Indian Research Journal of Extension Education

RESEARCH ARTICLE

Unveiling the Health Toll of Lifestyle and Dietary Habits in Rural India: A Focus on Non-Communicable Diseases (NCDs)

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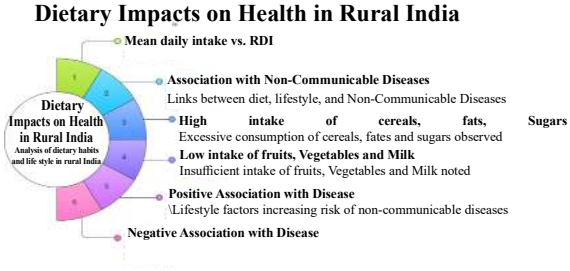
HIGHLIGHTS

- Daily physical activity has a protective effect on NCDs like diabetes, obesity, hypertension, and heart disease.
- Frequent intake of fruits and green leafy vegetables reduces the risk of non-communicable diseases
- Education, occupation, and socio-economic status significantly influence dietary patterns and health outcome.

GRAPHICAL ABSTRACT



ARTICLE INFO

Editors:

Dr. Rajula Shanthy

Dr. Ashok Kumar Sharma

Key words:

Diet consumption pattern, Food intake, Non-communicable diseases, Lifestyle, Physical activity,

Received : 18.02.2025

Accepted : 20.03.2025

Online published : 01.04.2025

doi:10.54986/irjee/2025/apr_sept/1-10

IRJEE METRICS

Google citations	- 10272
h-index	- 47
i10-index	- 319
NAAS rating (2024)	- 4.99
SJIF-2022	- 5.764
SJIF-2023	- 5.964
COSMOS CIF-2023	- 4.559
ABCD Index - 2023	- 6,5

ABSTRACT

Context: The current dietary habits, physical activity level, and lifestyle problems within a community are the key determining factors of their health in the future.

Objective: This study was conducted among 1238 rural people (18-75y) to assess the trends of food intake, dietary habits, physical activity level, and lifestyle problems among Indian rural community, and to find out their correlations with non-communicable diseases.

Methods: A cross-sectional research design, incorporating both qualitative and quantitative methods to provide a comprehensive understanding of the issue was adopted in the present study. Data on socioeconomic and lifestyle status, food consumption patterns, and disease prevalence patterns were collected with the help of a structured questionnaire using the online platform. Data on food intake was collected using the 24-hour recall method. The actual food intakes were compared to their respective reference values using a one-sample *t*-test. Pearson's correlation was established to check the correlation of independent factors with disease prevalence.

Results and discussion: Results indicated that the mean daily intake of cereals, fats and oils, and sugars was found to be significantly higher than their respective RDIs, whereas, the mean daily intake of fruits, vegetables, milk and milk products, pulses and flesh foods, and nuts was significantly lower than their respective RDIs among the rural Indian community. Further, results indicated that age, alcohol, smoking, sugar intake, snacking, fast food intake, and fat intake were positively associated with non-communicable diseases, whereas, fruit intake, vegetable intake, and physical activity were negatively associated with non-communicable diseases.

Significance: Government policies and programs should focus on and include dietary advisory to the rural community.

India has witnessed a huge gap between production and consumption and availability and affordability of quality foods. For the reason that not everyone has equal access to diverse, micronutrient-rich foods such as fresh fruits, vegetables (Kharumnuid et al., 2021; Noopur et al., 2023a), legumes, pulses, and nuts and simultaneously other foods high in salt, sugars, saturated fats, and trans fats are cheaper and widely available, people are facing a triple burden of malnutrition (Kapoor et al., 2024; Chikkeri et al., 2023). Although India stands first in vegetable production but we are far behind to reach per capita recommended level of vegetables (Noopur et al., 2023b) besides the fact that vegetables are the main source of vitamins and minerals and therefore helpful in eliminating deficiency disease and in preventing number of diseases (Panwar, *et al.,* 2024).

In the past, Indians derived a large portion of carbohydrates from whole grains in their diets. However, in recent decades, whole grains have been replaced with white rice and refined wheat which are instantly digested and increase the levels of plasma glucose and insulin, leading to insulin resistance. Furthermore, the physical activity level has decreased along with shifting dietary patterns. The means of transport, smart devices in the home, market production, and reduction of manual tasks in the workplace have contributed to a more sedentary lifestyle (Shamsi *et al*., 2018). A healthy diet and adequate physical activity are the only strategies for halting or preventing the development of type 2 diabetes, coronary heart disease, stroke and obesity. The most sustainable solution to all forms of malnutrition is to ensure the availability, accessibility, and affordability of nutrient-rich foods, judicious selection of foods from different food groups and regular physical exercise (WHO/FAO, 2002; Amerikanou *et al.,* 2023).

Foods have been categorized into 10 groups to guide people make choices from different food groups. Consuming at least 5-7 food groups daily in adequate quantities and other foods at least two to three times a week will meet the adequacy of most of the nutrients (ICMR-NIN, 2024). Surveys conducted by the National Nutrition Monitoring Bureau (NNMB) and the National Institute of Nutrition (NIN) indicate that unhealthy diets contribute to 56.4 per cent of the total disease burden in India. Healthy diets and physical activity can reduce a substantial proportion of coronary heart disease and hypertension and prevent up to 80 per cent of type 2 diabetes (ICMR-NIN, 2024).

A major challenge in human health over the next 50 years will be in the area of chronic, non-communicable diseases (NCDs) as they act as the leading cause of death in the world, accounting for 63 per cent of 57 million deaths. According to WHO projections, the total annual number of deaths from non-communicable diseases will increase to 55 million by 2030. And around 60 per cent of NCD deaths will occur in India. One–third of deaths due to non-communicable diseases in India involve people less than 60 years of age. More than 80 per cent of NCD's related deaths happen in low and middle-income countries, and nearly a third of those deaths occur before 60 years of age. To reduce the incidence of NCDs, it is essential to color the food plate with vitamins, minerals and antioxidant-rich foods.

Realistically, eating habits are a complex phenomenon and deeply entwined with rituals, social functions, faith and spirituality, values and beliefs, cultural identity, and feelings of members of particular groups and communities (Das and Priya, 2022). Barriers to eating a healthful diet also included no sense of urgency, the social and cultural symbolism of certain foods, the poor taste of 'healthy' foods, the expense of 'healthy' foods and lack of information. Being self-reliant on food grains and vegetables is not enough to ensure a nutrition-secure nation (Noopur *et al*., 2021), efforts should be made to make food affordable to fill the gap between production and consumption. Segments of the population that potentially could be motivated to make dietary changes included women, men with health problems, young adults, the elderly, and those diagnosed with a severe, life-threatening disease (James, 2004; Ghosh *et al*., 2024).

Under-nutrition and non-communicable diseases (NCDs) are important public health issues in India, yet their relation with dietary patterns is poorly understood. An improved understanding of the links between dietary patterns and health may help to guide policies such as public education about diets and nutrition, strategies to improve access to healthy foods and investments in healthcare in preparation for changing disease profiles in the population (Edward *et al*., 2017). This research paper aims to reflect the correlation between current food consumption patterns, socioeconomic and lifestyle status, and NCDs and degenerative and nutritional deficiency diseases among the rural Indian community.

METHODOLOGY

A cross-sectional research design, incorporating both qualitative and quantitative methods to provide a comprehensive understanding of the research problem was adopted in the present study. The stratified proportionate random sampling procedure was followed to select the respondents to account for variations in factors like age group, gender, or socio-economic classification. This helped ensure diverse and representative data. The sample was selected from different strata, and covers fifteen agro-climatic zones of the country (Figure-1). Within these fifteen agro-climatic zones with the help of a proportionate random sampling procedure, the sample respondents were selected and the total sample size is 1238.

Data on socio-economic status (age, gender, education, occupation, annual income, no. of family member), lifestyle status (smoking, alcohol, and physical activity), food consumption pattern (eating habits, flesh foods consumption, frequency of meal consumption, skipping of meals, frequency of snacking, eating fast foods, daily water intake and frequency of fruit consumption), disease prevalence pattern (NCDs, degenerative diseases and nutritional deficiency disease) was collected with the help of structured questionnaire using online platform in the year 2024.

The data on dietary intake was collected using 24-hour recall, a method to determine the food intake from various food groups of an individual during the immediately preceding 24 hours as remembered by the subjects (Den *et al*., 2006). The consumed cooked foods were converted into their raw equivalents. Any ingredient consumed more than five grams was taken into account. The intake of various foods belonging to different food groups was represented as mean ± SD and compared with the recommended dietary intake suggested by ICMR-NIN, 2024.

Figure 1: The map of the study area

The data were statistically analyzed using the statistics package SPSS (version 20.0) for Windows. Data on socio-economic and lifestyle status, food consumption pattern, and disease pattern was analyzed using descriptive analyses and presented in frequency and per centage. Mean and standard deviations were calculated for food intake. The actual food intakes were compared to their respective reference values using a one-sample *t*-test. Pearson's correlation (n-1) was established to check the correlation of independent factors with disease prevalence. *P* value less than 0.05 was considered statistically significant.

RESULTS

Data regarding socioeconomic status presented in Table 1 indicated that the male and female adults and elderly people were almost equally distributed among the studied population, the majority of the people (45.15%) were belonging to the age between 30-49 years of age. The majority of the people (60.0%) were found to be educated at least a senior secondary standard. This information reflects the extreme diversity of the dataset.

Further, results regarding their livelihood, the majority of the people (73.82%) were occupied with agriculture farming and agribusiness, livestock, and poultry (Table 1). The majority of the people had an annual income up to three lakh rupees followed by 21.57 per cent of them having an annual income between three to five lakh rupees and 12.04 per cent having an annual income of more than 5 lakh rupees. The majority of the people had 5-8 members in their family which means they belonged to a joint family. The respondents were asked about their lifestyles and 47.34 and 43.21 per cent of them revealed that they were in a habit of smoking and alcohol, respectively. Physical activity has been considered an important factor that influences health to a great extent, It was observed that only half of the people (54.55 %) were in a habit of doing physical activity daily followed by weekly (21.08%) and occasionally (17.53%).

Data on the eating habits of Indian rural adults and elderly people have been presented in Table 2 which

Table 1. Socio-economic and lifestyle status of adults and elderly people in rural Indian community (N=1238)

Categories	No.	%
Gender		
Male	724	58.48
Female	514	41.52
Age		
Less than 30	352	28.43
Between 30-49	559	45.15
Between 49-60	214	17.28
More than 60	113	9.13
Education		
Illiterate	70	5.65
Primary	179	14.46
High School	246	19.87
Senior Secondary	245	19.79
Graduation	325	26.25
Post-graduation	147	11.87
PhD	26	2.1
Occupation		
Agriculture	602	48.62
Agribusiness	102	8.24
Livestock	106	8.56
Poultry	115	9.30
Other business	68	5.49
Private job	172	13.89
Government job	73	5.89
Family income		
Less than 1 lakh	231	18.66
Between 1-3 lakh	591	47.7
Between 3-5 lakh	267	21.57
More than 5 lakh	149	12.04
Family Size		
Upto 4 members	370	29.88
5-8 members	781	63.1
More than 8 members	87	7.02
Smoking		
No	652	52.66
Yes	586	47.34
Alcohol consumption		
No	703	56.79
Yes	535	43.21

reveals that the majority of the respondents (66.08%) were following a vegetarian diet either by including an egg or milk and milk products or both the egg and milk and milk products and rest of them (33.84%) were found be non-vegetarian. Further, it was observed that among non-vegetarians, fish, mutton, and chicken were eaten by 38.90 per cent of the respondents, whereas mutton and chicken were eaten by 28.15 per cent. Only chicken and only fish were eaten by 19.0 and 4.76 per cent of the respondents, whereas both chicken and fish were eaten by 19.0 per cent of them (Table 2).

Table 2. Food consumption pattern of adults and elderly people in rural Indian community (N=1238)

Categories	No.	%
Eating habits		
Vegetarian	35	2.83
Lacto-vegetarian	362	29.24
Ovo-vegetarian	150	12.12
Lacto-ovo-vegetarian	271	21.89
Non-vegetarian	419	33.84
Flesh foods consumption		
Fish only	20	4.76
Chicken only	80	19.0
Fish & Chicken	38	9.0
Mutton & Chicken	118	28.15
Fish, mutton & chicken	163	38.90
Frequency of meal consumption		
Four times a day	375	30.29
Three times a day	627	50.65
Two times a day	236	19.06
Skipping of meals		
Yes	423	34.17
No	815	65.83
Frequency of snacking		
No	230	18.58
Daily	164	13.25
Alternative days	427	34.49
Once in a week	265	21.41
Twice in a week	152	12.27
Eating fast foods		
Yes	616	49.76
No	622	50.24
Daily water intake		
< 2 liters	102	8.24
2-4 liters	706	57.03
>4 liters	430	34.73
Frequency of fruit consumption		
Do not eat	137	11.06
Daily	291	23.51
Alternative days	364	29.40
Once in a week	446	36.03

Regarding the frequency of consuming meals, it was observed that the majority of the respondents

(50.65%) had their meals three times a day, followed by four times a day (30.29%), and two times a day (19.06%). A habit of skipping meals was prevalent among 34.17 per cent of the respondents. Almost half of the respondents (47.74%) had a habit of snacking daily or on alternative days and again fast foods were eaten by half of the studied population (49.76%). The majority of the population drank plenty of water, it was observed that water between 2 to 4 liters per day was drunk by 57.03 per cent of respondents whereas water more than 4 liters per day was drunk by 34.73 per cent of them. Further, it was observed that the fruit was consumed daily or on alternative days only by 53.0 per cent of the respondents.

Data on non-communicable disease prevalence patterns among adults and elderly people in rural Indian community presented in Table 3 showed that a large number of people (42.49%) were suffering from either obesity, diabetes, hypertension, heart diseases, or asthma. Almost 22.0 per cent of the respondents were suffering from two or multiple non-communicable diseases. The prevalence of anemia and low vision was found among 28.92 and 25.20 per cent of respondents,

Table 3. Disease prevalence pattern among adults and elderly people in rural Indian community (N=1238)

Categories	No.	%
Non-communicable disease		
Normal	712	57.51
Obesity only	52	4.2
Diabetes only	80	6.5
Hypertension only	130	10.50
Diabetes & obesity	67	5.4
Diabetes & hypertension	40	3.2
Diabetes, hypertension & heart disease	42	3.4
Diabetes, hypertension, obesity & heart disease	57	4.6
Diabetes, hypertension, obesity & asthma	64	5.2
Nutritional deficiency disorder		
Normal	516	41.68
Anemia	358	28.92
Hypothyroidism	52	4.2
Low vision	312	25.20
Degenerative diseases		
Normal	568	45.88
Fatty liver	123	9.93
Arthritis	263	21.24
Kidney malfunctioning	143	11.55
Cataract	41	3.3
Gastritis	100	8.07

respectively. It was observed that 54.12 per cent of the respondents were suffering from either fatty liver or arthritis, kidney malfunctioning, cataract, and gastritis.

Food Intake Pattern : The daily mean food intake for different food groups compared to their respective recommended dietary intake has been presented in Figure 2. It was observed that the daily mean intake of cereals, millet, and their products was observed as 255 grams and 228 grams among male and female adults engaged in sedentary physical activity levels, respectively. The mean daily intake of oils and fats among male and female adults with the same physical activity levels was 50.7 grams and 44.3 grams, respectively.

The mean daily intake of pulses and flesh foods and milk and milk products among the male and female adults of sedentary lifestyles was found to be 58.7

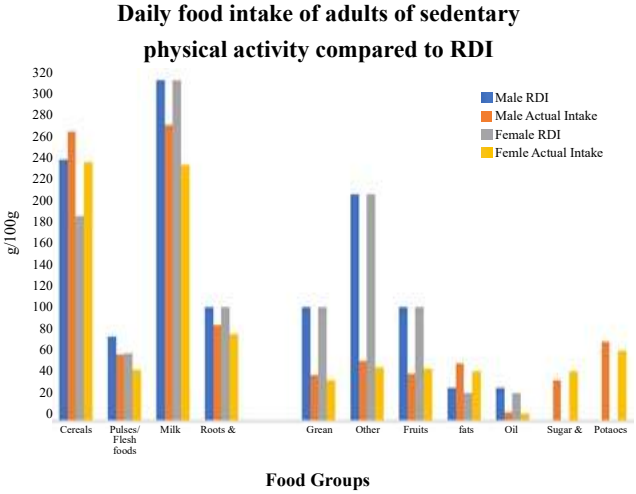


Figure 2, Daily mean food intake of adults having sedentary physical activity level in rural Indian community

grams and 45.5 grams and 260 grams and 225 grams, respectively. Further, it was observed that the daily mean intake of all types of vegetables and fruits was found to be 221.4 grams and 206.7 grams among male and female adults, respectively. The daily mean intake of cereals, millet, and their products and oils and fats were significantly ($p<0.05$) higher than their respective RDIs, whereas, the daily mean intake of milk and milk products, pulses, and flesh foods, all types of vegetable and fruits were significantly lower than their respective RDIs (Figure 2).

A similar trend for the daily mean intake of cereal, millet, and their products, pulses and flesh foods, milk, and milk products, all types of vegetables and fruits, and fats and oils were observed among the male and female

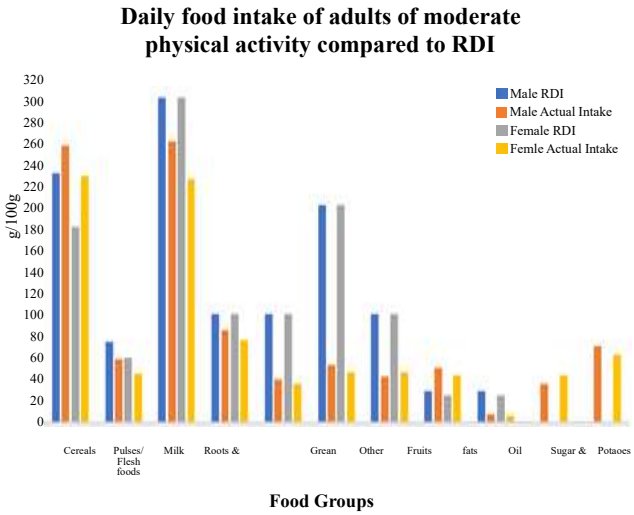


Figure 3. Daily mean food intake of adults having moderate physical activity level in rural Indian community

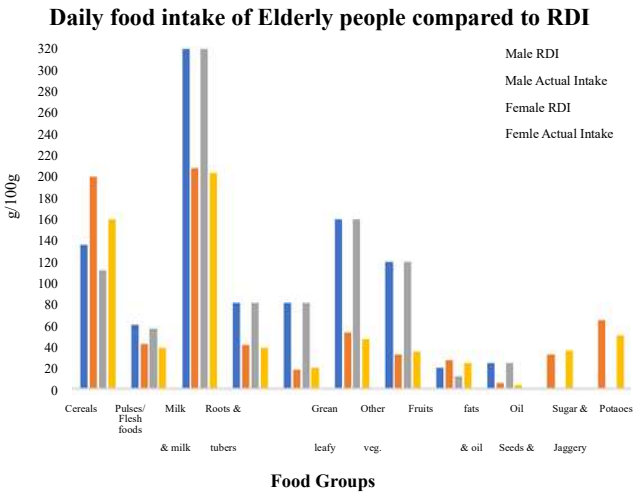


Figure 4. Daily mean food intake of adults having sedentary physical activity level in rural Indian community

adults of moderate physical activity level (Figure 3). As per the ICMR guidelines potato, being a starch food has been considered a starchy staple and therefore has not been recommended for intake in addition to cereals and millets in Indian diets. The recent dietary guideline of ICMR has recommended a 30-gram daily intake of nuts and oilseeds which was also not met by any of the group discussed above.

The mean daily food intake of elderly males and females has been given in Figure 4. A similar trend of daily food intake followed by adults of sedentary and moderate physical activity was observed for the elderly people of both genders. As per the ICMR guidelines, around 45 to 65 per cent of total energy should come from carbohydrates, however, in the present study if we take the example of elderly males' daily intake, they took 250 grams of cereal, millet, and their products, 40.8 grams of sugar and jaggery and 80.3 grams of potatoes and in total they consumed a mean average of 371 grams against the recommended dietary intake of 170 grams. A similar trend was followed by the whole population. A daily portion of 371 grams of carbohydrates will yield around 1484 Kcal of energy which will be around 80 per cent of total energy intake. A tremendously higher intake of carbohydrates and fats and oils together with the negligible intakes of vegetables, fruits, and nuts make Indian rural people unhealthy.

Association between lifestyle, food intake and non-communicable diseases : The results of the correlation of NCDs, degenerative and nutritional deficiency

Table 4. Correlation of NCDs, degenerative and nutritional deficiency disease with age, lifestyle, and food intake

Variable	Age	Alcohol	Smoking	Physical activity	Sugar intake	Fat intake	Fruit intake	GLV intake	Snacking	Fast food intake
Fatty liver	0.15^{NS}	0.39*	0.07^{NS}	-0.32*	0.11^{NS}	0.09^{NS}	-0.18*	-0.13*	0.13*	0.17*
Arthritis	0.41*	0.24*	0.37*	-0.26*	0.09^{NS}	0.07^{NS}	-0.12^{NS}	-0.09^{NS}	0.05^{NS}	0.08^{NS}
Kidney malfunctioning	0.11^{NS}	0.15^{NS}	0.12^{NS}	0.09^{NS}	0.09^{NS}	0.06^{NS}	0.08^{NS}	0.05^{NS}	0.07^{NS}	0.05^{NS}
Cataract	0.14*	0.11^{NS}	0.08^{NS}	0.12^{NS}	0.07^{NS}	0.05^{NS}	-0.19*	-0.14*	0.08^{NS}	0.09^{NS}
Gastritis	0.09^{NS}	0.10^{NS}	0.12^{NS}	0.14^{NS}	0.08^{NS}	0.07^{NS}	-0.18*	-0.15*	0.17*	0.11*
Anemia	0.07^{NS}	0.34*	0.10^{NS}	0.14^{NS}	0.13*	0.11^{NS}	-0.28*	-0.23*	0.19*	0.21*
Low vision	0.46*	0.24*	0.13^{NS}	0.06^{NS}	0.15*	0.10^{NS}	-0.21*	-0.29*	0.23*	0.29*
Hypothyroidism	0.08^{NS}	0.06^{NS}	0.09^{NS}	0.10^{NS}	-0.23*	0.08^{NS}	0.11^{NS}	0.10^{NS}	0.05^{NS}	0.07^{NS}
Obesity	0.39*	0.44*	0.21*	-0.36*	0.36*	0.40*	-0.43*	-0.50*	0.36*	0.28*
Diabetes	0.41*	0.11^{NS}	0.11^{NS}	-0.27*	0.22*	-0.24*	-0.29*	-0.36*	0.18*	0.21*
Hypertension	0.52*	0.45*	0.37*	-0.31*	0.26*	0.33*	-0.51*	-0.38*	0.36*	0.30*
Heart disease	0.36*	0.52*	0.41*	-0.53*	0.21*	0.37*	-0.46*	-0.42*	0.29*	0.27*

*Significant at 5% level, NS non-significant

disease with age, lifestyle, and food intake have been given in Table 4. It was observed that alcohol consumption among respondents was positively associated with the occurrence of fatty liver, arthritis, anemia, low vision, obesity, hypertension, and heart disease, whereas smoking had a positive correlation with the prevalence of arthritis, obesity, hypertension, and heart disease. Daily physical activity was found to be negatively associated with fatty liver, arthritis, obesity, diabetes, hypertension, and heart disease indicating the more the physical activity was done the less the occurrence of these diseases was found. The consumption of fruits and green leafy vegetables was also associated negatively with fatty liver, cataract, gastritis, anemia, low vision, obesity, diabetes, hypertension, and heart diseases (Table 4). However, snacking and fast-food consumption were positively associated with fatty liver, gastritis, anemia, low vision, obesity, diabetes, hypertension, and heart diseases.

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DISCUSSION

Socioeconomic diversity and its implications : The study captures the balanced distribution of genders across different age groups, with a significant proportion of participants aged 30-49 years. This age group is particularly relevant, as it is often at the intersection of lifestyle changes and the onset of non-communicable diseases (NCDs). The high level of education (60% educated to senior secondary standard or higher) reflects a commendable level of awareness and accessibility, suggesting opportunities for implementing health education programs. However, the extreme socioeconomic diversity—spanning varying incomes, livelihoods (agriculture and agribusiness being predominant), and family structures—indicates a need for tailored interventions to address health challenges unique to these diverse communities. A similar prevalence of obesity and hypertension was observed among women from Northeast India (Meshram *et al.,* 2022).

Lifestyle choices and health risks : The data on smoking and alcohol consumption reveal concerning trends that could significantly contribute to the rising prevalence of NCDs in rural populations. Despite half the population engaging in daily physical activity, the remaining proportion with sporadic or occasional physical activity highlights a gap in consistent health practices. Strategies to encourage regular physical activity and mitigate tobacco and alcohol use are crucial in addressing these preventable risk factors.

Dietary patterns and nutritional practices : The dominance of a vegetarian diet reflects cultural and regional dietary preferences in rural India. The detailed breakdown of non-vegetarian food consumption provides insights into protein intake patterns and their variability. Fast food consumption and a habit of snacking daily or on alternative days suggest shifts toward less traditional and potentially less nutritious dietary habits. Additionally, meal-skipping may contribute to nutritional imbalances, which are pivotal in the development of NCDs.

Water intake and fruit consumption : Encouragingly, most respondents reported consuming adequate water, with drinking 2-4 litres per day and drinking more than 4 litres daily. However, the relatively low frequency of daily or alternate-day fruit consumption is concerning. Fruits are vital for micronutrient intake and overall health; efforts to promote affordable fruit consumption and increase its accessibility should be prioritized. Similar results of poor vegetable intake were also observed in the Nigerian population by Kareem *et al*. (2016).

Interactions and Implications : The interplay between socioeconomic factors, lifestyle behaviors, and dietary patterns underscores the complexity of NCD prevention in rural settings. While some positive practices, like hydration and education levels, provide a foundation for health interventions, the simultaneous prevalence of risk behaviors (smoking, alcohol use, fast food consumption, and physical inactivity among some groups) calls for targeted, culturally sensitive approaches.

Dietary patterns and deviation from recommendations: The results highlight significant deviations from the recommended dietary intake (RDI) as per ICMR guidelines. The higher-than-recommended intake of cereals, millets, oils, and fats among both adults and elderly individuals indicates a diet heavily tilted towards

carbohydrate and fat-rich staples. This contributes to a disproportionate energy intake—up to 80 per cent of total energy sourced from carbohydrates—exceeding the recommended range of 45–65 per cent. Such dietary imbalances are a known risk factor for obesity, diabetes, and other NCDs, which were prevalent in 42.49 per cent of the population.

Conversely, lower-than-recommended intake of nutrient-rich foods, such as pulses, flesh foods, milk, vegetables, fruits, nuts, and oilseeds, signals an alarming lack of diversity in the diet. The insufficient intake of these food groups exacerbates micronutrient deficiencies, leading to "hidden hunger," which is reflected in the prevalence of anemia and low vision.

NCD prevalence and lifestyle factors : The high prevalence of NCDs—ranging from obesity, diabetes, and hypertension to heart diseases and asthma—is a concerning trend. Additionally, 22 per cent of respondents suffering from multiple NCDs points to cumulative health impacts, likely driven by poor dietary patterns, lifestyle issues, and possibly genetic predispositions. The prevalence of conditions like fatty liver, arthritis, kidney malfunctioning, cataract, and gastritis further underscores the multifactorial nature of health challenges in these populations.

These findings align with existing evidence from similar studies, such as in Northeast India and Kumaon, Uttarakhand, suggesting this is not an isolated issue but rather a widespread problem in rural communities. The social disparity cited in earlier studies highlights inequities in access to a balanced diet and healthcare, which perpetuate these health challenges. Similar results for the daily intake of different food groups were observed among adults of Kumaon region Uttarakhand (Nautiyal *et al*., 2023). Similar results of imbalanced and low intake of foods were observed by Nasreddine *et al*. (2007). Social disparity plays an important role in inadequate food intake, specifically micronutrient deficiencies causing hidden hunger (Vij and Mann, 2022).

Implications for elderly populations : The dietary patterns of elderly males and females mirror those of the adults, with excessive carbohydrate and fat intake and inadequate consumption of vegetables, fruits, and nutrient-dense foods like nuts and oilseeds. This trend is particularly worrying, as elderly populations are more vulnerable to NCDs and related complications due to age-related physiological changes.

Additionally, the findings illustrate the persistence of imbalanced dietary habits across generations, pointing to the need for interventions targeting entire communities rather than specific age groups.

Lifestyle, dietary habits, socio-demography and NCDs : The results of relational analysis underscore the significant role of lifestyle choices in the prevalence of NCDs. Alcohol consumption emerges as a major risk factor, showing positive associations with conditions like fatty liver, arthritis, anemia, low vision, obesity, hypertension, and heart disease. Similarly, smoking is strongly linked to obesity, arthritis, hypertension, and heart disease. These findings align with existing evidence on the harmful effects of alcohol and tobacco use, further emphasizing the urgent need for behavioral interventions targeting these habits in rural communities.

Conversely, daily physical activity is found to have a protective effect, being negatively associated with a range of conditions, including fatty liver, arthritis, obesity, diabetes, hypertension, and heart disease. This highlights the pivotal role of an active lifestyle in mitigating the risk of chronic and degenerative diseases.

The results reveal critical correlations between dietary habits and health outcomes. Frequent consumption of fruits and green leafy vegetables is inversely associated with the prevalence of several conditions, including fatty liver, cataract, gastritis, anemia, low vision, obesity, diabetes, hypertension, and heart diseases. This highlights the importance of a diet rich in micronutrients and antioxidants in preventing chronic illnesses.

On the other hand, snacking, fast-food consumption, sugar, and fat intake show positive correlations with a host of health issues, including fatty liver, obesity, diabetes, hypertension, and heart diseases. These findings suggest a growing shift toward energy-dense but nutrient-poor diets, which significantly contribute to the dual burden of overnutrition and micronutrient deficiencies, as observed in other rural populations.

Beyond lifestyle and dietary choices, factors like education, occupation, and socio-economic status play a significant role in determining health outcomes. Lower socio-economic status often limits access to nutritious foods, perpetuating a reliance on cheaper, carbohydrate-heavy staples. This contributes to the observed dual burden of malnutrition—undernutrition and obesity coexisting within the same populations or even individuals. A similar correlation between poor dietary intake and NCDs was observed by Bhargavi *et al* (2023). Similarly, a dual burden of malnutrition among rural adults in south Rajasthan was observed by Rani and Singh (2022). Other than lifestyle and food

intake education, occupation, and socio-economic status also play a significant role in the occurrence of NCDs (Gupta *et al*., 2012), However, judicious selection of foods and nutrients plays an important role in controlling NCDs (Krishnaswamy *et al*., 2016; Angeles-Agdeppa *et al*., 2020; Kang *et al*., 2021).

CONCLUSION

People in rural Indian community had very good status in education, occupation, and annual family income, however, they were also indulged in the poor habits of alcohol, smoking, and physical inactivity. The frequency of meal consumption was found to be optimum with mixed vegetarian and non-vegetarian food habits and sufficient water drinking, however, the frequent snacking and fast-food consumption is a matter of concern. The mean daily food intakes of fruits, vegetables, milk, pulses and flesh foods, and nuts and oil seeds were found to be significantly lower than their respective recommended limits. As a result of poor lifestyle and food habits half of the population was found to suffer from either NCDs, degenerative disease, or nutritional deficiency. Similarly strong positive correlations between alcohol, smoking, fat intake, sugar intake, snacking, and fast food and NCDs and strong negative correlations between fruit intake, vegetable intake, and physical activity and NCDs were observed. Indian rural community is facing a triple burden of malnutrition and NCDs therefore, government policies and programs should focus on imparting education on balanced diets and healthy lifestyles.

Funding: The study carried out without any funding support.

Declaration of competing interest: The authors have declared that there is no competing interest among them.

Data availability: Data would be made available upon request.

Authors' contribution: First Second and Third authors conceptualized and operationalized the research problem. Fourth and fifth authors preliminary edited and finalized the draft.

Acknowledgement: We would like to express our sincere gratitude to Dr. Ajay Kumar, J&K, Dr. Ajmal S., A&N Islands, Dr. AK. Dubey, Lucknow, Dr. AK. Verma, Agra, Dr. Anirban Mukherjee, Patna, Dr. Ankur Adhikary, West Bengal, Dr. Aparna Purohit. Adarsha Nagar, Gunupur, Odisha, Dr. Ashok kumar, Bihar, Dr. B. Shanmugasundaram, Kerala, Dr. Biman Maity, west Bengal, Dr. Dorjey Angchok, DRDO, Leh, Dr. Ganesh Das,Tripura, Dr. H.P. Singh, MP, Dr. Ingita Gohain Tripura, Dr. J D Singh, Arunachal Pradesh, Dr. Kangjam Sonamani Singh, Manipur, Dr. Karamjit Sharma, Punjab, Dr. Kavita U. Deshmukh, Maharashtra, Dr. Kinjulck K. Singh, MP., Dr. Kiran Chandravadia, Gujrat, Dr. Kuldeep Singh, Rajasthan, Dr. Nagesh B. Janekal, Karnataka, Dr. Pallabi Bora, Assam, Dr. Pallabi Das, Assam, Dr. Pallavi Deka, Assam, Dr. Prashant Dharpal, Maharashtra, Dr. Pratibha Singh, Rajasthan, Dr. Rajni D. Agashe, Chattisgarh, Dr. Ravindra Singh, Maharastra, Dr. Rishi Kumar Singh, Uttar Pradesh, Dr. S.K. Zamir Ahmed , A&N Islands, Dr. Sandeep Kumar Rastogi, Rajasthan, Dr. Sanjeev Kumar Garg, MP, Dr. Sarju Narain, Uttar Peadesh, Dr. Satyajeet, Haryana, Dr. Seema Rani, UP, Dr. Seema Singh, Jharkhand, Dr. Shah M Hussain, Arunachal pradesh, Dr. Sinki Barman, Assam, Dr. SK Badodiy, MP, Dr. Sonika Sharma, Rajasthan, Dr. V. Jyothi, Andhra Pradesh, Dr. Yashwantrao Yadav, TISS, Maharastra, Dr. Dhananjoy Mandal, WB, Dr. Geetha Channal, Karnatak, Dr. Deepali Suryawansi, ITM University, Gwalior, Dr. Marry N Odyuo, Nagaland, Dr. Rajesh Kumar, Bihar, Dr. Sukhvir Singh Chauhan, M.P. for therir constant support, encouragement valuable assistance and feedback in data collection for this nation wide study. There support has been crucial in competing this study.

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