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**MJ Chandre Gowda**  
ICAR-ATARI, Zone-XI, MRS,  
H.A. Farm Post, Hebbal,  
Bengaluru, Karnataka, India

**Ravi Y**  
Scientist, Department of Home  
Science, ICAR-KVK, Uttara  
Kannada, Karnataka, India

**Netravati Yattinamani**  
Scientist, Department of Home  
Science, ICAR-JSS KVK,  
Suttur, Mysuru, Karnataka,  
India

## Somatic status and dietary pattern of farm families in the rural areas of Karnataka state

**MJ Chandre Gowda, Ravi Y and Netravati Yattinamani**

### Abstract

India's food and nutrition problems continue to be formidable and malnutrition is still one of the crucial problems in the process of development. The magnitude of malnutrition and the ignorance about the relationship between food and health among a majority of the rural population. The main focus of the study was to assess Somatic status and dietary pattern of farm families. Questionnaire was used for data collection from rural farm families of Karnataka State. A well-structured questionnaire was framed to gather the information on somatic status and dietary pattern of the subjects was assessed by 24-hour diet recall method. The results revealed that, rural households were consuming cereals (93.33%), fat (92.47%) and sugars (90.58%) near to RDA levels. Consumption of pulses (79.95%) as well as milk and milk products (59.19%) were better than consumption of green leafy vegetables (54.87%) and other vegetables (57.82%). Consumption of fruits (52.49%) roots and tubers (50.86%), was very much less than RDA. Majority of rural households (63.4%) had at least one over-weight person and in 46.2% of the households, there was at least one under-weight member in their family.

**Keywords:** Dietary intake; 24-hour dietary recall; nutritional status; body mass index

### Introduction

Health and nutrition are the most important contributory factors for human resource development in the country. India represents almost 17.53 per cent of the world's population and is predicted to have more than 1.53 billion people by the end of 2030. India is home to 189.2 million undernourished people for the period of 2017-2019. Healthy diet is vital to stay fit and well throughout [1]. An average Indian consumes only about 2/3rd of the calories, about half the proteins, and around 1/4th the fats [2]. In 2021, about 45 million men and 53 million women in India were below poverty line [3]. About 28% in the rural and 26% in the urban areas are estimated to be below the poverty line [4].

Food security often refers to sufficient quantities of food (in terms of calories), but quality in terms of variety and content are given attention now [5]. The diet of early humans was dominated by low fat and high fiber, coupled with higher levels of physical activity. Industrial, agricultural and information revolution have changed the dietary pattern towards high fat, refined carbohydrate and low fiber foods [6]. Food consumption pattern in India is deeply rooted with tradition, lifestyle, religion, climate and agriculture conditions [7]. Dietary patterns vary greatly across India with South India preferring eat rice-based diets and North India for wheat-based diets. Rural population, which is mainly involved in food production through agriculture as major occupation were reported to consume inadequate quantity and imbalanced quality of food. Analysis of the NSSO survey (2011-12) revealed that the 40-50th percentile in rural India, consumed much less than its urban counterpart. Predicted future diets in India are expected to contain more fruit, vegetables, potatoes and dairy products. Consumption levels of cereals are expected to stay the same [8].

Keeping these facts in view, the study was conducted with the following objectives:

- To assess the dietary pattern of rural households.
- To assess anthropometric measurements of rural household members.
- To understand the relationship between somatic status and dietary pattern of rural household members as well as their socio-economic status

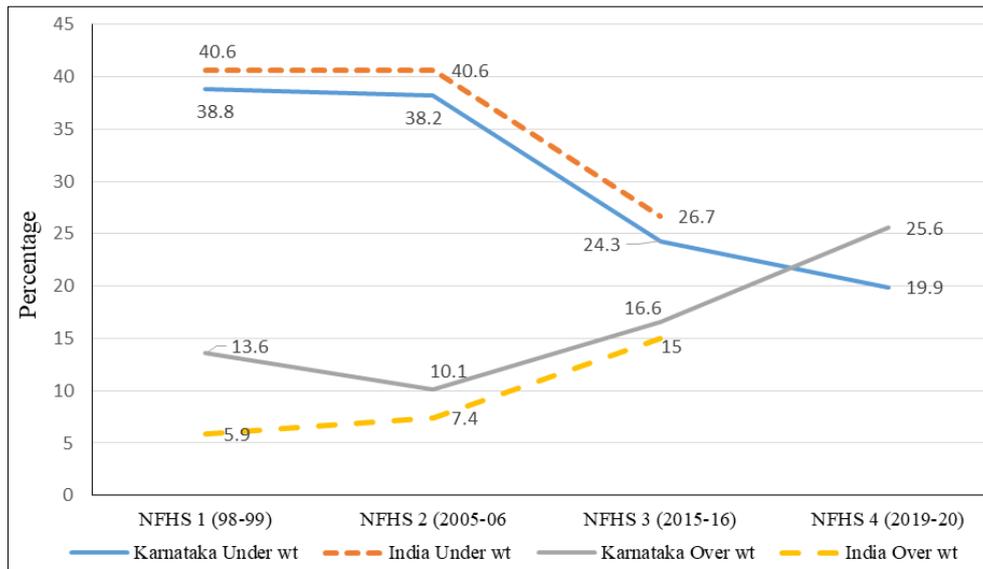
### Material and Methods

A cross sectional survey was conducted during the year 2020 in Karnataka state of India. The secondary data on health status, particularly the declining trend of under-weight population and the increasing trend of over-weight population in rural Karnataka depicted a true representation of the under-weight and over-weight trend in the rural population of the country as a whole (Fig 1).

**Corresponding Author:**  
**MJ Chandre Gowda**  
ICAR-ATARI, Zone-XI, MRS,  
H.A. Farm Post, Hebbal,  
Bengaluru, Karnataka, India

Hence, Karnataka state was considered for studying the food consumption pattern and Body Mass Index measures of the

household members.



**Fig 1:** Declining under-weight and increasing over-weight rural women population in Karnataka and India

The primary data on food consumption pattern of 366 households and the BMI measurements of all their family members (1089) were collected in 40 villages from across 12 districts in Karnataka state. The households were identified through a cluster sampling method.

Information was collected from the homemakers and family members of the identified households using pretested questionnaire. Diet survey of the selected households was conducted by using 24-hour recall method. Standardized cups, vessels, paper discs and rubber balls were used to measure the food intake. Homemakers were asked to recall the type of preparation made for breakfast, lunch, evening tea and dinner *etc.* for the previous day (other than feasting and fasting day).

Information on amount of raw ingredients used for each preparation and also on the total cooked amount of each preparation was recorded using standardized tools and as per the procedure [9]. The quantity of all the raw ingredients in the meals prepared and consumed by the family members in a day was calculated. The schedules were properly sorted out after verification and serially numbered. Quantity of cereals, pulses, milk and milk products, roots and tubers, green leafy vegetables, other vegetables, fruits, sugars and fats used for preparation of food in a 24-hour period were ascertained. Based on the number of adult men, adult women, and children in a family, Recommended Dietary Allowance (RDA) values of each food group as given below:

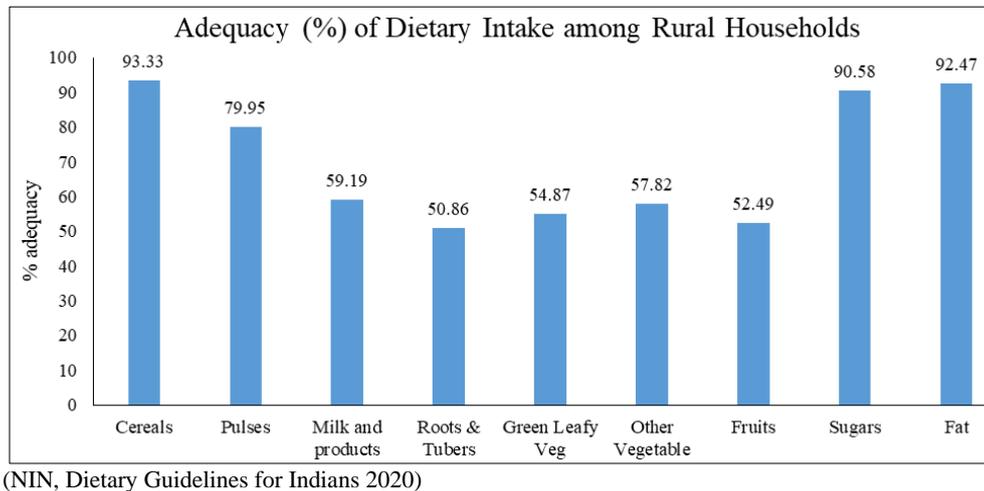
$$\% \text{ adequacy of a food group} = \frac{\text{Total Quantity of intake of each food group by the entire family in a day}}{\text{Total of RDA values of the food group for the entire family}} \times 100$$

A detailed schedule was formulated to elicit the information on various aspects related to members of the household. Information on somatic status using anthropometric measurements (height, weight, waist and hip circumference measurements) was taken using standard methods [10]. The derived anthropometrics measurements *viz.* BMI using the cutoff levels suggested for Asian women [11] were calculated.

**Results and Discussion**

The average consumption of different dietary components

among rural households is depicted as adequacy percentage in Fig. 2. Rural households were consuming cereals (93.33%), fat (92.47%) and sugars (90.58%) near to RDA levels. Consumption of pulses (79.95%) as well as milk and milk products (59.19%) was higher than consumption of green leafy vegetables (54.87%) and other vegetables (57.82%). Consumption of fruits (52.49%) roots and tubers (50.86%), was much less than RDA.

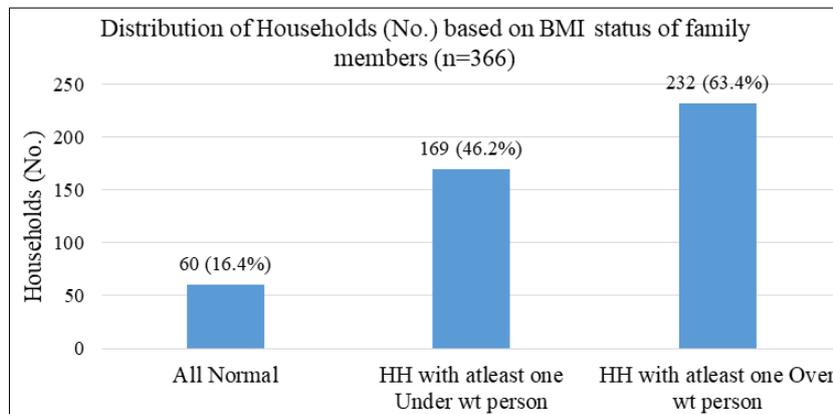


(NIN, Dietary Guidelines for Indians 2020)

**Fig 2:** Dietary intake of rural households as compared to RDA

Consumption of cereals near to RDA levels could be due to the government supported public food distribution supply (PDS) programme. India’s Public Distribution System with more than 500 000 fair price shops across the country, the largest social protection programme in the world, reach 800 million people with subsidized cereals that can be purchased from [12]. This could also be due to the fact that almost every farm household produces at least one cereal crop such as paddy, finger millet and sorghum depending on the agro-climatic region. This trend may also be due to the poor socio-economic condition of the rural households as cereals are available at cheaper rate compared to other commodities. Similar findings were reported by many studies. In a rural-urban interface setting in the same State [13]. Energy dense food (cereals, sugar, oil and fats) adequacy was more than RDA, but consumption of all other food groups were less than

RDA. It is also possible that the rural households may not have the awareness of importance of balanced nutrition consumption. The probable reason for inadequate intake of fruits, vegetables and milk and milk products may be due to lack of nutrition knowledge, low purchasing power and non-availability of required food article at the living place. A healthy diet cost exceeds the international poverty line and purchasing power parity (PPP) making it unaffordable for the poor. Lower consumption may also be attributed to lack of land allocation to annual and perennial fruit crops. Those that grow fruits often sell in market for cash needs without meeting nutrition needs of the household. A vibrant milk supply chain in India has facilitated selling almost the entire quantity of milk produced thereby depriving family members of its consumption to meet nutritional requirement.



**Fig 3:** Distribution of rural households according to somatic status indices

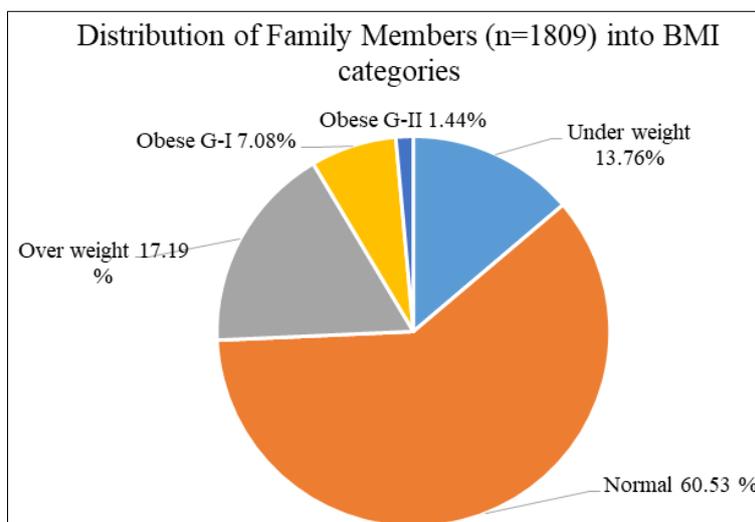
BMI was used to assess the current health status of the individuals in a family. The ratio of weight (kg) to square of the height (meter) is referred to as BMI. In 60 out of 366 households, all members were found in “normal” category of BMI (Fig. 3). Majority of rural households (63.4%) had at least one over-weight person and in 46.2% of the households, there was at least one under-weight member in their family. However, individuals BMI data presented in Fig 4, shows a better picture of the health status. Majority of the individuals had normal BMI (60.53%), 13.76% of the members were under-weight, 17.19 per cent were overweight, 7.08 per cent were obese Grade-I and 1.44 per cent were obese Grade-II. This data is in line with the general trend in India as well as in

Karnataka which is reflected in Fig 1. It is good to note that the under-weight population is declining, thanks to a well-functioning public food distribution system. It is worrying to note that the over-weight and obese population is increasing even in rural areas.

In addition to the food consumption pattern, the trend could be attributed to the changing life-styles in rural areas. There is general feeling that the amount of physical work done rural households is decreasing, mostly due to technology, mechanization and increased access to resources. Agricultural operations like tilling, sowing, planting, weeding, inter-cultivation, irrigation, harvesting, threshing, winnowing and transporting of the produce have been largely mechanized.

Entertainment in rural areas also has become more sedentary with the penetration of television and cable network connections. With the introduction of wide ranging welfare schemes and programmes for different sections of rural population, the dependency on wage work for earning a

livelihood has been reduced. On the whole, activities that helped in calorie burning have seen remarkable changes over the years in the rural areas, which could be the reason for increasing over-weight population [14].



**Fig 4:** Distribution of family members according to somatic status indices

Results of the cluster analysis of the consumption pattern are depicted in Table 1. Using this analysis, the households are grouped into five clusters based on similarity of consumption related parameters. The heterogeneity among the clusters in terms of differences in dietary intake is reflected in terms of average intake of the major predicting food group. It is also referred as Segmentation analysis as it segregates the households into consumption pattern-based groups. Maximum number of households (120 out of 366) were in cluster 3, where only sugar consumption was more than RDA and all other dietary components are consumed less than RDA. Cluster 2 that has 89 households appears closer to the desirable category wherein pulses, sugars, fat and cereal consumption was more than the RDA. Cluster 4 demands maximum attention as consumption of all the dietary components were less than the RDA in this group. Cluster 1,

dominated by sugar and fat consumption with 61 households and Cluster 5 dominated by cereals consumption with 42 households are the other two clusters. The most important predictor in the cluster analysis is the pulses consumption, with a value of 1.0 in the hierarchy. Pulses consumption is important for rural India as there is high incidence of vegetarianism. Protein apart, pulses also provide carbohydrates, dietary fiber, unsaturated fat, vitamins, and minerals, as well as antioxidants and phyto estrogens. As a cheaper source of protein, pulses offer a potential solution for reducing India’s high level of protein-energy malnutrition. The next important predictor is sugars consumption, with a predictor value of 0.8. Green leafy vegetables and fruits components have least or zero prediction factor. The results reiterate the low consumption level of these two important dietary components.

**Table 1:** Cluster analysis of dietary intake in the pattern

Input (predictor) Importance	Cluster 3	Cluster 2	Cluster 1	Cluster 4	Cluster 5
	Sugars >RDA (n=120)	Pulses, Sugars, Fat, Cereals >RDA (n=89)	Sugars, Fat > RDA (n=61)	All <RDA (n=54)	Cereals >RDA (n=42)
1.0	Pulses 69.39	Pulses 94.93	Pulses 74.03	Pulses 54.35	Pulses 45.21
0.8	Sugars 26.06	Sugars 36.17	Sugars 34.38	Sugars 20.81	Sugars 13.74
0.6	Other vegetables 113.19	Other vegetables 94.34	Other vegetables 165.84	Other vegetables 124.00	Other vegetables 40.31
0.6	Fat 18.83	Fat 25.56	Fat 22.75	Fat 7.98	Fat 15.21
0.4	Cereals 282.82	Cereals 314.19	Cereals 289.75	Cereals 208.51	Cereals 320.96
0.2	Milk & Product 174.03	Milk & Products 124.30	Milk & Products 227.02	Milk & Products 220.00	Milk & Products 63.62
0.2	Roots & Tubers 34.95	Roots & Tubers 46.10	Roots & Tubers 72.74	Roots & Tubers 61.06	Roots & Tubers 43.67
0	Fruits 65.62	Fruits 75.22	Fruits 120.95	Fruits 64.33	Fruits 19.55
0	Green Leafy Vegetables 85.15	Green Leafy Vegetables 59.72	Green Leafy Vegetables 115.65	Green Leafy Vegetables 92.56	Green Leafy Vegetables 45.50

BMI based distribution of households into the five clusters depicted in Table 2 is an attempt to link food consumption pattern with that of health status indicator. Maximum Percentage (34.94) of under-weight members was in cluster 3, which reported consumption of sugars higher than RDA. In

this cluster, consumption of all other dietary components was less than RDA. Maximum number of over-weight (28.34%) and obese-G I (44.62%) members also belonged to this cluster. Cluster 5, which consumed cereals at higher level than RDA, had very high percentage (42.86) of obese G-II.

On the contrary, maximum percentage of normal BMI category members (31.69%) was in cluster 2, which reported

consumption of pulses, sugars, fats and cereals at higher levels than RDA

**Table 2:** BMI status of members of households under different dietary intake clusters

Dietary Intake Clustering of Households (HH)	BMI-based Distribution of Family Members (%)				
	Under weight (n=249)	Normal (n=1095)	Over weight (n=311)	Obese G-I (n=128)	Obese G-II (n=26)
Cluster 1 Sugars, Fat > RDA (HH=120)	17.67	13.88	25.08	17.69	3.57
Cluster 2 Pulses, Sugars, Fat, Cereals >RDA (HH=89)	22.09	31.69	15.31	18.46	21.43
Cluster 3 Sugars >RDA (HH=61)	34.94	25.30	28.34	44.62	32.14
Cluster 4 All <RDA (HH=54)	14.06	15.62	18.57	6.92	0.00
Cluster 5 Cereals > RDA (HH= 42)	11.24	13.52	12.70	12.31	42.86
	100%	100%	100%	100%	100%

The results of chi-square test of association between food consumption pattern and the BMI status of family members are presented in Table 3. Consumption of fats more than RDA was evident with 45.6 per cent of the families, whereas about 40 percent of the households consumed cereals and sugars more than RDA. Only about 20 per cent of the households consumed pulses more than RDA level. This apart, the consumption of most other food group was less than RDA level. Less than 10 per cent of households consumed more than RDA levels of green leafy vegetables (8.5%), milk and milk products (6.8%), fruits (6.6%) and other vegetables (4.4%). Except one household, all households consumed less roots and tuber than RDA. The chi-square test results showed highly significant association between household dietary intake pattern and BMI parameters of family members with respect to other vegetables ( $X^2=39.61$ ) pulses (13.15), milk

and milk products (10.92) and green leafy vegetables (9.05). The level of association with respect to consumption of fruits was significant at five per cent level. It is important to increase the consumption levels of these categories of food so that the general health and well-being is maintained. Many studies have reported similar consumption pattern in different parts of India [15]. Reported inadequate intake of pulses and vegetables. Intake of pulses, leafy and non-leafy vegetables was less than RDA in 73, 88 and 67 per cent of households respectively. The diets of the rural households were monotonous and lacked variety. Cereals and millets together were the major food items among the rural households. The consumption of protective foods like fruits and vegetables was low in rural areas either due to non-availability or non-affordability.

**Table 3:** Association between dietary intake and BMI parameters of family members

Categorization of Households (n=366) based on Dietary Intake		BMI-based Distribution of Family Members				Chi square value	p value
		Underweight (n=249)	Normal (n=1095)	Overweight and Obese (n=465)	Total		
Cereals (300g)	<RDA (60.1% HH)	142	621	265	1028	0.015	0.9925
	>= RDA (39.9% HH)	107	474	200	781		
Pulses (90g)	<RDA (80.9% HH)	205	850	397	1452	13.15**	0.0014
	>= RDA (19.1% HH)	44	245	68	357		
Milk and Products (300 ml)	<RDA (93.2% HH)	226	1042	426	1694	10.92**	0.0043
	>= RDA (6.8% HH)	23	53	39	115		
Roots and Tubers (100 g)	<RDA (99.7% HH)	249	1094	462	1805	5.17	0.0751
	>= RDA (0.3% HH)	0	1	3	4		
Green Leafy Vegetable (150 g)	<RDA (91.5% HH)	232	1027	416	1675	9.05**	0.0108
	>= RDA (8.5% HH)	17	68	49	134		
Other Vegetables (200 g)	<RDA (95.6% HH)	243	1065	420	1728	39.61***	0.0000
	>= RDA (4.4% HH)	6	30	45	81		
Fruits (150 g)	<RDA (93.4% HH)	237	1030	422	1689	7.31*	0.0258
	>= RDA (6.6% HH)	12	65	43	120		
Sugar (30 g)	<RDA (61.2% HH)	158	638	279	1075	2.35	0.3086
	>= RDA (38.8% HH)	91	457	186	734		
FATS (20 g)	<RDA (54.4% HH)	143	554	252	949	4.55	0.1025
	>= RDA (45.6% HH)	106	541	213	860		

\*Significant at 0.05 level \*\*Significant at 0.01 level \*\*\*Significant at 0.001 level

The association between socio-economic variables of the home-makers, the demographic features of the households and the BMI-based distribution of family members are presented in Table 4. The age and educational status of

homemakers, the educational status of family members and the agricultural resources endowed by the households had significant association with the somatic status distribution of family members. In majority of the households (240 out of

366) where the homemakers were more than 35 years old, there were more over-weight family members. The distribution of family members was normally distributed in the households where the homemakers were young (< 35 years). Education level of the homemakers, which was mostly school-level (290 out of 366), was significantly associated with BMI-categories of the family members. Education level of members of the households (238 out of 366) was college level and their BMI distribution was more skewed towards over-weight category (28.38%). Households endowed with irrigated farms had more family members (26.78%) in the over-weight category. Increasing age was associated with a higher body mass index,

while higher education level and household income were linked to a lower body mass index [16]. Reported that BMI increases with age and it may be due to the decrease in energy requirements at rest. According to high body mass index was less frequent among well educated people [17], possibly because educated individuals tend to live in favorable environment to maintain appropriate weight [18], reported that income level is a risk factor for obesity as higher income increases affordability for energy dense foods. Higher fruit and vegetable intake was associated with a normal BMI, an effective dietary strategy to control weight and decreases the risk of obesity, Poverty and food insecurity may be the root cause for both under nutrition and overweight [19].

**Table 4:** Association between Demographic, Socio Economic Factors and BMI status

Households categorization based on demographic and socio-economic factors		BMI Category			Total	Chi square value	P value
		Under weight (n= 249)	Normal (n=1095)	Over weight/ Obese (n=465)			
Age of homemaker	Age (<=35) (n=126)	110 (16.60)	411	142 (21.42)	663	13.92***	0.0009
	Age (>35) (n=240)	139 (12.13)	684	323 (26.18)	1146		
Education of homemaker	School educated (n=290)	189 (13.27)	885	350 (24.57)	1424	7.37*	0.0251
	College educated (n=76)	60 (15.58)	210	115 (29.87)	385		
Family members' education	School education (n=128)	81 (14.62)	385	118 (20.20)	584	14.29***	0.0008
	College education (n=238)	168 (13.71)	710	347 (28.32)	1225		
Gender of family members	HH with more Male members (n=175)	105	522	227	854	4.82	0.3061
	HH with more Female members (n=85)	73	263	105	441		
	HH with male and female members equal (n=106)	71	310	133	514		
Family Type	Nuclear families (n=245)	147	631	244	1022	4.28	0.1174
	Joint families (n=121)	102	464	221	787		
Diet Pattern	Vegetarian families (n=188)	119	588	245	952	2.84	0.2416
	Non-vegetarian families (n=178)	130	507	220	857		
Agricultural Resource	Irrigated landholder (n=324)	217 (13.45)	964	432 (26.78)	1613	9.21**	0.0100
	Rainfed landholders (n=42)	32 (16.32)	131	33 (16.83)	196		
Livestock Resources	HH with Dairy Animals (n=263)	63	286	135	484	1.7253	0.4220
	HH without Dairy Animals (n=103)	186	809	330	1325		
Income source	Agriculture (n=284)	184	846	345	1375	2.3905	0.3026
	Agriculture +Nonfarm income(n=82)	65	249	120	434		
Income category	Below Poverty Line (n=317)	205	937	389	1531	2.0978	0.3503
	Above Poverty Line (n=49)	44	158	76	278		

\*Significant at 0.05 level \*\*Significant at 0.01 level \*\*\*Significant at 0.001 level

Normal body weight was found most often in younger respondents reported higher cereal consumption, fats and oils requirement was also fully met, whereas usage of pulses was less than half of requirement. Income and educational attainment are known to have substantial average associations with BMI across individuals [20].

**Conclusion / Summary**

Since the rural families belongs to a low socio-economic group in general, the reasons for the prevalence of under nutrition could be because women are over exhausted by the combination of reproductive demands and long term intake of lower amounts of food. Education, land holding, income, and age had a significant positive association with anthropometric measurements. The main food groups consumed daily were cereals followed by pulses. The roots & tubers, GLV and fruits intake was less and Majority of rural households (63.4%) had at least one over-weight person and in 46.2% of the households, there was at least one under-weight member in their family.

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