

# Geographical analysis of nutrition and related diseases of south Kashmir in District Anantnag, Jammu and Kashmir, India

Sheraz A. Lone · Bashir A. Lone · Manzoor A. Wani · Ishtiaq A. Mayer

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**Abstract** The main objective of this paper is to evaluate the “nutrition related” health issues altitudinal zone wise, based on chemical composition of food consumed by people in the region. The study area was divided into five altitudinal zones in GIS environment. Kendal’s ranking coefficient method, food surplus/deficit, nutrition intake was employed to show wide range of variations in terms of energy, protein, fat and calcium intake. The scenario of Nutrition related disease was worked out by applying Z score technique. Most of the population depends upon cereals for their basic food. Nutritional deficiency occurs maximum in higher altitudinal zones i.e. zone ‘D’ (C.I < 25.6) and zone ‘C’ (C.I 19.5–25.6) and low nutritional deficiency occurs in lower zones i.e. zone ‘A’ and zone ‘B’ (> C.I 19.3). The impact of this variation in nutrition intake pattern was reflected in the diseases which were found corresponding with the availability of food at each altitudinal zone. Nutritional status of the population in the study were found lower than the recommendations of Indian Council of Medical research Standards. Agriculture planning and nutritional awareness programs are badly needed to curb the grave problem and impose restrictions to land conversion a burning issue nowadays.

**Keywords** Altitude zone · Food deficit · Nutrition · Disease · Vulnerable

## Introduction

Diet and nutrition are important factors in the promotion and maintenance of good health throughout the entire life course (WHO 2003). By 2020, chronic diseases will account three quarters of all deaths worldwide, and that 71% of deaths due to ischemic heart disease (IHD), 75% of deaths due to stroke, and 70% of deaths due to diabetes will occur in developing countries (Aboderin et al. 2013). However, cardiovascular diseases are more prominent in India and China than in all the economically developed countries in the world (WHO 2003). Nutritional status is a person’s physiological level of nourishment in terms of energy and protein stores, micronutrient status and metabolic functioning” (FAO 2010), however, dietary intake is the amount of a nutrient that a person receives through their food intake or diet (Grosvenor and Smolin 2009). Food, nutrition and health are intimately linked and connected aspects that ensure good nutrition and health (Mudambi and Rajagopal 2007). People eat food not nutrients, however, the qualitative perspective of food lies in its nutritive value. It is the combination and the amount of nutrients in consumed foods that determine health. There are more than fifty known nutrients (including amino and fatty acids) and

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S. A. Lone (✉) · B. A. Lone · M. A. Wani · I. A. Mayer  
Department of Geography and Regional Development,  
University of Kashmir, Srinagar 190006, India  
e-mail: sheraz7geo@gmail.com

many more chemicals in food that impacts the functioning of human health (Gibney et al. 2009). The need and requirement of food depends on geographical factors like climate (the amount of required calories in less at high temperature) and on socio-cultural factors like age, sex, religion, etc. Health and nutrition are the most important contributory factors for human resource development in any country (Panter 1992).

Among the Indian population, about 40% in the rural and 30% in the urban areas are estimated to be below the poverty line (Varadarajan 2013). Per capita calorie intake is declining while as per capita intake of fats is unambiguously increasing. Today, more than three quarters of the population lives in households whose per capita caloric consumption per day is less than 2100 in urban areas and 2400 in rural areas, called as “minimum requirements” in India (Sen 2005). Cereal grains continue to play a dominant role in the diet pattern of people. Of the nearly 2 billion acres of cropland in the world, about 72% is used to produce grain, which accounts 55% of all food energy produced and are typically divided into food grains for people (wheat, rice and rye) and feed grains for livestock and poultry (oats, barley, sorghum etc.), any imbalance in the area devoted to food grains would definitely affect the food security (Snodgrass and Wallace 1982). In India the food problem arises from the supply demand gap. There are various causes leading to this gap, but changes in land use is most important (Singh and Sadhu 1986).

## Literature review

The work in this field was initiated by LD Stamp (1961) taking into account age and structure of population in various occupations, height, weight and climatic changes. He has also worked out that consumption of energy requires 2460 K cal in cold regions of western Europe. Therefore per capita energy requirements come to 1000,000 K cal and he called it Standard Nutrition unit (SNU). The work in this field was followed by Many Nutritionists, Medical Geographers across the world. In India Shafi (1960) have done a commendable work on land utilization in Utter Pradesh, in which he correlated the field produce and Nutritional level of people and considered per capita of daily energy intake 2200 K cal as the

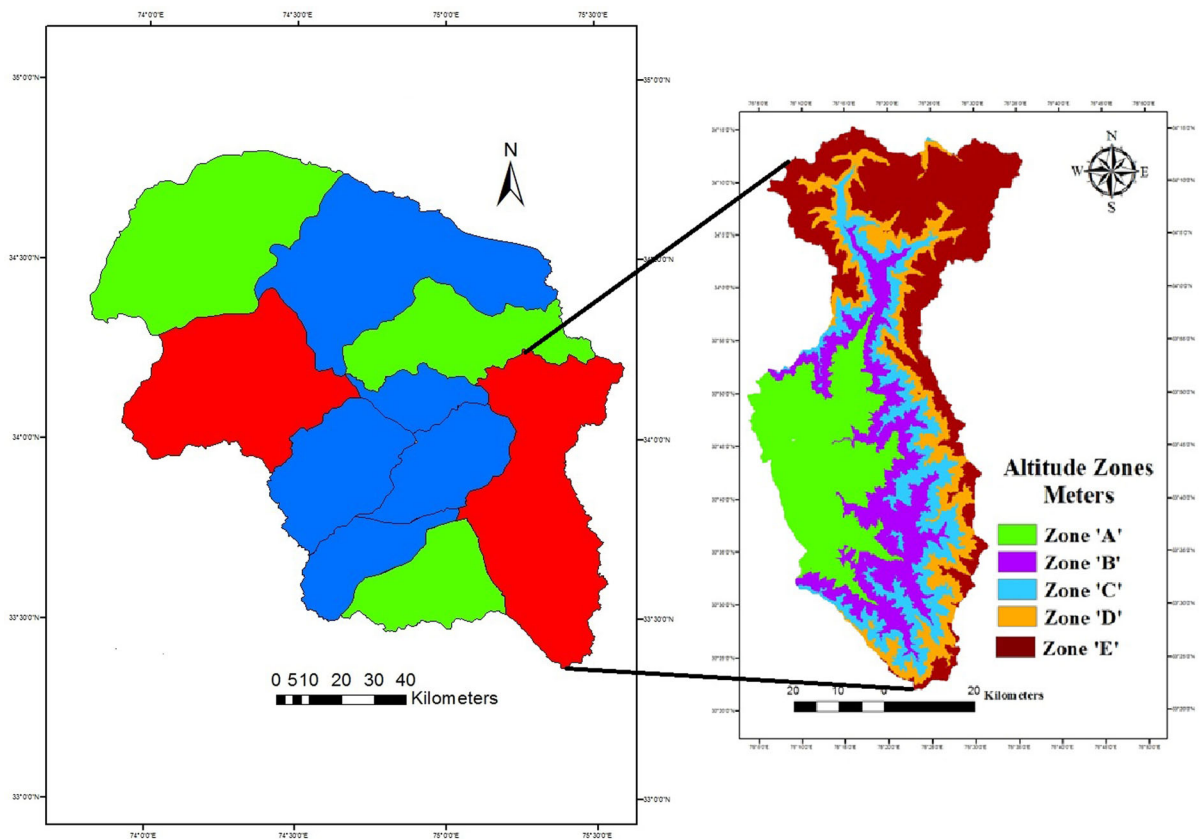
minimum requirement for taking account a loss of 10% in the process of post harvest. The work on Nutrition and deficiency diseases in relation to socioeconomic environment was carried out by Siddiqui (1968, 1971), Choubey (1985), Chouridule (1973), Mishra (1978), Izhar (1978), Ali Mohd. (1978), Noor Mohd. (1978), Mayer (2007). Other eminent workers who have carried out research directly or indirectly on Nutritional Geography in different parts of work include Vasanti Devi (1964), Kuriyan (1965), Kayastha (1965), Ayyar and Shrivastava (1968), Amani (1968), Bhattacharya (1968), Niyogi et al. (1968), Hammond et al. (1993), Koppert (1984), Khan and Al-Kanhal (1998), Bray and Popkin (1998a, b), Mayer (2007), Hurd and Kapteyn (2003), Swaminathan, (2008), Rehman et al. (2014), Aritonang and Siagian (2017). Like in other hilly states of India, nutrition problems are also prevalent in the state of Jammu and Kashmir because of inadequate, poor and faulty nutrition practices adopted besides geophysical constraints and socio-economic backwardness (Mohammad 1978; Akhtar 2016; Mayer 2008).

Keeping in view the methodologies adopted by previous researchers, the present study was also carried out to assess the geographical variation of nutrition and related health problems in Kashmir to arrive at the goal that can help the planners, geographers, nutritionists to improve the nutrition and health status.

## Study area

Anantnag district is in the southern sector of Jhelum valley, at an altitude of 5300 feet (1600 m) above mean sea level, at a distance of 33 miles (53 km) from main city Srinagar. The entire southern sector of the study area, which is contiguous with tehsils (administrative units) of Reasi, Banihal and Kishtwar of Jammu province, and eastern sector, which is contiguous with tehsil (administrative units) Kargil of Ladakh division comprises of thick forests and mountains. The northern and western sides are bounded by the Pulwama district, while Kulgam district falls in its west (Hussian 2013).

The study area has been delineated into five altitudinal zones that were generated from contour DEM as shown in Fig. 1, with a contour interval of 250 meters ranging from 1500 meters up to 5385 meters above mean sea level. Zone ‘A’ occupies an area of 37,751.3 hectares accounting 14.6% of the



**Fig. 1** Location map of the Study area. *Source:* Generated from SOI Toposheets, 1971 and Satellite image 2013

total area of the study area, while as zone ‘E’ occupies the largest area of 142,892.4 hectares accounting 55.4% of the total area.

**Materials and methods**

The data were collected and generated from different sources and have diverse nature and characteristics as presented in Table 1.

Sample survey/field survey

The study area was stratified into five altitudinal zones in order to assess the variation in nutritional status/dietary pattern zone wise and its impact on the health status. There are four methods of assessing the nutritional status viz. Anthropometric, biochemical, clinical and dietary (ABCD technique). The relevant component of the ABCD technique of nutritional measurement, i.e. ‘D’ (Dietary assessment) (Sukhatme and Margen 1982;

**Table 1** Type and source of data sets used. *Source:* Prepared by the author

S. no.	Data set	Type of data	Source	Date of acquisition
1	Topographic maps		Survey of India	1971
2	Primary data		Sample survey	2015–2016
3	Secondary Area	Prevalence of diseases	District Surveillance office, Anantnag	2015–2016
		Health institutions	CMO’s office Anantnag	2015–2016
		Population variables	Census of India, J&K Series, Srinagar/Jammu, 2011	2011
		RDA/nutritive value chart	National Institute of Nutrition (ICMR) Hyderabad	2010

Gopalan 1992; Seckler 1982), has been considered for the study. Moreover, 24 h recall, 7 days or more to food frequency questionnaires was also used to obtain information regarding the intake of different food items such as cereals, pulses, meat (beef, mutton, chicken, fish), vegetables, oil, milk and milk products. In this the quantity of food consumed by the respondents in terms of household measures (cup, spoons, ladles, spoons, katories, plates etc.) was used (Akhtar 1989, Akhtar and Learmonth 1986; Gopalan et al. 2010). A total of 52 Sample villages consisting of 571 households having a total population of 3995 persons, were surveyed across different altitudinal zones and Subjects were asked to recall the actual food consumed during last 24 h, last week or month and this was recorded on the diet sheet. The quantity was measured through these standardized containers. These were later converted into metric weight and the nutritive value was calculated by using food consumption table (Gopalan et al. 2010). Calculation of the nutrient intake was arrived at by using formulas (Rutishauser et al. 2002);

$$\text{Nutrient intake} = \text{Portion size (g)} \times \text{Frequency} \times \text{Nutrient content per gram.} \quad (1)$$

After that the nutritive value of different macro and micronutrients (proteins, fats, carbohydrates, riboflavin, niacin etc.) was compared with the Recommended Daily Allowance (RDA) of ICMR in order to assess the surplus and deficit of nutrition in each zone. The average RDA of all the age groups of both sexes has been considered for the study (Akhtar 1989; Akhtar and Learmonth 1986).

$$\text{Surplus/Deficit} = \text{Actual intake} - \text{Standard requirement} \quad (2)$$

$$\text{Percentage} = \frac{\text{Surplus/Deficit}}{\text{Standard requirement}} \times 100 \quad (3)$$

After the construction of composite index for each altitudinal zone, the scored values of composite index are classified into three categories which show the level of vulnerability.

$$\text{Composite index : } C.I = \sum_{j=1}^n \frac{X_{ij}}{X_j} \quad (4)$$

Here,  $X_{ij}$  = value of  $j$ th variate for  $i$ th altitudinal zone;  $n$  = number of variables,  $C.I.$  = Composite Index

In the present study the incidence rate of the disease's gender wise has been calculated by using the following formula:

#### Incidence rate

$$= \frac{\text{Number of new case of a disease during a given time period}}{\text{Total population at Risk during the same period of time}} \times 1000$$

For measuring disease intensity at zone level of the study area standardized score (**z-score**) method has been applied.

$$z = \frac{x - \mu}{\sigma}$$

where ' $\mu$ ' is the mean of the population and ' $\sigma$ ' is the standard deviation of the population

## Results and discussions

### Socio-economic setup

Socio economic status refers to as a finely graded hierarchy of social positions which can be used to describe a person's overall social position or standing and can be indicated by a number of sub concepts such as occupational status, educational attainment and income (Graetz 1995). Socio-economic status is commonly conceptualized as the social standing or class of an individual or group. It is often measured as a combination of education, income and occupation. The socio-economic conditions of the study area have been traced on the basis of various population dynamics like density, growth, literacy, sex ratio and the health care (Table 2)

### Health care infrastructure

Health care is a programme of services that should make available all facilities of healthcare and allied services necessary to promote and maintain the health of people. In India health care system is paralyzed because it has to face serious crises in coast, quality of care and equitable distribution of modes and standard services to the population as a whole (Shinde 1980). The levels of distribution of health care facilities in any region manifest itself at the level of health and human well being. The spatial distribution of health

**Table 2** Altitudinal zone wise socio-economic setup in District Anantnag

Socio-economic variables	Altitude zones			
	Zone “A”	Zone “B”	Zone “C”	Zone “D”
<i>Occupational structure (%)</i>				
Primary	65.5	68.1	73.2	78.6
Secondary	25.5	23.6	21.5	17
Tertiary	9.2	8.3	5.3	4.4
<i>Literacy</i>				
Male	81	75	71	65
Female	65	59	49	31
Total	73	67	60	48
<i>Income/month in percentage</i>				
< 8000	50	60	71	80
9000–16,000	60	24	9	7
17,000–22,000	16	9	6	4
> 23,000	13	7	4	2
<i>Sanitation (%)</i>				
Proper	65.40	47.30	19.30	07
Improper	34.50	52.60	80.70	93
<i>Population density (km<sup>2</sup>)</i>				
	790	410	221	80

care facilities appears to be affected by interrelated factors of physiographic constraints, socioeconomic and various demographic characteristics.

Tables 3, 4 shows altitudinal zone wise distribution and levels of various health care institutions in the study area. The study further shows that out of 159 health care institutions, there was 1 district hospital, 5 sub-district hospitals and 104 sub centers. The district hospital was found in the zone ‘A’ at Lalchowk Anantnag, out of 5 sub-district hospitals 3 were found in the zone ‘A’ at Bijbehara, Mattan, and Shangus and remaining 2 were found in zone ‘B’ at Dooru and Kokarnag. However, in zone ‘C’ and zone ‘D’ only 1 allopathic center and 4 sub centers were found (Figs. 2, 3; Table 5).

#### Nutritional intake pattern

The analysis of the Tables 6, 7 shows greater variation in the macro and micro nutrients across different altitudes.

#### Energy

The dietary intake of the population in the study area was deficient in quantity as recommended by Indian Council of Medical Research (ICMR). The intake of energy was showing inter zonal variation in the study area (Tables 6, 7). The average intake of energy was 2102.5, 2047, 1694 and 1001 K cal/day in the zone ‘A’, zone ‘B’, zone ‘C’ and zone ‘D’ respectively,

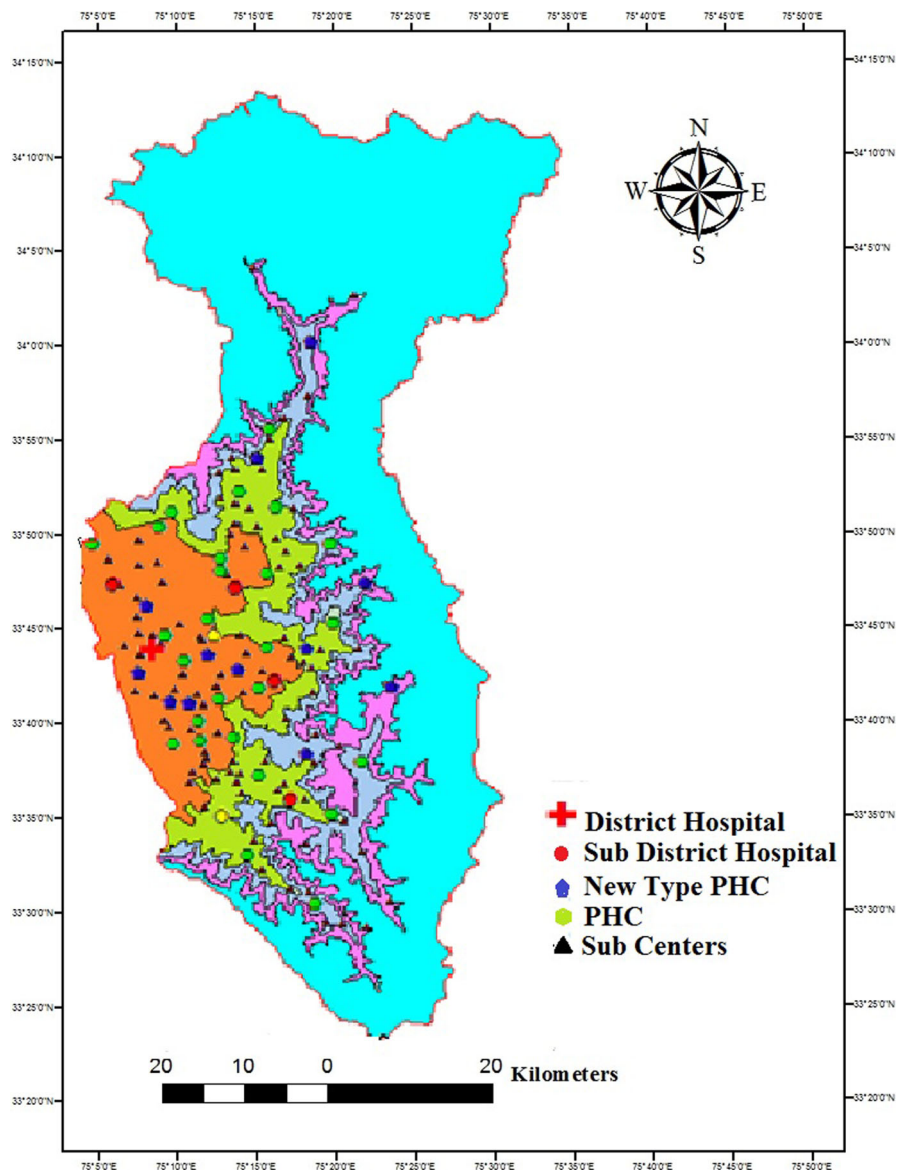
**Table 3** Altitudinal zone wise distribution of health care institutions in District Anantnag. Source: Chief Medical Officer, Anantnag, 2016

Altitude zones (m)	District hospital	Sub-district hospital	Primary health centers	Allopathic centers	Sub centers	Total
Zone ‘A’ (1500–1750)	1	3	20	10	50	84
Zone ‘B’ (1750–2000)	0	2	7	4	35	48
Zone ‘C’ (2000–2250)	0	0	4	3	15	22
Zone ‘D’ (2250–2500)	0	0	0	1	4	05
Total	1	5	31	18	104	159

**Table 4** Altitudinal zone wise levels of health care facilities in District Anantnag

Altitudinal zones (m)	Ranking coefficient	Levels of health care facilities
Zone 'A' (1500–1750)	3	High
Zone 'B' (1750–2000)	2	Medium
Zone 'C' (2000–2250)	1.2	Low
Zone 'D' (2250–2500)	0.6	Very low

**Fig. 2** Distribution of health care institutions of District Anantnag

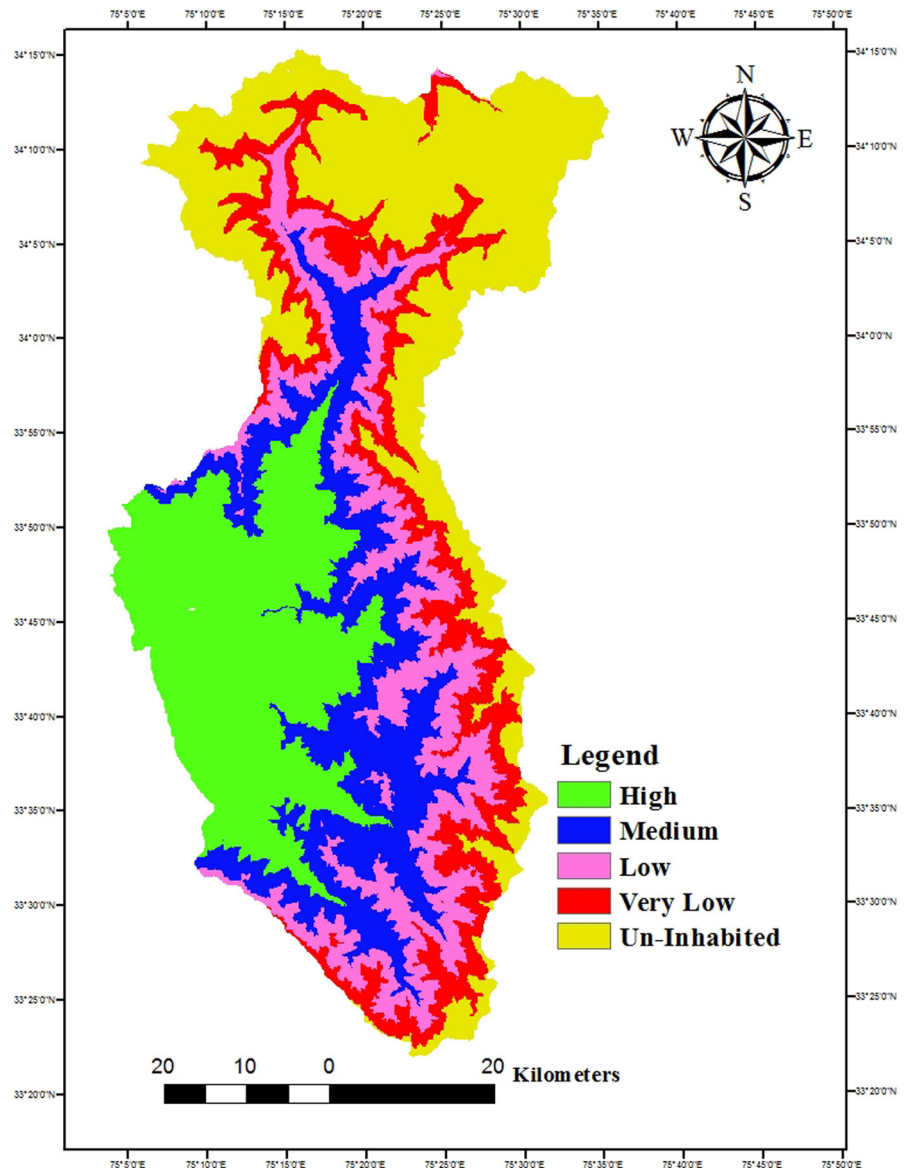


which were  $-0.45$ ,  $-3.05$ ,  $-19.76$  and  $-52.76\%$  deficit than recommended dietary allowance (RDA) of 2112 K cal/day. This variation exists because in Zone 'A', Zone 'B' population were mainly engaged with

secondary and tertiary activities and thus having high purchasing power, however in higher altitudes people were found engaged with primary sector (farming, domestication of animals and labors).the agriculture



**Fig. 3** Levels of health care facilities of District Anantnag



**Table 5** Altitudinal zone wise Population-doctor, institution-population and population bed ratio in district Anantnag. *Source:* Computed from Field Survey, 2016 and J&K, Census, 2011

Altitudinal zones (m)	Doctor-population ratio	Nurse-doctor ratio	Institution-population ratio	Population-bed ratio	Doctor-institution ratio
Zone 'A' (1500–1750)	1:4328	1:1	1:7781	1509:1	2:1
Zone 'B' (1750–2000)	1:4422	1:2	1:7781	1596:1	1:1
Zone 'C' (2000–2250)	1:7793	3:1	1:9092	2727:1	1:2
Zone 'D' (2250–2500)	1:23,077	3:1	1:11,538	23,077:1	1:2

**Table 6** Altitudinal zone wise intake of macro and micro nutrients in District Anantnag. *Source:* Field survey, 2015–16

Altitudinal zones (m)	Energy (K cal/day)	Protein (g/day)	Calcium (mg l/day)	Fat (g/day)	Iron (mg/day)	Niacin (mg/day)	Riboflavin (mg/day)	Vitamin 'C' (mg/day)
	ICMR Standards							
	2112	40	685	34	19	14	1.2	40
Zone 'A' (1500–1750)	2102.5	38.9	650	33	19.6	14.4	1.3	38.1
Zone 'B' (1750–2000)	2047.6	41.68	713.15	31.56	18.32	14.69	1.09	40.67
Zone 'C' (2000–2250)	1694.7	39.07	490.09	22.37	14.56	13.75	0.9	28.23
Zone 'D' (2250–2500)	1001	25.4	330	16	10	8.72	0.8	17.21

**Table 7** Ranking of macro and micro nutrients. *Source:* Compiled by author from Table 2

Altitudinal zones	Energy (K cal/day)	Protein (g/day)	Calcium (mg l/Day)	Fat (g/day)	Iron (mg/day)	Niacin (mg/day)	Riboflavin (mg/day)	Vitamin 'C' (mg/day)	Aggregate rank
Zone 'A' (1500–1750)	1	3	3	1	1	1	1	1	12
Zone 'B' (1750–2000)	2	1	2	2	2	2	2	2	14
Zone 'C' (2000–2250)	3	2	1	3	3	3	3	3	21
Zone 'D' (2250–2500)	4	4	4	4	4	4	4	4	32

land in lower zones is plain and having good drainage system and thus having high agricultural productivity while as in upper areas because of steep slope, poor drainage, immature soils and thus having low agriculture productivity.

#### *Protein*

The average intake of proteins among the population in the study area was 38.9, 41.68, 39.07 and 25.4 g/day in the zone 'A', zone 'B', zone 'C' and zone 'D' respectively, constituting a deficit of – 2.83, 4.21, – 23.2 and – 36.5 respectively. The average recommended dietary allowance (RDA) of proteins in the study area was 40 g/day (Tables 6, 7). In Zone 'A' and zone 'B' most of the agricultural land is under horticulture and farmers are growing cereals, pulses and other food crops while as in Zone "D" most of the land is under forests.

#### *Calcium*

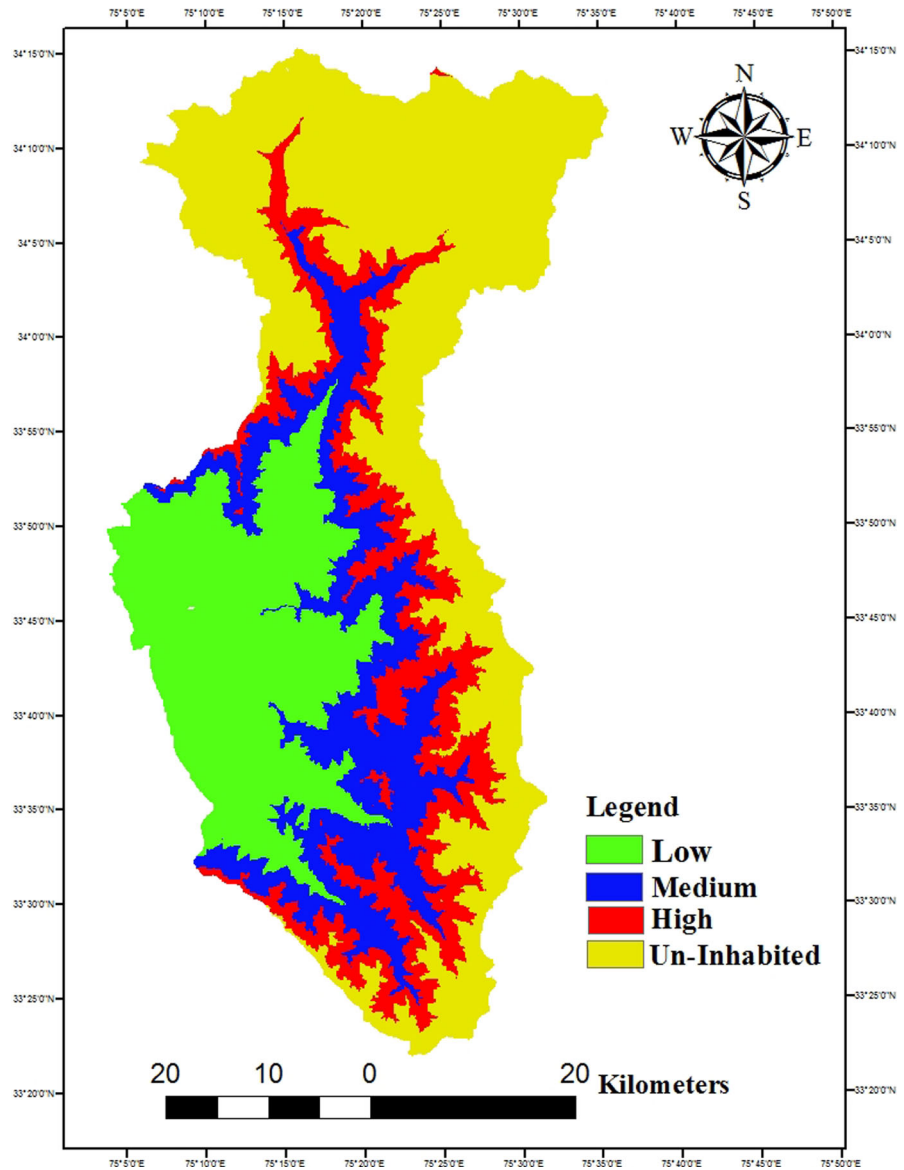
The average intake of calcium in the study area was 650.5, 713, 490 and 330 mg/day in the zone 'A', zone 'B', zone 'C' and zone 'D' respectively, constituting a deficit of – 5.04, 3.95, – 28.15 and – 51.82% respectively. The average recommended dietary allowance (RDA) in the study area was 685 mg/day.

#### *Fat*

The average consumption of fat in the study area were 33, 31.56, 22.37 and 16 g/day founded in the zone 'A', zone 'B', zone 'C' and zone 'D' respectively, showing a deficit of – 2.94, – 7.19, – 34.21 and – 51.8% lower than recommended dietary allowance (RDA) of 34 K cal/day.



**Fig. 4** Intensity of diseases of District Anantnag



*Iron*

The average intake of Iron among the population in the study area was 19.6, 17.32, 14.56 and 10 mg/day in the zone ‘A’, zone ‘B’, zone ‘C’ and zone ‘D’ respectively, showing a departure of 3.06, – 8.84, – 26.52 and – 47.36% respectively. The average recommended dietary allowance (RDA) in the study area was 19 mg/day.

*Niacin*

Highest intake of Niacin in the study area was found in zone ‘B’ 14.69 mg/day and lowest in zone ‘D’ 10.12 mg/day than the RDA (14 mg/day) showing departure of 4.99 and – 21% respectively.

*Riboflavin*

Riboflavin intake was showing inter zonal variation in the study area with highest intake were found in the zone ‘A’ (1.3 mg/day) and lowest in the zone ‘D’

**Table 8** Altitudinal zone wise distribution of selected major diseases in District Anantnag. *Source:* Compiled from District Surveillance office, Anantnag, 2015

Altitude zone (m)	Sex	Incidence rate of diseases						
		Cardiovascular diseases	Diabetes	Obesity	Anemia	Osteo malacia	ARI <sup>a</sup>	Diarrhea
Zone 'A' (1500–1750)	M	20.56	21.5	15.89	21.5	18.69	3.74	38.32
	F	15.2	22.3	20.3	29.4	16.2	6.1	38.5
	T	18	21.89	18	25.29	17.51	4.86	38.42
Zone 'B' (1750–2000)	M	18.98	18.98	14.6	35.04	24.82	17.52	43.8
	F	19.23	22.44	19.23	57.69	14.42	22.44	43.27
	T	19.1	20.63	16.81	45.84	21.39	19.86	43.54
Zone 'C' (2000–2250)	M	14.49	7.25	3.62	72.46	28.99	47.1	61.59
	F	16.46	12.35	8.23	94.65	28.81	61.73	57.61
	T	15.41	9.63	5.78	82.85	28.9	53.95	59.73
Zone 'D' (2250–2500)	M	16.95	0.00	0.00	118.64	50.85	101.69	67.8
	F	0.00	0.00	0.00	156.86	98.04	137.25	58.82
	T	9.09	0.00	0.00	136.36	72.73	118.18	63.64
Total		17.78	19.28	15.52	42.56	21.78	19.28	43.57

<sup>a</sup>ARI Acute Respiratory Infection

**Table 9** Altitudinal zone wise standard score of diseases in District Anantnag

Altitude zones (meters)	Cardiovascular diseases	Cancer	Diabetes	Obesity	Anemia	Osteo malacia	Respiratory tract infection	Diarrhea	Aggregate Z-Score
Zone 'A' (1500–1750)	0.58	– 0.462	0.86	0.901	– 0.97	– 0.691	– 0.881	– 1.055	– 1.718
Zone 'B' (1750–2000)	0.826	– 0.327	0.738	0.764	– 0.549	– 0.539	– 0.583	– 0.637	– 0.307
Zone 'C' (2000–2250)	0.002	– 0.694	– 0.331	– 0.501	0.211	– 0.244	0.094	0.686	– 0.777
Zone 'D' (2250–2500)	– 1.408	1.483	– 1.267	– 1.164	1.309	1.474	1.37	1.006	2.803

(0.8 mg/day) showing departure of 8.3 and – 33% respectively.

#### Vitamin 'C'

Tables 6, 7 reveals that intake of Vitamin 'C' was showing inter zonal in the study area. Highest intake were found in zone 'B' (40.67 mg/day) and the lowest was depicted in zone 'D' (17.21 mg/day) than the standard 40 mg/day, showing a departure of 0.25 and – 56.98.

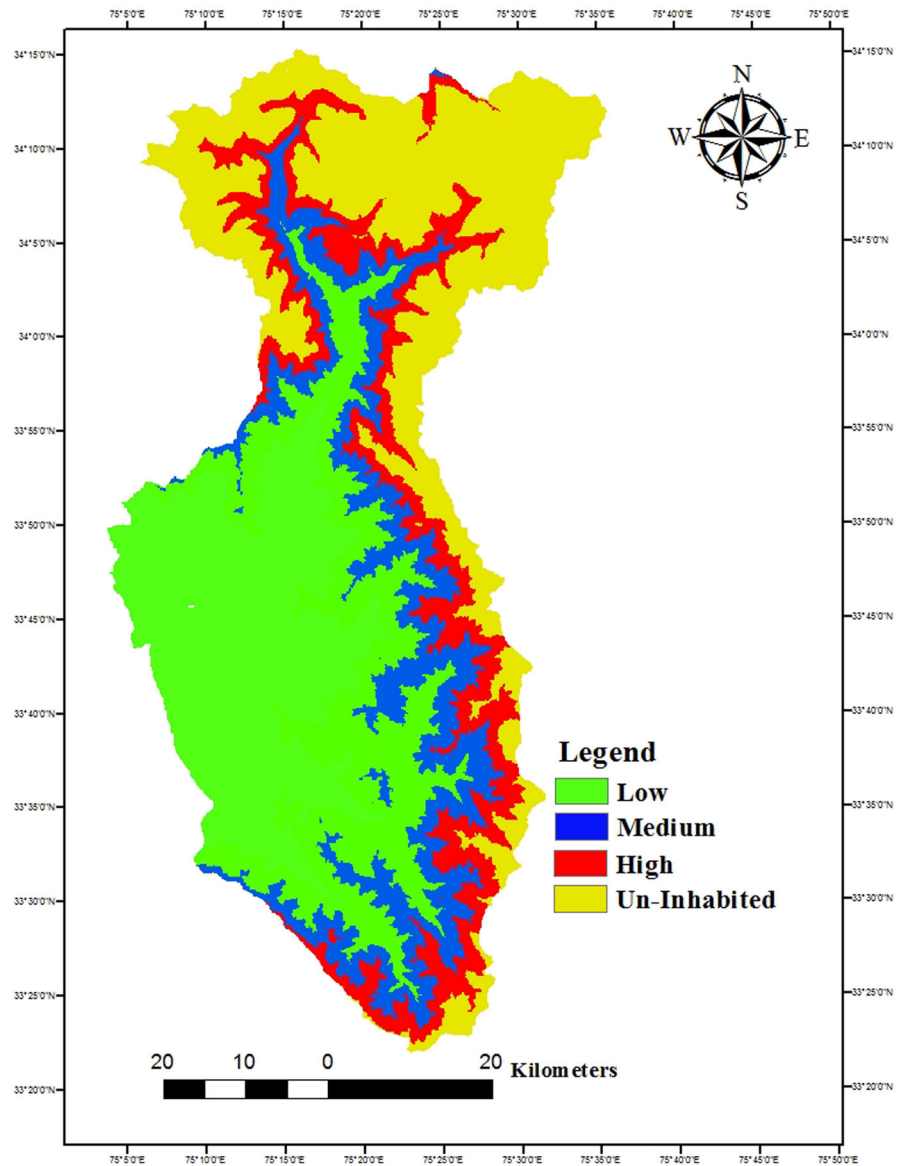
#### Distribution and intensity of diseases

Tables 6 and 8 depicts noticeable regional imbalances not only in nutritional intake but also in the intensity of

diseases across different altitudinal zones (Fig. 4). The study shows that diseases like Cardiovascular, Diabetes, Obesity were more dominant in lower altitudinal zones while as Anemia, Ostomalicia, Acute Respiratory Infection were dominant in Higher areas. Females were more to Anemia, Diabetes and Obesity as compared to males.

For the sake of delineation of diseases intensity regions of the study area, the diseases composite score by Z-score method has been applied and the values, which varies from – 1.78 in the zone 'A' to 2.803 in Zone 'D', have been put in three categories i.e. high diseases intensity zone, medium diseases intensity zone, and low diseases intensity zone (Table 9).

**Fig. 5** Nutritional vulnerability of District Anantnag



**Table 10** Altitudinal zone wise identification of vulnerable nutritional zones. *Source:* After author

Altitudinal zones (m)	Composite index (CI)	Vulnerable index
Zone 'A' (1500–1750)	> 19.3	Low
Zone 'B' (1750–2000)		
Zone 'C' (2000–2250)	19.3–25.6	Medium
Zone 'D' (2250–2500)	< 25.6	High

**Table 11** Altitudinal zone wise intensity of diseases in District Anantnag

Altitude zones (m)	Aggregate Z score	Diseases intensity zone
Zone 'D' (2250–2500)	2.803	High intensity
Zone 'B' (1750–2000)	– 0.307	Medium intensity
Zone 'C' (2000–2250)	– 0.777	
Zone 'A' (1500–1750)	– 1.718	Low intensity

## Nutritional vulnerable zones and related diseases

### *High vulnerable zones*

Mostly zone 'D' with higher altitude constitute the low intake of different macro and micro nutrients, viz. energy, protein, fat, calcium, iron, riboflavin, niacin and vitamin 'C', thereby found highly vulnerable to diseases like Anemia, ARI, Ostomalicia. (Tables 8, 10 and Fig. 5). The reasons being poor socio economic status, high food deficit (74%), low possession of agricultural land/productivity, poor fertile soils, and low awareness regarding balanced diet, as the diet that they consume is just to fill the stomach, inaccessibility, high food prices are a few reasons (Table 10).

### *Medium vulnerable zones*

Zone 'C' fall in this category. In this zone population takes medium to low intake of nutrients viz. energy, protein, fat, calcium, iron, vitamin 'A' and vitamin 'C' (Table 8). The reason being as most of the population was engaged in the primary sector. In this zone the domestic production of food crops was also found lower than their requirement, leading a food deficit of 59%, However, in case of disease intensity zone 'B' and zone 'C' fall in this category (Table 11).

### *Low vulnerable zones*

Zone 'A' and zone 'B' fall in the category of low nutrition vulnerable areas and is thus having high nutritional status and low intensity of diseases (Table 8). Although the dietary intake was lower than the recommended standards of ICMR, but still they consume adequate as compared to the other zones of the study area. The reasons being most of the population in these zones are engaged in secondary or tertiary sector with high literacy, high purchasing power parity and good awareness regarding the benefits of a balanced

diet, fertile soil, high productivity and low food deficit as compared to other zones of study area (Fig. 5).

## Conclusion

The study area is located along the foothills of Middle and greater Himalayas shows greater variation in topography, affecting the dietary pattern, agricultural productivity, occupational structure, farming practices, cropping pattern. All these factors are directly and indirectly affecting their nutritional status, which in turn is affecting their Health. The study shows that the intake of energy, protein, calcium, fat, Niacin, etc., shows an inter altitudinal variation. The highest intake of Energy was found in Zone "A" (2102.5 K cal/day) followed by Zone "B" and the lowest was found in Zone "D" (1001 K cal/day). Other Micro and micro nutrients were found following the same pattern. The effects of this nutrition vulnerability were reflected and translated by the disease intensity of the study area, resulted in low nutritional status and high intensity of the disease.

## Suggestions

In the study area income generation incentives should be provided at local level especially at higher altitudes. The government should provide free medicines to the affected zones and besides this awareness programs need to be organized by the health department, Aganwadi workers, local teachers and religious leaders, especially in the high intensity disease zone (zone 'D'). Rice promotion awareness programs by the agricultural department need to be held at the lowest administrative Panchayat level, as the area is gene centre of paddy cultivation in Kashmir, and is also the staple food of the area, however availability of HYV seeds should be assessed under agro climatic

conditions and only thereby made available to farmers at reasonable rates.

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### Compliance with ethical standards

**Conflict of interest** The authors are not having any conflict of interest to the previous studies.

**Ethical statement** This work was carried out with the help of human participants during our primary data collection. All the interests of the participants were taken into consideration during data collection and was approved by Department of Geography and Regional Development, university of Kashmir-Srinagar, India.

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