Undernutrition among under-five tribal children of Joda block, Keonjhar district, Orissa, India, 2008

By

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CERTIFICATION

This is to certify that this dissertation entitled **"Undernutrition among under-five tribal children of Joda block, Keonjhar district, Orissa, India, 2008"** submitted by Dr. Debasis Jethy in partial fulfillment of the requirements for the degree of Master of Applied Epidemiology is the original work done by him.

Director,

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Abstract

Background: We conducted a survey to estimate prevalence of under-nutrition and its risk factors in pre-school children in a tribal area of Kendujhar district, Orissa.

Methods: We used cluster sampling to select households. We collected data on the demographic and socio-economic environment of the child, health history, maternal and child anthropometry and child feeding practices. We classified children with under-nutrition as underweight, stunting and wasting according to weight-for-age, height-for-age and weight-for-height Z-score below –2 standard deviation (SD) using the CDC 2000 reference data. Severe under-nutrition was considered for those with Z-score below –3 SD. We calculated prevalence estimates and 95% confidence intervals (CI) of under-nutrition. We calculated adjusted Odds Ratios (AOR) and 95% CI in the multivariate analysis for factors associated with under-nourished children.

Results: Of the 600 children surveyed, the prevalence of stunting, underweight and wasting was 71% (95% CI: 66%-75%), 68% (95% CI: 63%-72%) and 40% (95% CI: 35%-45%), respectively. Of these, 46%, 41% and 21% children had severe stunting, underweight and wasting. Factors significantly related to under-nutrition were: inaccessible location of house (AOR:3.0; 95% CI:1.5-5.8 for wasting), mother working in mines (AOR:2.9; 95% CI:1.3-6.1 for underweight; AOR:2.1; 95% CI:1.3-3.4 for wasting), higher birth order >3rd (AOR:2.5; 95% CI:1.4-4.5 for stunting, AOR:4.9; 95% CI:2.0-8.3 for underweight) and exclusively breastfed for more than six months (AOR:1.7; 95%CI:1.0-2.6 for stunting; AOR:3.5; 95%CI:1.7-6.9 for wasting).

Conclusions: The nutritional status of the tribal children was unsatisfactory. The identified risk factors confirm the influence of socio-economic conditions and child feeding practices on the nutritional status of children. We recommend an integrated approach to improve the nutritional status of children in this tribal area.

Undernutrition among under-five tribal children of Joda block, Keonjhar district, Orissa, India, 2008

Introduction

Under-five children also referred to as 'preschool children' constitute the most nutritionally vulnerable segment of the population and their nutritional status is considered to be a sensitive indicator of community health and nutrition[1]. Even moderately undernourished children have 4 to 5 folds higher risk of mortality[2]. The survivors of undernutrition have its pervasive effects that include acute morbidity as well as long-term impairment of cognitive & social development, physical work capacity, productivity, and economic growth.

Globally undernutrition is responsible for 54% of 10.8 million under five deaths annually[3]. Out of the world's 182 million stunted under five children in developing countries, 128 million (70%) live in Asia[4]. In south East Asia (2005), 42% of under-five are stunted and 33% are underweight for age[5].

Reducing hunger and undernutrition is the key area of United Nation's Millennium Development Goals. One of the targets is to reduce by half (1) the prevalence of underweight children under-five years of age and (2) the proportion of population below minimum level of dietary energy consumption[13].

In India, prevalence of undernourished children less than 5 years is 46% in India[6]. About 60 million children are underweight in India. Of the overall undernutrition in India, 80% is contributed by Orissa. It accounts for nearly 20% of undernutrition deaths of the country[7], and has India's highest infant mortality rate at 69 per 1,000 live births in rural areas.[3] Rural

Orissa comprises predominantly of tribal people (64%) belonging to different tribes. National level surveys indicate that proportion underweight children in Orissa declined from 50% in 1998 to 41% in 2005.[6]

Interventions for combating undernutrition include, Supplementation of nutritious food and other activities by Integrated Child Development Services (ICDS) programme, Vitamin A prophylaxis, "Panchavyadhi chikitsa" to fight against infectious diseases, Iron and folic acid supplementation for pregnant women. However, undernutrition still remains a significant problem among tribal children due to a variety of factors including insufficient food intake, frequent infections, lack of access to health services, illiteracy, unhygienic personal habits and adverse cultural practices. In fact, the health indices of the tribal population indicate that over 55% children are underweight and under-five mortality rate is 127 per 1000 live births[8].

The 'Joda' is a hilly tribal block of Kendujhar district, Orissa. Its rural population comprises of more than 64% tribal people. People mostly work as mines labourer for their livelihood and as such agricultural activities are scarce leading to low amount of locally available food. People eat rice with salts and occasionally potato. Protein intake is very low. During a measles outbreak investigated in Joda block, Kendujhar, Orissa, 2007, of the 34 under five children there were 29 cases (attack rate: 85%) and 9 deaths (case fatality: 31%). The case fatality was two times higher among undernourished. This prompted us to conduct full-scale study on under-nutrition problem in this area with the objectives to (1) estimate the prevalence of undernutrition among under five tribal children (2) Propose recommendations to improve their nutritional status. As a secondary objective we wanted to identify the factors associated with under nutrition in this population.

Methods

Study population

Our study population was tribal children of Joda block, Keonjhar, Orissa who had completed 60 months of age by June 2008. We included only the permanent and tribal residents. We excluded floating population and also children born to mother who did not stay in the area during the pregnancy period.

Study design

We conducted community based, cross-sectional study.

Sample size

At 95 per cent confidence interval with 5 per cent precision and estimated proportion of 50% of undernutrition, the estimated sample was 480. However, considering anticipated non-response of 25% we proposed to include 600 children (i.e. 15 children from each of 40 clusters).

Sampling procedure

We chose cluster sampling with probability proportional to size. For this, we selected villages covered by a single anganwadi centre as a cluster. We selected the first house in a randomly selected direction every next nearest house till we assessed 15 under-five children.

Data collection

The primary investigator and four teams collected the information. Each team consisted of two field investigators, one female and a male health worker in each team. We also had two supervisors, one supervisor to supervise two teams. We used a structured questionnaire

(Annexure-2) and collected data on the demographic and socio-economic environment of the child, health history, maternal and child anthropometry and child feeding practices.

The anthropometric measurements included measuring of height, weight for both mothers and children, mid-arm circumference for children. We used an observational-check list to collect data on environmental factors at the household level.

Operational definitions

Under-five: Children who have not completed 60 months of age

Under-nutrition: it is defined according to WHO guidelines[5] as z-score below -2 standard deviation (SD) from the median.

Moderate under-nutrition: it is defined according to WHO guidelines[5] as z-score between -2 to -3 SD from the median.

Severe under-nutrition: it is defined according to WHO guidelines[5] as z-score below -3 standard deviation (SD) from the median.

Stunting is defined as children whose height-for-age Z-score is < -2 SD from the median of the reference population.

Wasting is defined as children whose weight-for-height Z-score is < -2 SD from the median of the reference population.

Underweight is defined as children whose weight-for-age Z-score is < -2 SD from the median of the reference population.

Chronic and acute undernutrition: While stunting and wasting reflect chronic and acute undernutrition respectively, underweight is a composite of the two.

Body mass index (BMI) is calculated by dividing body weight by height squared (kg/m^2)

Wasting or stunting is considered severe or moderate if the Z-score for weight-for-height or height-for-age is greater than -3 or between -2 & -3, respectively.

Below Poverty Line: Households having monthly income less than 1500 rupees.

Safe drinking water: according to WHO it includes household connection; public standpipe; borehole; protected dug well; protected spring etc[14]. In the rural area of Joda, tube well is the only source of water. Other sources such as kacha well, river, supply water are not safe.

Data analysis

We estimated the prevalence of under-nutrition using different indices and their 95% confidence intervals. The indices were weight for age, height for age and weight for height using WHO classification system. We classified children with more than two SD below the reference median on any of the indices as undernourished and those with more than three SD below the reference median as severely undernourished. We estimated prevalence odds ratio (POR) and 95% confidence intervals (95% CI) for the various factors in the univariate analysis. We conducted dose response analysis. We did stratified analysis to examine confounders and effect modifiers.. We included all the significant factors in a logistic regression model to estimate adjusted odds ratios (AOR) and 95% CI for the risk factors. We calculated population attributable fraction for each factor found statistically significant in logistic regression model.

Quality assurance

We submitted our research protocol for peer-review. We translated the instrument to the local language and back-translated to minimize discrepancy in the questionnaire. We conducted pilot test of the Oriya questionnaire in the nearby village and modified it as per the local

need. We trained the field investigator and the supervisors on data collection procedures. Data were double entered and checked for accuracy. To minimize the recall bias, we verified the anganwadi and hospital records wherever possible. Exact age assessment of children in the rural area especially from the tribal communities is very difficult due to ignorance, illiteracy and lack of any written records. Exact age is very essential for our nutritional studies and so we precisely ascertained it from the Anganwadi admission register book. The field supervisors crosschecked 20% of the cases to identify discrepancy in data collection. The principal investigator validated 10% of cases of interviews through observations of field procedures of data collection for quality assurance and consistency.

Protection of human subjects

We obtained written informed consent from every participant in the local language. We maintained confidentiality of each interview schedule. We referred children with severe wasting or symmetrical edema to the hospital for treatment. After the completion of the interview, we educated the participant about nutrition and hygiene. We obtained approval from the Institutional Ethical committee of the National institute of epidemiology (ICMR), Chennai.

Characteristics of study population:

The study population included predominantly three different tribes namely 'munda' (n = 600, 56%), bhuyan (27%) and santal (13%) (Table1). Of the 600 children, 41% lived in hilly terrains of which 21% were difficult to access areas. Majority of the population was below the poverty line (86%). The literacy level of the mothers was lower than the fathers (20% vs. 39%). One-third of the mothers worked as mines laborers. More than 60% of the children were exclusively breastfed for 4 – 6 months. Exclusive breastfeeding was prolonged *i.e.* beyond 6 months in case of 38% children. Six children had inadequate or no breast feeding due to lactation failure or death of the mother. In our study about 75% of children avail anganwadi service. Only one third (33%) have access to tube-well water supply.

Prevalence of undernutrition:

Of the 600 children, 427 had stunting (71%, 95% CI: 66%-75%), 406 were underweight (68%, 95% CI: 63%-72%) and 239 had wasting (40%, 95% CI: 35%-45%). Further, 46% (n=275), 41% (n=244) and 21% (n=124) children had severe stunting, underweight and wasting respectively (Table 2). Prevalence of undernutrition was more in male children.

Factors associated with undernutrition:

We present the results of the univariate and multivariate analysis for factors associated with under-nutrition by group them according to factors pertaining to child, parental and environmental and socioeconomic characteristics.

Univariate analysis:

Child characteristics

We identified higher birth order, improper weaning practices (reflected by prolonged exclusive breast feeding), and frequent diarrheal episodes were associated with undernutrition (table 3, 4, 5). The birth order of the children in our sample ranges from 1 to 10. As evident from a dose response analysis the risk of undernutrition (e.g. stunting) increases with birth order (χ^2 for linear trend =10.7, p=0.001) and prolonged exclusive breast-feeding (χ^2 for linear trend =15.7, p=0.00007). On stratified analysis, we identified improper weaning, maternal factors like low BMI during pregnancy and education as effect modifiers of birth order in stunted children. Occupation (as mines worker) and education of the mother were effect modifiers for improper weaning of the child leading to underweight; crude POR = 1.7, stratified POR = 1.6, 2.6 & 1.5, 2.2 respectively (annexure 3).

The infants (children in the first year of life) have a lower prevalence of underweight, stunting, wasting as compared to children 2-5 years of age. Subgroup analysis by age reveals that socioeconomic status was most significant for acute malnutrition during the 2nd year of life. Initiation of breast feeding was within 1 to 6 hours after birth. All except five children were not breastfed and out of them three due to primary lactational failure and two due to death of the mother. Of the 59 children $\leq$ 6 months, 24 (29%) had their mother working in mines as laborers.

Maternal characteristics:

The maternal factors statistically significant for undernutrition were mother working in mines , mother's BMI during pregnancy less than 18.5 kg/m^2 and illiteracy. We observed dose response relationship between mother's educational status and prevalence of stunting (χ^2 for linear trend = 17.1, p=0.00003). We stratified the association between mother illiteracy and

underweight by father's educational status. We identified that father's educational status was an effect modifier (crude POR = 1.9, Father illiterate POR = 1, and literate father POR = 2.3). However, the role of father's occupation and literacy *per se* in undernutrition is insignificant.

Environmental characteristics:

Location in hilly, difficult to access area and unsafe water were associated with undernutrition. Stratified analysis showed that with hilly area as an exposure factor for stunting the unsafe water is effect modifier; crude POR = 1.5, stratified POR = 1.5, 4.8 (annexure 2). Likewise, for unsafe drinking water as an exposure variable for underweight children mother's illiteracy is an effect modifier; crude POR = 1.5, stratified POR = 1.3, 2.4 (annexure 3). We have higher birth order of the child, illiteracy of the mother etc. are effect modifiers for inaccessibility leading to wasting; crude POR = 2.3, stratified POR = 4.6, 1.7 & 2.2, 0.9 respectively (annexure 4).

Socioeconomic characteristics:

We found monthly income of the family less than Rs. 1500 per month is associated with all three measures of undernutrition. On stratified analysis of socioeconomic condition as exposure of stunted children we found birth order and improper weaning as effect modifiers and BMI of the mother during pregnancy as confounder.

Multivariate analysis

In the multivariate analysis the following factors were associated with stunting: Child's birth order > 3, Child exclusively breast fed for > 6 months, Mother illiterate, Mother mines worker, Underweight mother during pregnancy, Difficult accessibility of the house, Inaccessible residence and monthly income <Rs. 1500

For underweight following factors were significantly associated in the multivariate analysis: Child's birth order > 3, child exclusively breast fed for > 6 months, underweight mother during pregnancy

In the multivariate analysis the factors associated with wasting were child exclusively breast fed for > 6 months, mother illiterate, underweight mother during pregnancy, difficult accessibility of the house and monthly income <Rs. 1500.

Discussion

In a tribal population of Orissa we identified that substantial proportion of under-five children were malnourished. The prevalence was higher among male children. We identified both biological and socio-economic factors to be associated with under-nutrition. The results provide information for the health services to plan interventions for addressing under-nutrition among tribal children in Kendujhar district of Orissa.

The prevalence of under-nutrition among tribal under-five children in our study area was higher than the Orissa state level estimates. Further, the categories of under-nutrition in terms of stunting, underweight, and wasting were also higher than the State average. So, we have failed by a substantial margin to address this key area of Millennium Development Goal *i.e.* hunger and undernutrition especially in tribal communities. In tribal populations, poverty, illiteracy, mountainous and inaccessible terrain form the social, economic and ecologic situations leading to food insecurity and undernutrition. The prevalence of all three indices of undernutrition increases after the 1st year of life. This is consistent with similar findings in earlier studies conducted in North-Eastern Province of Sri Lanka where underweight reaches a peak in the age groups 12-35 months, and then tapers of[12]. This increase may at least partly be attributable to improper weaning practices. In our study, higher birth order was associated with under-nutrition. Earlier study in children under five years of age in Nghean, Vietnam also shows higher number of children in a family to be an adverse factor for malnutrition[11]. Exclusive breast feeding for 4 – 6 months is beneficial but when prolonged i.e. beyond six months implies delayed weaning with supplementary foods and our study reveals it to be a significant factor associated with undernutrition. A similar study on preschool tribal children

in Madhya Pradesh concludes that prolonged breast feeding has adverse impact on nutritional status of the child[10]. Association of acute undernutrition with frequent diarrheal episodes is consistent with the fact that the former predisposes to infection and vice versa in a vicious cycle. Lack of significant association between undernutrition and anganwadi attendance is in contrast to data from national surveys, where prevalence of under-nutrition was inversely related to attendance at anganwadi centers. This is despite reported coverage of more than 70% under ICDS. Either in our study the data are having interviewer's bias, or the effects of interventions are small.

In our study maternal factors seem to have more impact on chronic health status of the child as evident from its greater significance in height for age analyses. The mothers working as mines laborer are perhaps not able to take proper care of the child leading to undernourishment. Nutritional status of the mother as evident from the low body mass index (< 18.5) during pregnancy had adverse effect on child's growth also. Mothers' education especially when it is at or above high school standard plays an important role in nutrition.

In difficult to access areas people live in isolation with little access to information, health and other facilities leading to undernutrition. Unsafe drinking water contributes thereto being a vehicle of water-borne diseases. Infections predispose to undernutrition and vice-versa in a vicious cycle.

Our study has few limitations. During the data collection procedure, there was possibility of recall bias and interviewer bias. We gave sufficient time to the participants to prevent recall bias. We also verified the record available at the sub-center and Anganwadi center to reduce recall bias. To minimize the interviewer bias, we did not involve the health workers of the same area in the investigation team. We could not account for size at birth as in most cases anganwadi registers did not record it and institutional deliveries were negligible. However.

our conclusions with respect to the identified risk factors would not have been different had we adjusted for birth weight of the children.

Based on the findings, we conclude that the problem of undernutrition in tribal under-five children in Joda block deserves urgent and immediate attention. We identified important factors related to under-nutrition including inaccessibility to health and other services, illiteracy and mother mines worker, delayed weaning, large family size and frequent infections.

Our study points to opportunities to improve the nutritional status of children in tribal area through various government departments and by reviewing nutritional interventions in Kendujhar district. We recommend both short-term and long-term measures. In the short-term firstly, we need to educate the mothers about the nutritional status of their children through health services and anganwadi workers. Secondly, we recommend providing nutritional supplementation for children with acute under-nutrition through anganwadi workers. Thirdly, health services need to organize outreach clinics in difficult to access areas for diagnosis of protein-energey under-nutrition as well as micro-nutrient deficiency problems.

On a long-term basis, firstly, the government needs to review the performance of the ICDS and reproductive and child health programme at the district level. Secondly, social welfare department needs to review the existing schemes to strengthen the poorer section of the population. Thirdly, the implementation of mines act needs to be reviewed in terms of employing women with under five children.

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Tables and Figures

Table 1: Socio-demographic characteristics of under five tribal children (n=600), Joda block, Kendujhar, Orissa, India, 2008

Characteristics		#	%
Monthly income < Rs. 1500		518	86
Age of the child (in years)	0 – 1	170	28
	>1 – 2	170	28
	>2 – 3	118	20
	>3 – 4	84	14
	>4 – 5	58	10
Age of the mother (in years)	< 20 years	44	7
	20 to 34	426	71
	≥ 35	86	14
Mother's educational status (number of years studied)	8+	40	7
	6 – 7	24	4
	1 – 5	52	9
	0	479	80
Occupation of mother	Mines worker	172	29
	Other	424	71
Father's education status (number of years studied)	8+	100	17
	6 – 7	76	13
	1 – 5	56	9
	0	368	61
Occupation of father	Mines worker	463	77
	Other	136	23
Tribe	Munda	335	56
	Bhuyan	164	27
	Santal	75	13
	Others	26	4

Table 2: Prevalence of different categories of under-nutrition among tribal children by gender, Joda block, Kendujhar, Orissa, India 2008

Characteristics (Anthropometry)	Z score and measure of undernutrition	Boys (n = 307)		Girls (n = 293)		Total (n = 600)	
		#	(%)	#	(%)	#	(%)
Height for age	< -3 SD (severe stunting)	161	52.4	114	38.9	275	45.8
	<-2 to -3SD (moderate stunting)	67	21.8	85	29.0	152	25.3
	≥ -2 SD	79	25.7	94	32.1	173	28.8
Weight for age	< -3 SD (severe underweight)	118	38.4	126	43.0	244	40.7
	<-2 to -3SD (moderate underweight)	96	31.3	66	22.5	162	27.0
	≥ -2 SD	93	30.3	101	34.5	194	32.3
Weight for height	< -3 SD (severe wasting)	61	19.9	63	21.5	124	20.7
	<-2 to -3SD (moderate wasting)	62	20.0	54	18.4	115	19.2
	≥ -2 SD	184	60.1	176	60.1	360	60.1

Table 3: Prevalence of stunting according to selected characteristics, among tribal under-five children of Joda block, Kendujhar, Orissa, India, 2008

		Frequency of exposure				Prevalence odds ratio	95% confidence interval
		Among stunted		Among not stunted			
		#	%	#	%		
Child characteristics	Female gender	199	67.9	94	32.1	0.7	0.5 – 1.0
	Birth order > 3rd	117	83.6	23	16.4	2.4	1.5 – 4.0
	Birth interval < 24 months	205	74.3	71	25.7	1.2	0.7 – 1.9
	Exclusively breast fed for > 6 months[1]	146	78.5	40	21.5	1.9	1.2 – 2.9
	Breast fed for 24 months	244	71.6	97	28.4	0.6	0.2 – 1.3
	> one diarrheal episode in last 3 months	150	67.9	71	32.1	0.7	0.5 – 1.1
	> one URTI episode in last 3 months	222	71.8	87	28.2	1.0	0.7 – 1.5
	Child not attending anganwadi centre	111	73.5	40	26.5	1.1	0.7 – 1.7
Parental characteristics	Underweight mother during pregnancy[2]	166	76.5	51	23.5	1.7	1.1 – 2.5
	Mother mines worker	134	77.9	38	22.1	1.6	1.0 – 2.4
	Mother illiterate	335	74.1	124	25.9	1.9	1.2 – 2.9
	Father mines worker	335	72.4	128	27.6	1.2	0.8 – 1.9
	Father illiterate	270	73.4	98	26.6	1.3	0.9 – 1.8
Environmental characteristics	Unsafe drinking water	300	74.9	104	25.7	1.5	1.0 – 2.2
	Residence in hills	188	75.8	60	24.2	1.4	1.0 – 2.1
	Inaccessible residence	135	82.8	28	17.2	2.3	1.5 – 3.7
Economic status	Monthly income <Rs. 1500	382	73.7	136	26.9	2.3	1.4 – 3.7

[1] Reference group: exclusively breastfed for 5-6 months
[2] BMI < 18.5 kg/m^2

Table 4: Prevalence of underweight according to selected characteristics, among tribal under-five children of Joda block, Kendujhar, Orissa, India, 2008

		Frequency of exposure				Prevalence odds ratio	95% confidence interval
		Among underweight		Among not underweight			
		#	%	#	%		
Child characteristics	Female gender	192	65.5	101	34.5	0.8	0. 5 – 1.1
	Birth order > 3rd	111	79.3	29	20.7	2.1	1.3 – 3.3
	Birth interval < 24 months	202	73.2	74	26.8	1.4	0.9 – 2.2
	Exclusively breast fed for > 6 months[3]	144	77.4	42	22.6	1.7	1.1 – 2.6
	Breast fed (total) for 24 months	246	72.1	95	27.9	1.6	0.8 – 3.1
	> one diarrheal episode in last 3 months	160	72.4	61	27.6	1.4	1.0 – 2.0
	> one URTI episode in last 3 months	211	68.3	98	31.7	1.0	0.7 – 1.5
	Child not attending anganwadi centre	104	68.9	47	31.1	1.0	0.7 – 1.6
Parental characteristics	Underweight mother during pregnancy[4]	154	71	63	29	1.3	0.9 – 1.9
	Mother mines worker	133	77.3	39	22.7	1.9	1.2 – 2.9
	Mother illiterate	339	70.8	140	29.2	1.9	1.2 – 2.9
	Father mines worker	313	67.6	150	32.4	0.9	0.6 – 1.4
	Father illiterate	263	71.5	105	28.5	1.5	1.1 – 2.2
Environmental characteristics	Unsafe drinking water	285	70.5	119	29.5	1.4	1.0 – 2.1
	Residence in hills	182	73.4	66	26.6	1.5	1.1 – 2.2
	Inaccessible residence	129	79.1	34	20.9	2.1	1.4 – 3.3
Economic status	Monthly income <Rs. 1500	367	70.8	151	29.2	2.6	1.6 – 4.3

[3] Reference group: exclusively breastfed for 5-6 months
[4] BMI < 18.5 kg/m^2

Table 5: Prevalence of wasting according to selected characteristics, among tribal under-five children of Joda block, Kendujhar, Orissa, India, 2008

		Frequency of exposure				Prevalence odds ratio	95% confidence interval
		Among **wasted**		Among **not wasted**			
		#	%	#	%		
Child characteristics	Female gender	117	39.9	176	60.1	0.9	0.7 –
	Birth order > 3rd	60	42.9	80	57.1	1.1	0.7 –
	Birth interval < 24 months	107	38.8	169	61.2	1.0	0.6 –
	Exclusively breast fed for > 6 months[5]	89	47.8	97	52.2	1.5	1.0 –
	Breast fed for 24 months	136	39.9	205	60.1	1.2	0.6 –
	> one diarrheal episode in last 3 months	109	49.3	112	50.7	1.8	1.3 –
	> one URTI episode in last 3 months	135	43.7	174	56.3	1.3	0.9 –
	Child not attending anganwadi centre	67	44.4	84	55.6	1.2	0.8 –
Parental characteristics	Underweight mother during pregnancy[6]	90	41.5	127	58.5	1.1	0.7 –
	Mother mines worker	88	51.2	84	48.8	1.9	1.3 –
	Mother illiterate	200	41.8	279	58.2	1.4	0.9 –
	Father mines worker	175	37.8	288	62.2	0.6	0.4 –
	Father illiterate	156	42.4	212	57.6	1.2	0.9 –
Environmental characteristics	Unsafe drinking water	174	43.1	230	56.9	1.4	1.0 –
	Residence in hills	113	45.6	135	54.4	1.4	1.0 –
	Inaccessible residence	87	53.4	76	46.6	2.1	1.4 –
Economic status	Monthly income <Rs. 1500	223	43.1	295	56.9	2.8	1.6 –

[5] Reference group: exclusively breastfed for 5-6 months
[6] BMI < 18.5 kg/m^2

Table 6: Logistic regression analysis of selected characteristics for under-nutrition, among tribal under-five children of Joda block, Kendujhar, Orissa, India, 2008

Exposure characteristics	Stunting		Underweight		Wasting	
	Crude Odds ratio	Adjusted odds ratio (95% confidence interval)	Crude Odds ratio	Adjusted odds ratio (95% confidence interval)	Crude Odds ratio	Adjusted odds ratio (95% confidence interval)
Child's birth order > 3	2.4	2.5 (1.4-4.5)	2.1	4.9 (2.0-8.3)	1.5	1.4 (0.9-2.1)
Child exclusively breast fed for > 6 months	1.9	1.7 (1.0-2.6)	1.7	3.5 (1.7-6.9)	1.8	1.9 (1.3-2.9)
Mother illiterate	1.9	1.3 (0.7-2.2)	1.4	0.6 (0.3-1.1)	1.9	2.1 (1.3-3.4)
Mother mines worker	1.6	1.4 (0.8-2.4)	1.9	1.0 (0.4-2.6)	1.4	0.8 (0.4-1.5)
Underweight mother during pregnancy	1.7	1.7 (1.1-2.6)	1.9	2.9 (1.3-6.1)	2.1	3.0 (1.5-5.8)
Residence in hills	1.4	0.9 (0.5-1.7)	1.3	1.1 (0.6-2.0)	1.4	1.8 (1.1-2.7)
Difficult accessibility of the house	2.3	2.2 (1.0-4.5)	1.5	0.5 (0.1-1.8)	2.8	2.8 (1.4-5.5)
Inaccessible residence	1.5	1.4 (0.9-2.2)	1.5	0.9 (0.4-2.2)	1.5	1.4 (0.9-2.1)
Monthly income <Rs. 1500	2.3	1.5 (0.8-2.7)	2.1	2.4 (0.9-6.5)	1.8	1.9 (1.3-2.9)

ANNEXURES

Annexures 1-5: Additional tables

Annexure1: Dose response analysis of selected variables associated with under-nutrition among under-five among tribal under-five children of Joda block, Kendujhar, Orissa, India, 2008

Characteristics	Level	Stunted children			Underweight children			Wasted children		
		χ^2 OR	χ^2 for linear trend	P value	χ^2 OR	χ^2 for linear trend	P value	χ^2 OR	χ^2 for linear trend	
Birth order	≤3	1	10.7	0.001	1	18.1	0.00002	1	8.3	0.001
	4	1.89			1.30			1.27		
	5	2.93			2.57			1.15		
	6+	3.05			10.35			1.26		
Exclusive breast feeding	4 – 6	1	15.7	0.00007	1	10.2	0.001	1	9.4	0.002
	7	1.20			1.29			1.28		
	8	2.24			1.61			1.37		
	9+	6.66			4.65			2.97		
Education of the mother	8+	1	17.1	0.00003	1	20.7	0.00001	1	6.1	0.01
	6 to 7	1.44			3.46			2.40		
	1 to 5	3.32			4.67			2. 71		
	Illiterate	3.50			5.03			2.87		

Annexure2: Stratified analysis of selected characteristics leading to stunting in tribal under-five children of Joda block, Kendujhar district Orissa 2008

Exposure variable	Variable of stratification	Strata	OR and 95% CI	Interpretation	Mantel Haenszel adjusted OR
Higher birth order (>3) of the child	–	Crude	2.5 (1.4 – 4.5)		
	BMI of the mother	< 18.5	1.4 (0.6 – 3.2)	Effect modification	Not relevant
		≥ 18.5	4.0 (2.0 – 8.0)		
	Exclusive breast feeding in months	> 6	2.0 (0.7 - 5.1)	Effect modification	Not relevant
		4 – 6	3.3 (1.6 - 6.6)		
	Education of the mother	Illiterate	2.1 (1.2 - 3.7)	Effect modification	Not relevant
		Literate	3.4 (0.9 - 12.7)		
	Accessibility of the house	Difficult	1.3 (0.5 - 3.2)	Effect modification	Not relevant
		Easy	2.9 (1.6 - 5.3)		
Illiteracy of the mother	–	Crude	1.9 (1.3 – 3.0)		
	Literacy of the father	Illiterate	1.7 (0.8 – 3.6)	Confounding	1.86
		Literate	1.9 (1.1 – 3.4)		
	BMI of the mother in kg/m^2	< 18.5	2.2 (1.1 – 4.4)	No confounding and no effect modification	Not relevant
		≥ 18.5	1.7 (1.0 – 3.0)		
	Exclusive breast feeding in months	> 6	1.9 (0.8 – 4.3)	Confounding	1.97
		4 – 6	2.0 (1.1 – 3.5)		
	Occupation of the mother	Mines worker	2.7 (0.8 – 9.2)	Effect modification	Not relevant
		Others	1.7 (1.1 – 2.7)		
Location of the house in hilly area	–	Crude	1.5 (1.0 – 2.1)		
	Accessibility of the house	Difficult	0.0 (0.0 – 8.4)	Effect modifier	Not relevant
		Easy	0.8 (0.5 – 1.4)		
	Drinking water source	Unsafe	1.5 (0.8 – 2.8)	Effect modifier	Not relevant
		Safe	4.8 (2.1 - 11.0)		
	Education of the mother	Illiterate	1.3 (0.9 - 2.0)	No confounding and no effect modification	1.38 (0.95 – 2.02)
		Literate	1.6 (0.7 – 3.9)		
	Occupation of the mother	Mines worker	1.5 (0.7 – 3.0)	Effect modification	Not relevant
		Others	1.4 (0.9 – 2.2)		
Below poverty line	–	Crude	2.1 (1.2 - 3.6)		
	Exclusive breast feeding in months	> 6	1.3 (0.5 – 3.7)	Effect modifier	Not relevant
		4 – 6	2.5 (1.3 – 4.9)		
	Birth order	> 3	3.9 (1.0 – 15.1)	Effect modifier	Not relevant
		≤ 3	1.9 (1.2 – 3.3)		
	BMI of the mother in kg/m^2	< 18.5	2.1 (0.9 – 4.7)	Confounder	2.36 (1.44 - 3.85)
		≥ 18.5	2.4 (1.2 – 4.6)		
	Occupation of the mother	Mines worker	2.1 (0.7 – 6.1)	No confounding and no effect modification	Not relevant
		Others	2.2 (1.3 – 3.7)		

Annexure3: Stratified analysis of selected characteristics leading to **underweight** in tribal under-five children of Joda block, Kendujhar district Orissa 2008

Exposure variable	Variable of stratification	Strata	OR and 95% CI	Interpretation	Mantel Haenszel adjusted OR
Prolong exclusive breast feeding		Crude	1.7 (1.2 -2.6)		
	BMI of the mother	< 18.5	1.8 (0.9 – 3.6)	No confounding and no effect modification	Not relevant
		≥ 18.5	1.6 (0.9 – 2.8)		
	Occupation of the mother	Mines worker	2.6 (0.8 – 8.6)	Effect modification	Not relevant
		Others	1.6 (1.0 – 2.6)		
	Education of the mother	Illiterate	1.5 (0.9 – 2.5)	Effect modification	Not relevant
		Literate	2.2 (0.9 – 5.1)		
	Accessibility of the house	Difficult	2.0 (0.6 – 6.6)	No confounding and no effect modification	Not relevant
		Easy	1.7 (1.1 – 2.8)		
Occupation of the mother		Crude	1.9 (1.2 – 2.9)		
	BMI of the mother	< 18.5	1.5 (0.7 – 3.3)	Effect modification	Not relevant
		≥ 18.5	2.2 (1.3 – 4.0)		
	Birth order	> 3	1.3 (0.5 – 3.4)	Effect modification	Not relevant
		≤ 3	2.2 (1.4 – 3.4)		
	Education of the mother	Illiterate	1.8 (1.1 – 2.7)	Confounder	1.9 (1.3 – 2.9)
		Literate	1.7 (0.5 -6.0)		
	Accessibility of the house	Difficult	1.4 (0.6 -3.0)	Effect modification	Not relevant
		Easy	2.0 (1.2 – 3.2)		
Unsafe drinking water		Crude	1.5 (0.8 – 2.8)		
	BMI of the mother	< 18.5	0.9 (0.5 – 1.8)	Effect modification	Not relevant
		≥ 18.5	2.0 (1.3 – 3.2)		
	Education of the mother	Illiterate	1.3 (0.9 – 2.0)	Effect modification	Not relevant
		Literate	2.4 (1.0 -5.2)		
	Accessibility of the house	Difficult	0.8 (0.3 – 1.7)	Effect modification	Not relevant
		Easy	1.8 (1.2 – 2.7)		
Low socio economy (monthly income < Rs. 1500)		Crude	2.7 (1.6 – 4.3)		
	BMI of the mother in kg/m^2	< 18.5	2.7 (1.3 – 5.8)	No confounding and no effect modification	Not relevant
		≥ 18.5	2.7 (1.4 – 5.3)		
	Birth order	> 3	2.8 (0.7 – 10.7)	No confounding and no effect modification	Not relevant
		≤ 3	2.4 (1.5 – 4.1)		
	Education of the mother	Illiterate	2.5 (1.3 – 4.9)	Confounder	2.2 (1.3 – 3.6)
		Literate	1.9 (0.9 – 4.0)		
	Accessibility of the house	Difficult	5.4 (1.8 – 16.0)	Effect modification	Not relevant
		Easy	2.1 (1.3 – 3.6)		

Annexure4: Stratified analysis of selected characteristics leading to **wasting** in tribal under-five children of Joda block, Kendujhar district Orissa 2008

Exposure variable	Variable of stratification	Strata	Stratified OR and 95% CI	OR across the strata	Interpretation	Mantel Haenszel adjusted OR
Diarrhea more than once in last 3 months		Crude	1.9 (1.3 – 2.7)			
	BMI of the mother in kg/m^2	< 18.5	2.5 (1.4 – 4.3)	Different	Effect modification	Not relevant
		≥ 18.5	1.6 (1.0 – 2.5)			
	Occupation of the mother	Mines worker	2.8 (1.4 – 5.5)	Different	Effect modification	Not relevant
		Others	1.6 (1.0 – 2.4)			
	Education of the mother	Illiterate	1.9 (1.3 – 2.8)	Identical and crude value within strata	No confounding and no effect modification	Not relevant
		Literate	1.9 (0.9 – 4.1)			
	Accessibility of the house	Difficult	1.5 (0.8 – 3.0)	Different	Effect modification	Not relevant
		Easy	2.2 (1.5 – 3.3)			
Occupation of the mother as mines worker		Crude	2.2 (1.4 – 3.2			
	BMI of the mother in kg/m^2	< 18.5	2.8 (1.5 – 5.5)	Different	Effect modification	Not relevant
		≥ 18.5	1.8 (1.1 – 3.0)			
	Birth order	> 3	3.6 (1.7 – 7.8)	Different	Effect modification	Not relevant
		≤ 3	1.6 (1.0 – 2.4)			
	Education of the mother	Illiterate	1.8 (1.3 – 2.7)	Different	Effect modification	Not relevant
		Literate	1.5 (0.5 – 5.2)			
	Accessibility of the house	Difficult	1.0 (0.5 – 1.9)	Different	Effect modification	Not relevant
		Easy	2.2 (1.5 – 3.6)			
Difficult accessibility of the house		Crude	2.3 (1.5 – 3.3)			
	BMI of the mother in kg/m^2	< 18.5	1.8 (0.9 – 3.5)	Different	Effect modification	Not relevant
		≥ 18.5	2.6 (1.6 – 4.2)			
	Birth order	> 3	4.6 (2.2 – 9.9)	Different	Effect modification	Not relevant
		≤ 3	1.7 (1.1 – 2.6)			
	Education of the mother	Illiterate	2.2 (2.5 – 3.2)	Different	Effect modification	Not relevant
		Literate	0.9 (0.3 – 3.1)			
Low socio economy (monthly income < Rs. 1500)		Crude	2.8 (1.5 – 5.0)			
	BMI of the mother in kg/m^2	< 18.5	2.1 (0.9 – 4.7)	Different	Effect modification	Not relevant
		≥ 18.5	3.6 (1.6 – 8.5)			
	Birth order	> 3	0.7 (0.2 – 2.7)	Different	Effect modification	Not relevant
		≤ 3	3.9 (2.0 – 7.4)			
	Education of the mother	Illiterate	4.0 (1.7 – 9.9)	Different	Effect modification	Not relevant
		Literate	1.8 (0.8 – 4.1)			
	Accessibility of the house	Difficult	5.3 (1.4 – 19.3)	Different	Effect modification	Not relevant
		Easy	2.3 (1.2 – 4.2)			

Annexure5: Population Attributable Fraction (PAF) of selected characteristics leading to **undernutrition** in tribal under-five children of Joda block, Kendujhar district Orissa 2008

Measure of undernutrition	Exposure factor	# children with undernutrition	# undernutrition children exposed to factor	proportion of cases exposed	POR	PAF
stunting	breast feeding	427	146	0.34	1.7	0.14
	bir order		117	0.27	2.5	0.16
	outreach		188	0.44	2.2	0.24
	lowBMIm		166	0.39	1.7	0.16
under-weight	breast feeding	406	144	0.35	3.5	0.25
	bir order		111	0.27	4.9	0.21
	mother-mines		133	0.33	2.9	0.21
wasting	outreach	240	87	0.36	3	0.24
	BPL		227	0.95	2.8	0.60
	unsafe water		174	0.73	1.8	0.32
	diar		109	0.45	1.9	0.21
	mother-mines		88	0.37	2.1	0.19

Annexure: 6 Data collection instrument

Undernutrition among under-five tribal children of Joda block, Kendujhar, Orissa, India, 2008

Information about the child (to be asked to the mother)

ID No:	Team No:	Date:
Age:	Sex:	
Date of birth:		
Now I will ask some questions **about your child.**		
Q1. What was the weight of baby at the time of birth (in gm)? (To be verified from Anganwadi's register.)		
Q2. When was the child started on breast feeding?	1. Within 30 minutes	2. 31 min. to 1hr
	3. 1 hour to 2 hours	4. more than 2 hours
Q3. for how many months was the child taking mother's milk only (i.e. exclusively): write in months		
Q4. How many times in a day do you breast feed your child (Write in number)?		
Q5. Do you feed your child on demand	1. yes	2. no
Q6. Up to what years do you breast feed your baby? (Write in number)		
Q7. What extra food was given to the baby along with mother's milk? (this is to ascertain weaning practices)	1. Water	2. Cow's milk
	3. handia (country liquor)	4. prepared food other than handia
Q8. After the child has totally stopped breast feeding, what are the food items you give to your baby? (there may be more than one answer; quantify each in terms of how many times a day/ week / month)	1. Rice and pulses	2. Vegetables
	3. Fish, meat, crabs,	4. Handia
Q7. Where does your child stay?	1. Living with both parents	2. Living with mother (not father)

	3. Living with father (not mother)	4. Living with neither parent
Q8. Does your child go to anganwadi center	Yes regularly	Yes, but irregularly
	No	
Q9. Has your child received vaccines? (To be verified from the records of anganwadi)	1. Yes completely	2. No
	3. partially	
Q9. How many times your child suffers from diarrhea in the last 3 months? (write the number)		
Q10. How many times your child suffers from respiratory tract infection in last 3 months? (write in number)		
Q11. What do you do when your child is sick?	1. consult govt. doctor	2. consult village practitioner
	3. give traditional medications	4. Do "puja" (superstitious animal sacrifice etc.)

Questionnaire about the mother of the child

ID No _____	Team No _____	Date_____
I will ask you **(mother** of the baby)few questions about you and your family		

Questionnaire items	**Options**	
Q1. What is your age (in completed years)?	_____	
Q2. What is your educational status?	1. Non educated	2. primary (1st to 5th class)
	3. secondary (6th to 7th class)	4. 8th and above
Q3. What is your husband's educational status?	1. Non educated	2. primary (1st to 5th class)
	3. secondary (6th to 7th class)	4. 8th and above
Q4. Are you working as mines labourer?	1. yes	2. no
Q5. Is your husband working as mines labourer?	1. yes	2. No
Q6. What is your family average monthly income (in Rupees)?	1. < 1500	2. >1500
Q7. Type of house (Observation)	1. Hut	2. Kutcha
	3. Mixed	4. Pucca

Anthropometric measurements		
1	Weight of the child in Grams	
2	Height of the child in Cms	
3	Age of the child	
4	Date of birth of the child (to be verified from anganwadi register)	
5	Weight of the mother at first antenatal check up	
6	Height of the mother at present	

Now, I will ask you some questions regarding **various health services** you received **during the antenatal period.**		
Q8. Did you register your name for antenatal check up (ANC) at the sub-center?	1. Yes	2. No
If No, Skip 2 to 6		
Q9. When did you register your name for antenatal check up (in weeks)?		
Q10. How many ANC was done during the pregnancy period (Write number)?	0	1
	2	3
Q11. Who did the antenatal check up?	1. Doctor	2. Staff nurse
	3. Health worker (F)	4. Trained dhai
	5. Others	
Q12. How many inj TT you have received?	1. No	2. One
	3. Two	
Q13. What was your age at the time of pregnancy (in years)?	☐	
Q14. Did you receive any supplemental feeding from the Anganwadi center?	1. Yes	2. No
Q15. Height of mother in cms (Measure by tape)	☐	NA
Q16. What was your weight at the time of first ANC (in kgs)? (verify Health worker record)	☐	NA
Q17. Was your blood tested for Hemoglobin level?	1. Yes	2. No
If No, Skip Q. No 8J		
Q18. What was the hemoglobin level (in gm %)?	_____	2. Does not remember

ID No _____		
Q19. did you get food supplementation from anganwadi centre	1. Yes	2. No
Q20. did anganwadi taught you about what food should be taken during pregnancy	1. Yes	2. No
Q21. Had you taken full course IFA tablet (100 tablets) after 3 months of pregnancy?	1. no	2. yes, complete
	3. incomplete	
Q22. What was the birth order of this child?	1st	2-3
	4-5	6 & more
Q23. What was the duration of gap from the previous pregnancy (in months)?	<24	24 to 47
	48+	NA (as it is the 1st birth)
Now, I will ask you some questions regarding various health services you received during the natal & perinatal period.		
Q24. In which place did you deliver the baby?	1. Govt. hospital	2. Private hospital
	3. Sub – center	4. Home
	5. Outside Home	
Q25. Who did the delivery?	1. Doctor	2. Staff nurse
	3. Health worker	4. Trained Dhai
	5. Untrained personnel	6. self
Food frequency questionnaire (FFQ) Now I will ask about the food and water you take		
Q26. Do you take rice	Yes	No
Q27. (If Q26 ans. is yes), how often? (In terms of how many times a day or week or month)		

Q28. (If Q26 ans. is yes) What is the quantity every time? (In gram)		
Q29. Do you take pulses	Yes	No
Q30. (If Q29 ans. is yes) How often? (In terms of how many times a day or week or month)		
Q31. (If Q29 ans. is yes) What is the quantity every time? (In gram)		
Q32. Do you take milk / curd	Yes	No
Q33. (If Q32 ans. is yes) How often? (In terms of how many times a day or week or month)		
Q34. (If Q32 ans. is yes) What is the quantity every time? (In gram)		
Q35. Do you take vegetables	Yes	No
Q36. (If Q26 ans. is yes) How often? (In terms of how many times a day or week or month)		
Q37. (If Q26 ans. is yes) What is the quantity every time? (In gram)		
Q38.Do you take meat/ fish/egg/ants/crabs	Yes	No
Q39. How often? (In terms of how many times a day or week or month)		
Q40. What is the quantity every time? (In gram)		
Q41. Do you take country liquor (handia)	No	As a part of diet
	As a beverage	As the only dietary item
Q42. Where from you get water for drinking	pond / river	shallow well
	Fountain	tube well
thank the family for participation		

Thank You

Annexure: 7 Consent form

Consent form for Undernutrition among tribal under-five of Joda block, Keonjhar, Orissa, India, 2008

Dear participants

Namaskar,

We are ---------- and ---------- working with Dr. Debasis Jethy (MAE, FETP scholar, Chennai) for a research on **"undernutrition among tribal under-five of Joda block, Kendujhar, Orissa".** We are looking into the factors associated with tribal under-five. By knowing these factors, the health department will take care of these factors to reduce undernutrition.

To find out why there is undernutrition, we need to ask questions to parents of under-five children. We would like to confidentially ask these few questions to you once. Answering these questions will take about 30 minutes of your time.

Taking part in this survey is voluntary. No compensation will be paid to you for taking part in this study. You can choose not to take part. You can choose not to answer a specific question. You can also stop answering these questions at any time without having to provide a reason. This will not affect your rights to health care in the government hospitals, or any other rights. There is no specific benefit for you if you take part in the survey. However, taking part in the survey may be of benefit to the community, as it may help us to understand the problem, its causes and potential solutions. After the results are analyzed, a report will be shared with all the participants by focus group discussion at the village and the local health officials, so that the right measures can be taken to prevent and control undernutrition among the tribal under-five population.

The information we will collect in this survey will remain between you and the investigation team. We will not write your name on this form. We will only use a code instead. Only the principal investigator will know the key to this code. It will be kept under lock and key. It will be destroyed after the project is over.

If you wish to find out more about this survey before taking part, you can ask us all the questions you want. You can also contact Dr. Debasis Jethy, MAE-FETP Scholar, NIE, Chennai (principal investigator of this survey) who will be happy to give you more details. If you are okay to take part, we will go ahead now.

Signature / Thumb impression of the participant

Name of the interviewer

Date:

Signature of witness

Date:

Annexure 8: certificate of consent

I have read the foregoing information, or it has been read to me. I have had the opportunity to ask questions about it and any questions I have asked have been answered to my satisfaction. I consent voluntarily to participate as a participant in this study and understand that I have the right to withdraw from the study at any time without in any way it affecting my further medical care.

Name of the study participant

Signature/thumb impression of the study participant

Name of the witness

Signature of the witness

Name of the interviewer

Signature of the interviewer

(One copy to be given to the participant after signature of participant, witness and investigator)

Nutritional status and characteristics related to malnutrition under five years of age Nghean, Vietnam
The nutritional status of children has an impact on their heal

SECTION: II LITERATURE REVIEW

Introduction

Malnutrition is associated with about half of all child deaths worldwide. Malnourished children have lowered resistance to infection; they are more likely to die from common childhood ailments like diarrhoeal diseases and respiratory infections; and for those who survive, frequent illness saps their nutritional status, locking them into a vicious cycle of recurring sickness, faltering growth and diminished learning ability.[2]

Malnutrition has been responsible, directly or indirectly, for 60% of the 10.9 million deaths annually among children under five. Well over two-thirds of these deaths, which are often associated with inappropriate feeding practices, occur during the first year of life. [3]

Underweight prevalence declined from 32 per cent to 28 per cent in developing countries over the past decade. The most remarkable progress has been in East Asia and the Pacific.[2] The profile of malnutrition in India is one where the distribution of children's age-standardized weight is dramatically to the left of the global reference standard, suggesting a major undernutrition problem.[4]

Preventing under-nutrition has emerged as one of the most critical challenges to India's development planners in recent times. Despite substantial improvement in health and well-being since the country's independence in 1947, under-nutrition remains a silent emergency in India, where almost half of all children under the age of three are underweight, 30 percent of newborns born with low birth weight, and 52 percent of women and 74 percent of children are anaemic. Other major nutritional deficiencies of public health importance in the country are Vitamin A deficiency and iodine deficiency.[5]

Under-nutrition is the underlying cause for about 50% of the 2.1 million Under-5 deaths in India each year. The prevalence of under nutrition is the highest in Madhya Pradesh (55%), Bihar (54%), Orissa (54%), Uttar Pradesh (52%) and Rajasthan (51%), while Kerala (37%) and Tamil Nadu (27%) have lower rates.[5]

Interventions for combating undernutrition include, Supplementation of nutritious food and other activities by Integrated Child Development Services (ICDS) programme, Vitamin A prophylaxis, "Panchavyadhi chikitsa" to fight against infectious diseases, Iron and folic acid supplementation for pregnant women. However, undernutrition still remains a significant problem among tribal children due to a variety of factors including insufficient food intake, frequent infections, lack of access to health services, illiteracy, unhygienic personal habits and adverse cultural practices. In fact, the health indices of the tribal population indicate that over 55% children are underweight and under-five mortality rate is 127 per 1000 live births[16].

Under-five children: Under-fives (also referred to as preschool children by NNMB) constitute the most nutritionally vulnerable segment of the population and their nutritional status is considered to be a sensitive indicator of community health and nutrition.[6]

Nutrition

Nutrition is an input to and foundation for health and development. Interaction of infection and malnutrition is well-documented. Better nutrition means stronger immune systems, less illness and better health. Healthy children learn better. Healthy people are stronger, are more productive and more able to create opportunities to gradually break the cycles of both poverty and hunger in a sustainable way. Better nutrition is a prime entry point to ending poverty and a milestone to achieving better quality of life.

Freedom from hunger and malnutrition is a basic human right and their alleviation is a fundamental prerequisite for human and national development.

WHO has traditionally focused on the vast magnitude of the many forms of nutritional deficiency, along with their associated mortality and morbidity in infants, young children and mothers. However, the world is also seeing a dramatic increase in other forms of malnutrition characterized by obesity and the long-term implications of unbalanced dietary and lifestyle practices that result in chronic diseases such as cardiovascular disease, cancer and diabetes.

All forms of malnutrition's broad spectrum are associated with significant morbidity, mortality, and economic costs, particularly in countries where both under- and overnutrition co-exist as is the case in developing countries undergoing rapid transition in nutrition and life-style.[8]

Nutrition of mother and child: The health and nutritional status of mothers and children are intimately linked. Improved infant and young child feeding begins with ensuring the health and nutritional status of women, in their own right, throughout all stages of life and continues with women as providers for their children and families. Mothers and infants form a biological and social unit; they also share problems of malnutrition and ill-health. Whatever is done to solve these problems concerns both mothers and children together. [3]

Measurement of undernutrition by anthropometry

A) For children: stunting, underweight and wasting

Population-based anthropometric measures of child malnutrition include stunting, wasting and underweight children. Stunting is defined by the child's length given his or her age, and

wasting by weight for a given length. Underweight is measured by weight for a given age. To measure children's nutritional status, we use anthropometric standards to calculate children's Z-scores for length-for-age and weight-for-age. The Z-scores are calculated using the reference growth curves developed by the US National Center for Health Statistics and recommended by the World Health Organization for international use (World Health Organization Working Group 1986□; Dibley et al. 1987). Z-scores are calculated as the difference between the anthropometric score (length-for-age and weight-for-age) and the standard score, divided by the standard deviation. ... Moderately stunted or underweight children are between two and three standard deviations below these standards; severely stunted or underweight children are those who fall more than three standard deviations below. [9]

B) For adults: Body Mass Index

Body Mass Index (BMI) is a simple index of weight-for-height that is commonly used to classify underweight, overweight and obesity in adults. It is defined as the weight in kilograms divided by the square of the height in metres (kg/m^2). [10]

Table: The International Classification of adult underweight, overweight and obesity according to BMI

Classification	**BMI(kg/m^2)**	
	Principal cut-off points	**Additional cut-off points**
Underweight	**<18.50**	**<18.50**
Severe thinness	<16.00	<16.00
Moderate thinness	16.00 - 16.99	16.00 - 16.99
Mild thinness	17.00 - 18.49	17.00 - 18.49
Normal range	**18.50 - 24.99**	**18.50 - 22.99**
		23.00 - 24.99
Overweight	**≥25.00**	**≥25.00**
Pre-obese	25.00 - 29.99	25.00 - 27.49
		27.50 - 29.99

Obese	**≥30.00**	**≥30.00**
Obese class I	30.00 - 34-99	30.00 - 32.49
		32.50 - 34.99
Obese class II	35.00 - 39.99	35.00 - 37.49
		37.50 - 39.99
Obese class III	≥40.00	≥40.00

Source: Adapted from WHO, 1995, WHO, 2000 and WHO 2004.

Factors associated with undernutrition

Child undernutrition is a consequence of the complex interactions of multiple determinants. One way to conceptualize these interactions is with the use of a framework that traces the causal pathways of undernutrition through different levels – the most immediate, the underlying, and the basic causes. The first level is composed of the most immediate causes of malnutrition and highlights the importance of both food intake *and* the absence of infection for improving child nutritional status. Inadequate dietary intake and infections create a vicious cycle that is responsible for much of the high morbidity and mortality among children in developing countries. On the one hand, when children do not consume enough, immune response is lowered, rendering them more susceptible to infectious diseases. On the other hand, ill children deplete their nutritional stores and are in poor health because of reduced intake, poor absorption of nutrients and the increased demands of combating disease.[11] Various causes of undernutrition are Low birth weight, Introduction of Supplementary Food too late/too early, Infections[12]

Complications

Undernutrition, both protein-energy malnutrition and micronutrient deficiencies, directly affects many aspects of children's development. In particular, it retards their physical and cognitive growth and increases susceptibility to infection, further increasing the probability of malnutrition. Child malnutrition is responsible for 22 percent of India's burden of disease. Undernutrition also undermines educational attainment, and productivity, with adverse implications for income and economic growth.[4]

As a result, malnutrition has been estimated to be associated with about half of all child deaths and more than half of child deaths from major diseases, such as malaria (57 percent), diarrhea (61 percent) and pneumonia (52 percent), as well as 45 percent of deaths from measles (45 percent). In India, child malnutrition is responsible for 22 percent of the country's burden of disease. Undernutrition also affects cognitive and motor development and undermines educational attainment; and, ultimately impacts on productivity at work and at home, with adverse implications for income and economic growth. [13]

Proposed interventions with proper food

A) Antenatal Care: an opportunity to counsel and educate the pregnant mother to take about nutritious food, iron tablets, folic acid suppliments.

B) Breast feeding: Breastfeeding is the ideal way of providing young infants with the nutrients they need for healthy growth and development. Virtually all mothers can breastfeed, provided they have accurate information, and the support of their family and the health care system. [14] Colostrum, the yellowish, sticky breast milk produced at the end of pregnancy, is recommended by WHO as the perfect food for the newborn, and feeding should be initiated within the first hour after birth.

Exclusive breastfeeding is recommended up to 6 months of age.[15] Lack of exclusive breastfeeding during the first half-year of life – are important risk factors for infant and childhood morbidity and mortality that are only compounded by inappropriate complementary feeding. The life-long impact includes poor school performance, reduced productivity, and impaired intellectual and social development. [3]

No more than 35% of infants worldwide are exclusively breastfed during the first four months of life; complementary feeding frequently begins too early or too late, and foods are often nutritionally inadequate and unsafe.[3]

Faulty feeding practices begin with giving any other nourishment but breast milk before complementary feeding is nutritionally required – or with substituting entirely for breast milk, which places babies at risk of illness, even death. When complementary feeding begins, uninformed decisions can also interfere with good nutrition in terms of which foods are given, how much and how often and whether breastfeeding continues, as it should. Nutritionally inadequate or contaminated food, and starting complementary feeding too early or too late are major causes of malnutrition in infants and young children. [17]

Breastfeeding is an unequalled way of providing ideal food for the healthy growth and development of infants; it is also an integral part of the reproductive process with important implications for the health of mothers. A recent review of evidence has shown that, on a population basis, exclusive breastfeeding for 6 months is the optimal way of feeding infants. Thereafter infants should receive complementary foods with continued breastfeeding up to 2 years of age or beyond.

To enable mothers to establish and sustain exclusive breastfeeding for 6 months, WHO and UNICEF recommend:

- Initiation of breastfeeding within the first hour of life

- Exclusive breastfeeding – that is the infant only receives breastmilk without any additional food or drink, not even water
- Breastfeeding on demand – that is as often as the child wants, day and night
- No use of bottles, teats or pacifiers

Breastmilk is the natural first food for babies, it provides all the energy and nutrients that the infant needs for the first months of life, and it continues to provide up to half or more of a child's nutritional needs during the second half of the first year, and up to one-third during the second year of life.[18]

Breastmilk promotes sensory and cognitive development, and protects the infant against infectious and chronic diseases. Exclusive breastfeeding reduces infant mortality due to common childhood illnesses such as diarrhoea or pneumonia, and helps for a quicker recovery during illness. These effects can be measured in resource-poor and affluent societies[7]

Breastfeeding contributes to the health and well-being of mothers, it helps to space children, reduces the risk of ovarian cancer and breast cancer, increases family and national resources, is a secure way of feeding and is safe for the environment. [18]

C) **Timely introduction of Supplementary Food:** Adequate nutrition during infancy is essential for lifelong health and wellbeing. Infants should be exclusively breastfed for the first six months of life to achieve optimal growth, development and health. Thereafter, to meet their evolving nutritional requirements, infants should receive nutritionally adequate and safe complementary foods, while continuing to breastfeed for up to two years or more.[19]

When breastmilk is no longer enough to meet the nutritional needs of the infant, complementary foods should be added to the diet of the child. The transition from exclusive

breastfeeding to family foods, referred to as complementary feeding, typically covers the period from 6 to 18-24 months of age, and is a very vulnerable period. It is the time when malnutrition starts in many infants, contributing significantly to the high prevalence of malnutrition in children under five years of age world-wide. WHO estimates that 2 out of 5 children are stunted in low-income countries.

Complementary feeding should be *timely*, meaning that all infants should start receiving foods in addition to breastmilk from 6 months onwards. It should be *adequate*, meaning that the nutritional value of complementary foods should parallel at least that of breastmilk. Foods should be prepared and given in a safe manner, meaning that measures are taken to minimize the risk of contamination with pathogens. And they should be given in a way that is *appropriate*, meaning that foods are of appropriate texture and given in sufficient quantity.

The adequacy of complementary feeding (adequacy in short for timely, adequate, safe and appropriate) not only depends on the availability of a variety of foods in the household, but also on the feeding practices of caregivers. Feeding young infants requires active care and stimulation, where the caregiver is responsive to the child clues for hunger and also encourages the child to eat. This is also referred to as active or responsive feeding.

WHO recommends that infants start receiving complementary foods at 6 months of age in addition to breastmilk, initially 2-3 times a day between 6-8 months, increasing to 3-4 times daily between 9-11 months and 12-24 months with additional nutritious snacks offered 1-2 times per day, as desired.

Inappropriate feeding practices are often a greater determinant of inadequate intakes than the availability of foods in the households. WHO has developed a protocol for adapting feeding recommendations that enables programme managers to identify local feeding practices,

common problems associated with feeding, and adequate complementary foods. The protocol builds upon available information and proposes household trials to test improved feeding recommendations. WHO recommends that the protocol be used to design interventions for improved complementary feeding, and is included as part of adaptation process of the Integrated Management of Childhood Illness strategy.

Research has shown that caregivers require skilled support to adequately feed their infants. Guidelines for appropriate feeding are included as part of the Integrated Management of Childhood Illness guidelines and training course for first-level health workers. Extending these guidelines, WHO has developed the guide Complementary feeding: Family Foods for breastfed children that gives more detailed guidance for health workers on how to support complementary feeding. The guide is the basis of a 3-day training course for health professionals, which is currently under development.[20]

Non-nutritional measures to combat undernutrition and its complications:

Prevention, early detection and treatment of infections

A) Growth monitoring

B) Malnourished children who survive are more frequently sick and suffer the life-long consequences of impaired development. [3]

Integrated Child Development Scheme:

It was designed to address the multidimensional causes of undernutrition. As the program expands to reach more and more villages, it has tremendous potential to impact positively on the nutritional and health status and well-being of the millions of women and children who are eligible for participation. The key.[21]

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