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Association between dietary profile and socio demographic characteristics among adults with Type 2 Diabetes and Hypertension in South Andaman

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ABSTRACT

Background: Dietary profile describes an individual's usual dietary pattern, including the type, quantity and diversity of foods consumed, along with nutritional adequacy. Although diverse, nutrient-rich diets are recommended for the prevention and management of Non-Communicable Diseases (NCDs), dietary diversity among individuals with Type 2 Diabetes and Hypertension remain inadequately documented, particularly in geographically isolated regions like South Andaman. This study assesses the dietary profile of adults with Diabetes and/or Hypertension in South Andaman and examines its association with selected sociodemographic and clinical factors.

Materials and Methods: A facility-based cross-sectional analytical study was conducted among 400 adults with diagnosed Type 2 Diabetes and/or Hypertension attending three health centres in South Andaman. Participants were consecutively recruited sociodemographic details, anthropometric measurements and a 24-hour dietary diversity recall were obtained. Dietary diversity scores were computed as per FAO recommendations, while calorie and protein intake were assessed using ICMR guidelines.

Results: Dietary diversity was predominantly high (95%). It showed no association with most of the sociodemographic and clinical variables considered except for BMI ($P=0.048$) and sleep duration ($P=0.005$). Females reported significantly low calorie intake ($P=0.047$). Lower protein intake was associated with female gender ($P<0.001$), lower socioeconomic status ($P=0.047$), nuclear family ($P<0.001$) and BMI ($P=0.010$).

Conclusion: Although dietary diversity was largely adequate among adults with Type 2 diabetes and hypertension in South Andaman, disparities in calorie and protein intake warrant focused nutritional interventions.

Key-words:Diabetes, Dietary diversity, Dietary profile, Food and Agricultural Organization Hypertension, Indian Council of Medical Research, Non-Communicable Diseases

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INTRODUCTION

Dietary profiling refers to the systematic assessment of habitual food intake to evaluate overall diet quality, diversity and nutritional adequacy. Dietary diversity, commonly measured as the number of different food groups consumed over a reference period, serves as a proxy indicator of micronutrient adequacy in nutritional epidemiology. [1] Diverse diets contribute to metabolic balance, insulin sensitivity and blood pressure regulationkey factors in the pathogenesis of Type 2 Diabetes and Hypertension. [2,3] Globally, nearly 830 million people live with Diabetes and 1.4 billion with Hypertension, while in India the prevalence is estimated at 19.8% and 36%, respectively. [4–6] Although international and national guidelines emphasize diverse, nutrient-rich diets for NCD prevention and control, evidence on dietary diversity among individuals with Diabetes and Hypertension remains limited and inconsistent. [7,8] In this context, the present cross-sectional study was conducted in South Andaman to assess dietary diversity, calorie and protein intakeand their association with selected sociodemographic factors among adults with Type 2 Diabetes and Hypertension.

Methods

Study design and sample

A facility based cross sectional study design was adopted where residents of South Andaman above the age of 18 years who have been diagnosed and undergoing treatment for Type 2 Diabetes and Hypertension in South Andaman were recruited from three health training centres. Individuals who were critically ill, hospitalized, medically unstable, pregnant, lactating, or cognitively impaired were excluded. The sample size was calculated using the formula for estimating sample size in a cross-sectional study $(n = z^2 p(1-p)/d^2)$, assuming 99.9% confidence level (z = 3.291), proportion of high dietary diversity among hypertensives to be 8% based on a previous study by Deshmukh et al. and an absolute precision of 5%. Based on this calculation, the required minimum sample size was 319. [9] After accounting for a non-response, the final sample size was rounded up to 400 participants.

Data collection

Participants were selected consecutively for data collection at the three health centres affiliated with the Department of Community Medicine, Andaman and Nicobar Islands Institute of Medical Sciences. The participants were approached after their consultation at the outpatient department and briefed about the research and interview procedure. After obtaining written informed consent, data was collected via interview method. The study was completed in three months, after obtaining the approval of Institutional Ethical Committee.

The interview schedule consisted of sociodemographic details of the participants, anthropometric measurements and dietary diversity questionnaire from Food and Agriculture Organisation (FAO). Dietary diversity questionnaire comprised of a 24-hour recall of the participant's diet and it assessed for dietary diversity by using 16 food groups recommended by FAO. The dietary diversity groups were regrouped under 9 main food groups and scores were estimated. The proportion of patients consuming each tertile of food groups was categorised as diets with high (score $\geq$6), medium (score 4-5) and low diversity (score <4) as per the Food Frequency questionnaire (FFQ) score (Appendix A). [10] The total calorie and protein intake was calculated from the 24-hour recall of the diet consumed and was categorised as adequate, excess or deficient based on the ICMR cut offs for calorie consumption for the age and physical activity of the participants (Appendix B). [11] Statistical Analysis was conducted using 26th version of International Business Machines Statistical Package for the Social Sciences.

Ethical considerations

Ethical considerations were rigorously adhered to throughout the study. Prior approval was obtained from the Institutional Ethics Committee before the commencement of data collection. All participants were informed in detail about the objectives, procedures, and voluntary nature of the study, and written informed consent was obtained prior to enrolment. Participants were assured that they could withdraw at any stage without any consequences. Confidentiality and anonymity were strictly maintained by de-identifying all data and restricting access to the research team; no personal identifiers were used in analysis or reporting. Additionally, artificial intelligence tools were used solely to assist in language editing and improving the clarity of the manuscript; these tools did not contribute to data generation, analysis, or interpretation.

Results

Most participants were below 60 years of age (68%) and slightly more than half were women (55.5%). The mean age was 56.6 ± 10.8 years (range: 32–93 years). Educational levels were low, with nearly one-third being illiterate (32.5%) and only 5.3% having graduate or professional qualifications. More than half of the participants (55.8%) were unemployed or retired and most were engaged in unskilled or semi-skilled work. Socioeconomically, a majority belonged to the upper-lower (49%) and lower middle (15.5%) classes. The population was predominantly Hindu (73%), from the general caste (77.3%) and largely island residents (94.3%). Nuclear families were most common (52.2%) and most participants were married (88.8%), with 10.8% widowed. The detailed sociodemographic profile is presented in Table 1.

Table 1. Distribution of study participants across sociodemographic categories

Sociodemographic Variables (N=400)		Frequency (%)
Age in years	Less than 60	272 (68.0)
	More than 60	128 (32.0)
Gender	Male	178 (44.5)
	Female	222 (55.5)
Education	No formal education	130 (32.5)
	Primary education	134 (33.5)
	Secondary education	115 (28.8)
	Diploma and above	21 (5.2)
Occupation	Elementary occupation	56 (14.0)
	Plant and machine operators and assemblers	12 (3.0)
	Craft and related trade workers	17 (4.3)
	Skilled agricultural and fishery workers	12 (3.0)
	Skilled workers and shop and market sales workers	39 (9.7)
	Clerks	21 (5.3)
	Technicians and associate professionals	8 (2.0)
	Professionals	12 (3.0)
	Unemployed/ retired	223 (55.7)
Socioeconomic status	Upper	35 (8.8)
	Upper Middle	51 (12.7)
	Lower Middle	62 (15.5)
	Upper Lower	196 (49.0)
	Lower	56 (14.0)
Religion	Hindu	292 (73.0)

	Muslim	77 (19.3)
	Christian	31 (7.7)
Caste	SC	5 (1.3)
	ST	3 (0.7)
	OBC	83 (20.7)
	General	309 (77.3)
Type of family	Nuclear	209 (52.2)
	Joint	158 (39.5)
	Extended	33 (8.3)
Marital status	Married	355 (88.8)
	Unmarried	2 (0.5)
	Widowed	43 (10.7)
Resident status	Native island resident	377 (94.3)
	Non-native resident	23 (5.7)

Amongst the 400 participants, 228 were diabetics, 279 were hypertensive while 107 participants suffered from both the comorbidities. Majority of the participants (47%) belong to Obese category as per the Asian BMI classification. [12] The average sleep duration was 6.59 ± 1.34 hours per day, which is marginally below recommended levels. [13] Dietary diversity was predominantly high, with a mean score of 9.52 ± 2.13, with 380 participants (95%) classified in the high dietary diversity category (FFQ score ≥ 6), while 20 (5%) fell into the medium category (FFQ score = 4-5); none of the participants were categorised as having low dietary diversity (FFQ ≤ 3). Despite this high dietary diversity, total energy intake was inadequate for most participants, with mean daily caloric intake of the participants being 1235.79 ± 378.68 kcal, 372 (93%) participants exhibiting deficient calorie intake and only 28 (7%) reporting excess intake. Protein intake was similarly suboptimal, as 307 participants (76.8%) consumed protein below recommended levels; only one participant (0.3%) met adequate protein intake, while 92 (23%) had protein intake in excess. Average protein consumption was 49.41 ± 18.61 g per day. Salt consumption showed an almost equal distribution, with 199 participants (49.8%) consuming salt within recommended limits and 201 (50.2%) exceeding the recommended intake. However, the mean salt intake was 5.85 ± 1.39 g per day, exceeding the recommended upper limit, suggesting a tendency towards higher dietary salt consumption. Collectively, these findings indicate that high dietary diversity did not necessarily translate into adequate nutrient intake, with widespread deficits in energy and protein intake alongside substantial excess salt consumption. The frequency distribution of participants with respect to quantity and quality of food consumed is depicted in figure 1 and 2. Table 2 shows the association between dietary diversity and selected sociodemographic and clinical variables. Most participants below 60 years had high dietary diversity (68.7%), while among those above 60 years, 31.3% were in the high category. Females formed a similar proportion in both high (56.1%) and medium (55.5%) dietary diversity groups. Dietary diversity did not show a statistically significant association with age, gender, socioeconomic status, religion, caste, family type, marital status, residence, or BMI. Significant associations were also observed between sociodemographic factors and calorie and protein intake. Among those with calorie deficit, 67.2% were below 60 years, while 78.6% of those with excess intake were under 60. Calorie intake showed a significant association with gender (χ^2 = 4.635, P = 0.047), with females forming the majority in both deficit and excess groups. No other sociodemographic variable was significantly associated with calorie intake. Similarly, protein intake was significantly associated with gender (χ^2 = 12.758, P < 0.001), socioeconomic status (χ^2 = 6.201, P = 0.047), family type (χ^2 = 19.052, P < 0.001) and BMI (χ^2 = 13.372, P = 0.010). Most participants in both protein deficit and excess categories were below 60 years, belonged to lower socioeconomic class and obese class formed the largest proportion in both groups.

Table 2. Association of dietary diversity with sociodemographic variables

Sociodemographic Variables		Dietary Diversity		Chi-square/ Fischer's Exact test	*P* value
		High	**Medium**		
Age	Less than 60 years	261 (68.7)	11 (55.0)	1.63	0.20
	More than 60 years	119 (31.3)	9 (45.0)		
Gender	Male	167 (43.9)	11 (44.5)	0.94	0.33
	Female	213 (56.1)	9 (55.5)		
Socioeconomic status	Upper	235 (61.9)	17 (85.0)	4.01*	0.11
	Middle	110 (28.9)	3 (15.0)		
	Lower	35 (9.2)	0 (0)		
Religion	Hindu	277 (72.9)	15 (75.0)	0.52*	0.85
	Muslim	74 (19.5)	3 (15.0)		
	Christian	29 (7.6)	2 (10.0)		
Caste	SC	5 (1.3)	0 (0)	0.60*	1.00
	ST	3 (0.8)	0 (0)		
	OBC	79 (20.8)	4 (20.0)		
	General	293 (77.1)	16 (80.0)		
Type of family	Nuclear	199 (52.4)	10 (50.0)	1.87*	0.41
	Joint	148 (38.9)	10 (50.0)		
	Extended	33 (8.7)	0 (0)		
Marital status	Married	337 (88.7)	18 (90.0)	0.77*	1.00
	Unmarried	2 (0.5)	0 (0)		
	Widowed	41(10.8)	2 (10.0)		
Residence	Native island resident	359 (94.5)	18 (90.0)	0.22*	0.32
	Non-native island resident	21 (5.5)	2 (10.0)		

**** Fisher's Exact Test applied.***

† No participant reported low dietary diversity

Illustrations (Figures)

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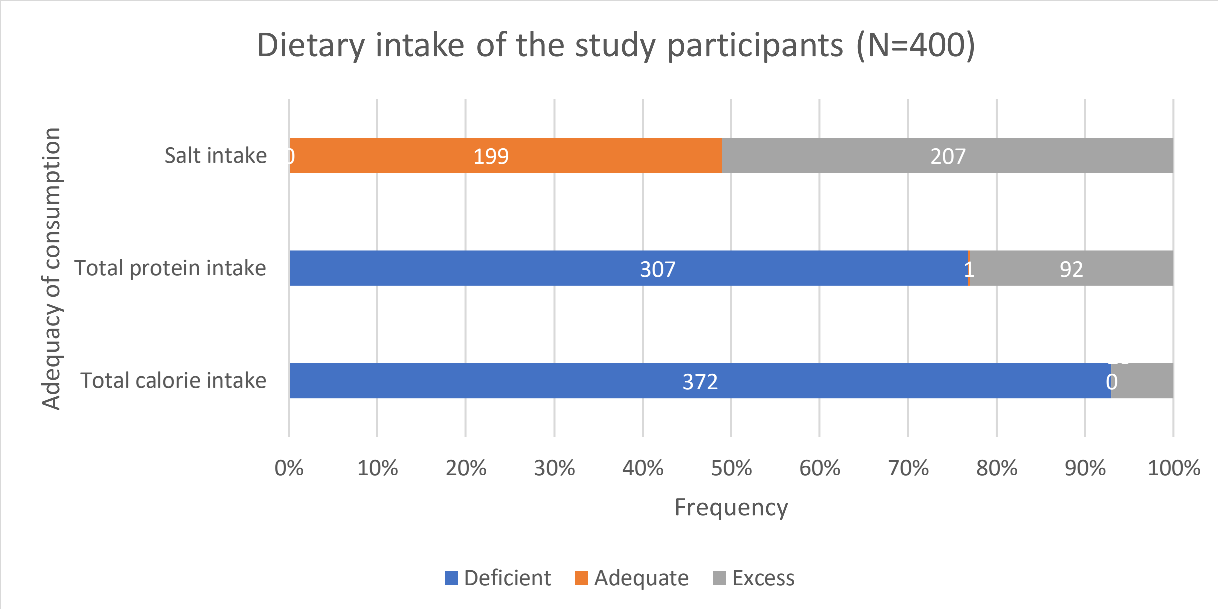

Figure 1. Adequacy of Dietary Intake among the Study Population (N = 400)

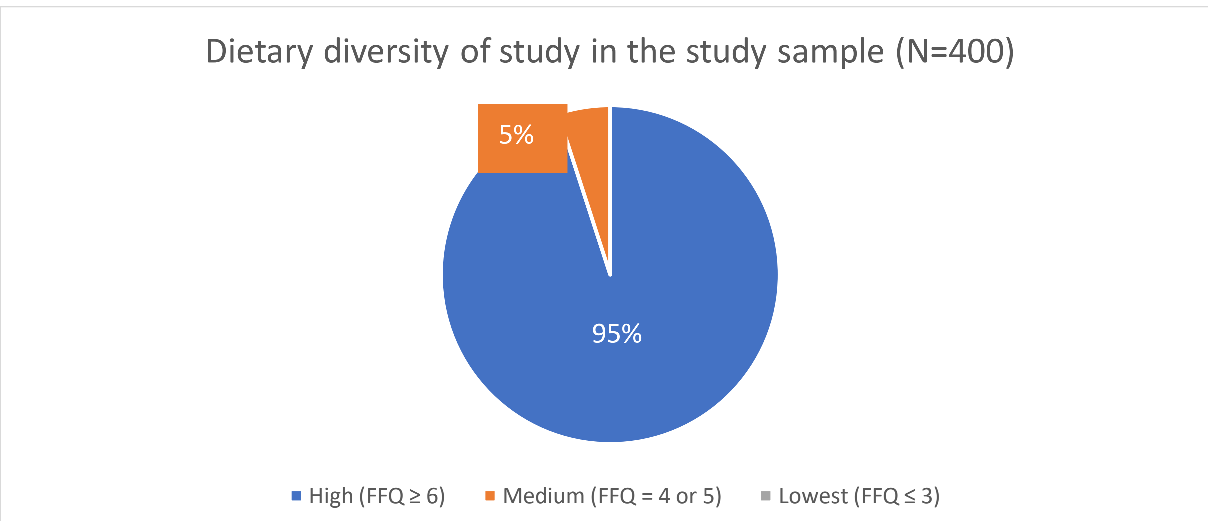

Figure 2. Dietary Diversity among the Study Participants (N = 400)

Table 3 shows the association of dietary diversity with clinical and lifestyle variables. Dietary diversity was not significantly associated with disease status (Type 2 Diabetes, Hypertension, or both) (χ^2 = 3.058, P = 0.229). Among Diabetics about 98% had high dietary diversity and about 88% had high dietary diversity. Of the 20 participants with medium dietary diversity, 3 were diabetic, 12 hypertensive and5 had both. No participant fell into the low dietary diversity category, suggesting generally moderate to high dietary variety in the study population. Sleep duration was classified as adequate (≥7 hours) or inadequate (<7 hours) as per established recommendations [13]. Dietary diversity showed a significant association with sleep adequacy (χ^2 = 7.792, P = 0.005). Inadequate sleep was reported by 15 participants (3.6%) in the medium dietary diversity group and 164 (96.4%) in the high dietary diversity group. BMI was also significantly associated with dietary diversity (P

= 0.048). Despite having high dietary diversity 56.35 of the participants were obese, 20.8% had normal BMI, 2.6% were underweight and 20.3% overweight.

Table 3. Association of dietary diversity with selected clinical and lifestyle factors

Sociodemographic factors		Frequency (%) of dietary diversity categories		Chi-square/ Fischer's Exact test	*P* value
		High	**Medium**		
Chronic diseases	Diabetic	118 (31.1)	3 (15.0)	3.05	0.22
	Hypertensive	160 (42.1)	12 (60.0)		
	Both	102 (26.8)	5 (25.0)		
BMI	Normal	79 (20.8)	7 (35.0)	7.41*	**0.04**
	Underweight	10 (2.6)	2 (10.0)		
	Overweight	77 (20.3)	1 (5.0)		
	Obese	214 (56.3)	10 (50.0)		
Number of hours of sleep	Adequate	216 (56.8)	5 (25.0)	7.79	**0.005**
	Inadequate	164 (43.2)	15 (75.0)		

**** Fisher's Exact Test applied***

Table 4 shows the association between dietary diversity categories and total calorie and protein intake. Despite having high dietary diversity about 93% Among participants with high dietary diversity, 28 (7.4%) had excess calorie intake and 352 (92.6%) had deficient calorie intake, whereas all participants with medium dietary diversity had deficient calorie intake (20; 100%); this association was not statistically significant (*P* = 0.382). Similarly, among those with high dietary diversity, 90 (23.7%) had excess protein intake and 290 (79.3%) had deficient protein intake, while among participants with medium dietary diversity, 2 (10.0%) reported excess protein intake and 18 (90.0%) had deficient intake; the association between dietary diversity and protein intake was also not statistically significant (*P* = 0.272).

Table 4. Association between Dietary Diversity and Energy and Protein Consumption

Macro-nutrient Intake		Dietary diversity categories		Chi-square	*P* value
		High	**Medium**		
Total calorie intake	Excess	28 (7.4)	0 (0.0)	0.23*	0.382
	Deficient	352 (92.6)	20 (100)		
Total protein intake	Excess	90 (23.7)	2 (10.0)	0.09*	0.272
	Deficient	290 (79.3)	18 (90.0)		

**** Fisher's Exact Test applied***

† No participant reported low dietary diversity.

DISCUSSION

In this study, dietary diversity was significantly associated with BMI and average sleep duration, but not with total calorie or protein intake, indicating that diversity alone may not adequately reflect nutritional sufficiency in this population. The majority of participants demonstrated deficient calorie and protein intake, highlighting a considerable burden of quantitative undernutrition. Females were found to consume fewer calories and protein than males and lower protein intake was particularly evident among individuals from nuclear families, those belonging to lower socio-economic strata and participants with lower BMI.

In the present study, dietary diversity was not found to be significantly associated with the type of NCDs (Type 2 Diabetes and/or Hypertension), even though the available scientific literature says otherwise [2]. In Indian (and South Asian) populations, more diverse diets are not automatically protective; benefits depend strongly on what foods make up that diversity as is evident from a large urban study conducted by Kapoor D et al. in 2018 among South Asian cohorts (Delhi, Chennai, Karachi).[14] However, National Family Health Survey-4 (NFHS-4) data on >110,000 Indian men found the opposite: higher dietary diversity was linked to about twice the odds of having Diabetes, while only moderate diversity was associated with slightly lower heart disease and cancer risk.[15] Taken together, these findings suggest that the relationship between dietary diversity and cardiometabolic outcomes in Indian populations is complex and context-specific and that diversity alone, without consideration of the quality and composition of foods consumed, may not independently predict the presence of Type 2 Diabetes or Hypertension.

Another important finding in this study is the gender disparity in calorie and protein intake among the participants. Although dietary diversity did not have a significant association to gender, adequate intake of calorie and protein was found to be statistically higher among men than women, although the numbers appear to be comparable. This is in accordance with the commonly reported pattern of males generally consuming more calories and protein than females, though both sexes often fall short of recommended intakes.[16] Large surveys and smaller studies conducted among Indian adults with Type 2 Diabetes or Hypertension also show that macronutrient distribution is often similar by sex, but women consume fewer total calories, so their total grams of protein are lower. [17–20].However rigorous sex-stratified intake data among hypertensive adults are still sparse.

In the present study, dietary diversity was high but did not correspond to adequate energy or protein intake and no significant association was observed with nutrient consumption. This highlights the limitation of dietary diversity as a standalone indicator of dietary adequacy. In resource-limited settings, small quantities of diverse foods may yield high diversity scores despite inadequate nutrient intake. Additionally, dietary restrictions among individuals with Type 2 Diabetes or Hypertension may influence intake patterns. These findings emphasize the need to combine dietary diversity with quantitative nutrient assessment when evaluating diets in populations with a high burden of non-communicable diseases.

This study provides one of the first cross-sectional assessments of dietary intake in the Andaman and Nicobar Islands, examining both dietary quality and quantity. However, causal relationships cannot be inferred due to the cross-sectional design and dietary assessment relied on self-reported data, which may be affected by recall and social desirability bias. Dietary adequacy was assessed against standard reference values for normal Indian adults as per the ICMR-NIN Dietary Guidelines for Indians 2024, as disease-specific energy recommendations were beyond the scope of this study. Despite these limitations, the findings provide important insights into dietary patterns in a population with a burden of chronic diseases more than national average. [21] The findings from this study emphasize the need for comprehensive public health strategies that address both dietary quality and macronutrient adequacy, with focused attention on socially and nutritionally vulnerable groups.

Appendices

Appendix A.

Assessment of Individual Dietary Diversity

Dietary diversity was assessed at the individual level using the dietary diversity questionnaire developed by the Food and Agriculture Organization of the United Nations (FAO). The questionnaire captures qualitative food consumption data through a 24-hour dietary recall, asking respondents to describe all foods and drinks consumed the previous day, from morning to night, whether at home or outside the home.

The individual dietary diversity score (IDDS) serves as a proxy indicator of the nutritional quality of the diet and, for women, the probability of micronutrient adequacy. An increase in dietary diversity score is associated with improved nutrient adequacy of the diet across multiple age and sex groups.

A.1 Food Group Classification

Foods reported in the 24-hour recall were classified into food groups following the FAO dietary diversity framework. The food group classification used in this study is based on the approach applied in Mozambique (FAO, 2006), where food groups were defined to reflect locally available foods and dietary patterns. The 16 food groups in the questionnaire were then aggregated into 9 food groups for calculation of the Women's Dietary Diversity Score (WDDS), as described in Table A1.

Table A1. Food group classification for individual dietary diversity assessment

No.	Food Group	Examples of Foods Included	Local Foods (Mozambique context)
GROUP 1: STARCHY STAPLES (aggregated from Cereals + White Roots and Tubers)			
1a	Cereals	Maize, rice, wheat, sorghum, millet, bread, noodles, porridge	Ugali (nshima/nsima from maize), xima, mapira porridge
1b	White roots and tubers	White potato, white yam, white cassava, plantains	Mandioca/cassava (white), matapa base (cassava leaves excluded here)
GROUP 2: DARK GREEN LEAFY VEGETABLES			
2	Dark green leafy vegetables	Spinach, kale, amaranth greens, cassava leaves, moringa leaves	Matapa (cassava leaves), couve (kale), folhas de abóbora (pumpkin leaves)
GROUP 3: OTHER VITAMIN A RICH FRUITS AND VEGETABLES (Vit A-rich vegetables/tubers + Vit A-rich fruits + red palm oil)			
3a	Vitamin A rich vegetables & tubers	Pumpkin (orange), carrot, orange sweet potato, red pepper	Abóbora (orange pumpkin), cenoura, batata-doce laranja
3b	Vitamin A rich fruits	Ripe mango, cantaloupe, ripe papaya, apricots, dried peaches	Manga madura, papaia madura, mamão
3c	Red palm oil / palm nut products	Red palm oil, palm nut, palm nut pulp sauce	Óleo de palma vermelho (óleo de dendém), polpa de palma
GROUP 4: OTHER FRUITS AND VEGETABLES (Other vegetables + Other fruits)			
4a	Other vegetables	Tomato, onion, eggplant, cabbage, cucumber, okra	Tomate, cebola, beringela, quiabo, pepino
4b	Other fruits	Banana, apple, orange, guava, watermelon, pineapple	Banana, laranja, goiaba, melancia, ananás
GROUP 5: ORGAN MEAT			
5	Organ meat	Liver, kidney, heart, gizzard, lung, blood-based foods	Fígado, rim, moela, coração
GROUP 6: MEAT AND FISH (Flesh meats + Fish and seafood)			
6a	Flesh meats	Beef, pork, lamb, goat, chicken, duck, rabbit, insects	Carne de vaca, frango, cabrito, porco, caça (nyama)
6b	Fish and seafood	Fresh or dried fish, shellfish, canned fish, prawns	Peixe seco (machamba), camarão, peixe fresco, sardinhas
GROUP 7: EGGS			

7	Eggs	Chicken, duck, guinea fowl or any other bird egg	Ovos de galinha, ovos de pato
GROUP 8: LEGUMES, NUTS AND SEEDS			
8	Legumes, nuts and seeds	Dried beans, lentils, peas, groundnuts, seeds, peanut butter, tofu	Feijão, amendoim, nhemba, manteiga de amendoim
GROUP 9: MILK AND MILK PRODUCTS			
9	Milk and milk products	Milk, cheese, yogurt, curd, infant formula, ice cream	Leite, iogurte, queijo
Note: Food groups not included in the WDDS score but recorded: Oils and fats (Q14), Sweets (Q15), Spices/condiments/beverages (Q16). Foods consumed in quantities ≤15g (approximately one tablespoon) were excluded from the score.			

A.2 Scoring and Categorisation

The individual dietary diversity score was calculated by summing the number of food groups (out of 9) consumed by the respondent over the preceding 24-hour period. Each food group was scored as 1 (consumed) or 0 (not consumed), giving a potential score range of 0 to 9. Following the approach applied in the Mozambique dietary diversity study (FAO, 2006), dietary diversity was categorised into three levels based on tertile distribution of scores, as described in Table A2.

Table A2. Dietary diversity score categories and interpretation

Category	Score Range	Number of Food Groups Consumed	Interpretation
High Dietary Diversity	≥ 6 food groups	6 – 9	Diet includes a wide variety of food groups, suggesting adequate micronutrient intake
Medium Dietary Diversity	4 – 5 food groups	4 – 5	Diet is moderately diverse; some nutritional gaps may exist
Low Dietary Diversity	≤ 3 food groups	≤ 3	Diet is monotonous; high risk of micronutrient inadequacy
Source: Adapted from FAO (2006) Mozambique Baseline Survey and Kennedy et al. (2007). Categories reflect tertile distribution of food group scores consistent with the approach used in central Mozambique dietary diversity assessments.			

A.3 Data Collection Procedure

The dietary diversity questionnaire was administered to individual respondents using the following procedure:

- Respondents were asked to freely recall all foods and drinks consumed the previous day (from morning until night), including foods eaten inside and outside the home.
- All foods mentioned were recorded across meal occasions: breakfast, morning snack, lunch, afternoon snack, dinner, and evening snack.
- When composite dishes were mentioned, respondents were asked to list all ingredients so that each could be assigned to its appropriate food group.
- After free recall was complete, interviewers probed for any food groups not mentioned (e.g., fruits, vegetables, fats/oils, condiments) to ensure completeness.
- Foods consumed in very small quantities (approximately ≤15g, equivalent to one tablespoon) were not counted toward the individual dietary diversity score, consistent with recommendations for individual-level scoring.
- Surveys were not conducted during national holidays, religious fasting

periods (e.g., Ramadan), or following atypical food events, to avoid recording non-representative dietary patterns.

Appendix B

ICMR-NIN Recommended Energy and Protein Requirements for Indian Adults (2020)

Source: *ICMR-NIN Expert Group on Nutrient Requirements for Indians. Recommended Dietary Allowances (RDA) and Estimated Average Requirements (EAR) – 2020. Hyderabad: Indian Council of Medical Research – National Institute of Nutrition; 2020.*

B.1 Recommended Daily Energy Requirements for Indian Adults

Energy requirements are calculated as Total Energy Expenditure (TEE) = Basal Metabolic Rate (BMR) × Physical Activity Level (PAL). The PAL values used are specific to the Indian population, which expend lower energy for given activities compared to Western populations. The BMR equations have been further adjusted with a 10% reduction to account for the lower BMR observed among Indians due to their higher body fat composition. Reference body weights used are 65 kg for men and 55 kg for women.

Category	Activity Level	Reference Body Weight (kg)	Energy Requirement (kcal/day)	Energy per kg Body Weight (kcal/kg/day)
Adult Men	Sedentary work	65	2110	32
Adult Men	Moderate work	65	2710	42
Adult Men	Heavy work	65	3470	53
Adult Women	Sedentary work	55	1660	30
Adult Women	Moderate work	55	2130	39
Adult Women	Heavy work	55	2720	49

** These values represent requirements for reference individuals. Actual requirements should be adjusted for the individual's actual body weight and physical activity level.*

B.2 Recommended Daily Protein Requirements for Indian Adults

The protein requirements are the same across all physical activity levels (sedentary, moderate, and heavy work) for a given sex, as they are based on body weight rather than activity level. The ICMR-NIN 2020 report adopted the FAO/WHO/UNU (2007) approach to define protein requirements, using median obligatory nitrogen loss to compute the EAR and RDA.

Category	Reference Body Weight (kg)	EAR (g/kg/day)	RDA (g/kg/day)	EAR (g/day)	RDA (g/day)
Adult Men	65	0.66	0.83	42.9	54.0
Adult Women	55	0.66	0.83	36.3	45.7

** For individuals consuming predominantly cereal-based diets with low protein quality, the protein requirement is 1 g/kg/day.*

** The recommended cereal-to-legume-to-milk ratio in the diet is 3:1:2.5 to ensure good protein quality.*

EAR = Estimated Average Requirement (recommended for assessing population-level adequacy and individual diet planning); RDA = Recommended Dietary Allowance (97.5th percentile of the requirement distribution).

B.3 Application in This Study

In this study, dietary adequacy for calorie intake was assessed by comparing each participant's reported daily energy intake against the appropriate ICMR-NIN 2020 reference value based on their sex and self-reported physical activity level (sedentary / moderate / heavy work). For protein, adequacy was assessed using the EAR of 0.66 g/kg body weight/day, which is the recommended standard for population-level adequacy estimation as advised by the ICMR-NIN 2020 committee.

REFERENCES

1. Kennedy G, Ballard T, Dop M. Guidelines for measuring household and individual dietary diversity. Rome, Italy: Food and Agriculture Organization of the United Nations; 2013.
2. Mozaffari H, Hosseini Z, Lafrenière J, Conklin AI. The role of dietary diversity in preventing metabolic-related outcomes: Findings from a systematic review. Obes Rev [Internet]. 2021 Feb [cited 2026 Jan 19];22(6). Available from: https://onlinelibrary.wiley.com/doi/10.1111/obr.13174
3. Htay ZW, Michihata N, Nakamura Y, Hippo Y, Otonari J, Ikezaki H, et al. Dietary diversity and the risk of metabolic syndrome in a Japanese population: an analysis of baseline cross-sectional data from the J-MICC study. Eur J Clin Nutr. 2025 Nov;79(11):1106–13. doi:10.1038/s41430-025-01654-6
4. Uncontrolled high blood pressure puts over a billion people at risk [Internet]. [cited 2026 Jan 19]. Available from: https://www.who.int/news/item/23-09-2025-uncontrolled-high-blood-pressure-puts-over-a-billion-people-at-risk
5. Sekher TV, Flood D, Green H, Hu P, Ali MK, Shete A, et al. Prevalence, awareness, treatment, and control of diabetes in India: a nationally representative survey of adults aged 45 years and older. Lancet Glob Health. 2025 Sep 1;13(9):e1543–52. doi:10.1016/S2214-109X(23)00502-8 PubMed PMID: 40784358.
6. Diabetes [Internet]. World Health Organization; [cited 2026 Jan 19]. Available from: https://www.who.int/health-topics/diabetes
7. Healthy diet [Internet]. World Health Organization; [cited 2026 Jan 19]. Available from: https://www.who.int/news-room/fact-sheets/detail/healthy-diet
8. Dietary Guidelines for Indians. Indian Council for Medical Research- National Institution of Nutrition; 2024.
9. Deshmukh AT, Patil V, Patil M. Assessment of Dietary Diversity Among Adult Hypertensives. J Hypertens. 2023 Jan;41(Suppl 1). doi:10.1097/01.hjh.0000917248.77010.7d
10. **Kennedy G, Ballard T, Dop MC.** Guidelines for measuring household and individual dietary diversity. Rome: Food and Agriculture Organization of the United Nations; 2010..
11. ICMR-NIN Expert Group on Nutrient Requirements for Indians. Recommended Dietary Allowances (RDA) and Estimated Average Requirements (EAR) – 2020. Hyderabad: Indian Council of Medical Research – National Institute of Nutrition; 2020.
12. Misra A, Chowbey P, Makkar BM, Vikram NK, Wasir JS, Chadha D, et al. Consensus statement for diagnosis of obesity, abdominal obesity and the metabolic syndrome for Asian Indians and recommendations for physical activity, medical and surgical management. J Assoc Physicians India. 2009 Feb;57:163–70. PubMed PMID: 19582986.
13. Watson NF, Badr MS, Belenky G, Bliwise DL, Buxton OM, Buysse D, et al. Recommended Amount of Sleep for a Healthy Adult: A Joint Consensus Statement of the American Academy of Sleep Medicine and Sleep Research Society. Sleep. 2015 Jun 1;38(6):843–4. doi:10.5665/sleep.4716 PubMed PMID: 26039963; PubMed Central PMCID: PMC4434546.
14. Kapoor D, Iqbal R, Singh K, Jaacks LM, Shivashankar R, Sudha V, et al. Association of dietary patterns and dietary diversity with cardiometabolic disease risk factors among adults in South Asia: The CARRS study. Asia Pac J Clin Nutr. 2018 Nov 1;27(6):1332–43. doi:10.6133/apjcn.201811_27(6).0021
15. Dolui M, Sarkar S, Ghosh P, Hossain M. Dietary diversity and association with non-communicable diseases (NCDs) among adult men (15–54 years): A cross-sectional study using National Family and Health Survey, India. PLOS Global Public Health. 2023 Apr 26;3(4):e0001775. doi:10.1371/journal.pgph.0001775
16. Paira K, Ao M. Exploring the determinants of dietary nutrients intake among the rural households: a cross-sectional study in Jhargram district of West Bengal, India. Discover Public Health. 2024 Dec 8;21(1):224. doi:10.1186/s12982-024-00350-3
17. Joshi SR, Bhansali A, Bajaj S, Banzal SS, Dharmalingam M, Gupta S, et al. Results from a dietary survey in an Indian T2DM population: a STARCH study. BMJ Open. 2014 Oct 1;4(10). doi:10.1136/bmjopen-2014-005138
18. Alsulami S, Bodhini D, Sudha V, Rani CSS, Pradeepa R, Anjana RM, et al. Lower Dietary Intake of Plant Protein Is Associated with Genetic Risk of Diabetes-Related Traits in Urban Asian Indian Adults. Nutrients. 2021 Aug 31;13(9). doi:10.3390/nu13093064
19. Kanneganti A, Hussain M, Sri R, Sahay R, Kudugunti N, Sashi L. A Comparison of Macronutrient Intake and Anthropometric Profile between Male and Female Type 2 Diabetics. The Indian Journal of Nutrition and Dietetics. 2020 Jun 23;164–77. doi:10.21048/ijnd.2020.57.2.24586
20. Kaur P, Yadav AK, Pal A, Jassal RS, Shafiq N, Sahni N, et al. Estimation of dietary intake of sodium, potassium, phosphorus and protein in healthy Indian population and patients with chronic kidney disease. Front Nutr. 2024 Feb 29;11. doi:10.3389/fnut.2024.1312581
21. National Family Health Survey - 5 Report: Union Territory Fact Sheet Andaman & Nicobar Islands [Internet]. International Institute of Population Sciences, Mumbai: Ministry of Health and Family Welfare, International Institute for Population Sciences. Available from: https://mohfw.gov.in/sites/default/files/NFHS-5_Phase-II_0.pdf (Last Accessed: 03 March 2026).