

Food Utilization Patterns under Mountain and Plain Specificities: A Comparative Study

Deepak Bhagat^{1,*}, Shweta Priyamvada², Pavnesh Kumar³, Golli Mohan⁴

¹Department of Agribusiness Management & Food Technology,
North-Eastern Hill University, Tura Campus, Meghalaya-794002, India

²Department of Rural Development, University of Science & Technology,
Ri Bhoi, Meghalaya-793101, India

³School of Management Studies, IGNOU, New Delhi-110068, India

⁴ICSSR, Major Research Project, North-Eastern Hill University,
Tura Campus, Meghalaya-794002, India

*Corresponding Author: dip19bhagat@gmail.com

Abstract

The present study attempted to make a comparative investigation of the conditions underlying food and nutrition security in plain and mountain environments of rural India on the utilization dimension of food security. For this, two states from North-East India (Assam and Meghalaya) and two States from East India (Bihar and Jharkhand), who are having lowest SDG Index Score (NITI Aayog 2021) were taken. Thus from each specificity 30 villages were selected and then from each village 30 households were selected making a total of 900 sample households selected for the study from each specificity. From the study it was observed that income distribution differs significantly between the two regions. The majority of households in the mountain region fall into the low-income category (≤ 5000.00), while the plain region has a higher representation in the middle- and upper-income categories. In the mountain region, 21% of mothers are underweight, while the majority, 79.3%, fall within the normal BMI range, and 38.2% are classified as obese. In contrast, the plain region shows a much higher proportion of underweight mothers at 79%, with only 20.7% in the normal range and 61.8% categorized as obese. The data reveal that in mountain regions, chronic malnutrition represented by stunting is relatively stable but with steady figures across ages. Wasting, indicating recent or acute nutritional deficiency is somewhat variable but remains a concern, especially in the 36- 47 months age group. Conversely, children in the plain regions show lower but more fluctuating levels of these indicators, with some age groups experiencing higher malnutrition rates. While maternal nutrition requires greater attention in the plains, targeted child focused interventions are urgently needed in the mountains. Addressing these disparities is essential for strengthening the overall food and nutrition security of rural households across both environments.

Keywords: Food security, Utilization, Nutrition, Mountains and Plains, Anthropometric measurements, Body Mass Index (BMI)

Introduction

Food security is multi-dimensional, consisting of physical availability, physical and economic access, food utilisation, and stability of food supply and access over time as essential components (FAO, 2008). “Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life” (FAO, 1996). Fighting hunger in a changing world demands that we stay vigilant in our efforts to collect, analyze and disseminate information that is so very critical for designing and implementing hunger solutions which can save lives in emergencies, as well as putting the hungry poor on the path to food security (WFP, 2009). However, the present information on the subject fails to clearly differentiate the vulnerability to food insecurity under plain and mountain/hill specificities, thus providing little information to policy makers to prepare separate strategies under plain and mountain/hill specificities (Bhagat, 2021). This necessitates several comparative studies under plain and mountain specificities on complex food systems to facilitate the portrayal of existing trends and challenges and make available comprehensive information to policymakers (Bhagat, 2021; Dame, 2018). The present study attempted to make a comparative investigation of the conditions underlying food and nutrition security in plain and mountain environments of rural India on the utilization dimension of food security. For this, two states from North-East India (Assam and Meghalaya) and two States from East India (Bihar and Jharkhand), who are having lowest SDG Index Score (NITI Aayog 2021) were taken.

Research Methodology

Based on “Comprehensive Food Security and Vulnerability Analysis (CFSVA) guidelines” designed by World Food Programme of United Nations (WFP, 2009a), a stratified two-stage cluster sampling was used in the present study. In the first step the household aggregation that will be used as “clusters” is defined. Since aggregations should be pre-existing and recognized, the administrative aggregations such as villages as clusters were recommended in CFSVA Guidelines (2009). Based on this, for the present study the villages of Assam (Karbi Anglong Plateau), Meghalaya (Meghalaya Plateau), Bihar and Jharkhand were identified as clusters. List of villages and population statistics of the villages were drawn from Census, 2011 (District Census Handbook, Village and Town Wise, Primary Census Abstract, Census, 2011 Series- 19, Part- XII-B). Since the focus of the study was to investigate vulnerability of indigenous people food insecurity, the blocks with highest tribal population (based on basis of “Socio Economic and Caste Census (SECC), 2011(Rural)”, Ministry of Rural Development Government of India) were short-listed for the purpose of inclusion in the sample. CFSVA Guidelines (2009) recommends a 30-by-30 cluster sampling where 30 households are selected in each of 30 villages (CFSVA Guidelines, 2009). Thus, in the first stage first 30 villages i.e. 30 clusters are selected separately under plain and mountain specificities. And then in the second stage from each village 30 households are selected. To do this the villages having less than 30 households were dropped from the initial list of villages. The new list comprises only those villages which were having 30 or more than 30 households. The sampling frame of all the households in the selected clusters i.e. villages were constructed with the help of electoral roll and with consultation with the village headman. After that

following the procedure of systematic random sampling the households were selected for inclusion. Thus, in brief it can be said that in the first stage first 30 villages i.e. 30 clusters are selected. And then in the second stage from each village 30 households are selected. Thus from each specificity 30 villages were selected and then from each village 30 households were selected making a total of 900 sample households selected for the study from each specificity. The total sample thus constituted 1800 rural households. The present study was initiated on 1st of April, 2023. Pilot survey was carried out from July, 2023 to August, 2023 and actual data collection was started from 2nd Week of November, 2023 and completed in the last week of February, 2025.

Results and Discussion

Food utilization, typically reflected in an individual's nutritional status, is determined by the quantity and quality of dietary intake, along with health status and its determinants. Based on Lele et al. (2016), Burchi et al (2011), Riely et al. (1999), WFP (2009a) and WFP (2009b), the individual and household food utilization of indigenous hill people of Meghalaya were explored with following indicators.

- (i) Access to water and sanitation
- (ii) Anthropometric measurements of children under 5 (wasting, stunting underweight); mid-upper arm circumference (MUAC) of children under 5;
- (iii) Maternal body mass index (BMI)

The findings of the study on the above dimensions are presented below

Socio-Economic Conditions of the Rural Households under Mountain and Plain Specificities

From the study it was observed that the majority of families in both regions have four or five members (42.2% of families under mountain specificities and 32.4 % under plain specificities). The mean age in the mountain region was found to be 32.69 years, whereas in the plain region, it is significantly higher at 42.87 years with statistically significant difference. The younger household heads in the mountain region may reflect migration or newer family formations. It was observed that the age dependency ratio is higher under mountain regions than in plain regions. The study reveals the majority of respondents in both the mountain and plain regions reported not having access to credit, with 86.0% and 78.9%, respectively. Regarding land holding patterns, the study shows that the majority of landholders in the mountain region own marginal land (92.9%), whereas the plain region has a more diverse landholding pattern, including small, semi-medium, and medium-sized lands. The Kruskal-Wallis test ($H(2) = 254.828, p = 0.000$) confirms significant regional differences in land use. These differences shape the agricultural potential and socio-economic conditions, with plains favoring market-oriented farming and mountains relying on diverse livelihoods amidst challenging farming conditions.

Food Utilization Patterns under Mountain and Plain Specificities

Household Wealth Index

The distribution of households across wealth quintiles reveals a stark difference between the mountain and plain regions (Table 1). In the mountain region, a large proportion of households (91.84%) fall within the poorest quintile (Q1). The mean WI in plain is significantly higher at 1.263, revealing a better economic standing. The wealth index values increase progressively from Q1 to Q5 in both regions, but households in the plain region attain higher maximum values (up to 4.461) compared to the mountain region (2.980). The Kruskal-Wallis test results ($H = 138.237$, $p = 0.000$) reveal a statistically significant difference in wealth distributions between the two regions. The mean rank is higher in the plain region in contrast to the mountain region, suggesting that overall households in the plains are significantly wealthier than those in the mountains.

Table 1: Wealth Index

Quintile	Mountain	Plain
Q1 (Poorest)	300 (PC: 91.84; WI: -1.251)	184 (PC: 44.84; WI: -1.635)
Q2 (Poor)	94 (PC: 302.97; WI: -0.908)	196 (PC: 224.76; WI: -0.867)
Q3 (Middle)	152 (PC: 441.25; WI: -0.021)	227 (PC: 456.02; WI: -0.184)
Q4(Rich)	221 (PC: 635.81; WI: 0.800)	163 (PC: 667.98; WI: 0.769)
Q5 (Richest)	133 (PC: 824.74; WI: 2.160)	130 (PC: 824.41; WI: 2.980)
Mean (WI)	-0.726	1.263
Median (WI)	-1.034	-0.312
Standard Deviation	1.003	1.512
Variance	1.006	2.285
Minimum	-2.913	-2.032
Maximum	2.980	4.641
Range	5.893	6.673
Skewness	0.444	1.071
Kurtosis	-0.163	0.397
Kruskal-Wallis Test		
Mean Rank	756.67	1044.33
<i>H</i> statistic	H (2) =138.237, p = 0.000. Since the p-value is less than 0.05, the result is statistically significant	

Water and Sanitation

Drinking water sources vary significantly between the regions. The mountain region predominantly relies on rivers, streams, and mountain sources, whereas piped water is more common in the plain region. The Kruskal-Wallis test ($H (2) = 428.718$, $p = 0.000$) from Table 2 indicates a significant disparity in water access between regions. The average time required to collect water is slightly longer in the mountain region (13.33 min) compared to the plain region (12.24 min) (Table 3). Although the difference is statistically significant ($H (2) = 12.597$, $p = 0.000$), both regions experience challenges in water collection. Additionally, there is no statistically significant difference in the distance travelled for good quality drinking water ($H (2) = 3.115$, $p = 0.07$) (Table 4). Water collection responsibilities vary by region, with girls and women playing a more significant role in the plain region compared to the mountain region, where responsibility is more evenly distributed. The Kruskal-Wallis test (H

(2) = 127.955, $p = 0.07$) suggests no statistically significant difference in gender roles for water collection (Table 5). The mountain region has a higher percentage of households with flush toilets (84.0%) compared to the plain region (57.6%). The Kruskal-Wallis test ($H(2) = 178.357$, $p = 0.07$) suggests no significant difference in sanitation facilities (Table 6).

Table 2: Main Sources of Drinking Water

Source of Drinking Water for Household	Mountain Region	Plain Region
Piped water	0 (0.0%)	317 (35.2%)
Well/borehole protected	118 (13.1%)	223 (24.8%)
Well/borehole unprotected	172 (19.1%)	110 (12.2%)
River, stream, or dam	301 (33.4%)	132 (14.7%)
Mountain source	309 (34.3%)	118 (13.1%)
Total	900 (100.0%)	900 (100.0%)
Mean	3.89	2.4567
Median	4	2
Standard Deviation	1.0237	1.42647
Variance	1.048	2.035
Minimum	2	1
Maximum	5	5
Range	3	4
Skewness	-0.514	0.554
Kruskal-Wallis Test		
Mean Rank	1148.6	652.4
<i>H</i> statistic	H (2) =428.718, $p = 0.000$. Since the p-value is less than 0.05, the result is statistically significant	

Table 3: Duration to Collect Drinking Water

Time Required to Collect water	Mountain Region	Plain Region
Very Short (≤ 5 mins)	219 (24.3%)	239 (26.6%)
Short (6–10 mins)	262 (29.1%)	344 (38.2%)
Moderate (11–20 mins)	307 (34.1%)	226 (25.1%)
Long (21–30 mins)	106 (11.8%)	83 (9.2%)
Very Long (> 30 mins)	6 (0.7%)	8 (0.9%)
Total	900 (100.0%)	900 (100.0%)
Mean	13.33 min	12.24 min
Median	10.00 min	10.00 min
Standard Deviation	7.28	7.08
Variance	52.99	50.1
Minimum	5	1
Maximum	45	45
Range	40	44
Skewness	0.874	1.315
Kurtosis	0.726	2.17
Kruskal-Wallis Test		
Mean Rank	942.62	858.38
<i>H</i> statistic	H (2) =12.597, $p = 0.000$. Since the p-value is less than 0.05, the result is statistically significant	

Table 4: Distance to Access Quality Drinking Water

Distance	Mountain Region	Plain Region
Very Short (≤ 10 km)	199 (22.1%)	178 (19.8%)
Short (11–30 km)	322 (35.8%)	243 (27.0%)
Moderate (31–60 km)	124 (13.8%)	184 (20.4%)
Long (61–100 km)	116 (12.9%)	235 (26.1%)
Very Long (>100 km)	139 (15.4%)	60 (6.7%)
Total	900 (100.0%)	900 (100.0%)
Mean	54.98	52.85
Median	30	40
Standard Deviation	52.56	42.43
Variance	2762.39	1800.33
Minimum	8	8
Maximum	300	300
Range	292	292
Skewness	1.499	1.536
Kurtosis	1.779	3.557
Kruskal-Wallis Test		
Mean Rank	879.1	921.9
<i>H</i> statistic	H (2) = 3.115, p = 0.07. Since the p-value is less than 0.00, the result is not statistically significant	

Table 5: Gender Distribution in Drinking Water Collection

Collection of Water	Mountain Region	Plain Region
Girls	136 (15.1%)	293 (32.6%)
Boys	100 (11.1%)	27 (3.0%)
Women	66 (7.3%)	278 (30.9%)
Men	109 (12.1%)	38 (4.2%)
Every One	489 (54.3%)	264 (29.3%)
Total	900 (100.0%)	900 (100.0%)
Mean	3.7944	2.9478
Median	5	3
Standard Deviation	1.54321	1.59621
Variance	2.382	2.548
Minimum	1	1
Maximum	5	5
Range	4	4
Skewness	-0.825	0.038
Kurtosis	-0.959	-1.463
Kruskal-Wallis Test		
Mean Rank	1032.36	768.64
<i>H</i> statistic	H (2) = 127.955, p = 0.07. Since the p-value is less than 0.00, the result is not statistically significant	

Table 6: Access to Sanitation Facilities among Households

Sanitation	Mountain Region	Plain Region
Flush latrine/toilet with water	756 (84.0%)	518 (57.6%)
Traditional pit latrine (no water)	85 (9.4%)	89 (9.9%)
(Partly) open pit (no roof or no wall)	13 (1.4%)	110 (12.2%)
Communal latrine	27 (3.0%)	0 (0.0%)
None/bush (go into forest)	19 (2.1%)	183 (20.3%)
Total	900 (100.0%)	900 (100.0%)
Mean	1.2978	2.1567
Median	1	1
Standard Deviation	0.8198	1.58304
Variance	0.672	2.506
Minimum	1	1
Maximum	5	5
Range	4	4
Skewness	3.178	0.975
Kurtosis	9.745	-0.702
Kruskal-Wallis Test		
Mean Rank	769.33	1031.67
<i>H</i> statistic	H (2) = 178.357, p = 0.07. Since the p-value is less than 0.00, the result is not statistically significant	

Income and Expenditure

Income distribution differs significantly between the two regions. The majority of households in the mountain region fall into the low-income category (≤ 5000.00), while the plain region has a higher representation in the middle- and upper-income categories. The Kruskal-Wallis test ($H(2) = 178.357, p = 0.000$) indicates a significant disparity in income levels (Table 7). Expenditure patterns show that households in the plain region have higher expenditures than those in the mountain region. The Kruskal-Wallis test ($H(2) = 10.608, p = 0.001$) confirms a significant difference in spending behaviour between the two regions (Table 8). The results suggest notable demographic and socio-economic differences between households in the mountain and plain regions. The mountain state tends to have younger household heads, larger families and a higher dependency ratio, which may indicate differences in economic opportunities and migration trends. The plain state, with its older household heads and higher levels of secondary education, may reflect a more stable and established population. These findings provide essential insights into regional differences that can inform policy-making, particularly in areas of education, family planning, and economic development. The analysis highlights significant regional differences in financial access, land use, water supply, sanitation and income levels. The findings emphasize the need for targeted policies to address disparities in resource access and economic opportunities across different regions.

Table 7: Household Income Distribution

Income	Mountain Region	Plain Region
Low ($\leq 5K$)	600 (66.7%)	300 (33.3%)
Lower-Mid (5K–10K)	280 (31.1%)	250 (27.8%)
Middle (10K–20K)	20 (2.2%)	200 (22.2%)
Upper-Mid (20K–50K)	0 (0.0%)	100 (11.1%)
High ($> 50K$)	0 (0.0%)	50 (5.6%)
Total	900 (100.0%)	900 (100.0%)
Mean	5,559.20	11,624.86
Median	5,562.50	6,423.00
Standard Deviation	943.49	11,790.74
Variance	8,90,165.82	13,90,21,485.61
Minimum	2,942.00	958
Maximum	9,796.00	99,733.00
Range	6,854.00	98,775.00
Skewness	0.374	3.254
Kurtosis	0.621	14.612
Kruskal-Wallis Test		
Mean Rank	769.33	1031.67
<i>H</i> statistic	H (2) = 178.357, p = 0.000. Since the p-value is less than 0.05, the result is statistically significant	

Table 8: Household Expenditure Patterns

Expenditure Category	Mountain Region	Plain Region
Low ($\leq 5K$)	848 (94.22%)	531 (59%)
Middle (5K–20K)	52 (5.78%)	333 (37%)
High ($> 20K$)	0 (0.0%)	36 (4%)
Total	900 (100%)	900 (100%)
Mean	4182.46	4289.88
Median	4123.5	4218
Standard Deviation	829.18	867.01
Variance	6,87,531.78	7,51,700.17
Minimum	1756	1722
Maximum	8465	8685
Range	6709	6963
Skewness	0.7	0.84
Kurtosis	1.447	1.874
Kruskal-Wallis Test		
Mean Rank	860.6	940.4
<i>H</i> statistic	H (2) = 10.608, p = 0.001. Since the p-value is less than 0.05, the result is statistically significant	

Anthropometric Indicators of Malnutrition

Age Distribution of Children Under 5 Years

The analysis of Tables 9 and 10 reveals negligible differences in the demographic profiles of children below five years across mountain and plain regions.

Table 9: Age Distribution of Children Under 5 Years

Statistic	Mountain Region	Plain Region
0–11 months	42 (18.34%)	41 (16.87%)
12–23 months	48 (20.96%)	52 (21.40%)
24–35 months	43 (18.78%)	47 (19.34%)
36–47 months	48 (20.96%)	61 (25.10%)
48–59 months	48 (20.96%)	42 (17.28%)
Total	229 (100.0%)	243 (100.0%)
Mean	3.0524	3.0453
Median	3	3
Standard Deviation	1.41324	1.35528
Variance	1.997	1.837
Minimum	1	1
Maximum	5	5
Range	4	4
Skewness	-0.037	-0.073
Kurtosis	-1.309	-1.225
Kruskal-Wallis Test		
Mean Rank	236.95	236.08
<i>H</i> statistic	H (2) = .005, p = .943. Since the p-value is not less than 0.05, the result is not statistically significant	

Age distributions in both geographical settings are closely aligned. Moreover, the application of the Kruskal- Wallis test confirms that no statistically significant disparity exists with respect to age distribution between the two regions ($p = 0.943$). Likewise, gender distributions exhibit only marginal variation, with both regions reflecting a slight predominance of female children.

Table 10: Gender Distribution of Children Under 5 Years

Gender	Mountain Region	Plain Region
Female	120 (52.40%)	128 (52.67%)
Male	109 (47.60%)	115 (47.33%)
Total	229 (100.0%)	243 (100.0%)

Table 11 presents the age group distribution of mothers with children below five years. In the mountain area, a majority of mothers (58.5%) fall within the 20- 24 years age group, followed by 23.1% in the 25- 29 years bracket. In contrast, the plain region shows a more even distribution across age groups, with 42.4% in the 25- 29 years, 28.4% in 20- 24 years, and 18.9% in 30- 34 years. The mean age of mothers in the mountain region is 22.84 years compared to 27.07 years in the plain region. Statistical measures reflect notable differences in the two regions. A Kruskal-Wallis test comparing the two groups' age distributions resulted in a significant difference ($H = 103.663$, $p < 0.001$), confirming that the age profiles of mothers in mountain and plain regions differ statistically.

Table 11: Age Group Distribution of Mothers with Children Under 5 Years

Age Group of Mothers below 5-year child	Mountain	Plain
Mother age ≤ 19	36 (15.7%)	4 (1.6%)
Mother age (20–24)	134 (58.5%)	69 (28.4%)
Mother age (25–29)	53 (23.1%)	103 (42.4%)
Mother age (30–34)	6 (2.6%)	46 (18.9%)
Mother age (≥ 35)	0 (0.0%)	21 (8.6%)
Total	229	243
Mean	22.843	27.072
Median	23	26.4
Standard Deviation	3.105	4.651
Variance	9.642	21.632
Minimum	18	18.1
Maximum	33	42.5
Range	15	24.4
Skewness	0.512	0.784
Kurtosis	-0.054	0.616
Kruskal-Wallis Test		
Mean Rank	170.73	298.48
H statistic	H (2) = 103.663, p = 0.000. Since the p-value is less than 0.05, the result is statistically significant	

3.2.4.2. BMI Status of Mothers with Children Under 5 Years

The Table 12 presents the distribution of Body Mass Index (BMI) categories among mothers in the mountain and plain regions. In the mountain region, 21% of mothers are underweight, while the majority, 79.3%, fall within the normal BMI range, and 38.2% are classified as obese. In contrast, the plain region shows a much higher proportion of underweight mothers at 79%, with only 20.7% in the normal range and 61.8% categorized as obese. The standard deviation and variance values show that there is more variation in BMI categories among mothers in the plain region compared to those in the mountain region. A Kruskal-Wallis test reveals a statistically significant difference ($H = 14.105$, $p < 0.001$) in the BMI distributions between the mountain and plain regions, affirming that maternal nutritional status varies substantially between these geographic areas. In summary, mothers in the mountain region exhibit a healthier distribution of BMI, with most falling in the normal category and fewer underweight cases. In contrast, the plain region has a higher prevalence of underweight mothers alongside a notable proportion of obesity, indicating a bimodal nutritional challenge requiring targeted health and nutrition interventions in both regions.

The Tables 13 and 14 provide a detailed overview of the nutritional status of children aged 6 to 59 months in mountain and plain regions, focusing on various indicators such as stunting, wasting, underweight, and MUAC (Mid-Upper Arm Circumference). In the mountain regions, the prevalence of stunting across all age groups ranges from approximately 0.00% to 28.42% indicating a persistent issue of chronic malnutrition. Wasting which reflects acute malnutrition ranges from about 7.69% to 36.84%, with the highest incidence observed in the 36-47 months age group. Underweight children show a similar pattern, with percentages between 12.50% and 31.58%. MUAC measurements, an additional indicator of nutritional status, indicate a notable proportion of children at risk of malnutrition, particularly in the

older age groups ranging to 31.58%. In contrast, the plain regions show a significantly different pattern. The prevalence of stunting is lower in the younger age groups but increases with age, reaching up to 30.00% in the 24- 35 months group.

Table 12: BMI Distribution among Mothers

BMI Category	Mountain Region	Plain Region
Underweight	33 (21.0%)	124 (79.0%)
Normal	146 (79.3%)	38 (20.7%)
Obese	50 (38.2%)	81 (61.8%)
Total	229 (100%)	243 (100%)
Mean (Category)	2.0742	1.823
Median	2	1
Standard Deviation	0.5988	0.9031
Variance	0.358	0.816
Minimum	1	1
Maximum	3	3
Range	2	2
Skewness	-0.027	0.357
Kurtosis	-0.213	-1.685
Kruskal-Wallis Test		
Mean Rank	259.32	215.00
<i>H</i> statistic	H (2) =14.105, p = 0.000. Since the p-value is less than 0.05, the result is statistically significant	

Food and Nutrition (In) Security among Children Aged 6-59 Months

Wasting is also present but at lower levels compared to the mountain region, with the highest prevalence around 14.29% to 16.67%. Underweight children in the plain region have a similar pattern, with some age groups reaching around 17.86% to 20.00%. MUAC data shows that a smaller proportion of children are at risk, but the overall pattern suggests these children are vulnerable to malnutrition with MUAC ranging to 14.29%. The data reveal that in mountain regions, chronic malnutrition represented by stunting is relatively stable but with steady figures across ages. Wasting, indicating recent or acute nutritional deficiency is somewhat variable but remains a concern, especially in the 36- 47 months age group. Conversely, children in the plain regions show lower but more fluctuating levels of these indicators, with some age groups experiencing higher malnutrition rates. In conclusion, both regions face significant nutritional challenges among children, but the patterns differ. Mountain children tend to suffer more from chronic malnutrition, while acute issues are also evident, especially in specific age groups. The plain regions show generally lower prevalence but still require targeted nutritional interventions. A comprehensive strategy addressing both chronic and acute malnutrition is essential for improving childhood health outcomes across these regions.

Table 13: Prevalence of Food and Nutrition (In) Security among Children Aged 6-59 months in Mountain Regions

Age in Months	Number of Children (with %)	Height-for-Age (Stunted)	Weight-for-Height (Wasted)	Weight-for-Height (Severely Wasted)	Weight-for-Age (Underweight)	MUAC (< -2SD)
Female children						
0-11	0 (0.0%)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
12-23	26 (12.09%)	26 (27.37)	6 (7.69)	2 (7.69)	2 (7.69)	2 (7.69)
24-35	25 (11.63%)	25 (26.32)	4 (10.00)	1 (4.00)	7 (28.00)	7 (28.00)
36-47	27 (12.56%)	27 (28.42)	6 (16.00)	1 (2.22)	7 (25.93)	7 (25.93)
48-59	17 (7.91%)	17 (17.89)	6 (22.22)	0 (0.00)	7 (29.41)	7 (29.41)
Total	120 (55.81%)	95 (52.49)	27 (28.42)	3 (3.16)	21 (22.11)	21 (22.11)
Male children						
0-11	2 (1.03%)	2 (2.33)	1 (50.00)	0 (0.00)	0 (0.00)	0 (0.00)
12-23	19 (9.74%)	19 (22.09)	5 (26.32)	2 (10.53)	3 (15.79)	3 (15.79)
24-35	23 (11.79%)	23 (26.74)	5 (21.74)	3 (13.04)	4 (17.39)	4 (17.39)
36-47	23 (11.79%)	23 (26.74)	8 (34.78)	8 (21.74)	5 (21.74)	5 (21.74)
48-59	19 (9.74%)	19 (22.09)	7 (36.84)	6 (26.32)	6 (31.58)	6 (31.58)
Total	109 (55.9%)	86 (47.51)	26 (30.23)	15 (17.44)	18 (20.93)	18 (20.93)

Table 14: Prevalence of Food and Nutrition (In) Security among Children Aged 6-59 months in Plain Regions

Age in Months	Number of Children (with %)	Height-for-Age (Stunted)	Weight-for-Height (Wasted)	Weight-for-Height (Severely Wasted)	Weight-for-Age (Underweight)	MUAC (< -2SD)
Female Children						
0-11	7 (3.02%)	0 (0.00)	0 (0.00)	0 (0.00)	1 (14.29)	0 (0.00)
12-23	24 (10.34%)	5 (20.83)	2 (8.33)	1 (4.17)	3 (12.50)	2 (8.33)
24-35	28 (12.07%)	8 (28.57)	4 (14.29)	1 (3.57)	5 (17.86)	3 (10.71)
36-47	25 (10.78%)	6 (24.00)	3 (12.00)	1 (4.00)	4 (16.00)	3 (12.00)
48-59	20 (8.62%)	4 (20.00)	2 (10.00)	0 (0.00)	3 (15.00)	2 (10.00)
Total	128 (55.17%)	23 (22.12)	11 (10.58)	3(2.88)	16(15.38)	10(9.62)
Male Children						
0-11	8 (3.56%)	1 (12.50)	0 (0.00)	0 (0.00)	1 (12.50)	0 (0.00)
12-23	25 (11.11%)	6 (24.00)	3 (12.00)	1 (4.00)	4 (16.00)	3 (12.00)
24-35	30 (13.33%)	9 (30.00)	5 (16.67)	2 (6.67)	6 (20.00)	4 (13.33)
36-47	26 (11.56%)	7 (26.92)	4 (15.38)	1 (3.85)	5 (19.23)	4 (15.38)
48-59	21 (9.33%)	5 (23.81)	2 (9.52)	1 (4.76)	3 (14.29)	3 (14.29)
Total	115 (51.11%)	28 (25.45)	14 (12.73)	5(4.55)	19(17.27)	14 (12.73)

Conclusion & Policy implication

The comparative analysis of food and nutrition in security across mountain and plain specificities reveal distinct patterns in maternal and child nutritional outcomes. Mothers in the hill region demonstrate better BMI status than those in plains. This difference may be attributed to more equitable intra household food distribution and smaller family sizes in mountain communities which allows women greater access to avail food resources. In contrast, households in the plains tend to have larger family structures and stronger male dominated food allocation norms which can limit women's dietary intake leading to poorer maternal BMI outcomes. However despite better maternal nutrition in the hills, child nutritional indicators are more favourable in the plains. Children in plain regions benefit from greater access to and probably more efficient delivery of government supported nutrition interventions, such as mid-day meal schemes, Integrated Child Development Services (ICDS), and Anganwadi centres. Poor households often rely on these programmes to ensure that children receive at least one nutritious meal daily. In the hill region children face reduced access to such services due to challenging terrains, restricted mobility, limited service coverage and lower participation in formal schooling. As a result malnutrition among children remains more prevalent in mountain communities. Both regions face significant challenges but the nature of vulnerabilities differs. While maternal nutrition requires greater attention in the plains, targeted child focused interventions are urgently needed in the mountains. Addressing these disparities is essential for strengthening the overall food and nutrition security of rural households across both environments.

Acknowledgements

This work is part of research conducted under ICSSR Major Research Project entitled “Vulnerability of Rural Households to Food Insecurity in Plain and Hill States of India: A Comparative Study” funded by Indian Council of Social Science Research (ICSSR), New Delhi. Grant Number: F.No.02/71/OBC/2022-23/ICSSR/RP/MJ. All the help received from them is highly acknowledged.

Conflict of Interest

The authors declare no conflict of interest.

References

- Bhagat, D. (2021). Household food insecurity and the nutritional status of children aged 6–59 months: Insights from rural indigenous Garo tribes of Meghalaya, India. *Indian Journal of Agricultural Economics*, 76(3), 460–470.
- Burchi, F., Fanzo, J., & Frison, E. (2011). The role of the food and nutrition system approaches in tackling hidden hunger. *International Journal of Environmental Research and Public Health*, 8(2), 358–373. <https://doi.org/10.3390/ijerph8020358>
- Dame, J. (2018). Food security and trans-local livelihoods in high mountains: Evidence from Ladakh, India. *Mountain Research and Development*, 38(4): 310- 322. <https://doi.org/10.1659/MRD-JOURNAL-D-18-00026.1>

- FAO. (1996). Rome declaration and plan of action. Rome: Food and Agriculture Organization. Retrieved from Rome Declaration website: <http://www.fao.org/docrep/003/w3613e/w3613e00.htm>
- FAO. (2008). An introduction to the basic concepts of food security. Food security information for action: Practical guide. Retrieved from <http://www.fao.org/3/al936e/al936e.pdf>
- Lele, U., Masters, W. A., Kinabo, J., Meenakshi, J. V., Ramaswami, B., Tagwireyi, J., Bell, W. F. L., & Goswami, S. (2016). Measuring food security and nutrition: An independent technical assessment and user's guide for existing indicators. Measuring Food and Nutrition Security Technical Working Group. Rome: Food Security Information Network. Retrieved from https://reliefweb.int/sites/reliefweb.int/files/resources/1_FSIN-TWG_UsersGuide_12June2016.compressed.pdf
- NITI Aayog. (2021). National Multidimensional Poverty Index Baseline Report. <https://www.niti.gov.in/>
- Riely, F., Mock, N., Cogill, B., Bailey, L. & Kenefick, E. (1999). Food security indicators and framework for use in the monitoring and evaluation of food aid programs. Arlington, Va: Food Security and Nutrition Monitoring Project (IMPACT), ISTI, Inc., for the U.S. Agency for International Development. Retrieved from https://pdf.usaid.gov/pdf_docs/Pnacg170.pdf
- WFP. (2009a). Comprehensive food security & vulnerability analysis guidelines. Rome, Italy: World Food Programme (WFP) & Food Security Analysis Service. Retrieved from https://documents.wfp.org/stellent/groups/public/documents/manual_guide_proced/wfp203208.pdf
- WFP. (2009b). Emergency food security assessment handbook (2nd Ed). Rome, Italy: United Nations World Food Programme (WFP). Retrieved from https://documents.wfp.org/stellent/groups/public/documents/manual_guide_proced/wfp203246.pdf
- World Food Programme. (2009). Comprehensive food security and vulnerability analysis (CFSVA) guidelines. Rome, Italy: Author. Retrieved from <https://www.wfp.org/publications/comprehensive-food-security-and-vulnerability-analysis-cfsva-guidelines-first-edition>