

Food Security Status and Nutritional Adequacy in Arid Part of India: A District Level Analysis

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Abstract

The study uses cross-sectional data of a sample of 350 individuals from two villages in Jodhpur district of western Rajasthan. This paper examines the socio-demographic characteristics, extent of food insecurity, dietary diversity and nutritional status at the household level. To this end, subjective and objective measures like Household Food Insecurity Access Scale (HFIAS) and Household Dietary Diversity Score (HDDS) and Body Mass Index (BMI) were employed. Bivariate and multivariate correlation analysis was performed to check the statistical significance of the findings. Average HFIAS Score of the villages were 0.83 and 0.90, respectively. Mild and moderate type of food insecurity prevailed in the area which reflected food insecurity more of qualitative nature rather than quantitative. Findings suggested that around 30 per cent of population was having lower BMI in both the villages and women were more prone to under nutrition than men. Dietary diversity scores for the villages were 7.23 and 6.96, respectively.

Keywords: Food insecurity, Nutritional status, Household Dietary Diversity, 24-hr dietary recall, BMI

1. Introduction

There is a significantly greater proportion of drylands almost 3 billion Hectare and 100 per cent of all hyper arid lands are in developing countries (Millennium Ecosystem Assessment, 2005). Dry lands are characterized by high evaporation rates, exceptionally high day temperature in summer, low humidity, high run off and low soil fertility in all over the world. As far as India is concerned there is 108 million hectare rainfed area which is about 75 per cent of total arable land in the country. Around fifty percent of this rainfed area (~47 million Hectare) is dry land. Arid to hyper arid situations exist in the north western plateau of India spread in 28.57 million hectare in western part of Rajasthan known as 'Thar' Desert and in small pockets in south India in 3.13 million hectare. The desert part covers around 10 per cent of the total geographical area of India and Rajasthan is a state where nearly 61 per cent of this arid area is spread which forms the eastern extremity of the great arid and semi-arid belt of the world (Sharma and Mehra, 2009) which itself highlights the importance of the particular region in dry land research. Harsh climatic conditions in such areas affect the life of human and cattle adversely and make it difficult and insecure. Unstable state of agriculture and regular famines made food security in these areas a cause of concern not only for the government but community at large.

Historically, because food security was envisioned at the regional and national level and was considered synonymous with national food self-sufficiency, it was principally measured at the macro level by assessing national food production and supply (Maxwell, 1996). However, the aggregated measures at national level often mask major disparities at the micro level, and to help policy planning and effective allocation of resources, food security must also be considered at the household or individual level. In addition, not only food availability but also access to food has to be taken into account (Sen, 1981) as well as the subjective perception of food security. It is now well acknowledged that food security is a composite concept supported by 3 pillars: availability, access, and utilization of foods (FAO, 1996) which should result in food sufficient in quantity and quality. Associations between food insecurity and adverse physical or mental health effects, including underweight, obesity, poor growth, micronutrient inadequacy, anxiety, and depression, have been evidenced among adults or children especially in developing countries (Isanaka et al., 2007; Hadley & Patil, 2006; Cook & Frank, 2008; Dinour et al., 2007). The need of such studies are high for many operational agencies which are involved in regular measurements and monitoring of changes and for assessing the impact of food and agricultural programmes, further, such databases help in effective futuristic planning and management in the target areas. Thus, the present study focuses at assessing food insecurity status, dietary diversity and nutritional status especially in rural conditions in desert areas of arid areas of western Rajasthan in India.

2. Methods

Various indicators have been used to measure different facets, determinants, or outcomes of food insecurity. Among these indicators, the promising tools to provide important information about household food insecurity with a view to drive action is the (HFIAS) household food insecurity access scale Coates et al, (2007) which formally measures several dimensions of household food insecurity, and the household dietary diversity score HDDS (FAO, 2007) which complements this measure by the assessment of household dietary adequacy, a central notion in the definition of food security. With these indicators simple derived measures such as Body mass Index or nutritional status provide additional complementary data of the prevailing situation of the area (Haddad et al, 1994; FANTA, 2003).

2.1 Setting, Sampling, and Design

In India, the great Indian desert of *Thar* (CAZRI, 2001), forms a part of the country's north-west arid zone. The greater part of desert has remained arid to hyper arid conditions. The study took place in Jodhpur district of arid western Rajasthan placed between 26.2900° north and 73.0300° east. The annual precipitation in the study area is low, and ranges from 250-300mm. It is highly erratic and about 90 per cent of the rainfall is received during July and August. Delayed onset and early withdrawal of monsoon is quite common. Summer temperature remains high, reaching up to 48°C in May and June at some places. Dust storms are quite common with wind velocity above 30 km/h. Our survey unit was the household, which was defined as a group of persons sharing housing and meals, managing a common budget, and led by a head of household. For study purpose Bheejwadia and Ummednagar villages of Osian *panchayat samiti* (administrative unit) were selected randomly. Both the villages were partially irrigated by wells while some area of the village was unirrigated, rainfed, mono cropping area. Cereal crops, pulses and vegetables were grown mainly in the villages. The households in each village were selected by cluster sampling. Proportionate samples were selected randomly also covering Schedule caste /Schedule Tribe (group of disadvantaged people recognized in article 341 and 342 of the constitution of India) households. A total of 30 households were selected from each village representing different caste, landholding size and settlement pattern. This paper presents results for two rounds of data collection on a random sample of 60 households covering 350 individuals. The first round of data collection took place at the beginning of the rainy season (end of May to mid-August) and the second round took place at the beginning of the dry season (mid-October to mid-December). All the data were collected by trained enumerators in face-to-face interviews.

2.2 Socio-Demographic Aspects

All the selected households were examined for socio-demographic aspects such as caste, age, sex, number of family members, size of land holding, occupation, land size, annual income and expenditure on food and non-food items etc. The data were collected by personal interview method using a pre-structured interview schedule. For assessment of socio-economic status Kuppaswami scale (Kuppaswami, 1981; Ghosh&Ghosh, 2009) modified was used. In the modified scale, the educational and occupational criterion remains the same.

However, to modify economic criteria, national urban consumer price index for India was noted for the year (2011-12) and the conversion factor between the index of 1976 and 2012 was determined. Subsequently, all the income groups in the scale were multiplied with the conversion factor to get appropriate income groups.

2.3 Anthropometric Measurement

All the members in the household were examined for anthropometric measurements (height and weight). The measurements were taken following standard techniques (Bamji et al., 2010). Body weight is the most widely used and the simplest reproducible anthropometric measurement for the overall evaluation of nutritional status. For measurement of body weight electronic balance (Atlas weighing equipments, India) was used. The weight of individual was taken with minimum clothing, standing erect without shoes, or holding any support. Height was measured by using antropometer on a leveled surface, without shoes, looking straight with heels together and toes apart. To calculate the Body Mass Index (BMI) following formula was used.

$$\text{Body Mass Index (BMI)} = W / H^2 \quad W = \text{Weight (Kg), } H = \text{Height (mt)}$$

Individuals (adults > 18 yrs.) were classified according to their BMIs based on classification proposed by WHO, 2004. The limitation of the method is that it does not differentiate between muscle mass and body fat thus, less suitable for elderly population.

2.4 Dietary Data and Household Food Insecurity Access Scale (HFIAS)

The standardized HFIAS questionnaire, which consists of a list of 9 specific questions about worry and availability and accessibility to foods for the household during the previous 30 d, was field tested before use as recommended (Coates et al., 2007). The standard procedure for scoring was used: zero was attributed if the event described by the question never occurred, 1 point if it occurred 1 or 2 times during the previous 30 d (rarely), 2 points if it occurred 3–10 times (sometimes), and 3 points if it occurred 10 times (often). For each household, the HFIAS score corresponded to the sum of these points and could range from 0 (food security) to 27 (maximum food insecurity) (Coates et al., 2007). The respondent was preferably the spouse in charge of food provisioning and cooking in the household or the head of the household. Average HFIAS Score for the sample population can be computed by the following formula.

$$\text{Average HFIAS Score} = \text{SUM of HFIAS scores in the sample} / \text{Number of HFIAS scores in the sample}$$

Household Food Insecurity Access Prevalence (HFIAP) Status indicator is an additional indicator used to report household food insecurity prevalence. The HFIAP indicator categorizes households into four levels of household food insecurity; food secure, mild, moderately and severely food insecure. Household food insecurity access prevalence can be computed by using following formula

$$\text{HFIA Prevalence} = (\text{Number of households in HFIA category 1,2,3 or 4} \times 100) / \text{Total number of households}$$

2.5 Household Dietary Diversity Score (HDDS)

The household dietary diversity score (HDDS) is meant to reflect, in a snapshot form, the economic ability of a household to consume a variety of foods. Measurement of dietary diversity is a rapid, user-friendly and cost effective approach which measure changes in the dietary quality of a household. Dietary diversity score of each family were created by summing either the number of individual foods or food groups consumed over the reference period. The household dietary diversity score (HDDS) of sample population can be created by the following formula.

$$\text{Average HDDS} = \text{SUM (HDDS)} / \text{Total number of households}$$

For this purpose, an open qualitative recall of all foods consumed during the previous 24 h was performed with 1 respondent in the household, preferably a woman. If there was no woman available or no woman at all in the household, the respondent was the head of household. From this open qualitative recall, the enumerator, with the assistance of the respondent, checked which food groups were consumed from a list of locally adapted food groups. A final prompt was offered for food groups that were not cited. The HDDS was constructed according to FAO recommendations by recompiling all the food groups in 12 food groups and attributing 1 point for each group consumed in the previous 24 h.

3. Statistical Analysis

All the statistical analysis was drawn out by computerized statistical package MS Excel. Simple descriptive statistics was used by taking the sampling design into account. Clustered smooth column plots were drawn to graphically represent the relationship between each of the candidate indicators. Bivariate and multivariate analysis was also used to study the relation among study variables.

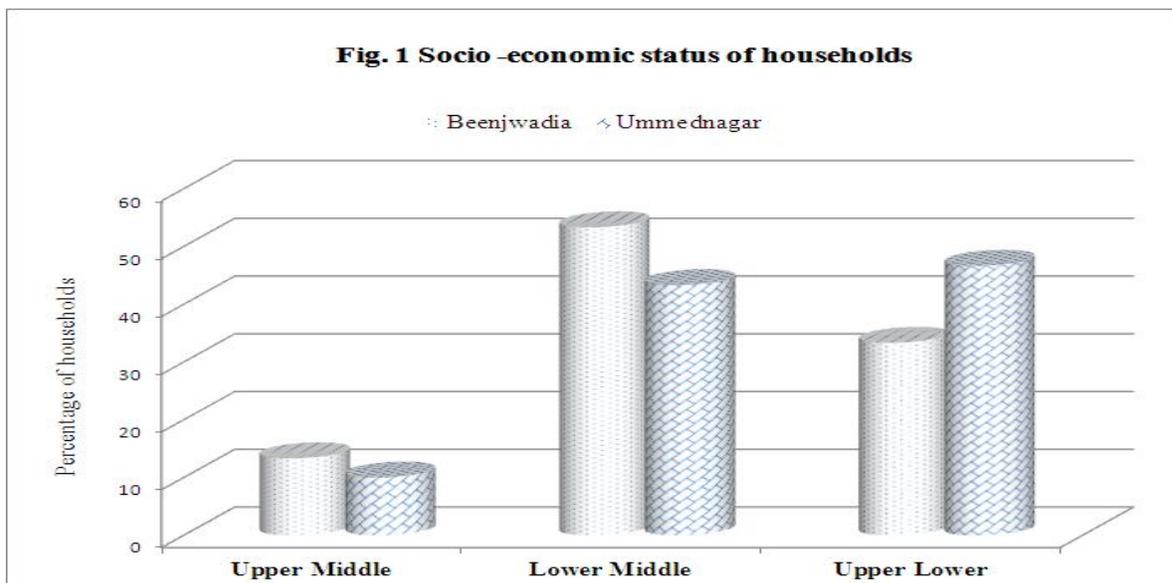
4. Results and Discussion

4.1 General Characteristics

A total of 350 individuals were surveyed in two selected villages covering 60 households, 30 from each village. Most households comprised a male head of household with spouse, children and their parents. The particulars of households from each village are described in “table1”.

4.2 Socio-Economic Status of Households

Socioeconomic status was conceptualized as the social standing or class of an individual or group and measured as a combination of education, income and occupation. In case of rural settings in India, agriculture is one of the most important sources of livelihood, which also affect the food security of the household. In fact, the impact of socio-economic status was highly significant over the food security and nutritional status of families. Thus, an improvement in earning affects positively the food intake, and its quality. There are several other factors which make up the overall social structure of a society. As far as social and cultural setting of the area is concerned the educational level was found low, wide spread illiteracy especially female illiteracy, factionalism, veil system, gender preference for male child, poor hygiene were the obvious problems. In the present study the socio-economic status of farm families was assessed by using Kuppaswami Scale (*modified*) which takes in to account educational status, occupation and monthly income of households and scores were provided for each attribute. Differences were found in the socio-economic setting of both the villages (Fig. 1). It was observed that approximately half of the population (53.33) per cent was in lower middle category and the percentage of households in upper lower category was lesser (33.33) percent in Bheejwadia village where as in case of Ummednagar the percentage of households belonging to upper lower category were slightly higher (46.66) than the low middle category (43.33).

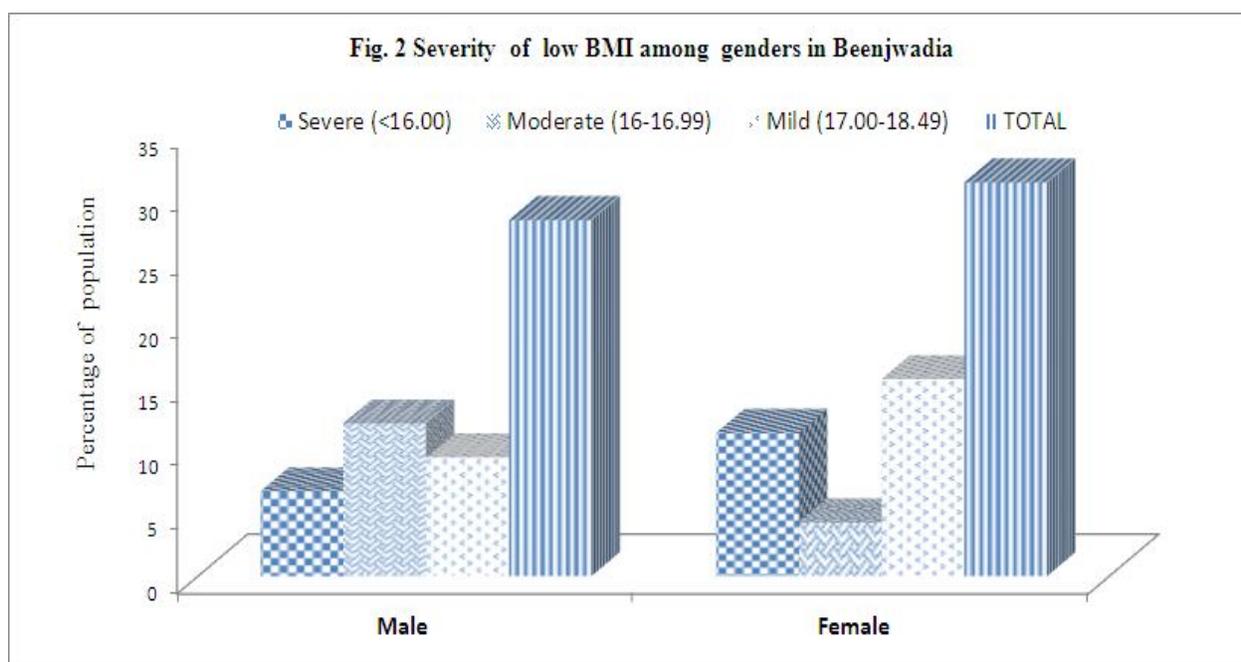


As far as the agricultural system of the area is concerned it is by and large subsistence and rainfed. However, in many of the villages 15-25 per cent of the area is irrigated. Bheejwadia and Ummednagar were also partially irrigated villages and the situation of Bheejwadia was slightly better than Ummednagar. During the survey of farm families it was also observed that majority of the farmers were adopting mixed cropping, crop rotation, fallowing of land etc. Farmers who did not have assured irrigation facility were primarily doing rainfed agriculture and taking crops such as pearl millet, mung, moth, guar, til, etc. while other crops like wheat, vegetables and horticultural crops were cultivated by some farmers having assured irrigation.

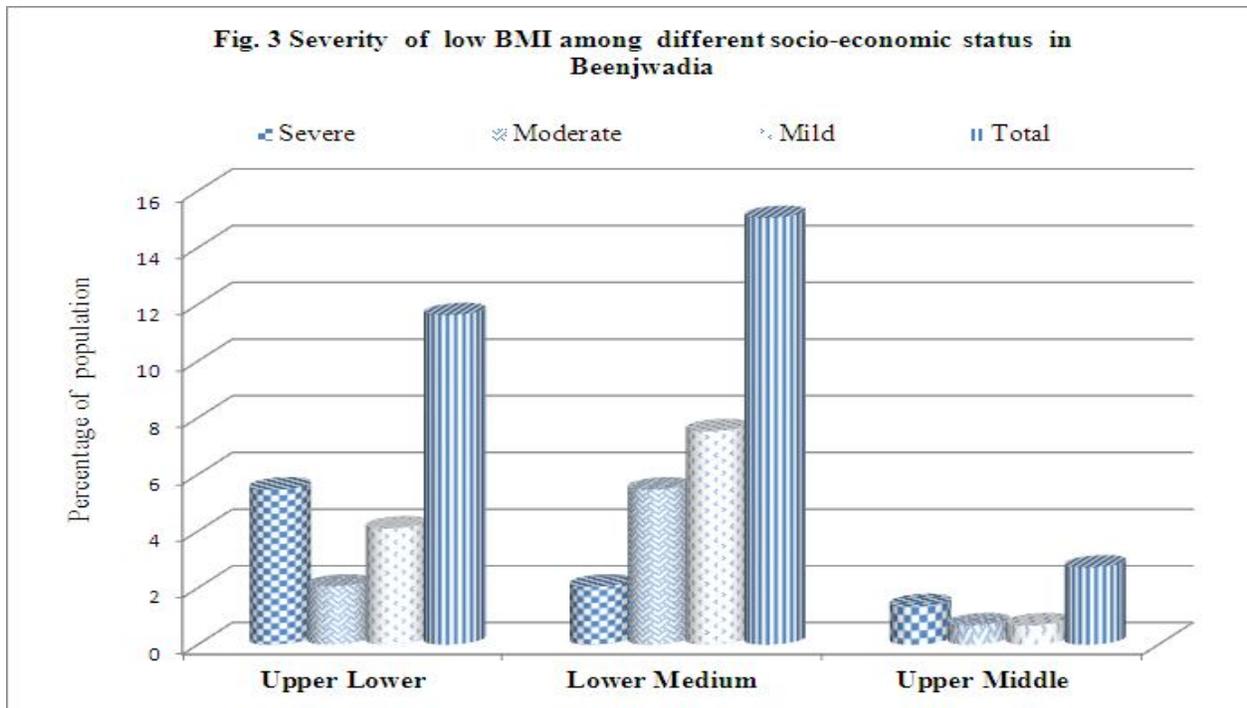
Along with crops farmers were having mixed type of livestock for their survival. Small ruminants such as goats were kept by upper lower to resource poor lower middle class families especially for milk purpose and in event of crop failure they would get something from livestock. It was also observed that agriculture was not the only means of getting their bread and butter but the member of farm families were engaged in some secondary occupation in non-farm sector. The reasons behind this were diverse. One of the theories is that the traditional large sized families are rapidly disintegrating in to small sized nuclear families which are causing fragmentation of land. With the decreasing land: man ratio people are not able to meet their family needs from agriculture alone. Agriculture was also not very promising in this region because of low soil fertility, lack of assured irrigation and dependence on climatic vagaries. There were many people engaged in rural non-farm sector primarily due to limited opportunities in agriculture. It was seen in the villages that people who did not have a sizable land holding, resource poor or land less were practicing contract farming or working as agricultural laborers. Almost every family was having some sort of secondary occupation along with agriculture such as tailoring, welding, carpentry, electronic repair work, working as labors at retail shops in nearby cities for earning their livelihoods.

4.3 Nutritional Status of the Population

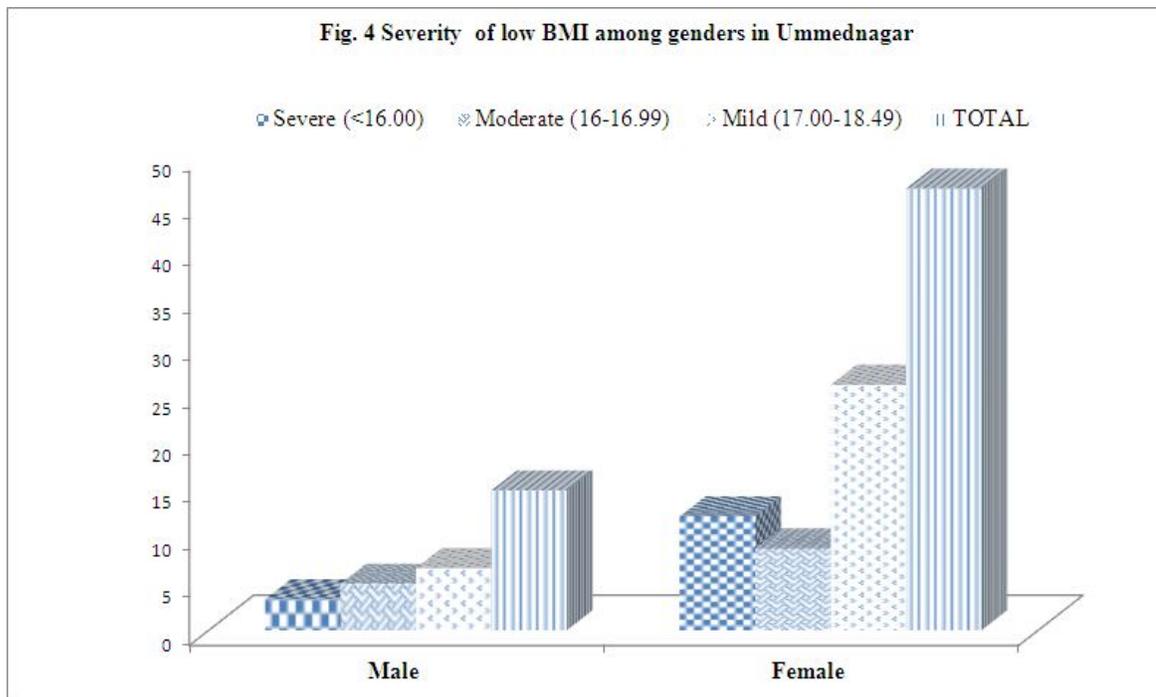
All the individuals having body mass index more than 18.50 were considered as normal. The cases which reflected BMI, <18.50 were subdivided in to three categories according to the degree of severity viz. severe (BMI<16.00), moderate (BMI 16.00-16.99) and mild (BMI 17.00-18.49), respectively.



A total of 181 adult individuals were surveyed from 30 households at village Bheejwadia. Data pertaining to body mass index revealed that 29.43 per cent of individuals were having lower BMI than standard. When the cases were further categorized according to the degree of severity it was revealed that severe, moderate and mild cases were 8.90, 8.21, and 12.32 per cent, respectively. Gendered classification according to degree of severity has been shown in “figure 2”. Higher proportion of women had low BMI as compared to men. It was seen that a total of 30.98 percent of woman were having low BMI and percentage of severe and mild cases were higher in women. When the interrelationship between severity of low BMI and socio-economic conditions was established, highest numbers of cases of low BMI were found in lower middle category i.e. 15.05 percent than the upper lower which was 11.62 percent. The aggregate percentage of cases of low BMI was more in low middle category than the upper lower because of higher number of mild cases in the same which was the reason of the higher aggregate percentage but the upper lower category was more prone severity wise because higher number of severe cases were in this category compared to lower middle category (Fig. 3).

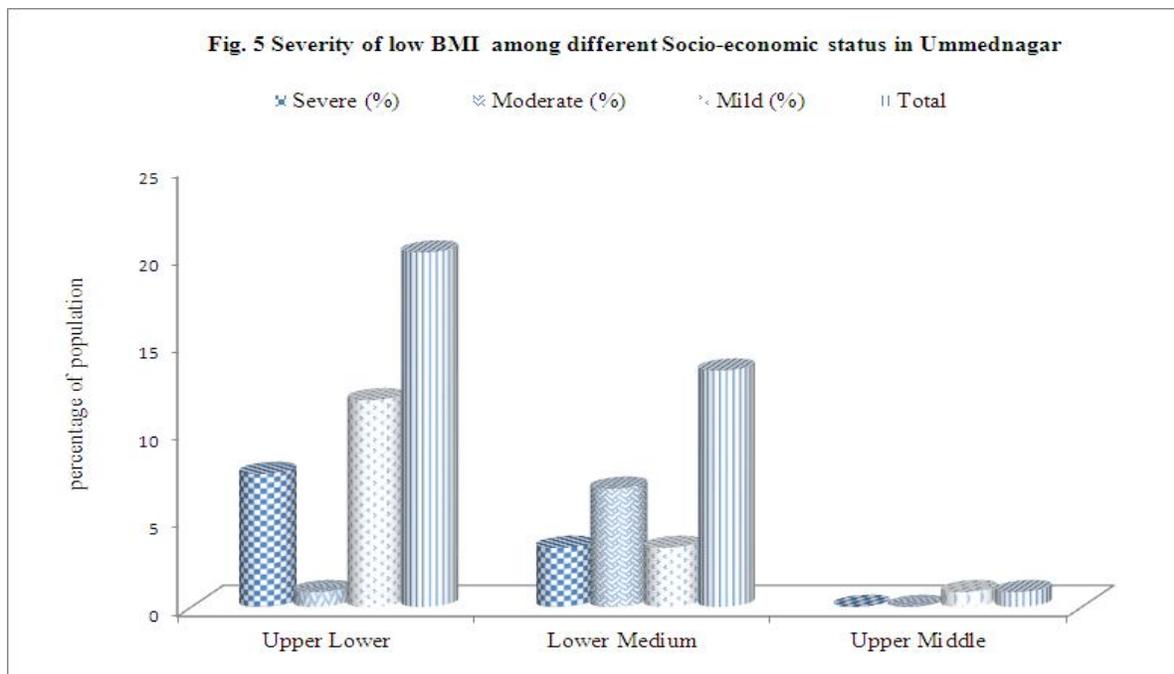


Likewise, a total of 167 individuals were surveyed from 30 households in Ummednagar village. The extent of malnutrition in Ummednagar was not much different than the previous village. A total of 29.99 percent cases of low BMI were observed, among which severe 7.5, moderate 6.6 and mild cases were 15.83 percent, respectively in the sample population (Fig. 4).



The data showed that percentage of severe and moderate cases were lower in Bheejwadia whereas mild cases were on higher side. Gendered classification according to degree of severity was also prepared. It was seen that in Ummednagar village the extent of low BMI among females were quite higher 46.55 percent than the males 14.75 per cent (Fig. 5). When the relationship between the socioeconomic status of households and the severity of low BMI was explored it showed an obvious trend.

The cases of low BMI were highest in upper lower category 20.16 percent, followed by low middle category 13.44 per cent, and upper middle class 0.84 per cent. to study the statistical significance of data bi variate and multivariate correlation was used and it was seen that there was significantly negative correlation ($r^2 = -0.135$) between the age and nutritional status of individuals when it was further studied on gender basis highly significant negative correlation ($r^2 = -0.307$) was



Observed between the nutritional status and age of females while a statistically insignificant positive correlation in case of males. When the correlation between socioeconomic status and BMI was explored it showed a significant positive correlation ($r^2 = 0.173$) between the variants which showed as the SES is increasing the nutritional status also increased.

4.4 Household Food Insecurity Access Scale (HFIAS)

Food security is said to exist when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO 2009). In western Rajasthan pearl millet (*bajra*) is the staple food due to lack of irrigation facility. Pearl millet is a coarse cereal and nutrient rich in comparison to wheat or rice which are the staple foods in other parts of India. In addition to pearl millet mainly pulses contribute as the second largest part of the typical diet of arid zone people. Livestock is an integral part in the living and life of these people and they consume milk and milk products in good amounts. Handmade bread of pearl millet (*sogra*), some locally available vegetables, ghee and buttermilk is included in the daily diet. Rice is almost absent from the regular diet of households as it is not grown here due to water scarcity. It was observed that some farmers who had assured irrigation facility cultivated wheat in their farms. The consumption of wheat flour was recorded more in those families who either grown wheat at their fields or had good purchasing power. Scarcity of water and fresh green vegetables had their effect on the diet. Sogra, pickle or preserves make up the regular diet of the people there. They use a wide variety of lentil preserves, and other pickled food to make for the lack of availability of fruits and vegetables round the year. The vegetables are hard to grow and many are totally not possible to be grown except few vegetables and some arid fruits. The food here is mostly in the form of dried vegetables because there is a very small growing season of the monsoons and that too has no guarantee of arrival. Grains like pearl millet too can only be grown in monsoon season, so there are many indigenous ways of storing them like mixing in the 'ash powder'. Two perennials *Capparis decidua* and *Cordiamixa* which give rise to the very famous foods called as 'ker' and 'Gunda' are traditionally used in the diet which are also having good nutritional value. People eat dried pods (sangri) of *Prosopis cineraria* (khejri) which is known as the life line of this region. A very famous food item used in this region called "PANCHKUTA" has these three out of the five ingredients ker, sangri and gunda.

Vegetables, which grow itself as wild vegetable such as *Cucumiscolosus* (kachri), raw *Cucumiscolosus*(kachra), raw *Citrulluslanatus* (mateera), *Praecitrullus fistulosus* (tindsi) and leguminous vegetables like cluster bean (*guar phalli*), are very popular here. People preserve *kachri*, *sangri*, and *guar phalli* by sun drying to eat in the off season. The food habits consist mainly of grains and pulses and have minimal vegetables in form of dried things.

Household food insecurity access scale (HFIAS) was used to assess the food insecurity in the two villages i.e. Bheejwadia and Ummednagar. Household food security access scale (HFIAS) is a gold standard promising tool to measure of the adequacy of household's diets (Becquey et al., 2012; Knueppel et al., 2010; Maes et al., 2009). This tool has already been tested for external validation and quite efficient in measuring the household food insecurity conditions in both rural and urban settings. However, there are some limitations that the test did not allow to measure the food consumption at individual level rather reflects the intake at household. The average HFIAS score for village Bheejwadia and Ummednagar were 0.83 and 0.90, respectively. Household food insecurity access prevalence test (HFIAP) categorizes households as food secure, mildly food insecure, moderately food insecure and severely food insecure and help to understand the severity. The study indicated that in village Bheejwadia and Ummednagar, 70-74 per cent of households were food secure. None of the households were found in severely food insecure category in both the villages. Mild food insecurity was seen in 23- 26 per cent of population, while about 3-4 per cent were moderately food insecure. The situation of mild food insecurity reflects the worry of the households regarding adequacy of diets or the qualitative aspects rather than quantity which indicated that the households were getting sufficient diets and there was no direct food shortage but people were getting limited variety of food stuffs and expected more diversity in their regular diets.

Their regular diet was having food items such as pearl millet bread (sogra) or sometimes wheat bread (roti) eaten with curry of some locally grown wild vegetables such as kachri, guar phalli or tindsi or dried vegetables or some seasonal vegetables, daal or buttermilk or traditional recipe made from buttermilk and pearl millet flour (kadi). Buttermilk was very popular and integral part of the regular diet of people. The sources of milk and milk products were livestock they had. People preferred wheat over pearl millet in their regular diet as the better off people in their society had. Vegetables and fruits were also lacking due to water scarcity and higher input costs to grow. Variety in their food basket was found low. They were also concerned sometimes about the future food security of the households, which can be understand as agriculture is not very promising in this region, households were primarily depend on the yield of their own field for the food supply of the family and if the yield get affected due to some reason such as drought or crop diseases may affect otherwise the food security of the family. Dietary diversity in this case is certainly low as the households may have limited choices of food, however, it may not be correlated with the nutritional value of the diet. Moderate food insecurity is seen in 3-4 per cent of population which is concerned with the diet both qualitatively and quantitatively lower than the requirement of households. The households which were majorly depending on labor wages were reflecting the condition of moderate food insecurity. Here it is essential that the term 'diet lower in quantity' should not be confused with the 'absolute hunger'. Moderate food insecurity was recorded as in case of some families which were landless and having labor wages as the primary source of their livelihoods. The major food item in their diets were pearl millet bread and curry of some locally grown wild vegetable such as *kachri*, *guar phalli*, *aloo* and *mirchi*. The consumption of pulses and milk and milk products was low due to lower purchasing power of households. They generally use goat milk for household purposes. Fruits and green vegetables were rare in their diets. Some seasonal wild fruits grown in the village itself such as *Citrullus lanatus* (mateera), *Ziziphus mauritiana* (ber), *Cordia mixa* (gunda), *Salvadora oleiodes* (pilu) were eaten by them but they didn't had enough purchasing power to consume other popular fruits and vegetables. However, they were getting food for their stomach but it was having very low variety and absolutely lacking preferred food items. The observations suggested that the overall food insecurity status was not severe in the area, improvement was required related to dietary diversity of affected households. More vulnerability was seen especially in the resource poor sections that were primarily dependent on labor wages for their survival.

4.5 Household Dietary Diversity Score (HDDS)

Dietary diversity reflects the involvement of different kind of food groups in the diet which is related to the economic ability of the household regarding access of foods and dietary adequacy as per the nutritional requirements. Average household dietary diversity score (HDDS) for village Bheejwadia and Ummednagar was 7.23 and 6.96, respectively, which reflects the average availability of 12 standard food groups in the diet of households.

Average HDDS scores showed that dietary diversity was fairly good in both the villages while dietary diversity of Bheejwadia was slightly better than Ummednagar. Dietary diversity pattern showed that cereals, pulses, milk/milk products and oil and fats ranked highest among the food groups included in the daily diet of households. Which were the main source of energy and protein in the diet. Among cereals group pearl millet scored much higher than wheat as it is the major cereal crop of arid area. However, regarding wheat the intake was higher in lower middle and upper middle class as they harvested wheat in their own fields. While, in upper lower class pearl millet was the major cereal because of unavailability of irrigation to harvest wheat which also affects its availability for consumption also. Intake of vegetable and fruits was lower, however, lower than required level. Intake of white roots and tubers as well as other vegetables were significant among vegetable group which also included wild rescue vegetables occurring in the farmers' field themselves like *Cucumis momordica* (kachra), *Cucumis melo* ssp. *Agrestis* (kachri) *Cucumis callosus*(kachra), and others were *Cyamous tetragolobe* L. *Taub* (cluster bean or guar phali), indian bean (*semphali*), *Praecitrullus fistulosus* (tinda), *Lagenaria siceraria* (bottle gourd, etc. Consumption of yellow vegetables rich in vitamin A and green leafy vegetables (GLVs) was also reported in some cases. The reason for better consumption of yellow fruits and vegetables than GLVs was better due to inclusion of carrot and vegetables of of *cucumis* group which are good source of vitamin A and other vitamins and minerals. Green leafy vegetables were not grown in the farmers' field thus inclusion of this group was very low in the diet of households. However, both the villages were partially irrigated but only few farmers grew and harvested vegetables because of higher input cost to grow and low productivity. Consumption of fruits was quite low mainly due to higher prices. However, inclusion of seasonal wild fruits was observed in the diet like, *mateera* (*Citrullus lanatus*), muskmelon (*Cucumis melo*), round melon (*Praecitrullus fistulosus*, kakdi (*Cucumis* spp.,) ber (*Ziziphus mauritiana*), aomla (*Phyllanthus emblica*), pilu (*Salvadora oleiodes*) etc. Consumption of animal products like meat and eggs was very low due to the religious reasons. Intake of milk and milk products like buttermilk was found quite significant. Majority of the families had 1-2 milch animals like cows or buffaloes while households of lower socioeconomic group had goats which were a significant source of milk for the households. Other minor food groups like sugars and spices were regularly used in the diet of the households. In the nutshell it can be said that dietary diversity was fair in the villages still betterment is required in the food basket.

5. Conclusions and Implications

It may be concluded that food insecurity does exist at household level and its severity varies across areas, socioeconomic status, genders and it also has a seasonal dimension. Overall, the findings suggest contrary to the belief about the arid regions, the situation was not that poor in the study area, since, the villages were partially irrigated and people were following livestock mix farming system. Regarding the availability of different food groups and dietary diversity, it was fair in the study area. People were using their own diet related indigenous coping strategies and preservation methods to increase the availability during off-season. Moreover, the overall economic access was also increased in the study area due to recently launched governmental employment generating schemes and external remittances. Households with lower income were more food insecure particularly those who did not have good land size and irrigation facility and depend largely on agricultural and non-farm labor wages. The extent of under nutrition was approximately similar in both the villages but its severity varied across genders and SES. There was positive correlation between prevalence of under nutrition and socioeconomic status. Findings agreed with the view that food energy sufficiency was implied in the population, however, may not be true in case of other nutrients and the concept of household food security need to be studied and broadened to include micronutrients also.

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