ORIGINAL ARTICLE

An Exploration of Nutritional Status in Relation to Diet Quality, Functional and Mental Ability among Elderly in Tonk, India

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ABSTRACT

Introduction: Ageing is a natural and irreversible process, associated with deterioration of physiological, social and cognitive activities. The nutritional status of the elderly is adversely affected by declining cognitive and functional ability. The association of nutritional status with diet quality, functional and cognitive ability and depression among the elderly is not well understood. This study aimed to compute the association of nutritional status with diet quality, functional and cognitive ability and depression among the elderly. **Method:** A cross-sectional study was undertaken on 250 elderly (146 men, 104 women) of ≥65 years, residing in Tonk district of Rajasthan (India). Self-developed elderly dietary index (EDI) was used to evaluate diet quality and standardized tools, viz., geriatric depression scale (GDS), activities of daily living (ADL), instrumental activities of daily living (IADL), mini nutritional assessment (MNA), and short portable mental status questionnaire (SPMSQ) were used to assess depression, functional status, nutritional status and cognition respectively. **Results:** Two-thirds of the elderly in this study were at risk of malnutrition (66.67%, n= 167). MNA scores had significant association with Indian EDI (χ^2= 47.50, p=0.000), ADL (χ^2= 32.37, p= 0.000) and SPMSQ (χ^2=18.61, p= 0.001), whereas MNA scores had non significant association with IADL (χ^2 = 14.30, p= 0.006) and GDS scores (χ^2= 5.44, p= 0.066). IADL scores were found to be significantly correlated with GDS (r= -0.255) and SPMSQ (r= -0238) Conclusion: Present study shows that the nutritional status of the elderly is associated with diet quality, functional and cognitive ability, but is not associated with depression in the elderly of Tonk.

Keywords: Ageing, Cognition, Depression, Diet quality, Functional ability

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INTRODUCTION

The elderly population is increasing rapidly throughout the world. Ageing is accompanied by wide range of physiological, social, and psychological changes that can make older people vulnerable to nutritional deficiencies (1). The most common health problems among the elderly are chronic non-communicable diseases, cognitive decline, ocular morbidity and functional disability (2). Malnutrition is a major health problem and common condition among the elderly. Malnutrition is generally associated with various health problems such as a decline in functional ability, impaired bone mass and muscle strength, cognitive impairment. A high risk of malnutrition in elderly has been reported in Tonk, India. The MNA results showed that 85% of the elderly subjects were found to be at risk of malnutrition (3). A study conducted in Rajasthan showed that 48% of the older population was found to be at risk of malnutrition whereas 7.3% were malnourished according to MNA scores (4). Accumulating evidence has shown the association between poor nutrition and other comorbidities such as depression, decreased cognitive functioning and functional dependency (5-6). Fang et al (2017) (7) observed that depression and cognition are associated with adverse health outcomes. These lead to a decrease in appetite, skipping the meal, lower intake of food and weight reduction. Change in appetite and diminution of dietary intake results in poor nutritional status and poor nutrition predisposes the elderly to depression, agitation and irritability (8). Many studies have suggested that functional impairment and poor nutritional status play a crucial role in cognitive impairment in the elderly population. In parallel, another study concluded that cognitive deficit might lead to poor nutritional status (9). Maintaining a good nutritional status of older people is therefore crucial for maintaining health, functional ability and quality of life. Therefore, it is imperative to assess the association of nutritional status with diet quality, functional and cognitive ability, and depression in the older population. However, little research has been done on the association of nutritional status with diet quality, functional ability, depression and cognition in the elderly population in Rajasthan. Therefore, the present

endeavor describes the association of nutritional status with diet quality, functional and mental ability, as well as diet quality assessment of older people by using a validated indigenous elderly dietary index (EDI). It is hypothesized that impaired nutritional status will be associated with impaired functional ability, depression and cognition disability in older adults.

MATERIALS AND METHODS

Participants

This community-based cross-sectional study was conducted among 250 elderly (146 men, 104 women) of age ≥65 years, residing in Tonk district of Rajasthan which is a resource-poor district of Western India. Simple random sampling was used in this study. Participants were included if they were living in their homes and able to communicate and comprehend the questions. Participants were excluded if they had a swallowing problem, known eating disorder, taking artificial feeding. Sample size was calculated using Sloven's formula: n= N/1+ N(e)2, where n= sample size, N=total population (11079.32), e= error or confidence level (0.05). Hence, the sample size was 250.

All participants were apprised about the information on the purpose of this study and their informed written consent was collected. The study was conducted in conformity to Ethical Guidelines on Human Subjects (10), as per the revised Helsinki Declaration (2013). All the data that were collected were non-invasive. The Research Advisory Committee of the Department did not suggest the need for getting ethical approval from the Institutional Ethical Committee as the data collection from human subjects was completely non-invasive.

Nutritional assessment

Anthropometric assessment

Bodyweight, height, triceps skinfold thickness (TSF), mid upper arm circumference (MUAC), mid arm muscle circumference (MAMC), hip circumference, waist circumference (WC), waist-hip circumference, calf circumference, and waist-height ratio (WHtR), were assessed using standard techniques and instruments (11). All anthropometric measurements were taken using consistent equipment by following all standard procedures (12). All measurers received anthropometric measurement training to ensure the accuracy of these methods. Body mass index (BMI) was also calculated using the weight and height data of all participants. As per WHO criteria, normal weight was recognized as BMI 18.50-24.99 kg/m2, underweight as <18.50 kg/m2, overweight as ≥25.00 kg/m2 and obese as ≥30.00 kg/m2 (13).

Diet quality assessment

To ascertain the diet quality of the elderly, a standardized elderly dietary index (EDI) was used. Indian EDI was subdivided into 2 parts. The first part consists of 15 food groups based on components (i.e. questions on the frequent consumption of cereals, pulses, millets, roots, tubers, green leafy vegetables, milk and milk products, fruits, sugar, nuts, fats and oils, flesh foods, and eggs). The second part consisting of 14 dietary components, served as an indicator aiming to evaluate commonly consumed foods from each food group. The scoring assigned to all components of EDI was dependent upon dietary recommendations for Indians (14) through a healthy diet for adult men and women. Values closer to maximal scores indicate better diet quality of older adults, whereas, minimal scores indicate less adherence to the recommendation. The maximum possible score (75) for Indian EDI was subdivided through statistically calculated tertiles. Scoring 15-38 points indicated as unhealthy diet category, 39-42 points as moderate healthy diet category, and ≥43 as healthy diet category (15).

Reliability was determined by Cronbach's alpha method (0.75) and test-retest method (0.99). Content validity (0.52) was evaluated by subject matter experts.

Data collection tools

A self-designed proforma was used to gather data on the general information of participants. Geriatric depression scale (GDS), activities of daily living (ADL), instrumental activities of daily living (IADL), mini nutritional assessment (MNA), and short portable mental status questionnaire (SPMSQ) were used to assess depression, functional status, nutritional status and cognition respectively.

Mini nutritional assessment (MNA)

It is a well-validated tool for nutrition assessment of geriatric (≥65 years). MNA devised by Nestle contains 18 questions grouped in four parameters: anthropometric, subjective, dietary, general assessment. This tool was validated to allow 2 steps (screening and assessment) process. Total MNA scoring fall between 0 to 30 points, which distinguishes the elderly with adequate nutritional status (≥23.5), borderline at risk of malnutrition (17-23.5) and undernutrition (<17) (16).

Activities of daily living and instrumental activities of daily living scale

These are the most appropriate scales to evaluate the functional ability of the geriatric population. ADL refers to the Katz index of independence in six functions of daily such as dressing, bathing, toileting, transferring, continence, and feeding (17). ADL scoring falls between 0-6 points categorizes respondents in the following order; completely dependent (scores 0), severe functional impairment (scores 2 to less), moderate impairment (scores 4), and full function (scores 6) (18).

The Lawton IADL is the most appropriate scale to assess independent living skills in 8 domains of functions

including the ability to use food preparation, telephone, shopping, housekeeping, laundry, handling finances, responsibility for own medication and transportation. The scoring system of IADL consists of scores between 2-8 points which categorize subjects as very dependent (scores 2-4), high function (scores 5-6) and dependent (scores 7-8) (19).

Alternate geriatric depression scale

Alternate geriatric depression scale (GDS) created by Sheik and Yesavage (1986) (20) was used to screen depression in the geriatric population. GDS consisting of 15 questions takes 10-15 minutes to complete. Total GDS scoring is between 0-15. Scoring ranging from 0-4 indicates Normal, 5-9 indicates possible depression, >9indicate depression. The questions are responded to "yes" or "no" which facilitate easier use by the geriatric population with impaired functions.

Short portable mental status questionnaire (SPMSQ)

It is a test of cognitive functioning, widely used to screen for dementia and other cognitive dysfunction in elderly patients. SPMSQ consisting of 10 items can easy to administer by any clinician in a hospital, or in the office to measure the several mental operations and the memory capacity for self-care (21). SPMSQ scoring is ranged from 0 to 10, which interprets 0 to 2 errors indicate intact cognitive functioning, 3 to 4 errors indicate mild cognitive impairment, 5 to 7 errors indicate moderate cognitive impairment and 8-10 errors indicate severe cognitive impairment.

Statistical analysis

Data were analyzed using M.S. Excel software and SPSS-20.0. Mean, standard deviation (SD), and percentage were used to express the results. Karl Pearson coefficient of correlation was conducted to compute the correlation of MNA screening scores with nutrient intake, ADL and IADL scores, GDS scores, and SPMSQ scores and diet quality. In inferential statistics, chi-square test was conducted to compute the association of MNA with ADL, IADL, SPMSQ, GDS and diet quality.

RESULTS

Subject characteristics

The sample was composed of 146 (58.4%) males and 104 (41.6%) females, the age of males and females being 71.4±5.78 and 70.1±5.33 years, respectively. In this study, most elderly who lived with spouses and other members accounted for the highest percentage (60.8%) and those living alone were few. The study showed that 1.2 percent of the elderly were unmarried. The percentage of divorced was 2.8; whilst widowed was 20.8 percent. Nearly half of the respondents placed themselves in lower-income groups and more than one-third placed themselves in the middle-income group. Fifty-five percent were following moderate activity patterns, making it the most prominent physical activity type in the study population. More than half of the subjects were literate. Based on smoking habits, 76.4% of study participants replied negatively about this habit. In this study, a small portion (9.6%) of the subjects was that of regular alcohol consumers. In the context of alternative medicine for healing, allopathic drug users were more as compared to nonallopathic drug users. A greater proportion (55.2%) of participants reported indulging in regular consumption of drugs.

Anthropometric measurements

Anthropometric measurements of all participants have been presented in Table I. The height of men and women varied from 142.5-180.0 cm and 130.0-175.0 cm respectively. The mean values weight of all participants aged 65-80 years and >80 were 57±8.60 and 55.2±8.62 kg respectively. The BMI of participants varied between 12.8 kg/m2 to 32.5 kg/m2. It ranged between 14.3-32.5 kg/m2 and 12.8-30.0 kg/m2 in men and women respectively. Among the total of 250 elderly, 78.0% were normal, 7.2% were underweight, 13.2% were pre-obese and 1.6% were in obese class 1. Gender wise distribution revealed that males had higher mean MUAC compared to females. Ninety-two percent of all participants (n=230) fell in the normal range category of MUAC. TSF (mm) ranged between 10.0-23.0 and 10.2-26.4 in men and women respectively. MAMC of participants ranged from 11.4 cm to 28.1 cm. Men with waist circumference ≤94cm and female with waist circumference ≤80cm classified as normal and half of all participants were thus graded as normal. Hip circumference revealed that females had higher hip circumference than males. The highest calf circumference was observed in 65-70 year old whilst, lowest in ≥85 year old adults. WHR value for men and women was ranged between 0.81-0.99 and 0.60-0.97 respectively. Based on WHR, men with ≥0.90 cm and women with ≥0.85cm classified as increased risk of metabolic complications. More women (78%) were at increased risk of metabolic complications than men (66%). The ratio of WHtR was varied from 0.37 to 0.67 in all participants.

Table I: Anthropometric measurements of the subjects

Parameters	Men	Women	Total
		(Mean±SD)	
Height (cm)	162.1±8.16	156.3±11.31	159.7±10.00
Weight (kg)	60.1±7.94	53.1±7.91	56.3±10.12
Body mass index (kg/m^2)	22.7±2.97	21.4±2.56	22.1±3.64
Triceps skinfold thickness (mm)	15.8±3.13	15.9±3.49	16.0±3.28
Mid upper arm circumference(mm)	255.1±33.55	234.5±52.53	245.9±37.49
Mid arm muscle circumference (cm)	20.6±3.23	21.5±26.80	20.6±14.92
Waist circumference (cm)	91.4±7.77	80.0±9.40	88.4±9.80
Waist-to-hip ratio	0.9±0.03	0.9±0.04	0.90±0.04
Hip circumference (cm)	86.8±10.27	98.5±10.43	96.6±11.25
Calf circumference (cm)	31.9±2.62	30.2±2.34	32.8±16.85
Waist-to-height ratio	0.5±0.04	0.5±0.04	0.54±0.05

Table II: Distribution of the subjects according to tertiles of Indian EDI

Tertiles of EDI	Total participants	
	N	%
1st (15-38 scores) Unhealthy diet	32	12.8
2nd (39-42 scores) Moderate healthy diet	87	34.8
3rd (≥43 scores) Healthy diet	131	52.4

Assessment of diet quality by Indian EDI

The distribution of participants according to tertiles of Indian EDI has been depicted in Table II. The mean diet quality scores of men and women were 43.2±3.55 and 42.4±3.78 respectively out of the maximum possible score of 75. The Indian EDI scores of all participants ranged between 34 and 54. An unhealthy diet was followed by all the old-old participants, whilst a healthy diet was followed by more than half of the participants who belonged to the young-old and middle-old category. Gender-wise data revealed that a healthy diet was higher in men (57.5%) than women (45.0%).

Mini nutritional assessment

The mean scores of components of the MNA tool of all participants have been depicted in Table III. The result of MNA revealed that 27.2% of subjects were normal, 64.4% were at risk of malnutrition and 8.4% were malnourished. The mean anthropometric scores obtained from men and women were 6.01±1.54 and 5.0±1.64 respectively. In general assessment, mobility assessment showed a greater proportion of younger subjects than middle and old-old participants could easily go anywhere whilst the proportion of old-old participants was higher than that of middle and young who were in bed or chair restricted condition. Mental stress or feeling sad was observed higher in men (20%) than women (15.0%), whereas, a greater proportion of women (48.0%) than men (29.0%) had neuropsychological problems. Maximum participants had no appetite-related problem. Concerning eating habits, the majority of the participants were taking three meals a day. Nearly one-fourth of the total participants were consuming ≥2 servings of vegetables and fruits per day. The examination of fluid intake revealed that it was lower than recommended. This study also evaluated the self-perception of nutritional status and it was found that females were uncertain about their nutritional status.

Table III: Mean scores on different components of MNA tool

Components	Highest possible score	Mean±SD
Anthropometry assessment	8	5.6±1.67
General assessment	9	7.2±1.55
Dietary assessment	9	6.0±1.25
Self assessment	4	2.4±1.02
Overall MNA scores	30	22.3±12.11

Functional status assessment

The distribution of the study subjects according to ADL and IADL scores has been depicted in Table IV. On a possible scale of 0 to 6, the total score for ADL ranged from 2 to 6. Obtaining higher scores of ADL means more independence in the participant's functional activities. Nearly half elderly in the study acquired an ADL score of 5.0. The mean scores of ADL by age group were 4.9±0.85 (young-old), 4.8±0.95 (middle-old), and 3.0±0.0 (old-old). Dependency and independency were also analyzed based on components of ADL. All categories of ADL components except continence showed independence of the majority of participants (Table V).

IADL score ranged from 1 to 8; the minimum score was acquired by 4 participants, whilst the maximum was procured by only a single participant. One-third elderly in the study acquired the IADL score of 5 (highest observed frequency). The mean scores of IADL by age group were 5.5±0.47 (young-old), 5.3±1.23 (middle-old) and 4.0±1.41 (old-old). Dependency and independency were also evaluated concerning 8 domains of the IADL scale. Independency was found in the majority of participants concerning all domains except food preparation and shopping tasks (Table V).

Table IV: Distribution of the study subjects according to ADL and IADL scores

	Status	Score	N (%)
ADL	Full function	5-6	170(68%)
	Moderate functional impairment	3-4	79(31.6%)
	Severe functional impairement	2 or less	1(0.4)
	Dependent	0	-
IADL	Independent	7-8	43 (17.2%)
	High function	5-6	168(67.2%)
	Low function	2-4	39(15.6%)
	Dependent	Less than 2	-

Table V: Distribution of the study subjects according to dependency and independency in ADL and IADL components

Variables		N (%)	
		Dependent	Independent
ADL	Bathing	1(0.4%)	249(99.6%)
	Toileting	1(0.4%)	249(99.6%)
	Dressing	5(2.0%)	245(98.0%)
	Transferring	18(7.2%)	232(92.8%)
	Feeding	92(36.8%)	158(63.2%)
	Continence	152(60.8%)	98(39.2%)
IADL	Ability to use telephone	-	250(100%)
	Food preparation	181(72.4%)	69(27.6%)
	Shopping	154(61.6%)	96(38.4%)
	Housekeeping	54(21.6%)	196(78.4%)
	Mode of transportation	5(2.0%)	245(98.0%)
	Able to handle finance	93(37.2%)	157(62.85)
	Laundry	41(16.4%)	209(83.6%)
	Responsibility for own medication	111(44.4%)	139(55.6%)

Depression assessment

The GDS score ranged from 0 to 7 on a scale varied from 0 to 15. The cut off scores of ≥5 was used to predict depression. Ninety-one participants received GDS score of 2 as the highest observed frequency. The mean scores of GDS in men and women were 2.4±1.41 and 2.5±1.47 respectively. Participants were also categorized by scores of GDS such as normal, possible depression and depression. Using GDS scores, the majority of participants were found to be the normal category.

Cognitive assessment

The total score of SPMSQ ranged from 0 to 7 on a possible scale of 0 to 10. Ninety-two participants received the SPMSQ score of 2 as the highest observed frequency. The mean score of SPMSQ were 2.8±1.26 (young-old), 2.8±1.26 (middle-old) and 4.5±3.53 (old-old). Participants were also categorized by various intellectual levels of functioning such as intact intellectual functioning, mild intellectual impairment and severe intellectual impairment. It was revealed that intact intellectual functioning was observed in the majority of participants. The majority of participants belonging to the young-old group (48.0%) were observed in intact intellectual functioning class. The highest proportion of the participants belonging to the middle-old group (44.4%) was having mild intellectual impairment class. All the participants belonging to old-old were falling in moderate intellectual impairment.

Association and correlation between various variables

MNA scores had a significant association with Indian EDI, ADL and SPMSQ, but had a non-significant association with IADL and GDS scores (Table VI). MNA scores were significantly correlated with ADL, IADL scores. MNA scores had a significantly weak correlation with GDS scores with but IADL had a significant correlation with GDS scores. ADL and IADL scores had also a significant correlation with SPMSQ scores (Table VII).

Table VI: Association of MNA scores with Indian EDI, ADL, IADL, GDS and SPMSQ scores of subjects

Variables	Total participants	
	χ^2	**p**
MNA and Indian EDI	47.50	0.000*
MNA and ADL	32.37	0.000*
MNA and IADL	14.30	0.006^{NS}
MNA and GDS	5.44	0.066^{NS}
MNA and SPMSQ	18.61	0.001*

*-p≤0.05, significant at 5% level
NS- Non significant

Table VII: Correlation between various variables

Variables	Total participants **r value**
MNA and ADL	0.206*
MNA and IADL	0.198*
MNA and SPMSQ	-0.170*
IADL and GDS	-0.255*
ADL and SPMSQ	0.414*
IADL and SPMSQ	-0.238*

*-p≤0.05, significant at 5% level

DISCUSSION

The current study investigated the association of nutritional status with diet quality, functional and cognitive ability, and depression in the elderly. Self developed indigenous elderly dietary index (EDI) was used to assess the diet quality of the Indian geriatric population.

Our result indicated that most participants were at an increased risk of malnutrition. Previous studies showed that the elderly are at risk of poor nutrition not only because of the ageing process but because of poor oral health, reduced appetite (22) lack of physical activity, chronic disease, depression, and lack of access to good quality food (23). A study conducted in Coimbatore showed functional impairment, lower socioeconomic conditions, living alone and no pension were associated with high rates of malnutrition (24).

Ageing may come with diseases and conditions that limit health span such as physical and mental decline, depression, as well as impaired swallowing and chewing (25). In the present study, inadequate diet and poor nutritional status were associated with a decline in functional ability as assessed by ADL and IADL and corroborated other studies (26, 27, 28). Elderly persons are more susceptible to chronic diseases. The presence of chronic diseases is the leading cause of functional ability among the elderly (29). Combination of diseases along with medications can lead elderly individuals to poor quality of life and loneliness, thus contributing to functional impairment (30). It was found that malnourished persons were 1.7 times more likely to be functionally impaired compared to those who had normal nutritional status (31).

In the present study, worse nutritional status is significantly related to the worse cognitive profile of the elderly and corroborated other studies (32, 33). The elderly face many nutritional problems including swallowing and chewing problems which lead to reduced dietary intake that further exacerbate malnutrition. Inadequate dietary intake of nutrients also contributes to the cognitive deficit which is considered a common disabling condition in older people (34). In the current study, it was found that the correlation between nutritional status and depression assessed by GDS was not significant. This was in contrast to many studies including one in which Payahoo et al, found a positive significant correlation between nutritional status and depression.

In this study, diet quality (assessed by self-developed

and validated EDI) was correlated with mini nutritional assessment (MNA). Our study replicated previous findings that factors like the decline in anthropometric measurements, poor self-care, nutritionally compromised diet, all are responsible for an inferior quality of diet and these factors are associated with the nutritional status of the old age (35, 27).

This study has a few demerits. It was a cross-sectional study where temporality and causality cannot be proven, therefore longitudinal studies are recommended in the future to portray nutritional status of the elderly in our population. This study includes relatively small sample size and single locality; this may not represent the whole population of Rajasthan. Several biases may also arise in this study, older people with cognitive impairment may be biased by differential memorization because of the inability to remember information (for example the MNA items related to food, liquid, and the number of meals a day). In the development of Indian EDI, similar scoring was given to all nonvegetarians' foods. Post-translational validity was not carried out for translated EDI which also needs to be considered in the future. We obtained only baseline information of the anthropometric measurements, we did not assess the change which may have occurred during follow-up. The sensitivity and specificity of the anthropometric measurement were not evaluated to assess the accuracy and precision of these measurements. The result of this study may not be equally valid across diverse cultures and demographic groups. Also, confounding factors such as socio-economic factors, medical conditions which had influence on nutritional state and dietary intake, were not assessed in this study.

Additionally, the results of this study have some merits focusing on the role of impaired functional ability, depression, and cognitive disability with nutritional status in old age. Our findings have some important implications for policymakers and health care professionals to put the policies into action for maintenance of health, functional independence along with upgrading the quality of life for the greying population in India. The current study will also help to identify the nutritional requirements of those elderly who are malnourished or at increased risk of malnutrition and assist to prevent the consequences of untreated malnutrition. The findings of this study will provide the base for other comprehensive comparative studies on the elderly

CONCLUSION

The study concludes that poor nutritional status is associated with diet quality, functional and cognitive ability, but is not correlated with depression in the elderly of Tonk.

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