI=1.07-1.26) times risk of underweight as compared to children from the highest wealth index. Morbid-

Table 4. Median intake of nutrients and foodstuffs (mean intake/day) among children of 1-5 years during 1998-99 and 2008-09

		Nutrients								
Age groups (yrs)	Year	Protein (g)	Energy (Kcal)	Calcium (mg)	Iron (mg)	Vit A (µg)	Thiamin (mg)	Riboflavin (mg)	Niacin (mg)	Vit C (mg)
1-3	1998-99	19.7	750	167	5.5	191	0.4	0.3	4.6	19
	2007-08	16.8	675	95	3.8	32.3	0.4	0.2	4.9	7.2
	RDA	16.7	1060	600	09	400	0.5	0.6	8	40
4-5	1998-99	27.6	1047	216	7.9	250	0.6	0.4	6.6	27
	2007-08	25.4	1002	132	5.8	47.3	0.6	0.3	7.4	12.0
	RDA	20.1	1350	600	13	400	0.7	0.8	11	40
		Food stuffs								
		Cereals & Millets	Pulses & Legumes	Green Leafy Veg	Other Veg	Roots & Tubers	Nuts & Oilseeds	Milk & Milk Products	Fats & oils	
1-3	1998-99	156	14	14	18	15	2	17	4	
	2007-08	149	15.5	9.8	15.1	17.2	2.0	16.6	4.3	
	RDI	175	35	40	20	10	-	300	15	
4-5	1998-99	230	20	20	27	22	3	13	5	
	2007-08	231	23	14.1	23	25.3	3.1	13.7	5.9	
	RDI	270	35	50	30	20	-	250	25	

RDA-Recommended dietary allowances, Source: Nutrients requirements and recommended dietary allowances for Indians- A report of the Expert Group of the Indian Council of Medical Research (ICMR)- 2010. RDI-Recommended dietary intakes. All food stuffs are in grams, and milk product and fats & oils in ml.

Table 5. Nutritional status of under 5 years old children according to socio-economic and demographic variables (SD classification)

Particulars	n	Underweight	Stunting	Wasting
Age (y)			OR (95% CI)	
0-1	2629	1.0	1.0	1.0
1-3	6057	1.90 (1.72-2.08)*	2.51 (2.28-2.76)*	1.00 (0.90-1.11)
3-5	5899	1.98 (1.80-2.18)*	2.06 (1.87-2.27)*	0.77 (0.69-0.86)*
Gender				
Boys	7355	1.14 (1.07-1.22)*	1.21 (1.13-1.29)*	1.18 (1.09-1.28)*
Girls	7230	1.0	1.0	1.0
Type of family				
Nuclear	9147	1.0	1.0	1.0
Ext. Nuclear	2686	1.02 (0.94-1.12)	0.92 (0.84-1.00)	0.94 (0.85-1.05)
Joint	2749	1.08 (0.98-1.17)	1.02 (0.94-1.11)	1.04 (0.94-1.16)
Family size				
1-4	5011	1.0	1.0	1.0
5-9	8955	1.21 (1.13-1.30)*	1.13 (1.05-1.21)*	1.12 (1.02-1.21)*
≥ 10	599	1.43 (1.21-1.69)*	1.15 (0.97-1.36)	1.30 (1.07-1.58)*
Literacy status of father				
Illiterate	8355	1.51 (1.36-1.67)*	1.41 (1.27-1.56)*	1.19 (1.05-1.35)*
1 st to 8 th standard	4381	1.18 (1.06-1.32)*	1.21 (1.09-1.36)*	1.08 (0.94-1.23)
9 th & above	1841	1.0	1.0	1.0
Literacy status of mother				
Illiterate	9347	1.85 (1.64-2.08)*	1.68 (1.50-1.88)*	1.38 (1.19-1.59)*
1 st to 8 th class	3840	1.48 (1.30-1.67)*	1.42 (1.25-1.60)*	1.27 (1.08-1.48)*
9 th & above	1390	1.0	1.0	1.0
Households Wealth Index				
Lowest	5764	1.53 (1.41-1.65)*	1.56 (1.44-1.69)*	1.12 (1.01-1.23)*
Middle	4582	1.24 (1.14-1.35)*	1.33 (1.22-1.44)*	1.13 (1.03-1.25)*
Highest	4236	1.0	1.0	1.0
H/o morbidity (during preceding fortnight)				
Absent	12957	1.0	1.0	1.0
Present	1628	1.28 (1.15-1.42)*	1.04 (0.94-1.15)	1.25 (1.11-1.41)*

* $p < 0.01$

ities during preceding fortnight was associated with a 1.3 times higher risk of underweight among children under 5 years old (Table 6).

There was a two-fold increase in risk of stunting among 1-3 and 3-5 year old children (OR 2.5, CI=2.29-

2.78 and OR 2.0, CI=1.85-2.24, respectively) as compared to infants. The risk of stunting was 1.2 (CI=1.15-1.31) times higher among boys as compared to girls. The risk (95% CI) was 1.5 (1.36-1.73) and 1.4 (CI=1.22-1.58) times higher among children whose mothers were illiter-

Table 6. Stepwise logistic regression analysis for undernutrition among age under 5 years old children

Outcome variable	Underweight		Stunting		Wasting	
	OR	95% CI	OR	95% CI	OR	95% CI
Independent variable						
Age groups(yrs)						
0-1	1.00		1.00		1.00	
1-3	1.89	1.72-2.08*	2.53	2.29-2.78*	0.99	0.89-1.10
3-5	1.94	1.77-2.14*	2.04	1.85-2.24*	0.75	0.67-0.84*
Gender						
Boys	1.17	1.09-1.25*	1.23	1.15-1.31*	1.19	1.10-1.28*
Girls	1.00		1.00		1.00	
Family Size						
1-4	1.00				1.00	
5-9	1.10	1.02-1.18*	-	-	1.11	1.02-1.21*
≥10	1.28	1.07-1.52*	-	-	1.29	1.06-1.57*
Literacy status of Mother						
Illiterate	1.56	1.32-1.83*	1.54	1.36-1.73*	1.35	1.17-1.57*
1 st to 8 th class	1.50	1.28-1.76*	1.39	1.22-1.58*	1.27	1.08-1.49*
9 th & above	1.00		1.00		1.00	
Households wealth Index						
Lowest	1.39	1.28-1.51*	1.47	1.35-1.60*	-	-
Middle	1.16	1.07-1.26*	1.27	1.16-1.38*	-	-
Highest	1.00		1.00		-	-
H/o morbidity (during preceding fortnight)						
<1	1.25	1.13-1.39*	-	-	1.25	1.11-1.41*
1-3	1.00		-	-	1.00	

*p<0.01

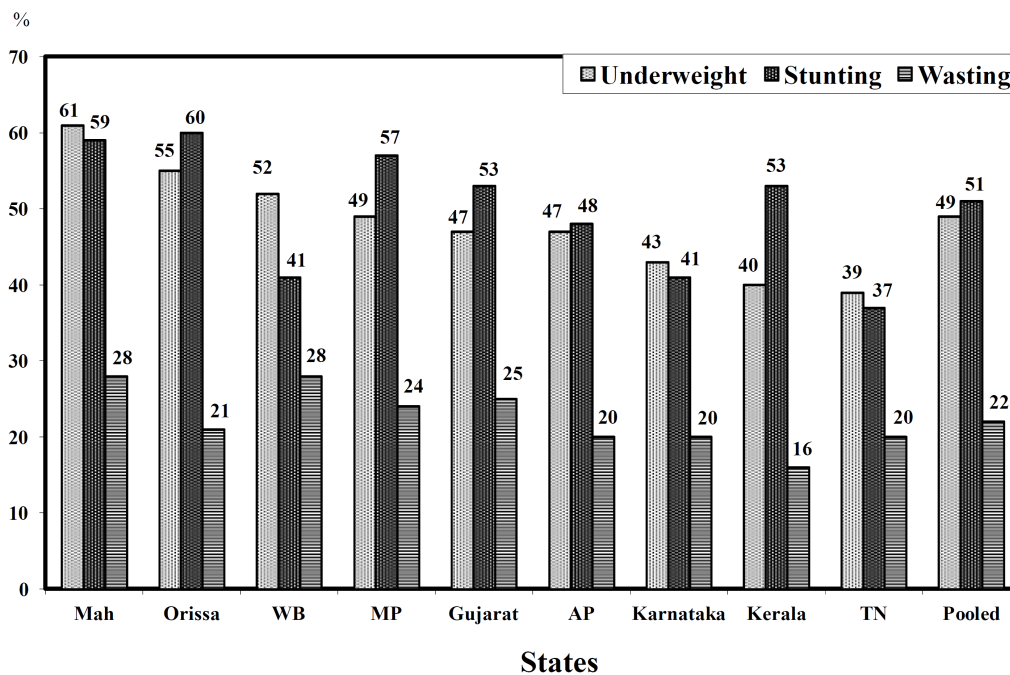


Figure 1. Statewise prevalence of undernutrition among under 5 year children

ate and those educated up to 8th standards, as compared to children whose mothers were educated to the level of higher secondary and above. Children belonging to lowest and middle HHs wealth index had a risk of 1.5 (CI=1.35-1.60) and 1.3 (CI=1.16-1.38) of being stunted as compared to children from highest wealth index (Table 6).

Risk of wasting was significantly ($p<0.01$) lower among children of 3-5 years as compared to children 12 months and younger. Boys were at 1.2 times higher risk (CI=1.10-1.28) as compared to girls. Children living in overcrowded families (family size ≥ 10) had a risk of 1.3

(CI=1.06-1.57) of being wasted as compared to children with family size of ≤ 4 . The risk of wasting was 1.4 (CI=1.17-1.57) and 1.3 (CI=1.08-1.49) times higher among children of illiterate mothers and those educated up to 8th standards as compared to children whose mothers were educated higher to the level of secondary and above. History of morbidity during preceding fortnight was associated with a 1.3 (CI=1.11-1.41) times higher risk of wasting (Table 6).

States wise prevalence of undernutrition

The states wise prevalence of undernutrition is shown in

figure 1. The prevalence of undernutrition was higher in the states of Maharashtra (Mah), Madhya Pradesh (MP), Orissa and West Bengal (WB).

Morbidities during the preceding fortnight

Fever was the most common morbidity among the children (8.1%), followed by ARI (3.5%). Diarrhoea and dysentery was reported in 1.3% of the children. The prevalence of fever was significantly ($p < 0.01$) higher among children of 1-3 years (8.8%) and 3-5 years (8.1%) as compared to those 1 year and younger (6%), while diarrhoea was more prevalent among 1-3 year old children (1.7%) as compared to 3-5 year old children (0.8%).

DISCUSSION

The government of India has been implementing several nutritional intervention and developmental programmes under tribal sub-plan approach for up-liftment of health and nutritional status of tribal populations. Undernutrition is still high among the tribal children as compared to their rural counterparts.¹⁶

India is the only country in South and South-East Asia with a higher prevalence of undernutrition in rural areas (underweight 43%, stunting 48% and wasting 20%). Neighbouring countries such as Nepal (underweight 39%, stunting 49% and wasting 13%) and Bangladesh (underweight 41%, stunting 43% and wasting 17%) had lower prevalence of undernutrition in rural areas.⁸

A study carried out by NIN (first repeat survey),¹⁶ during 1998-99 reported that the prevalence of under-weight, stunting and wasting was 57%, 58% and 23%, respectively (WHO standard). In the present study, the prevalence of under-weight, stunting and wasting was 49%, 51% and 22%, respectively. Rao *et al.* (2006) reported higher prevalence of underweight (72%) and stunting (67.8%), while the prevalence of wasting (13.4%) was lower among pre-school children of the Saharia tribe of Rajasthan.¹⁷ Another study reported higher prevalence of underweight (61.6%) and wasting (32.9%), while the prevalence of stunting was similar (51.6%) among pre-school tribal children in Madhya Pradesh.¹⁸ Higher prevalence of undernutrition among 1-3 year old children might be due to faulty feeding practices such as untimely initiation of complementary feeding, non-exclusively breast feeding up to first six months and high prevalence of infections such as diarrhoea, ARI in this age group. The prevalence of undernutrition was higher among boys than girls, which is similar with other studies.^{19,20} The cause of this discrepancy is not well established, but there is a belief that boys are more influenced by environmental stress than girls.^{21,22}

Although there was marginal decline in the intake of major nutrients and food stuffs over the period, the prevalence of undernutrition has significantly declined during two time periods. This may be due to the control of certain infectious diseases in the community by ongoing immunization programmes, supply of safe drinking water and other nutritional intervention programme at the community level. Integrated child development services (ICDS) which aims to improve the nutritional and health status of children by providing supplementary nutrition

and other health care services may be important reasons for this change.

Logistic regression analysis shows that age and gender of child, literacy status of the mother, households' wealth index, family size, and morbidity during previous fortnight was significantly associated with undernutrition. Underweight and stunting was significantly higher among children whose mothers were illiterate or had primary or upper primary education compared with children whose mothers were educated to the level of higher secondary and above. The mother's education level is associated with more efficient management of limited HHs resources, greater utilization of health care services, better health promoting behaviour, lower fertility and more child-centred caring practices.^{23,24} Household wealth index and per capita income are the indicators for socio-economic development and observed to be associated with underweight and stunting as observed by other authors.²⁵ Lower wealth index is associated with low literacy, lower purchasing capacity, food insecurity and thus higher rates of undernutrition. Children living in overcrowded families are found to be at greater risk of underweight and wasting, a finding supported by other studies.²⁶ This could be attributed to the facilitated spread of infections such as ARI and diarrhoea in overcrowded families. Some studies observed a protective effect of family size on undernutrition.²⁷

Apart from the above factors associated with undernutrition, other factors such as breastfeeding and child feeding practices, hygienic practices and maternal knowledge about feeding and care during illness are all important determinants of undernutrition that needs further study to explore their association.

In conclusion, the results of the study indicate that undernutrition is still an important public health problem among children under 5 years and is associated with maternal literacy, socio-economic condition and morbidities. Steps are needed to improve socio-economic conditions by income generating activities such as an employment guarantee scheme, food for work programme etc. for food security along with increased dietary intake of calories and proteins, improved maternal education along with maternal health promotion, improved sanitation and provision of safe drinking water for prevention of diarrhoeal and other infections.

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AUTHOR DISCLOSURES

There is no conflict of interest associated with this work.

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Original Article

Trends in the prevalence of undernutrition, nutrient & food intake and predictors of undernutrition among under five year tribal children in India

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印度部落 5 歲以下孩童之營養缺乏盛行率和營養素及食物攝取趨勢以及營養不良預測因子

在印度，五歲以下孩童營養缺乏，是非常重要的公共健康問題。本研究目的為評估五歲以下幼童之營養狀態、營養素和食物攝取，在兩個不同時期之趨勢。此為印度部落地區之社區橫斷面研究。共涵蓋 14,587 位 0-5 歲孩童，評估其營養狀態是否有過輕、矮小及消瘦的情況。從調查家戶中抽取次樣本來做 24 小時膳食評估。使用主成分分析法建立財富指標。隨著年代的改變，體重過輕及矮小的盛行率有顯著下降(過輕比例 49%對照 57%；矮小 51%比上 58%)，然而消瘦的盛行率並無明顯差別(22%對比 23%)。食物及營養素的攝取，則有些微減少且低於建議攝取量。逐步回歸顯示，孩童母親未受教育以及家戶財富指標為中或低之孩童，具有顯著較高的過輕及矮小風險($p < 0.01$)。受訪前兩個禮拜有發燒、腹瀉或急性呼吸道感染等疾病者，其為過輕及消瘦的風險增為 1.3 倍。總之，部落孩童之營養缺乏為重要的健康問題，且這與母親是否受教育、家戶財富指標以及罹病相關。因此，實施適當的營養介入策略，及透過公共分配體系提高家戶糧食可獲度，改善食物攝取、社經狀況、雙親教育以及個人衛生，可能有助於改善部落孩童的營養狀況。

關鍵字： 體重過輕、矮小、消瘦、家戶財富指標、營養素攝取