



## HEALTH PROMOTION

# A Snapshot Investigation on Assessment of Role of Dietary Diversity in Healthy Ageing among Elderly Living at Ahmedabad City, India

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## Keywords

Activity of daily living • Dietary Diversity • Elderly • Healthy ageing

## Summary

**Background.** Dietary Diversity (DD) is one of the crucial determinants to address Healthy ageing among elderly people.

**Objectives.** To estimate prevalence with concerned determinants of Dietary Diversity, to assess intake-pattern of various nutrients and correlation of dietary diversity with healthy ageing among study participants.

**Methodology.** A cross-sectional study was conducted among 192 Elderly people ( $\geq 60$  years of age) residing at Ahmedabad city, India, selected by two-stage Cluster sampling [As per Rapid Assessment Method for Older People (RAM-OP) survey sampling technique]. A pretested, semi-structured questionnaire including Socio-Demographic and Dietary-Diversity related details was utilised as survey-instrument. Healthy ageing was assessed with selected General Health status using two domains of total five; namely General Activity of Daily Living and Instrumental Activity of Daily Living (IADL) were applied to collect relevant data.

**Results.** Prevalence of Dietary-Diversity was 44.27% among study-

participants. Various determinants such as living alone, socio-economic-class, co-morbidities, type of diet, oral health and meal-frequency revealed statistically significant association with Dietary Diversity. Cereals (96.9%), roots and tubers (91.7%), and condiments and mushrooms (90.1%) were the most common food-groups consumed by study participants. Of 85 participants with positive dietary diversity, more than two-thirds (67, 78.82%) were able to manage activities of daily living independently whereas approximately three-fifth (66, 61.68%) of sub-cohort of counterpart could manage the same independently. Predictors of IADL like use of telephone, practice of taking medications and managing their own money showed statistically significant association with presence of dietary-diversity. **Conclusion.** Dietary diversity was prevalent among less than half of study-participants. A diverse diet showed statistical significant role in ensuring independence in general activities of daily living while gender-specific variations for instrumental activities of daily living.

## Introduction

The World Health Organisation (WHO) has defined “older people” as, those who are 60 years of age or older [1]. Population of elderly individuals is consistently growing in nations with advanced medical and social services and a high quality of life. By 2025, the global population of elderly individuals is projected to exceed 1.2 billion, with a significant majority residing in developing nations [2]. Based on the data from Census 2011, India is home to 104 million older individuals, accounting for 8.6% of the overall population [3]. The significant change in the proportion of older Indians presents a range of social, economic, and healthcare challenges that need to be addressed.

The food choices and eating practices of older individuals have a significant impact on their nutrient adequacy and overall health. The food choices of older individuals are influenced by a variety of factors, including ageing, psychosocial factors, personal resources, life experience, living situation, perceived health, personal motivation and support from other family members [4]. Age-concerned factors such as oral and dental health, diminished appetite, and limited physical capabilities are

common determinant in shaping the prevailed physical health at any given point.

Dietary diversity (DD) is defined as the number of foods or food groups people consume during a given period [5]. Dietary diversity is an important aspect of maintaining good health and wellbeing, as no single food can provide all the essential nutrients needed [6]. The policy encompasses a wide range of food groups, including milk and milk products, cereals, roots, and tubers, fruits and vegetables, meats, eggs, and fish, legumes, nuts, and seeds, fats, sugars, and other groups [7]. Dietary diversity guarantees the probability of sufficient and diverse nutrients. There are several negative consequences associated with low/poor dietary diversity, including an elevated risk of cardiovascular disease, cognitive decline, muscle loss, frailty, depression, and limitations in daily activities, reduced quality of life, increased healthcare costs, and a higher likelihood of death. Dietary diversity is closely linked to energy intake adequacy, which is important for maintaining optimal body function. Along with energy intake, the protein-source food group is important for promoting muscle anabolism. Fruits and vegetables are packed with a wide range of beneficial phytonutrients

that play a crucial role in protecting against various non-communicable diseases. In addition, Dietary diversity has a strong correlation with the diversity and abundance of numerous beneficial gut microbiota, which contribute to overall health and well-being [8].

The healthy ageing concept is a very broad term which can be assessed by many tools, namely Cognitive functioning, Physical functional status, chronic diseases, Personal disability and Instrumental disability. Activity of Daily Living (ADL) are self-care activities that a person performs daily (*e.g.*, eating, dressing, bathing, transferring between the bed and a chair, using the toilet, controlling bladder and bowel functions) [9]. Instrumental (IADL) are activities that are needed to live independently (*e.g.*, doing housework, preparing meals, taking medications properly, managing finances, using a telephone) [9].

Dietary diversity plays a significant role in the overall health and functional ability of elderly individuals, particularly in their ability to perform Activities of Daily Living (ADLs) and Instrumental Activity of Daily Living (IADL). ADLs are basic self-care tasks, including bathing, dressing, eating, toileting, and mobility whereas managing medications or planning meals, shopping or house cleaning are examples of IADL. IADLs require strong cognitive abilities. Deficiencies in nutrients like protein, calcium, vitamin D, and B vitamins have been linked to sarcopenia, osteoporosis, and cognitive decline, all of which can impair ADL and IADL. Nutrients such as omega-3 fatty acids, antioxidants (vitamins C and E), and polyphenols found in fruits, vegetables, nuts, and fish have neuroprotective effects [10]. Mental health is a key determinant of IADL performance. Depression, anxiety, or apathy can reduce the motivation and capacity to perform complex tasks. Dietary diversity, especially the inclusion of mood-enhancing nutrients like tryptophan, magnesium, and omega-3 fatty acids, supports emotional well-being [11].

Indian subcontinent, being in rapid transitional phase of demography, is bearing privileges and encumbrances of demographic dividend and burden respectively. To decrease liability for later cohort, direct out-of-pocket expenses arising out of adverse health and consequent multiple indirect expenses, healthy ageing is utmost important. Geriatric health is often disregarded in India due to socio-cultural customs and beliefs. The key health programs of government are either directed towards maternal and child health or communicable disease. The emerging status of global hub of NCDs has not yet claimed sufficient health-budget in total amount, planned routinely by health system. As a short-term solution the NCDs related program is fitting the square pegs in round holes. Dietary diversity can work as effective primordial and primary prevention tool against majority of NCDs in true sense. To assess the spectrum of dietary diversity, considering the resources available with investigators, current research was planned at one of the biggest cities of western India, *i.e.*, Ahmedabad, which is financial capital of Gujarat province and situated at central part of state with benefit of very well connectivity to all intra-state and inter-state destinations by various

means of travelling across country. It typically presents example of ever-evolving urban-setting where migrants from almost all parts of India are settling due to city's exponential growth in industrial and other sectors. The young generations settled recently is having fusion cultural pattern which includes varied dietary pattern whereas their dependents of extreme ages prefer their cultural diet in recent years of migration.

Current study was conducted with objectives of: 1) To estimate prevalence of Dietary Diversity among study participants; 2) To evaluate various determinants associated with Dietary Diversity; 3) To describe presence of intake pattern of various Dietary nutrients among study participants; 4) To find correlation between Dietary Diversity and selected General Health status among study participants.

## Methods

A cross-sectional study (snapshot investigation) was conducted from February to June 2024 among community-dweller elderly people ( $\geq 60$  years of age) [1] who were residing at Ahmedabad city, India. The sample-size was calculated as per guidelines from Rapid Assessment Method-Older People (RAM-OP) survey [7]. Accordingly, calculated sample-size of 192 was considered for current study. Sampling-frame was constituted by all elderly people residing at administrative territory of Ahmedabad Municipal Corporation. For further sampling technique, Two-stage cluster sampling method [7] was used as per the RAM-OP survey guidance.

Ahmedabad city is divided into seven administrative zones by the Municipal Corporation Authority [12]. Considering resource limitations, four of these zones were selected randomly by lottery method in first stage of sampling. Each zone is divided in multiple wards for administrative ease by municipal corporation. From each selected zone, four wards were selected by a table of random numbers. So, total (4 zones) x (4 wards from each zone) = 16 wards (study area) were included in final sampling frame for current research. In second stage of sampling; the list of households was obtained from respective ward offices of municipal corporation. From each selected ward, 12 households were selected by systematic random sampling with  $K^{\text{th}}$  sampling interval. (Total 16 wards X 12 households per ward = 192 households were selected). Each selected ward had a different sampling interval, *i.e.*,  $K^{\text{th}}$  number, as each ward was having a unique number of registered households in its list. The first household of pre-selected ward was chosen randomly with the currency note method, and remaining eleven households were selected subsequently by adding the  $K^{\text{th}}$  number applicable to that ward.

From each selected households, one elder person was recruited as study participant who fulfils inclusion criteria. If, there were more than one elder person in selected household available at the time of visit who fulfilled the inclusion criteria, then only one

participant was selected by the lottery (chit) method. A selected participant was interviewed personally after receiving oral informed consent. If no elder participant was available in selected household, then the next immediate numbered household was approached. The same sampling technique was applied to all sixteen pre-selected wards to collect data from twelve elderly persons from twelve households. Thus, 16 X 12=192 in toto participants were recruited.

Elderly participants, who were willing to participate, prepared to give oral informed consent, were pre-considered inclusion criteria while migrants (non-residents as per voter list of Municipal Corporation); debilitated elderly people who were severely ill to respond the questionnaire including hearing and/or mental disability were excluded.

Draft questionnaire was pilot tested with a sample of twenty elderly respondents in the field practice area of Urban Health Teaching Centre of Mother Institute. These responses were excluded from final data analysis. A pretested, pre-validated, semi-structured questionnaire was used to collect the relevant details which were filled out by interviewer in manual forms. Questionnaire encompasses socio-demographic information such as age, gender, occupation, and income, as well as personal details like habits, diet and oral health, anthropometric details such as height, weight, and body mass index (BMI) according to the Asia Pacific classification [13]. It also collected Dietary Diversity-related details using the RAM-OP standard questionnaire format, [7] which includes 11 questions for 11 food-groups and meal frequency using the 24-hour recall method. For dietary diversity assessment; participants who had taken  $\geq 6$  food groups and  $<6$  food groups were considered dietary-diversity present and diversity absent, respectively. Socio-economic class was assessed by Modified Kuppaswami classification as per January 2024 update [14].

Healthy ageing is about creating the environments and opportunities that enable people to be and do what they value throughout their lives. Being free of disease or infirmity is not a requirement for healthy ageing, as many older adults have one or more health conditions that, when well controlled, have little influence on their wellbeing [15]. Healthy Ageing assessment includes 5 domains: (i) Cognitive functioning, (ii) Physical functional status, (iii) Chronic diseases, (iv) Personal disability and (v) Instrumental disability. Out of these five domains, on account of time and technical constrains, healthy ageing status was assessed using last two domains after feasibility check during pilot study. Domain of "personal disability" was assessed by Activity of Daily Living (ADL) questionnaire which included 6 questions – each having equal scoring value, 0 for dependent and 1 for independent; final score value range 0-6, where participants with total scores of 6 and  $<6$  were considered independent and dependent, respectively [16]. Personal disability was considered when there is impairment in at least one ADL (bathing, dressing, toileting, transferring, and eating) [17]. Second domain of "instrumental disability" was assessed by Instrumental Activity of

Daily Living (IADL) questionnaire which included six questions for male participants and nine questions for female participants [8, 18]. Each question had three categories; namely unable to perform independently, need assistance to perform and perform independently with score value of 1, 2 and 3 respectively [16].

Both, ADL and IADL questionnaire are pre-validated and the same was re-confirmed in pilot study during current research. Data were analysed using IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp. and MS Excel 2021, applying appropriate statistical tests. For descriptive statistics- mean, standard deviation and proportion; for continuous variables- unpaired t-test and ANOVA were applied. Association between dietary diversity with components of ADL and IADL were analysed by applying unpaired-t test and chi-square test respectively. Logistic regression using odds ratio was applied to evaluate the risk conditions that are associated with an unvaried diet. The research was approved by Institutional Ethical Committee vide its letter no. GCSMC/EC/Research Project/Approve/2024/618.

## Results

Among 192 study participants, 85 (44.27%) showed presence of Dietary Diversity (Score  $\geq 6$ ) while 107 (55.73%) participants revealed lack of Dietary Diversity (Score  $<6$ ). Thus, Prevalence of Dietary Diversity was found to be 44.27% among study participants. In context to gender-specific prevalence, of total 94 male participants, 46 (48.9%) and of total 98 female participants, 39 (39.79%) had dietary diversity present showing favourable results amongst male gender.

Of total recruited participants, the age-distribution of studied elderly was near-equally distributed among 60-70 (73, 38.02%), 70-80 (61, 31.77%) and more than 80 (58, 30.20%) years sub-groups with slightly more preponderance of 60-70 years age-group. The distribution of dietary diversity in these three sub-groups showed diverse prevalence with maximum revelation in 70-80 years age-group, *i.e.*, 50.82% while minimal presence in first decade of geriatric phase of life, *i.e.*, 60-70 years (39.73%). The gender distribution of recruited participants was almost equal, 94 (48.96%) males and 98 (51.04%) females. Nearly half of studied male participants (46, 48.94%) while two-fifth of recruited females (39, 39.80%) showed presence of dietary diversity in their food. The revealed gender difference for prevalence of dietary diversity did not establish statistical significance. ( $p = 0.204$ ). Of total participants surveyed, majority (102, 53.13%) had lost their spouse while nearly one-third, (68, 35.42%) were living with spouse whereas 38 (19.79%) participants were living alone, irrespective of spouse alive or not. Almost two-thirds of elderly (134, 69.79%) were suffering from one or more co-morbidities at the time of interview. The presence of dietary diversity was statistically significantly affected by living alone and suffering from co-morbidities. Majority of elderly belonged to class III and IV of modified Kuppaswami

classification, which had statistically significant impact on presence of dietary diversity. In context of BMI, 134 (69.76%) elderly participants were in normal category of Asia-pacific classification whereas 52 (27.08%) were in pre-obese category. Types of diet consumed (vegetarian, eggetarian and mixed variety) revealed statistically significant impact on presence of dietary diversity. Two-fifths (80, 41.67%) of participants were addicted to one or more substances, mainly tobacco and majority (176, 91.67%) had habit of drinking tea/coffee more than once a day. The dentin status and meal frequency per day were assessed which revealed strong statistical significance ( $p < 0.0001$  and  $0.0005$  respectively) on presence of dietary diversity amongst studied elderly.

A value of Odd's Ratio (OR)  $>1$  suggests higher odds with lack of dietary diversity (*i.e.*, negative outcome), and OR  $< 1$  suggests protective effect or higher odds with dietary diversity (*i.e.*, positive outcome). The reference group (OR = 1) is the category against which others were compared. Females had 1.45 times higher odds of *not* having dietary diversity than males. Divorced status had 2.11 times higher odds of not having dietary diversity than married participants. Participants with class IV socio-economic status had 3 times whereas participants representative from class V socio-economic strata had 3.67 times higher odds of lacking dietary diversity as compared to participants from class II. Individuals with mixed diet had 0.26 times lower odds of lacking dietary diversity than participants with vegetarian diet. Edentulous participants had 21.6 times while partially dentulous had 5.2 times higher odds of lacking dietary diversity than dentulous participants. Participants who were having 4-6 meals in a day were having 0.29 times lower odds of lacking dietary diversity than those who were having 1-3 meals in a day. (Tab. I).

As described in methodology, the dietary information to classify dietary diversity was collected by asking intake of 11 sub-groups of food as pre-defined in RAM-OP standard questionnaire format [7]. The result revealed cereals (186, 96.9%), roots and tubers (176, 91.7%), and condiments and mushrooms (173, 90.1%) were the most common food-

groups consumed by more than 90% of study participants. All meats (34, 17.7%), fish (31, 16.1%) and eggs (79, 41.1%) were the least consumed food-groups. (Fig. 1).

The activity of daily living was assessed as a component of healthy ageing. The association of same with dietary diversity was found statistically significant. Of 85 elderly with dietary diversity present in their diet, more than two-thirds (67, 78.82%) were able to manage activities of daily living independently whereas approximately three-fifth (66, 61.68%) of sub-cohort with dietary diversity absence in diet could manage the same independently. (Tab. II).

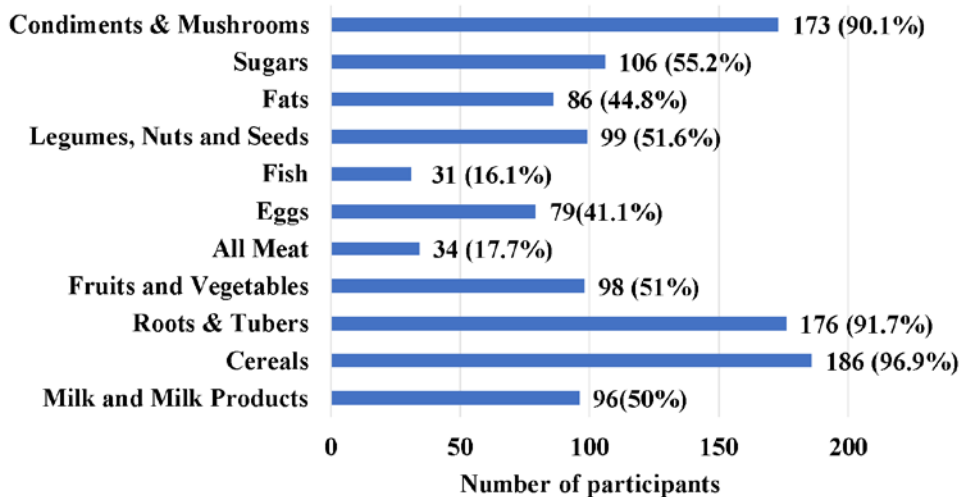
The effect of presence of dietary diversity on instrumental activities of daily living (IADL) was assessed with six and nine questions in male and female gender respectively. The three common variables, namely use of telephone, practice of taking medications and managing their own money showed statistically significant association with dietary diversity. The participants with female gender showed statistically significant association with dietary diversity in five additional variables than mentioned above. Getting to places which are out of walking distance, preference/attitude to take medication by self, shopping for groceries, preparing their own meals and doing their own housework were instrumental activities of daily living which were significantly associated with dietary diversity amongst female elderly participants. (Tab. III).

## Discussion

The study aimed to evaluate the prevalence and determinants of dietary diversity among older adults and its association with various aspects of health and daily living. Review of literature at renowned medical databases did not reveal much information about assessment of Dietary Diversity among Elderly using RAM-OP questionnaire, especially in Indian sub-continent.

The prevalence of Dietary Diversity in current research was found to be 44.27% while similar research conducted

Fig. 1. Intake pattern of various Food-groups among study participants (n = 192).



Tab. I. Association of various socio-demographic, anthropometric and diet related determinants with Dietary Diversity (n = 192).

Variables	Dietary Diversity		Total	Mean	SD	Odds ratio (95% CI)	p Value
	Present (n = 85)	Absent (n = 107)					
<b>Age (In Completed Years)</b>							
60-70	29 (39.73%)	44 (60.27%)	73	0.40	0.49	1	0.431#
70-80	31 (50.82%)	30 (49.18%)	61	0.51	0.50	0.64 (0.32-1.27)	
> 80	25 (43.10%)	33 (56.89%)	58	0.43	0.50	0.87 (0.43-1.75)	
<b>Gender</b>							
Male	46 (48.94%)	48 (51.06%)	94	0.49	0.50	1	0.204*
Female	39 (39.80%)	59 (60.20%)	98	0.40	0.49	1.45 (0.82-2.57)	
<b>Marital Status</b>							
Married	38 (55.88%)	30 (44.11%)	68	0.56	0.50	1	0.08#
Widow	40 (39.22%)	62 (60.78%)	102	0.39	0.49	1.96 (1.05-3.66)	
Divorced	6 (37.50%)	10 (62.5%)	16	0.37	0.50	2.11 (0.69-6.47)	
Living together	1 (50%)	01 (50%)	02	0.50	0.70	1.27 (0.08-21.1)	
Single (Never married)	0 (0.00%)	04 (100%)	04	0.00	0.00	-	
<b>Living Alone</b>							
Yes	9 (23.68%)	29 (76.31%)	38	0.24	0.43	1	0.004*
No	76 (49.35%)	78 (50.64%)	154	0.49	0.50	1.38 (0.78-2.45)	
<b>Any Co-Morbidities present</b>							
Yes	68 (50.75%)	66 (49.25%)	134	0.49	0.50	1	0.001#
No	7 (50%)	07 (50%)	14	0.50	0.51	1.03 (0.34-3.1)	
Don't know	1 (16.67%)	05 (83.33%)	06	0.08	0.28	5.15 (0.59-45.28)	
<b>Socio-Economic Status<sup>§</sup></b>							
Class I	2 (100%)	00 (0.00%)	02	1.00	0.00	-	0.003#
Class II	22 (59.46%)	15 (40.54%)	37	0.59	0.50	1	
Class III	30 (55.56%)	24 (44.44%)	54	0.56	0.50	1.17 (0.5-2.74)	
Class IV	21 (32.81%)	43 (67.18%)	64	0.33	0.47	3 (1.3-6.95)	
Class V	10 (28.57%)	25 (71.42%)	35	0.29	0.46	3.67 (1.37-9.81)	
<b>Type of Family</b>							
Joint	33 (49.25%)	34 (50.75%)	67	0.49	0.50	1	0.308*
Nuclear	52 (41.6%)	73 (58.4%)	125	0.42	0.49	1.36 (0.75-2.47)	
<b>Body Mass Index (BMI)<sup>¥</sup></b>							
Underweight	0 (0.00%)	01 (100%)	01	0.00	0.00	-	0.89 #
Normal	57 (42.54%)	77 (57.46%)	134	0.43	0.50	1	
Pre-Obese	26 (50%)	26 (50%)	52	0.50	0.51	0.74 (0.39-1.41)	
Obese class-1	2 (40%)	03 (60%)	05	0.40	0.55	1.11 (0.18-6.86)	
Obese class-2	0 (0.00%)	00 (0.00%)	00	0.00	0.00	-	
Obese class-3	0 (0.00%)	00 (0.00%)	00	0.00	0.00	-	
<b>Type of Diet</b>							
Vegetarian	39 (36.45%)	68 (63.55%)	107	0.36	0.48	1	0.004 #
Eggetarian	22 (51.28%)	28 (48.71%)	50	0.44	0.50	0.73 (0.37-1.28)	
Mix	24 (77.78%)	11 (22.22%)	35	0.69	0.47	0.26 (0.12-0.59)	
<b>Habit of tea/coffee</b>							
Yes	78 (44.32%)	98 (55.68%)	176	0.44	0.50	1	0.967*
No	7 (43.75%)	9 (56.25%)	16	0.44	0.51	1.02 (0.36-2.87)	
<b>Addiction</b>							
Yes	40 (50%)	40 (50%)	80	0.50	0.50	1	0.180*
No	45 (40.18%)	67 (59.82%)	112	0.40	0.49	1.49 (0.83-2.66)	
<b>Oral Health (Teeth)</b>							
Dentulous	36 (70.59%)	15 (29.41%)	51	0.71	0.46	1	<0.0001#
Partially Dentulous	30 (31.57%)	65 (68.42%)	95	0.32	0.47	5.2 (2.48-10.92)	
Edentulous	1 (10%)	09 (90%)	10	0.10	0.32	21.6 (2.51-185.8)	
Artificial Denture	18 (50%)	18 (50%)	36	0.50	0.51	2.4 (0.99-5.84)	
<b>Meal Frequency/day</b>							
1-3	56 (37.58%)	93 (62.42%)	149	0.38	0.49	1	0.0005*
4-6	29 (67.44%)	14 (32.56%)	43	0.67	0.47	0.29 (0.14-0.6)	

\* Un-paired t test; # ANOVA test; § Modified Kuppuswami classification (As per January 2024 update); ¥ Asia-pacific classification.

**Tab. II.** Association between Dietary Diversity and Activity of Daily Living (n = 192).

Selected General Health Status Variable	Dietary Diversity		Mean	SD	p Value (un-paired t test)
	Present n (%)	Absent n (%)			
<b>ADL (Activity of Daily Living)</b>					
Independent	67 (78.82)	66 (61.68)	0.50	0.50	<b>0.01</b>
Dependent	18 (21.18)	41 (38.32)	0.31	0.46	
Total	85 (100)	107 (100)	--	--	

**Tab. III.** Association between Instrumental Activity of Daily Living (IADL) and Dietary Diversity (DD) among study participants.

IADL Variables	Categories <sup>#</sup>	DD in Males (n = 94)			p Value	DD in females (n = 98)			p Value
		Present	Absent	Total		Present	Absent	Total	
Can you use the telephone?	I	13 (31.71%)	28 (68.29%)	41	<b>6.47 (0.01)</b>	11 (20.75%)	42 (79.25%)	53	<b>18.603 (&lt;0.0001)</b>
	II	25 (59.52%)	17 (40.48%)	42		21 (58.33%)	15 (41.67%)	36	
	III	8 (72.72%)	3 (27.27%)	11		7 (77.78%)	2 (22.22%)	9	
Can you get to places that are out of walking distance?	I	12 (38.71%)	19 (61.29%)	31	2.07 (0.36)	7 (20%)	28 (80%)	35	<b>10.33 (0.006)</b>
	II	18 (56.25%)	14 (43.75%)	32		24 (55.81%)	19 (44.19%)	43	
	III	16 (51.64%)	15 (48.39%)	31		8 (40%)	12 (60%)	20	
Can you go shopping for groceries?	I	14 (38.89%)	22 (61.11%)	36	2.63 (0.27)	9 (24.32%)	28 (75.68%)	37	<b>5.95 (0.05)</b>
	II	17 (58.62%)	12 (41.37%)	29		19 (48.72%)	20 (51.28%)	39	
	III	15 (51.72%)	14 (48.28%)	29		11 (50%)	11 (50%)	22	
If you had to take medication, could you do it? (males, n=74) (females, n=73)	I	5 (31.25%)	11 (68.75%)	16	5.04 (0.08)	2 (20%)	8 (80%)	10	<b>8.21 (0.01)</b>
	II	24 (60%)	16 (40%)	40		18 (42.86%)	24 (57.14%)	42	
	III	12 (66.67%)	6 (33.33%)	18		15 (71.42%)	6 (28.57%)	21	
Do you take your own medication? (males, n=20) (females, n=25)	I	0 (0.00%)	5 (100%)	5	<b>15.15 (0.001)</b>	0 (0.00%)	7 (100%)	7	<b>18.06 (&lt;0.0001)</b>
	II	1 (9.09%)	10 (90.91%)	11		1 (6.67%)	14 (93.33%)	15	
	III	4 (100%)	0 (0.00%)	4		3 (100%)	0 (0.00%)	3	
Can you manage your own money?	I	6 (24%)	19 (76%)	25	<b>8.48 (0.01)</b>	7 (6.66%)	23 (76.66%)	30	<b>5.67 (0.05)</b>
	II	21 (58.33%)	15 (41.66%)	36		19 (43.18%)	25 (56.81%)	44	
	III	19 (57.57%)	14 (42.42%)	33		13 (54.16%)	11 (45.83%)	24	
Can you prepare your own meals? *	I	-	-	-	-	7 (23.33%)	23 (76.66%)	30	<b>7.85 (0.02)</b>
	II	-	-	-		13 (37.14%)	22 (62.86%)	35	
	III	-	-	-		19 (57.57%)	14 (42.42%)	33	
Can you do your own housework? *	I	-	-	-	-	16 (43.24%)	21 (56.76%)	37	<b>3.62 (0.04)</b>
	II	-	-	-		16 (53.33%)	14 (46.67%)	30	
	III	-	-	-		12 (30.77%)	27 (69.23%)	39	
Can you do your own laundry? *	I	-	-	-	-	14 (41.18%)	20 (58.82%)	34	0.74 (0.23)
	II	-	-	-		13 (52%)	12 (48%)	25	
	III	-	-	-		16 (43.24%)	21 (56.76%)	37	

\*As per described in methodology; In IADL assessment, Male participants had 6 questions while Female participants had 9 questions. Classification of IADL categories: I – Unable to perform independently or even with assistance, II - Unable to perform independently, need assistance to perform, III – able to perform independently

by Bayih et al. [19] at Ethiopia revealed the same as 54.5% which is quite near to finding of current study. A few research evaluated dietary diversity with Dietary Diversity Severity (DDS) score (cut-off level = 20) [8, 20], like Chalobol C. [8] at Thailand and Rathnayake et al. [20] at Sri Lanka, following this evaluation technique, revealed the mean (SE) score of DDS as 18.4 and 11.4 respectively. Both of these research revealed diverse finding, may be due to difference in socio-economic and cultural diversity of both countries.

In current study, Various Socio-demographic,

Anthropometric and Diet related variables like-Living alone, comorbidities, socio-economic class, and type of diet, oral health and meal frequency were found to have statistically significant association with Dietary Diversity. A significant portion of the study participants were widowed (53.1%) and lived with comorbidities (80%). These factors can influence dietary choices and access to diverse food options. Shahar et al [21] assessed weight change from baseline and following widowhood, dietary intake, eating behavior, depression, and cognitive and physical functioning revealed widowed people were

found to be at increased risk for weight loss due to decreased appetite and enjoyment of their meals. Hanna and Collins [22] in their study found that living alone was negatively associated with dietary diversity.

In current research, the socio-economic status found statistically significant association with Dietary Diversity where majority of participants who lacked dietary-diversity belonged to lower socio-economic class. Sobal J. et al. [23] suggested that with lower socio-economic status often associated with reduced dietary diversity due to financial constraints and limited access to a variety of foods which is in line with current findings.

In current study, Types of diet consumed and meal frequency per day revealed statistically significant impact on presence of dietary diversity; the same findings were found reiterated in results revealed by Ruel MT [24] reflecting the importance of dietary variety and regular meal patterns. The association of dietary-diversity with oral health is particularly noteworthy. Participants with better oral health (dentulous) showed positive dietary diversity. The same is supported by findings of Logan et al. [25] concluding that having  $\geq 21$  natural remaining teeth positively affected the future intake of fruit, vegetables, and nuts, as well as diet quality, thus influencing dietary diversity.

A significant correlation between dietary diversity and various components of ADL and IADL was one of findings of current research. It was revealed that out of 85 participants with positive dietary diversity, more than two-thirds were able to manage activities of daily living independently whereas approximately three-fifth of sub-cohort of counterpart could manage the same independently. These findings were supported by Hsiao et al. [26] and Zhu et al. [27] in their research which linked dietary diversity with better functional status and quality of life in older adults.

The significant association was found among female participants regarding IADL, such as the ability to prepare meals and manage money, suggest that dietary diversity may have gender specific concerns on functional capabilities. A study conducted by Carmona et al. [28] reported that female gender was found to be associated with disability in general; whereas more individuals had disability for instrumental activities of daily living than disability for basic activities of daily living.

In current research, the elderly population in Ahmedabad, a typical exemplary ever-evolving urban city of western India, displayed a high intake of cereals and tubers but notably lower consumption of fish and meat. India has a vast geographical diversity, dietary patterns vary significantly across regions. Residents of coastal states like Kerala in southern India and West Bengal at north-eastern part of country prefer diets rich in seafood, coconut, and rice due to proximity to the sea and tropical agro-climatic conditions [29, 30]. The residents of northern plains focus more on wheat, dairy, and pulses, reflecting agrarian lifestyles and cultural practices [31]. Mountainous and tribal regions, such as those in the far northeast and central India, often rely on fermented foods, coarse grains like millets, and locally foraged greens, shaped by indigenous

food systems and terrain-based access [32, 33]. These regional contrasts suggest that geography and availability of foods significantly influence dietary diversity.

## Conclusion

Positive Dietary Diversity was observed amongst less than half of studied elderly. Various determinants like-status of living alone or with family, presence of any co-morbidities, socio-economic-class, type of diet, oral-health and meal frequency revealed statistically significant association with Dietary Diversity. In majority of the participants, cereals, Roots & Tubers, Condiments and mushrooms, Sugars, Legumes, Nuts, Seeds, fruits and vegetables were included in the Diet. Independence in general activities of daily living was statistically significantly associated with Dietary Diversity while the IADL showed gender-specific varied association with dietary-diversity.

## Recommendation

Considering resource-limited setting in India, targeted nutrition interventions for elderly individuals living alone or with low socioeconomic status to improve dietary diversity can be planned. Healthcare providers should optimally utilize opportunistic screening in terms of assessment and promoting balanced diets during routine visits; considering factors like age, oral health, living with family or alone, Socio-economic status, type of diet etc. while advising diet. Community-based programs and caregiver support can enhance dietary diversity, ensuring independence in daily activities. Policymakers should prioritize nutrition education and resources for vulnerable elderly populations while facing demographic transition.

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The researcher(s) claim(s) no conflicts of interest.

## Authors' contributions

VRD, KAP: conceptualization, methodology, study design, review of literature, data entry and analysis, writing—original draft, writing-review & editing. KAP: data Collection.

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