

## ORIGINAL ARTICLE

**Impact of Chronic Drought on Nutritional Status of the Community in Drought affected areas in India**

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**Abstract**

**Background:** Communities affected by chronic drought conditions face a wide variety of challenges including an adverse effect on their nutritional status. The Government of India, during the year 2002-03, declared nine States viz., Andhra Pradesh, Karnataka, Tamil Nadu, Madhya Pradesh, Maharashtra, Rajasthan, Gujarat, Chhattisgarh and Orissa as drought affected. **Material and Methods:** At the request of Department of Agriculture, Government of India, a rapid community based cross-sectional study was carried out adopting multistage random sampling procedure with the objective to assess the nutritional status of community in these nine chronic drought affected states in India. **Results:** In general, the intakes of all the nutrients were grossly deficit as against their RDAs. The nutrition intervention programmes initiated by the Government of India, in general, contributed to meet the daily requirement of staples like cereals & millets in most of the States. **Conclusion:** In drought-affected areas, where the level of famine impact is unknown, an early rapid assessment of the nutritional status and the health needs of the population are critical to estimate the degree of impact to plan timely and appropriate interventions.

**Key Words**

Drought; Nutrition; Chronic Energy Deficiency; Public Distribution Programs; Health

**Introduction**

Natural disasters such as Tsunamis, earth quakes and droughts effects country's economy adversely, by decreasing agricultural and industrial output, increasing rural unemployment, thus reducing purchasing power and increasing household food and nutrition insecurity, migration of the rural poor

to urban areas etc. In addition, acute shortage of drinking water and reduced access to food contribute significantly to increased morbidities and mortalities in the communities. Reduced food availability and accessibility is a key phenomenon in droughts due to decrease in agricultural yield (1). Disasters also disrupt commerce, supply chain systems and markets; destroy productive resources

and infrastructure, and make lives of the communities more difficult, negatively affecting the household economic security which in turn maximizes the impact of drought on an household (2). The societal impacts of drought can be slow to develop as they accumulate over time as the event continues, and the impacts can last for years. Most of the consequences of drought are usually indirect, and it differs substantially from other natural hazards (3).

There is no universally accepted definition for drought. Drought is a complex phenomenon that is difficult to accurately describe because, its definition is both spatially variant and context dependent (4). However, for this study we have considered the definition by Glickman which is a “a period of abnormally dry weather sufficiently prolonged for the lack of water to cause serious hydrologic imbalance in the affected area (5).

Drought is a medium-term emergency which is generally a result of crop failure from drought, and relief is needed until the next harvest is gathered. Long-term emergencies, which may be on a national scale and last several years, usually arise from the disruption of food supplies and normal life compounded by war and other calamities (6).

Several States in India have been experiencing recurrent drought during the past few years, due to inadequate or failure of rainfall or delay in the onset of monsoon. According to India Meteorological Department (IMD), in the year 2002, the country had experienced severe drought. The Government of India, during the year 2002-03, declared nine States viz., Andhra Pradesh, Karnataka, Tamil Nadu, Madhya Pradesh, Maharashtra, Rajasthan, Gujarat, Chattisgarh and Orissa as drought affected. At the request of Department of Agriculture, Government of India and Indian Council of Medical Research (ICMR), the National Institute of Nutrition, Hyderabad and National Nutrition Monitoring Bureau (NNMB) carried out a rapid survey during April - July 2003 with the objective to assess the impact of drought on the diet and nutritional status of the populations in the above States. The specific objectives of the study were

### Aims & Objectives

To assess the diet and nutritional status of the community in terms of food and nutrient intake, anthropometry and clinical examination for nutritional deficiency signs

### Material and Methods

**Study Design:** A rapid community based cross-sectional study was carried out adopting multistage random sampling procedure in nine chronic drought affected states of India. After obtaining the list of drought affected districts from the State revenue department, two severely drought affected districts were randomly selected from each State, and from each selected district, two severely drought affected blocks/taluks were selected randomly. Assuming that all the villages in a selected block were uniformly affected by drought, five villages were randomly selected for the present study. The information of household food security, coping mechanisms adopted and extent of participation in the drought relief activities during the current drought was also obtained.

**Selection of Households:** Each select village was divided into 5 natural geographical areas, based on groups of households/streets, of which one comprised of SC/ST population (Socially marginalized and economically poor segments of the population).

#### Ethical Clearance

The study was approved by the scientific advisory committee (SAC) of Indian Council of Medical Research (ICMR). Since a rapid assessment of nutritional status was carried out at the request of Department of Agriculture, Government of India, the ethical clearance was not obtained for this study.

**Sample size:** The sample size was estimated by assuming the 60% of households are consuming inadequate dietary energy, 60% of preschool children are with underweight (Weight for age < Median-2SD of NCHS standards) and 53% of adults with Chronic Energy efficiency (CED) as defined by Body Mass Index of <18.5, with 95% CI and 20% relative precision. In order to study the effect of drought in different socio-economically backward groups such as SC/ST communities, landless labourers and marginal farmers, and considering their proportion of total population as 30-35% each, thrice the actual estimated sample size was computed.

The information on household socio-economic & demographic particulars, nutritional status of preschool children & adults, household food & nutrient intake by one day 24-hour re-call method of diet survey, household food security status as perceived by the head of the household, extent of participation in drought relief programmes and

Identification of coping mechanisms adopted by the community during drought was collected.

**Statistical analysis:** The data was analyzed using SPSS 11.5 version. The average daily consumption of various foods and nutrients at the household level were computed per Consumption Unit (C.U), which is defined as the energy requirement of a reference man (aged 20-39 years, weighing 60 kg, healthy and doing sedentary work). The average daily intakes of various nutrients were computed, using 'Food Composition Tables (7). The food intakes were compared with the levels recommended in the balanced diets of 'Recommended Dietary Intakes for Indians' (8) The average intakes of nutrients were compared with the levels suggested in 'Nutrient requirements and Recommended Dietary Allowances for Indians' (9).

The nutritional status of preschool children was assessed according to weight for age, height for age and weight for height using National Center for Health statistics (NCHS) standards (10). They were categorized in to different grades of nutritional status based on Standard Deviation (SD) classification (11) recommended by the World Health Organization (WHO).

Based on Body Mass Index [Weight in kg / (Height in meters)<sup>2</sup>], the adults were categorized into different nutritional grades using BMI classification (12). Statistical tests such as Chi-square and proportion tests were carried out wherever applicable to study the associations/differences.

The results of the present study were compared with the figures reported for the State by National Nutrition Monitoring Bureau during non-drought period (Rural survey: 2000-01) and with the results of drought survey carried out earlier in severely affected areas (13)

## Results

A total of 11,501 households were covered for household socio-economic and demographic particulars from 190 villages distributed in 40 blocks spread over 19 districts in 9 States. Household food security status was assessed in a sub- sample of 3,805 HHs. Of them, every alternate household (1899 HHs) was covered for family diet survey using a one day 24-hour re-call method. In addition, a total of 26,343 individuals (6,037 preschool children and 20,306 adults) were covered for anthropometric measurements such as height and weight.

**Food & Nutrient Intakes:** In general, the mean daily intakes of all the foods were below the recommended daily intakes (RDI) for Indians, except for vegetables in the states of Gujarat, Madhya Pradesh and Maharashtra. The intakes of leafy vegetables and milk and milk products were grossly deficit as against their RDIs ([Table 1](#)). Similarly, the intakes of all the nutrients except for protein in the State of Gujarat were below the RDA in all the States. The intakes of micronutrients such as vitamin A, iron and riboflavin were grossly deficit in all the states ([Table 2](#)).

**Household Food Security Status:** Household Food security was defined as the ability of the household to secure enough food to ensure adequate dietary intake for all the members throughout the year (14). Food security is most often determined by purchasing power and food availability of the community. In the present survey, the HHs food security was assessed based on the perceptions of the head of the HH about the sufficiency or otherwise in the consumption of various foods during drought compared with that during non-drought period.

The proportion of HHs reporting <50% of insufficiency with respect to staple food viz., cereals & Millets was <10% in all the States, except for the state of Madhya Pradesh, where it was 78%. A wide variation was observed in the proportion of HHs reporting <50% insufficiency with regard to other food groups. More than 75% of the HHs in the States of Madhya Pradesh, Andhra Pradesh, Karnataka and Orissa expressed insufficiency with respect to consumption of vegetables.

### Nutritional Status

**Preschool children:** The prevalence of severe underweight (weight for age <Median – 3SD) ranged from a low of 11% in Tamil Nadu to a high 25% in Madhya Pradesh. However, the prevalence of severe underweight during the current drought was lower than the figures reported earlier in all the States, except for Andhra Pradesh (23% vs. 18%) and Karnataka (19.7% vs. 17.7%), where the prevalence was relatively higher.

Stunting reflects long duration undernutrition. The prevalence of severe stunting (<Median – 3SD) ranged from a low of 11% in Tamil Nadu to a high 39% in Madhya Pradesh. The prevalence of stunting during the current drought was significantly higher as compared to the earlier figures in the States of Andhra Pradesh, Gujarat and Rajasthan, indicating

chronic drought conditions prevailing in these States. The prevalence of severe wasting (weight for height <Median-3SD), an indicator of short duration of malnutrition ranged from a low 1% in Chattisgarh to a 3.1% in Orissa. The prevalence of stunting was lower during the period of current drought as compared to the figures reported earlier in all the States, except for the states of Orissa and Tamil Nadu, where the prevalence was marginally higher (Figure 1).

The most common morbidities reported during the preceding fortnight among the preschool children in various States were fever (1% to 14%), diarrhoea (<1% to 3.5%) and upper respiratory tract infections (<1% to 3.7%).

**Adults:** The overall prevalence of Chronic Energy Deficiency (BMI <18.5) among adult men during the period of current drought ranged from a low 26% in Tamil Nadu to a high 50% in the State of Andhra Pradesh. In the case of women, it ranged from a low 30% in Gujarat to 56% in Andhra Pradesh. The current levels of CED among both men and women were relatively higher (by about 5-10%) than the figures reported in earlier surveys in the States of Andhra Pradesh, Karnataka, Maharashtra and Orissa. Fever (<1% to 11%) and upper respiratory tract infections (<1% to 3%) were the common forms of morbidities reported during drought.

#### **Coping strategies adopted during drought**

It is important to understand the coping behavior of households in order to strengthen their capacity to face the adverse situations during drought conditions. The HHs reportedly adopted a variety of strategies, to tackle the food scarcity during the current drought. The extent and type of coping strategies adopted by the HHs during food scarcity varied between States. A majority of the HHs, except in the States Maharashtra, reportedly availed assistance from Government/NGOs. Some of the strategies adopted were, reduction in the frequency/quantity of foods consumed, consumption of low cost foods and use of food stocks/savings. In the State of Andhra Pradesh, Gujarat, Karnataka and Orissa, in about 20% of HHs, migration to urban areas was resorted to. About thirty percent of the HHs in Andhra Pradesh and sixteen percent in Tamil Nadu reportedly sold away household assets to buy foodstuffs during the current drought (Table 3).

#### **Drought relief works and other developmental programs**

The proportion of HHs availing Targeted Public Distribution System (TPDS) was reported to be maximum in the State of Karnataka (71%), followed by Tamil Nadu (66%), Andhra Pradesh (65%), Madhya Pradesh (47%), Maharashtra (47%), Chattisgarh (38%), Rajasthan (30%), Orissa (27%) and Gujarat (25%). About 50-70% of HHs in the States of Gujarat (69%), Chattisgarh (67%), Rajasthan (57%) and Madhya Pradesh (51%) reportedly participated in Food for Work Program (SGRY), while their proportion was very low in the States of Karnataka (10%) and Tamil Nadu (9%).

The percent of HHs availing different pension schemes like old age/widow/ disabled was in general low and ranged from about a high 16% in Andhra Pradesh to a low of <1% in Gujarat. The proportion of HHs participating in programs such as Anthyodaya Anna Yojana and Annapurna was also reported to be low (<1 to 16%). However, a large number of children were participating in supplementary nutrition programs such as Integrated Child Development Services (ICDS) and Mid Day Meal (MDM) Programme (50-90%).

#### **Major sources of staple food during drought**

Food grains supplied through Targeted Public Distribution System (TPDS) and Food for Work Programme (SGRY) formed the major sources of staple food to the community during current drought. However, variations were observed between States in the extent of coverage of HHs under different programs.

#### **Effect of drought on cattle/sheep**

About 50-60% of households owning cattle in the States of Rajasthan and Maharashtra reported deaths of cattle during the current drought, while in other States their proportion was relatively less (<20%).

#### **Starvation Deaths**

No starvation deaths were reported in any of the villages surveyed in the States, during the current drought.

### **Discussion**

Severe drought conditions were prevailing in the areas surveyed in all the States, which was reflected a drastic reduction in the area sown, yield of various crops, scarcity of the fodder for cattle and drying up of water sources. Drought conditions were prevailing for the past two to three consecutive years in some of the districts surveyed viz., Anantapur and Mahaboobnagar districts in Andhra Pradesh; Kutch

district in Gujarat; and Barmer and Jaisalmer districts in the state of Rajasthan. The impact of drought is not same across all the states may be due to their resilience and coping mechanisms which is not same in all communities.

Access to food and the maintenance of adequate nutritional status are critical determinants of people's survival in a disaster (14). Multiple micronutrient deficiencies were most common during an emergency or be made worse if they are already present. This happens because livelihoods and food crops may be lost; food supply chain might be interrupted; there is an increased risk of diarrhoeal diseases, resulting in mal-absorption and nutrient losses, and of infectious diseases, which suppress the appetite whilst increasing the need for micronutrients to help fight illness (15).

In general, the population residing in this chronic drought affected areas was subsisting on in adequate diets with gross deficit in micronutrients. The average daily intake of various foodstuffs especially protective foods such as pulses, green leafy vegetables and milk & milk products was reported to be lower than the recommended level even in normal situation, decreased further during the current drought. However, the Government nutrition intervention programmes in general and public distribution system (PDS) targeted public distribution system (TPDS) in particular, contributed to meet the daily requirement of cereals & millets in most of the States. The average duration of employment under food for work programme during current drought was less than a week.

The extent of undernutrition among preschool children during current survey remained essentially similar to that reported during earlier surveys, while in adults there was increase in the prevalence of CED adults in half of the States surveyed. The negative effects and consequences of drought on human health and nutrition may be reduced by improved health services, better disaster management, and poverty alleviation etc (16).

The fact that the nutritional status of the community in the severely affected areas, by and large, remained essentially similar to that reported earlier, shows that various developmental and drought relief programmes such as provision of employment through food for work programme and supply of food grains at affordable prices through TPDS/ PDS, would have averted deleterious effects of drought in the community. While responding to current

emergency needs in drought-affected areas, simultaneously supporting programs aimed at strengthening local populations' ability to cope with and combat the effects of drought, thereby reducing the need for future emergency interventions is crucial (17) to mitigate the impacts of drought on the communities.

### Conclusion & Recommendation

Drought has a serious long term effect on nutrition and health of the communities particularly on children. Government interventions such as targeted public distribution will help the communities to cope up with the drought effects to an extent. In drought-affected areas, where the level of famine impact is unknown, early rapid assessment of the nutritional status and the health needs of the population is critical to estimate the degree of current and impending problems and to plan timely and appropriate interventions (18).

### Limitation of the study

Since we carried out the rapid assessment of impact of drought on nutritional status of the community we could not obtain the ethical clearance for the study. Similarly, there may be a chance of bias in the information obtained from the head of the households on household food security as it was based on the perceptions of the head of HHs.

### Relevance of the study

Many states in India have been experiencing recurrent drought conditions, the results and recommendations of this study may be utilized for the preparedness of the communities and Government agencies to mitigate the adverse effects of drought on health and nutritional status of the communities in the drought affected and drought prone areas.

### Authors Contribution

All the authors contributed in conception, design, analysis and interpretation of data. AN and SBK drafted the article and VK analyzed the data. All the authors critically reviewed and approved final version of the manuscript.

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**Tables**

**TABLE 1 MEAN HOUSEHOLD INTAKES OF FOOD STUFFS (G/CU/DAY) BY STATES**

STATE	Cereals & Millets		Pulses & Legumes		Green Leafy Veg.		Milk & Milk Products		Other Vegetables	
	Drought	Non-Drought	Drought	Non-Drought	Drought	Non-Drought	Drought	Non-Drought	Drought	Non-Drought
Andhra Pradesh	431	420	28	16	4	4	21	18	15	19
Chattisgarh	353	436	22	30	24	17	2	33	19	51
Gujarat	403	500	28	27	2	2	164	102	34	30
Karnataka	457	439	38	38	4	11	31	88	11	25
Madhya Pradesh	313	436	19	30	11	17	3	33	38	51
Maharashtra	379	341	28	30	6	9	21	62	43	25
Orissa	439	435	23	20	12	33	7	9	31	66
Rajasthan	357	489	5	23	0	2	77	150	17	12
Tamil Nadu	405	398	40	35	5	8	67	117	27	51
RDI*	460		40		40		150		60	

\*RDI: Recommended Daily Intakes

**TABLE 2 MEAN HOUSEHOLD INTAKE OF NUTRIENTS (PER CU/DAY) BY STATES**

STATE	PROTEIN		ENERGY		VITAMIN A		IRON		RIBOFLAVIN	
	Current Drought	Pre.Drt/ NNMB	Current Drought	Pre.Drt/ NNMB	Current Drought	Pre.Drt/ NNMB	Current Drought	Pre.Drt/ NNMB	Current Drought	Pre.Drt/ NNMB
Andhra Pradesh	43	40	1836	1736	232	98	9	9	0.5	0.5
Chattisgarh	33	51	1424	1835	288	195	8.4	15.8	0.4	0.6

Gujarat	62	68	1938	2271	219	208	28	28	1.2	1.1
Karnataka	52	53	1927	2082	133	210	16	16	0.7	0.8
Madhya Pradesh	34	51	1262	1829	172	195	10	17	0.4	0.6
Maharashtra	46	48	1715	1751	428	160	17	17	0.7	0.7
Orissa	38	41	1755	1854	402	333	8.2	12.3	0.4	0.4
Rajasthan	61	71	1827	2163	127	213	24	33	1.0	1.3
Tamil Nadu	41	44	1768	1849	100	180	10.5	10	0.5	0.6
RDA*	60		2425		600		28		1.4	

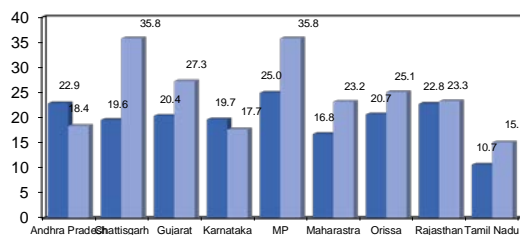
\*RDA: Recommended Dietary Allowances

**TABLE 3 DISTRIBUTION (%) OF HOUSEHOLDS ACCORDING TO COPING STRATEGIES ADOPTED DURING DROUGHT BY STATES**

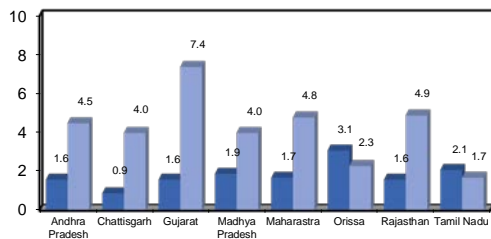
STATE	Obtained Govt/NGO Assistance	Reduce food consumption	Consumption of low cost foods	Use of food stocks/savings	Borrow cash/food	Migration	Sold assets
Andhra Pradesh	55	66	71	13	69	20	29
Chattisgarh	72	96	96	95	2	15	1
Gujarat	58	26	10	79	95	20	2
Karnataka	81	97	65	25	2	22	5
Madhya Pradesh	60	89	33	3	2	0	0
Maharashtra	0	97	79	3	16	0	10
Orissa	44	73	80	27	54	23	9
Rajasthan	28	25	10	23	48	6	3
Tamil Nadu	80	4	45	8	38	12	16

**Figures**

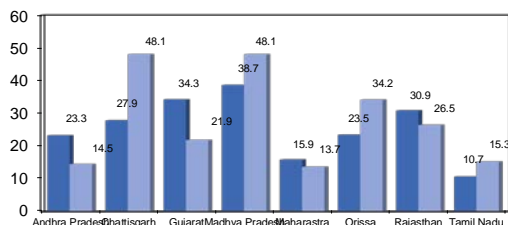
**FIGURE 1 PREVALANCE (%) OF SEVERE UNDERNUTRITION (<MEDIAN – 3SD) AMONG PRE-SCHOOL CHILDREN ACCORDING TO SD CLASSIFICATION BY STATES**



Severe Underweight (Weight for Age)



Severe Stunting (Height for Age)



Severe Wasting (Weight for Height)