



**RESEARCH ARTICLE**  
**SPATIAL VARIATION IN MALNUTRITION GRADES USING BODY MASS INDEX (BMI)-A  
COMPARATIVE STUDY AMONG KASHMIRI AND GUJJAR ADULTS OF SOUTH KASHMIR  
HIMALAYAS, J&K-INDIA**

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**ABSTRACT**

The present study focuses on the height, weight, and body mass index (BMI) of the adults (15-49 age group) in Kashmiri and Gujjars communities of South Kashmir - J&K, estimating the prevalence and severity of thinness and overweight in this population and to pronounce the association of BMI with education, age and income. The design of the study is cross sectional representative survey of 1538 adults (860 men and 678 women). The main findings depicts mean height, weight, and BMI were 165.0 cm, 56.7 kg, and 20.82 kg/m<sup>2</sup> for men (Kashmiris) and 160.3 cm, 49.5 kg and 19.26 Kg/m<sup>2</sup> (Gujars), while as 152.0 cm, 50.8 kg, and 21.98 kg/m<sup>2</sup> for Kashmiri women and 151 cm, 42.4 kg, and 18.5 kg/m<sup>2</sup> for Gujjars women respectively. 11% of men and 15% women were thin/underweight (BMI < 18.5 kg/m<sup>2</sup>) in Kashmiri community, while as 24% of men and 30% of women are thin/underweight among Gujjars community as compared overweight (BMI > 25 kg/m<sup>2</sup>) only 15% Kashmiri males and 19% women are overweight. The Gujjars depict a different story in overweight with 9% and 4% respectively. The analyses showed that age, level of education, income levels and smoking habits are independently associated with BMI. It is concluded that sequelae of underweight / thinness and overweight represent major health problems.

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**INTRODUCTION**

Body Mass Index (BMI) a measure of malnutrition is a standard measure of weight-for-height that is commonly used to classify underweight, overweight and obesity of people, calculated as weight in kilograms divided by the square of height in meters (kg/m<sup>2</sup>). It was Devised by Belgian polymath Adolphe Quetelet (1850), thus also called Quetelet Index. But it was modified by Ancel Keys in 1972 while publishing a paper on BMI published by Journal of Chronic Diseases, which found the BMI to be the best proxy for body fat percentage among ratios of weight and height. It is a simple, inexpensive, and noninvasive surrogate measure of body fat and correlate with future health risks of morbidity and death

Globally, one-fifth of the world's population accounting about 1.2 billion adolescents are under the grip of under nutrition with the number ever increasing mostly in developing countries (WHO, 2014); on the other hand USA, a developed country revealed that if obesity continues to increase at current rate nearly 90% of adults and two thirds of children by 2050 will be overweight or obese (GOSF, 2014). INDIA, with inter-state variation in the levels of malnutrition's, shows a dismal picture among adults with 15.8 percent men and 12.6 percent women suffering from underweight (severe/moderate) while 4.5 percent men and 9 percent women as overweight (obese) (WHO, 2012) as compared to children that accounts 43 percent as underweight (Underweight Disparity Report, 2013). The

state of Jammu and Kashmir where the present study is carried out also revealed dual burden of malnutrition in adults as well as children with 25 percent of women and 28 percent of men are too thin; and 17 percent of women and 6 percent of men are overweight or obese as compared to children under the age of five, 35 percent are stunted, 15 percent are wasted and one fourth i.e. 26 percent are underweight clearly portrays the bad impression on the face of Jammu and Kashmir state. (NFHS-3-J&K, 2005-006) The BMI of an individual is often the result of many inter-related factors which can be classified as immediate, underlying and basic, (UNICEF, 1990) complex, ranging from biological and social to environmental factors, political instability and slow economic growth, to highly specific ones such as the frequency of infectious diseases and the lack of education. Moreover suitable aspects of natural environment, or example, mineral traces in water, the geological nature of bed rock material and specific biologic complexes also affect human health and may lead to long term chronic ailments (Armstrong, 1971, Boyd, 1970) These factors can vary across countries, nations, regions as well as sub regions leading to variation in the standard of nutrition from country to country and within the regions of diverse agro-climatic conditions. Due to inequalities in SES, The spectrum of BMI spreads from severe malnutrition to obesity that is reflected by BMI. So the present study shall focus on the Variations in BMI with respect to SES of the people of south Kashmir.

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**Objectives of the study**

- To identify different grades of Malnutrition among both Gujjar and Kashmiri community.
- To compare BMI of Gujjar and Kashmir communities of the study area.
- To find out the association of malnutrition grades with socio-economic variables in both the communities.

**Literature Review:** Many factors can contribute to high rates of malnutrition, ranging from political instability and slow economic growth, to highly specific ones such as the frequency of infectious diseases and the lack of education. These factors can vary across countries, Nations; regions and sub-regions because of huge diversity in terms of geographical as well as human induced factors. Impact of nutrition on health is not a recent approach in Medical geography but has attracted the attention of medical geographers for the last more than half a century. Although plenty of literature is available at national, international level and least is available at regional level.

It was the Bhole Committee (GOI, Press report, 1943) who opened up the window for analyzing the brutality of malnutrition problem and forced the government of India to allocate funds for it. However academicians in geography also started working on the nutritional aspects and the pathfinder in this direction was Stamp (Stamp, 1960) who worked on the consumption of calories in terms of energy of 2460 K.Cal. for Western Europe and Shafi (1960) did same in Uttar Pradesh (INDIA) by introducing the concept of Standard Nutrition Unit (SNU) equal to 1,000,000 K.Cal. But we cannot deny the research efforts of different but allied disciplines of nutrition science, home science, anthropology etc. which time and time lime lighted the issue of malnutrition focused with clinical, anthropometric biophysical methodologies which later on leads the establishment of National Institute of Nutrition formerly named as Nutrition Research Lab which took the rod into her hands and did nation-wide nutritional survey based on food consumption and the results were published in the form of Nutrition and Diet Atlas of India (Gopalan, 1971). Among them are Zargar (1997) found 46.39 percent of the Population in Pulwama and 52.32 percent in Anantnag affected by goiter, while Khuroo (1988) have identified hepatitis D as an etiologic cause of an outbreak of ‘hepatitis’ within a mean age of  $28.2 \pm 10.5$  years (range 10–56 years) thus became leading cause of malnutrition. Rather (2004) identified twenty nine percent children suffering from various deficiencies because of low birth weight as compared to ICMR. Khanday (2005) related the malnutrition with conflict situation. Mayer (2007) identified diverse agricultural activities responsible for highest prevalence of anemia in Kashmir valley. Dewan (2008) attributed it to poor socio-economic status as the root causes of malnutrition with 25.2% women as compared to male’s 20.2%.in Punjab while Villar (2008) analysed the relationship between income and Body mass Index found the negative relationship between household income and women and Shukla (2011) revealed the encouraging association between literacy and malnutrition. Akhtar (2009), Koundal (2012) in J&K while Krishnan (2012) in Tamil Naidu find out the regional disparity in health care patterns and planning process of the state mainly responsible for malnutrition in J&K and Khan (2012) found feeding practices sub-standard before the recommended standards leading to parallel increase in the malnutrition with 14.1%, 17.2% and 16.8% of the children in

Jammu, Kashmir and Ladakh attributed. Gull (2014) Assessing the women health aspects of Gujjar and Bakerwal Community of J&K found the health of Gujjar and Bakerwal women's very deteriorating the reasons being high family pressure as all the work is being done by women folk besides rearing of animals, illiteracy, lack of awareness about the schemes and facilities through meager provided by the govt. agencies and lack of health services. So steps should be taken to uplift the group on leaps and bounds.

**Data Base and Methodology**

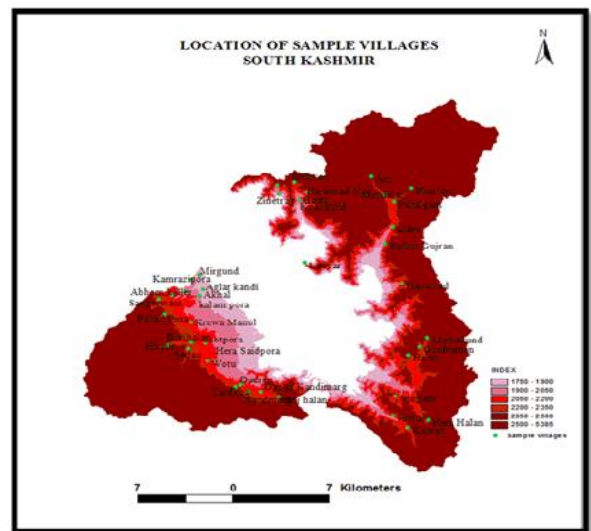
The present research paper was based mainly on primary data and partly on secondary data. The methodology was used under the following steps;

**Selection of Sample Village & Household Size:** Base map of the study area was delineated from the Survey of India(SOI) Toposheets with scale 1:50000 and processed digitally in GIS environment to divide the study area into different altitudinal zones (table 1) with the help of software’s like ERADAS Imagine 9.0 and Arc view GIS 3.2a. Stratified Random Sampling technique was used for selection of 15 % of sample villages (39) (Fig. 1) and 15% of sample households (3042) in proportion to total number of villages and households from each altitudinal zone.

**Table 1** Altitudinal Zones with Area

Altitudinal Zone	Area under each Zone	Percentage to total
A 1750-1900	422.29	10.2
B 1900-2050	360.04	8.7
C 2050-2200	337.12	8.4
D 2200-2350	294.28	6.7
E 2350- 2500	682.25	16.6
F Above 245	2046.73	49.4
<b>Total</b>	<b>4142.69</b>	<b>100</b>

Source: Derived from Counter DEM



**Fig.1**

Source: Computed from Counter DEM

**Anthropogenic Measurement**

As physical dimensions of body are influenced by nutrition particularly during the rapidly growing period of early adulthood thus body measurement can also provide information regarding malnutrition so Height, Weight and BMI was measured. The weight and height of all individual sample adults of different age groups of both male and female from each community i.e. Kashmiri and Gujjar was measured by using digital weight measuring machine and non-

stretchable tape. The method was repeated more than once and the mean was of the reading was taken as final.

**Analyses of Data**

First the BMI of all the sampled population was calculated by employing a formula

$$BMI = \frac{\text{Weight (Kg s)}}{\text{Height (meters)}^2}$$

but the prevalence and severity of thinness and overweight in the study area was done by using WHO Classification of 2007 (Table 2) to classify the sample population into different grades of malnutrition based on BMI .

**Table 2** Classification of Malnutrition Grades based on BMI

Classification	BMI(kg/m <sup>2</sup> )	
	Principal cut-off points	Additional cut-off points
Underweight	<18.50	<18.50
Severe thinness	<16.00	<16.00
Moderate thinness	16.00 - 16.99	16.00 - 16.99
Mild thinness	17.00 - 18.49	17.00 - 18.49
<b>Normal range</b>	<b>18.50 - 24.99</b>	<b>18.50 - 22.99</b>
Overweight	25.00	25.00
Pre-obese	25.00 - 29.99	25.00 - 27.49
Obese	30.00	27.50 - 29.99
Obese class I	30.00 - 34.99	30.00 - 32.49
Obese class II	35.00 - 39.99	32.50 - 34.99
Obese class III	40.00	35.00 - 37.49
		37.50 - 39.99
		40.00

Source: WHO, 2007

**Interpretation of Data**

The association of BMI with various socio-economic indicators was carried out by using various statistical techniques among which correlation, arithmetic means are a few and it was represented using various cartographic techniques like bar graphs. Map work was done by using Arc view 3.2a and Erdas Imagine 9.0.

**RESULTS AND DISCUSSION**

**Variation in Malnutrition grades based on Altitude using BMI**

Analysis of the table 3 reveals very good intraregional disparities in the constraints of malnutrition grades.

**Table 3** Variation in Malnutrition grades (percentage) Altitude wise using BMI

Altitudinal zone	Kashmiri				Gujjars			
	Total BMI<18.5	Severe/Moderate	Over-weight	Obese	Total BMI<18.5	Severe/Moderate	Over-weight	Obese
A1750-1900	14.30	6.78	7.38	4.54	0.00	0.00	0.00	0.00
B1900-2050	14.76	7.45	6.67	3.54	18.60	9.03	3.77	2.10
C2050-2200	12.54	7.80	5.24	2.56	17.52	10.17	3.49	1.56
D2200-2350	17.42	9.456	3.68	1.32	19.34	11.58	2.84	1.20
E2350-2500	19.01	11.84	2.81	0.98	22.06	14.00	1.30	0.84

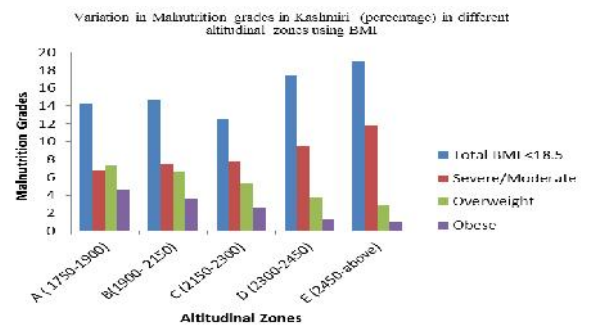
Source: Sample Survey, 2013-14

**Table 4.1** Gender (male) variation in Malnutrition grades (percentage) using BMI

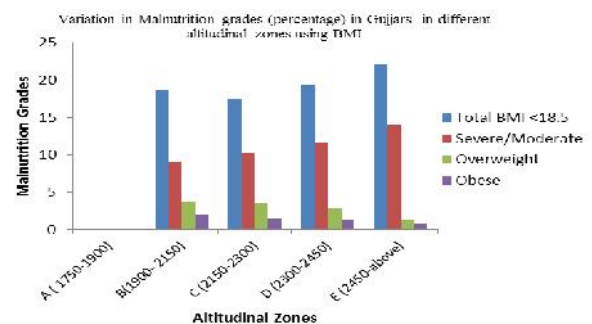
Altitudinal zone	Kashmiri male				Gujjar male			
	Total BMI<18.5	Severe/Moderate	Over-weight	Obese	Total BMI<18.5	Severe/Moderate	Over-weight	Obese
A 1750-1900	16.43	4.34	9.11	3.97	0.00	0.00	0.00	0.00
B 1900-2050	18.56	3.41	6.14	3.50	17.78	6.24	10.32	5.24
C 2050-2200	18.65	5.14	5.26	2.87	16.06	6.25	10.54	4.77
D 2200-2350	19.32	7.82	5.22	1.98	18.50	7.79	7.78	3.30
E 2350-2500	18.04	8.35	3.05	0.89	23.76	8.89	4.90	1.50

Source: - Based on Sample survey 2013-14

There is a positive correlation between altitude and the BMI levels. As we go from lower to higher altitudes the percentage of under nourished goes on increasing hence showing a positive correlation of 0.739 among Kashmiri and 0.803 in gujjars. The highest level of malnutrition is found in zone E among Kashmiri's 19.01 percent as compared to their counterparts Gujjars with 22.06 percent however the obese class is dominated by first two zones in Kashmiri community and by zone B in Gujjar community as no population is residing in zone A. while the obese class is mainly found in Kashmiri community with 4.54 percent in zone A followed by Zone B and C and least is found in zone E as compared to gujjars with 2.10 percent in Zone B and least is found in Zone E with 0.84 percent. The reasons being diverse geophysical constraints, socio-economic backwardness and traditional living styles, that pave way to the high malnutrition in gujjars as compared to Kashmiri community who are socio-economically forward and develop advanced living styles in them. However at higher altitudes the difference is least felt which is purely depicted in fig.2 and fig. 3 which shows inter zonal variations.



**Fig. 2.1**



**Fig. 2.2**

Source: Based on sample Survey 2013-2014

**Gender (male) variation in Malnutrition grades using BMI**

Analysis of the table 4.1 reveals malnutrition grades by Sex in men. The highest level of malnutrition is found in zone D among Kashmiri's 19.32 percent as compared to their counterparts Gujjars with 23.76 percent in zone E, the most vulnerable zones in both the communities are zone E followed by Zone D with little variation with 8.35,7.82 and 8.89, 7.79 percent respectively. The reasons must be quite hard labour work as most of the population in these zones is illiterate, besides diverse geophysical constraints, socio-economic backwardness and traditional living styles paves way to the high malnutrition in gujjars as compared to Kashmiri community who are somehow socio-economically forward and develop advanced living styles in them. However at higher altitudes the difference is least felt which is purely depicted in fig.3.1 and fig. 3.2.

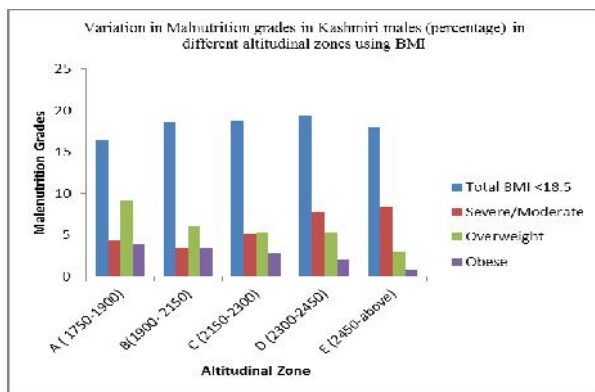


Fig.3.1

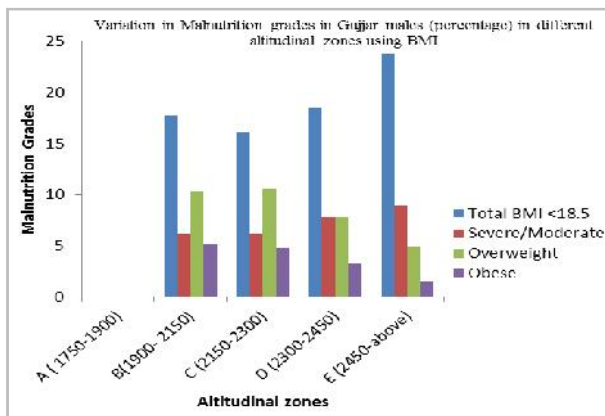


Fig. 3.2

Source: - Based on Sample survey 2013-14.

**Gender (Female) variation in Malnutrition grades using BMI**

Malnutrition grades by Sex in female population of both communities is shown in table 4b The highest level of malnutrition is found in zone E among Kashmiri's 21.44 percent as compared to their counterparts Gujjars with 29.25 percent in zone E, the most vulnerable zones in terms of

severity is Zone E with 10.19 percent and least by Zone B with 3.89 percent as compared to Gujjar female 13.35 and 5.25 percent respectively. The undernutrition depicts positive correlation with 0.958 in Kashmiris and +0.876 in gujjars However the inter zonal variation are interpreted in fig 4.2. The reasons found are early marriage, high fecundity, early weaning i.e. before 2 years as recommended by paediatians in Gujjar females leading to anemia intern low birth weight babies as compared to their counterparts Kashmiri females who enjoys better rights in every respect not upto mark but better than gujjars.

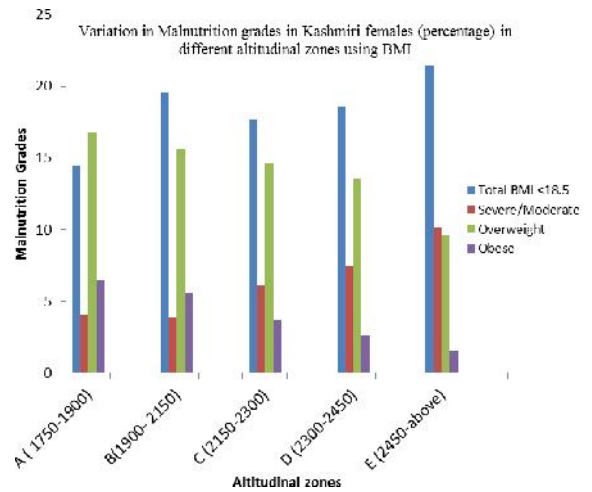


Fig.4.1

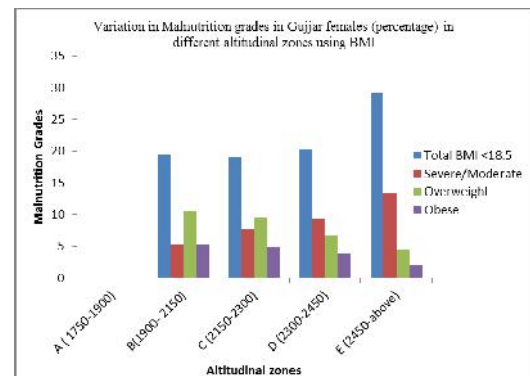


Fig.4.2

Source: - Based on Sample survey 2013-14

**Variation in Malnutrition grades by age group using BMI**

The whole sampled adult population was divided into four age groups as mentioned in the table 5 and was classified into different grades of malnutrition employing body mass index. . The correlation reveals negative correlation between age and undernutrition with -0.595 in Kashmiris and -0.6416 among Gujjars .From the table it is clear that in both the communities 15-19 age group is most vulnerable and affected because of the fact that this period is the most critical phase where by a boy attains manhood and all the bodily developments halts after

**Table 4.2** Gender (Female) variation in Malnutrition grades (percentage) using BMI

Altitudinal zone	Kashmiri females				Gujjars females			
	Total BMI<18.5	Severe/Moderate	Over-weight	Obese	Total BMI<18.5	Severe/Moderate	Over-weight	Obese
A1750-1900	14.51	4.08	16.78	6.43	0.00	0.00	0.00	0.00
B1900-2050	19.54	3.89	15.67	5.63	19.41	5.25	10.47	5.35
C2050-2200	17.65	6.1	14.67	3.65	18.98	7.83	9.54	4.8
D2200-2350	18.55	7.5	13.56	2.65	20.19	9.35	6.66	3.89
E2350-2500	21.44	10.14	9.65	1.54	29.25	13.35	4.4	1.98

Source: - Based on Sample survey 2013-14

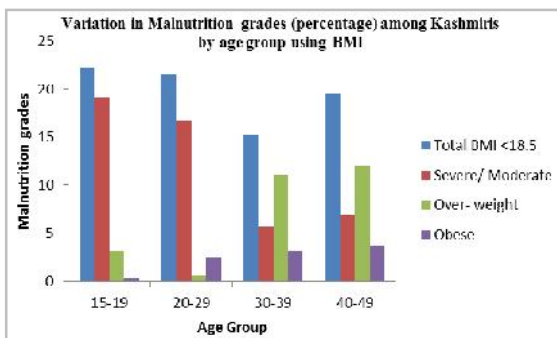


this period. so lot of calories are needed in addition to the daily requirements which are not provided by the required environment, followed by 40-49 19.5 and 23.7 percent respectively is under undernutrition. This is because group mostly remained engaged in diseases and infections leading to low consumption of calories poor immunity system, weakness of body organs thus poor BMI levels and only a scanty of population in both the communities is obese fig.5 reveals the rest interms of inter zonal variations.

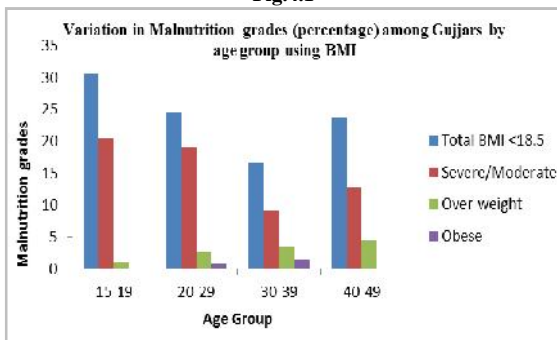
zone A. while the obese class is mainly found in Kashmiri community with 4.54 percent in zone A followed by Zone B and C and least is found in zone E as compared to gujjars with 2.10 in Zone B and least is found in Zone E with 0.84 percent. The reasons diverse geophysical constraints, socio-economic backwardness and traditional living styles paves way to the high malnutrition in gujjars as compared to Kashmiri community who are socio-economically forward and develop advanced living styles in them.

**Table 5** variation in Malnutrition grades (percentage) by age group using BMI

Age Group	Kashmiri				Gujjars			
	Total BMI<18.5	Severe/ Moderate	Over-weight	Obese	Total BMI<18.5	Severe/Moderate	Over-weight	Obese
15-19	22.2	19.1	3.2	0.3	30.6	20.43	1.	0.15
20-29	21.5	16.7	.5	2.4	24.5	19.10	2.65	0.9
30-39	15.3	5.7	11.1	3.1	16.5	9.26	3.4	1.35
40-49	19.5	6.9	12.	3.7	23.7	12.65	4.5	1.64



**Fig.4.1**



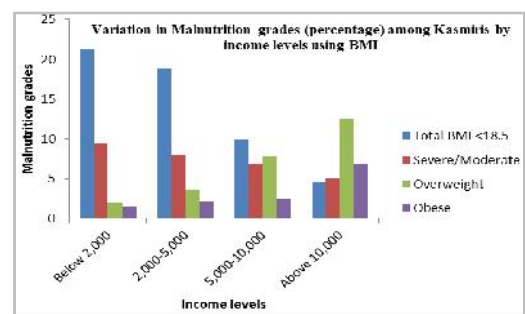
**Fig.4.2**

Source: - Based on Sample survey 2013-14

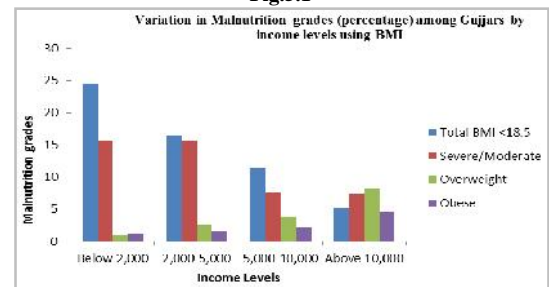
**Variation in Malnutrition grades by income level using BMI**

The table 6 reveals difference in income levels with has a pronouncing effect on the eating and standard of living in all the very good intraregional disparities in the constraints of malnutrition grades. There is a positive correlation between altitude and the BMI levels. As we go from lower to higher altitudes the percentage of under nourished goes on increasing. The highest level of malnutrition is found in zone E among Kashmiri's 19.01 percent as compared to their counterparts Gujjars with 22.06 percent however the obese class is dominated by first two zones in Kashmiri community and by zone B in Gujjar community as no population is residing in

However at higher altitudes the difference is least felt which is purely depicted in fig.3 which shows the interzonal variations.



**Fig.5.1**



**Fig.5.2**

**CONCLUSION AND SUGGESTION**

The BMI of Kashmiri adults is higher as compared to Gujjars and varies with respect to altitude, Age, Education levels, Gujjar women are more vulnerable to malnutrition as most of them belong to conservative society setup which make them more vulnerable at the time of marriage as the fecundity period is extended.

The main findings of the study were the mean height, weight, and BMI were 165.0 cm, 60.7 kg, and 22.29 kg/m<sup>2</sup> for men (Kashmiri) and 169.3 cm, 56.5 kg and 19.78 Kg/m<sup>2</sup>(Gujjars), while as 152.0 cm, 50.8 kg, and 21.98 kg/m<sup>2</sup>for Kashmiri women and 151 cm, 42.4 kg, and 18.5 kg/m<sup>2</sup> for Gujjars women respectively.

**Table 6** variation in Malnutrition grades (percentage) by income level using BMI

Monthly income	Kashmiri				Gujjars			
	Total BMI<18.5	Severe/Moderate	Over-weight	Obese	Total BMI<18.5	Severe/Moderate	Over-weight	Obese
Below 2,000	21.28	9.43	2.09	1.54	24.56	15.6	0.9	1.1
2,000-5,000	18.76	8.07	3.68	2.15	16.54	15.64	2.43	1.49
5,000-10,000	9.89	6.76	7.91	2.49	11.43	7.54	3.87	2.21
Above 10,000	4.54	5.10	12.5	6.74	5.20	7.44	8.10	4.62

Source: - Based on Sample survey 2013-14

Some 15% of men and 11% women were thin/underweight (BMI<18.5 kg/m<sup>2</sup>) in Kashmiri community, while as 30% of men and 16% of women are thin/underweight among Gujjars community. The proportion of adults with BMI above the normal weight is general attributed to high Socio-economic status (SES). Analyses reveal decrease of BMI with increase in Altitude. It may be attributed to traditional cropping practices and harsh agro climatic conditions which prevail there, besides non availability Crop essentials in the vicinity. The sample population face extended period of illness because of poverty and non- ability of Medicare and if present that too is of low standard thus affects the BMI. Some suggestions are recommended as under,

The present study shows a dismal picture of Malnutrition by analyzing the BMI of adults (15-49) age group. So, Awareness Programmes / counseling, regarding Balanced diet, health, and physical activity are needed badly. These Programmes should be encouraged through ICDS centers' as they are in deep slumber.

1. wide spread ignorance about Malnutrition among people in South Kashmir is a serious matter and needs to be addressed appropriately through intensive awareness campaigns in all the high and higher secondary's of the study area in particular and state in general as they are going to be the fore father of the society.
2. Implementation of various schemes of NRHM at gross root level as only AHSA component of JSA scheme is found visible in J&K. Availability/Appointment of Dietitian in every govt. and semi govt. institutions besides doctors as non- availability doctors left the patients in the hands of local pharmacists/medical Assistants who at times play the role of KASAYIE (the butcher).

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