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NUTRITIONAL STATUS, COGNITIVE PERFORMANCE AND QUALITY OF LIFE ASSESSMENT OF ELDERLY WITH AND WITHOUT DIABETES MELLITUS

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Abstract:-Diabetes mellitus is most common health problem among elderly in developing countries. It may be associated with increased risk of malnutrition, cognitive impairment as well as may result in deterioration in quality of life. This study attempted to assess the nutritional vulnerability, cognitive impairment and quality of life in elderly people with and without diabetes mellitus. Diabetes self management assessment was taken up with diabetic elderly. The sample comprised of 30 elderly each in diabetic and normal group (≥65 years; n=60). Twenty four hour dietary recall method was used for dietary assessment. Mini nutritional assessment (MNA), Short portable mental status questionnaire (SPMSQ), Diabetes self management questionnaire (DSMQ) and Quality of life questionnaire were used to collect information pertaining to nutritional status, cognitive impairment, diabetes self management related activities and overall quality of life respectively. More diabetic subjects were obese than the normal subjects as per BMI. Significant difference ($p< 0.05$) existed between energy and fat intake of diabetic and non- diabetic subjects. Half of the diabetic subjects were at risk of malnutrition. Diabetic subjects did more intellectual errors on SPMSQ. More than 50% diabetic subjects reported diabetes self care activities as poor. None of the subjects in both categories considered their overall quality of life to be very good. Elderly are nutritionally vulnerable and malnutrition is more rampant in elderly with diabetes and display significant excess of cognitive dysfunction associated with poorer ability in diabetes self care and have degraded quality of life.

Keywords:Body mass index, cognition, diabetes mellitus, elderly, malnutrition, nutritional status.

INTRODUCTION

Aging is usually associated with chronic diseases such as heart disease, stroke, hypertension, obesity, osteoporosis, inflammatory diseases and diabetes. The prevalence of diabetes increases in the elderly population as the rate of metabolism slows down due to decreasing lean body mass and increasing sedentary lifestyle. Diabetes is a life-long and life altering illness with no proven cures and demands only management (Rizvi, 2009). Being a degenerative disorder it can affect many parts of body, organ and tissue and increase risk of morbidity and mortality from acute and chronic complications (Ramchandran, 2000). The increased frequency of depression, anxiety and forgetfulness has also been reported in older patients with diabetes mellitus (Subramanium and Gold, 2005). In elderly patients, diabetes is much more than the glucose level. However, in elderly patients the disease accelerates other common conditions of that population and markedly complicates their management (Hornick and Aron, 2008). Type 2 diabetes is considered to be incurable and has a negative impact on life span and quality of life. Unfortunately, evidence shows that one in 20 deaths are from complications related to diabetes; worldwide 8,700 death every day; six death every minute (World Health Organization, 2011).

The aging process involves physiological and nutritional changes that are manifested by height and weight loss, muscular mass loss and fat mass increase. It also involves adipose tissue redistribution, with fat accumulation in the trunk and viscera. Changes in body composition differ in men and women at different life stages and are reflected in anthropometric measures. Consequently, different anthropometric indicators are used at different life stages to evaluate the nutritional status (Sanchez-Garcia etal, 2007). In this regard, mini nutritional assessment (MNA) tool has been developed as a reliable and valid screening tool to detect malnutrition in older people. Without any laboratory data, nutritional status of the elderly can be easily predicted with questions and anthropometric measurements (Vellas etal, 2006). Older adults with diabetes mellitus are at increased risk for cognitive impairment. Unrecognized cognitive impairment may interfere with the patient's ability to implement lifestyle modifications and take medications recommended by the clinicians (California Health Care Foundation, 2003). Several cognitive domains remain generally intact across the lifespan while notable decline is observed in others. Longitudinal studies of elderly and middle aged people with diabetes show increased rates of cognitive decline and dementia (Gregg etal, 2002). Cognitive impairment may particularly affect verbal memory or complex information processing in type 2 diabetes mellitus (Harten etal, 2007). Elderly diabetes patients require more health care to manage diabetes and control complications.

Self dietary restriction and daily self administration of oral medications on insulin may adversely affect an individual's health related quality of life (Redekop etal, 2002). Cognitive dysfunction, especially executive dysfunction can affect insight into one's behaviour and may, therefore, contribute to the patient minimizing the difficulties that he/she is experiencing. Such patients are unlikely to self- report either cognitive problem or difficulty managing their diabetes (Munshi etal, 2006). These are healthy eating, being physically active, monitoring of blood sugar, compliant with medications, good problem-solving skills, healthy coping skills and risk reduction behaviours (American Association of Diabetes Educators, 2008). All these seven behaviours have been found to be positively correlated with good glycemic control, reduction of complication and improvement in quality of life (Povery and Clark, 2007). Diabetes and its complication take a major toll on care costs of the society. Many studies have endeavored to develop effective chronic diseases management; however limited studies have focused on chronic diseases like diabetes mellitus management in older adults with cognitive impairment and poor quality of life. There are few well- designed studies to support the interdisciplinary care approach for the elderly diabetic population. Therefore, the present study was undertaken to assess the nutritional status, cognitive impairment, diabetes self management care and overall quality of life in elderly people with and without diabetes mellitus.

MATERIALS ANSD METHODS

Subject recruitment: This is a case controlled study, wherein a total of 60 subjects ($\geq$ 65 years) male and female (30 diabetics; wherein n = 20 males, n = 10 females and 30 non- diabetics, n = 22 male, n = 8 female) were selected from the urban areas of Bokaro (Jharkhand) and Banasthali Vidyapith, (Rajasthan), respectively. For the recruitment of diabetic group, two general practice clinicians were contacted. From there, elderly people with type 2 diabetes mellitus were identified. An initial 30 subjects were selected randomly. For the recruitment of non- diabetic group, 30 elderly people were randomly selected from Banasthali Vidyapith campus. Informed consent was taken from all of the participants of the study.

Exclusion criteria: Elderly people with known eating disorders, swallowing problems or those receiving artificial feeding were excluded. Those with known malabsorption or on a low salt or cholesterol

lowering diet and found to have abnormal thyroid functions were also excluded.

Nutritional assessment

a)Anthropometric assessment: Height, weight, mid upper arm circumference (MUAC) and calf circumference (CC) were measured using standard procedure (Gibson, 2005). Body mass index (BMI) was computed using height and weight data of subjects. These data formed an essential component of mini nutritional assessment (MNA) tool.
b)Biochemical assessment: Biochemical profile of the subjects was drawn on the basis of secondary data. Fasting blood sugar (FBS) and post prandial blood sugar (PPBS) values were taken from the recent (within last one month) investigation reports of the subjects. Diabetes was defined as having FBS ≥126mg/dl and PPBG ≥200mg/dl (World Health Organization, 2006).
c) Dietary assessment: For dietary assessment of the subjects, 24 hour dietary recall method was used (Thimmayama, 1987). As a retrospective method, it relied on an accurate memory intake, reliability of respondent not to under/misreport and an ability to estimate portion size. This was helped by the interview prompting the respondent to remember eating and drinking episodes by time periods (e.g., starting on awakening), or linking to day time activities (e.g., arriving at work). In addition, the interviewer used prompts to assist the respondent to estimate portion size of the items consumed. A quantity was allowed to be expressed in terms of weight or household volume, and for some foods, a pre cooked weight or volumes were also described using dimensions of common shapes. The interviewer used prompts to assist the respondent to estimate portion sizes of the item consumed. After obtaining the dietary information from the subjects, all the recipes were standardized in food laboratory of Home Science Department. Information obtained by this method is representative of usual intake of an individual. Intake of energy, protein, carbohydrate, fat, fiber and iron in the diet was also calculated and compared with recommended dietary allowances (RDA) (Gopalan etal, 2007).

Data collection tools: Background information proforma was used to collect baseline information of the subjects. Mini nutritional assessment (MNA) tool was used to assess nutritional status of the subjects. Short portable mental status questionnaire (SPMSQ) was used to assess the cognitive status of the subjects. Diabetes self management questionnaire (DSMQ) was used to assess self-care activities associated with glycemic control of the subjects. Older people's quality of life questionnaire (OPQOL) was also used to ascertain quality of life of elderly people.

a)Mini nutritional assessment: MNA is a single and rapid nutrition assessment tool, was developed to assess nutrition status as a part of the nutritional status evaluation of elderly. This tool has been devised by Nestle' and leading geriatricians to identify geriatrics (>65 years) patients at risk of malnutrition and it eliminated the need for more invasive test such as blood sampling (Van Nes etal, 2001). It is 18 items questionnaire and administered in two steps. In step 1, screening uses the six strongly correlated items that make up the MNA and takes less than 5 minutes. In first stage, if the MNA screening scores were ≥12 then the patient had an acceptable nutritional status; step 2 was used as an assessment for those persons who were at risk of malnutrition, consist of 12 questions and takes approximately 10 minutes to complete. The scoring system ranging from 0 to 30, categorized subjects as normal (having adequate nutritional status, score ≥24 points), border line (at risk of malnutrition, score 17 to 23.5) and undernourished (score ≤17 points).
b) Short portable mental status questionnaire: Short portable mental status questionnaire was used to screen older adults for dementia signs and other neurologically based deficits and to determine the degree of cognitive impairment. It is a 10-items questionnaire, can be easily administered by any clinician in the office or in a hospital or in any settings, has been designed, tested, standardized and validated (Pfeiffer, 1975). Scoring of SPMSQ ranged from 0-10, which interprets; score 0-2 errors as intact intellectual functioning; 3-4 errors as mild intellectual impairment; 5-7 errors as moderate intellectual impairment and 8 - 10 errors as severe intellectual impairment.
c)Diabetes self management questionnaire: A 16 items questionnaire to assess self-care activities associated with glycemic control was based on theoretical considerations and a process of empirical improvements. Four subscales, 'Glucose Management' (GM), 'Dietary Control' (DC), 'Physical Activity' (PA), and 'Health-Care Use' (HU) were used as a standard format (Schmitt etal, 2013). Responses were to be given on four point scale, i.e., 'applies to me very much', 'applies to me to a considerable degree', 'applies to me to some degree' and 'does not apply to me'.
d)Older people's quality of life: Quality of life is an individual's understanding of his/her life situation with respect to his/her values and cultural context, as well as in relation to his/her goals, expectations and

concerns. Material well-being (income, level of housing, availability of services, environment), close relationships (social relationships, social well-being, support, societal involvement), health (physical health, fitness, ability to move, symptoms of illness, ability to work), emotional well-being (emotions, self-esteem, spirituality, cognitive functions) and productivity (satisfaction with ability to work, competence, autonomy, meaningful roles) have been viewed as essential dimensions of quality of life (Hussko etal, 2013). This questionnaire consists of 35 items and was related to life, overall health, social relationships, home and neighbourhood, psychological and emotional well being, financial circumstances and leisure activities. Responses were given in five point rating scale, i.e., very good, good, alright, bad and very bad.

Statistical analysis: Data was statistically analyzed using M.S. Excel. Statistical tests were performed to evaluate normality of distribution. Student's t test was applied to assess the significant difference between mean intake of energy and nutrients (energy, protein, fat, calcium, fibre and iron) of diabetic and non-diabetic subjects. Significance was defined as $p < 0.05$.

RESULTS AND DISCUSSION

Demographic details of the subjects: The ages (mean±SD) of the diabetic and normal subjects were 68.3±2.3 and 70.2±5.2 years respectively. Nearly half of all subjects were in age range of 65-75 years of age. Longevity is increasing in India (Krishnaswami etal, 2008) which is also seen in our study, where the subjects were as old as 90 years. With longevity comes debility, as is evitable from the study data. This was also reflected in another study wherein increasing age had a deleterious effect on elderly individuals with diabetes mellitus (Verhaeghen etal, 2003). Thirteen diabetic subjects and sixteen normal subjects were illiterate. As revealed by The National Sample Survey Organization (NSSO) employment unemployment survey (2007-2008), only 50% of elderly men and 20% of women aged 60 years or more were literate through formal schooling (Irudaya, 2006). In the present study, none of the subject was unmarried in both the groups. Twenty two diabetic subjects and nineteen normal subjects were married, eight diabetic and ten normal elderly subjects were widowed; whereas only one normal subject was divorced. In this context, 2001 census of India showed that 33.07 percent of the elderly in India were without life- partners and the widowers among men were 14.98 percent as against 50.6 percent widows among women (Irudaya, 2006). Although most of the subjects were living a retired life; six subjects in normal category were working part time. Ryan etal (1992) reported that a major part of older persons in India are poor and economically dependent. They reported that 41% were economically dependent either completely or partly on the institutions. The subjects' perception of their activity pattern was also recorded. Sedentary activity was the most prominent response in both groups. Tabatabaei-Malazy etal (2011) reported that the highest rate of hospitalization was found amongst diabetic elderly male subjects; physical inactivity and vascular heart diseases were the main reasons for hospitalization.

Nutritional assessment:

The results are presented in the table given below with respect to nutritional assessment of the subjects.

Table- 1
Anthropometric assessment of the subjects

Parameters	Normal	Diabetics	All subjects
	Mean±SD		
Height (cm)	160.3±4.6	158.5±3.8	159.4±4.3
Weight (kg)	51.0±4.5	53.9±9.4	52.5±7.5
MUAC (cm)	21.4±1.9	22.3±2.4	21.85±3.2
Calf circumference (cm)	30.0±3.4	30.3±2.6	30.1±3.0
BMI (kg/m^2)	20.4±3.0	21.1±2.2	20.9±2.7

The mean values of anthropometric measurements are depicted in table 1. The height of the diabetic subjects ranged between 152 cm and 162 cm; whereas in normal counterparts, it was between 152 cm and 165 cm. The mean weight of both the groups was observed to be high when compared with their ideal body weight. The lowest observed weight was 40 kg and highest was 73 kg. The latter was diabetic and former was normal subject. MUAC is considered to indicate the status of muscle development. MUAC ranged from 17 to 30 cm in diabetic; whereas it was between 17 to 24 cm in normal subjects. Calf circumference is also a significant indicator of muscle status. As per the cut off criteria, ten diabetic and thirteen normal subjects had calf circumference <31cm whereas twenty diabetic and seventeen normal subjects had calf circumference >31 cm. From the results obtained through anthropometric assessments, it can be inferred that maximum number of elderly has poor nutritional status or are prone to be malnourished with the advancement in age. Due to non-availability of food, sometimes lack of economic resource, nutrition intervention programmes, nutrition and health education, the health and nutritional status of subjects deteriorate making ageing a serious state.

Table- 2
Distribution of subjects on the basis of BMI

Classification	BMI (kg/m^2)	Normal		Diabetics		All subjects	
		n	%	n	%	n	%
Underweight	<18.50	-	-	-	-	-	-
Severe thinness	<16.00	-	-	-	-	-	-
Moderate thinness	16.00-16.99	-	-	-	-	-	-
Mild thinness	17.00-18.49	07	23.3	01	3.3	08	13.3
Normal range	18.50-24.99	20	66.6	23	76.6	43	71.6
Over weight	=25.00	-	-	04	13.3	04	6.6
Pre-obese	25.00-29.99	03	10.0	02	6.6	05	8.3
Obese	=30.00	-	-	-	-	-	-
Obese I	30.00-34.99	-	-	-	-	-	-
Obese II	35.00-39.99	-	-	-	-	-	-
Obese III	=40.00s	-	-	-	-	-	-
Total		**30**	**100**	**30**	**100**	**60**	**100**

Distribution of subjects on the basis of BMI is depicted in table 2. On the basis of BMI, twenty three diabetics and twenty normal subjects were falling in normal category. Four diabetics were overweight; whereas two diabetics and three normal subjects were falling in pre obese category. Our results show a trend to reduction in most of the important anthropometric measurements with advancement of age, similar trend was reported by other investigators (Alfonso-Rosa etal, 2013). The mean BMI was found higher in diabetic subjects than normal subjects. Bays etal (2007) from their two surveys showed that an increase in BMI is generally associated with a significant increase ($p<0.001$) in prevalence of diabetes mellitus and hypertension.

Biochemical assessment: The mean value of fasting blood glucose has been observed to be 118.0 ±18.6 mg/dl. Fasting blood glucose ranged between 82 to 182 mg/dl. The mean value of post prandial blood glucose level of diabetic subjects was 193.1±31.9 mg/dl. In this regard, Araki and Ito (2009) reported that remarkable hyperglycaemia may directly cause several forms of geriatric syndrome such as cognitive impairment, poor quality of life and many others.

Dietary assessment: This section deals with the dietary intake of energy and nutrients by the subjects.

Table- 3
Daily energy and nutrients intake of the subjects

Nutrient	RDA	Normal	Diabetics	All subjects
		Mean±SD		
Energy (kcal)	2088	1084±210	1195±193.9	1139.6±208.5
Protein (g)	73	49.5±15.9	47.2±15.9	48.3±15.6
Fat (g)	58	29.8±5.4	30.1±7.2	29.9±6.3
Calcium (mg)	1000	342.3±93.5	311.9±7.2	327.1±96.9
Fiber (g)	30	16.3±10.9	12.3±7.2	14.3±9.4
Iron (mg)	17	19.5±12.03	17.3±5.0	18.4±9.2

Mean daily intake of energy, fat, protein, calcium, iron and fiber are depicted in table 3. Energy, protein and fat intake were lower than RDA. Diabetic subjects were consuming more energy and fat daily as compared to normal subjects. The highest energy consumption was1546.6 kcal and the lowest was 1454.2 kcal. The latter was a normal subject and former was a diabetic subject. Several researchers from the results of their study recommended that overconsumption of energy and macronutrients must be avoided by elderly to prevent occurrence of multiple chronic diseases like obesity, diabetes and cardio-vascular diseases (Singh etal, 2012). Twenty seven diabetic subjects as well as normal subjects were consuming protein below than RDA, while remaining three subjects in both the groups had their protein intake above RDA. The maximum value of protein consumption was 89 g and the minimum was of 24 g. Mean value of total fat consumed by the diabetic subjects was 30.1±7.2 g/day whereas in normal subjects it was 29.8±5.4 g/day. This shows that fat consumption was higher in diabetics compared to the normal subjects. High fat diets are associated with an increased risk for diabetes. High fat diets have also been linked to an increase in heart disease, which is a major concern for diabetic patients (Haimato etal, 2009). Highest calcium consumption by the diabetic subjects was 514 mg and lowest was 368 mg/day which are markedly below the recommended amount. Both the group of elderly was not taking calcium above RDA. Highest fiber consumption by the diabetic subjects was 36 g and lowest was 18 g. Three diabetic and seven normal subjects were consuming high fibre diet with their daily fibre intake exceeding 30 g/day. Highest iron consumption by the diabetic subjects was 26.9 mg/d and lowest was 9.9 mg/d. Fourteen diabetic and seventeen normal subjects were taking iron above RDA. Dietary and nutritional inadequacies were also reported by Fogarty and Nolan (1992). Their results revealed similar picture of inadequate intake of calcium, retinol, and insufficient intake of protein and overconsumption of fat in elderly people aged 60-75 years. Similar dietary inadequacies were also reported by Jain etal (2013). In the present study, there was no significant difference ($p > 0.05$) in diabetic and normal subjects with respect to their energy and nutrient intake.

Mini Nutritional Assessment: Various health and nutrition related aspects were covered by MNA. Appetite evaluation showed that nearly half of the subjects in both the groups had no appetite related problem. Above 30 percent of the diabetic subjects and twenty three percent normal subjects mentioned moderate loss of appetite. Weight loss was reported more by normal subjects compared to diabetic group. Examination of eating habits revealed that about 97% diabetics as well as normal subjects were eating twice daily. More than 90% of normal subjects were taking fruits and vegetables daily; whereas only 70% diabetics were indulging in this practice. Fluid intake was more in normal subjects as compare to diabetic subjects. Self perception of nutritional status was also evaluated and it was found that diabetic elderly considered themselves as malnourished. On the basis of MNA screening scores, 1 diabetic and 6 normal subject had normal nutritional status. Remaining 29 diabetics and 24 normal subjects were found at possible risk of malnutrition. Therefore, MNA full assessment was done for these subjects. Twelve subjects in diabetic and three in normal category were malnourished. On the other hand, 17 diabetic and 21 normal subjects were at risk of malnutrition. Guigoz (2006) studied over 30,000 elderly subjects, screened by the MNA and showed the mean prevalence of malnutrition as 1% in community healthy elderly, 4% in outpatients/home care, 5% in home living Alzheimer's diseases patients, 20% in hospitalized patients and 37% in institutionalized elderly. A study in Taiwan in a representative cohort of elderly >53 years of age (n =

4440) showed that the proportion of free-living elderly who were malnourished increased from 1% to 8% with advancing age from >60 to >80 years old, while those at risk for malnutrition increased from 10% to 30% (von Heideken etal, 2006). In 36 studies of hospitalized elderly patients (n = 8596), the prevalence of malnutrition is 23±0.5%, risk of malnutrition is 46±0.5% and percentage of well-nourished subjects is 31.5±0.5. Except for preoperative elective surgical patients who were not institutionalized, the MNA classified 50-80% of the geriatric patients as being at risk of malnutrition or undernourished. Over 90% of subjects admitted to sub-acute care were either at risk of malnutrition or malnourished on admission (Thomas etal, 2002).

Short Portable Mental Status Questionnaire: The range of SPMSQ scores varied between 2 to 9. The lowest score was same for both the groups. The highest score were 9 and 8 for diabetic and normal subjects respectively. Diabetic subjects did more intellectual errors and had greater cognitive impairment compared to normal subjects. Some cross-sectional studies have shown that diabetes impairs cognitive functioning. A review summarizing 19 studies found that, type 2 diabetes subjects had significantly lower scores on at least one cognitive test and affects were specifically strong for verbal memory and complex information processing suggesting a domain specific effect of diabetes on cognition (Yaffee etal, 2004).

Diabetes Self Management Questionnaire: All items were formulated as behavioural descriptions taking the first person view. Respondents were asked to rate the extent to which each state applies to the personal self management with regard to the previous eight weeks. In order to perform this, 30 diabetics were assessed with the preliminary set of 16 items. The majority of diabetics had effective blood glucose measurement and medication intake. In response to the question about diabetes self care, half of the subjects agreed that it is poor. Similar study of Williams etal (2004) revealed that the mean duration of diabetes mellitus in diabetic person was of 11.0±9.8 years and were treated with diet only (50%), insulin only (22%), or a combination of oral hypoglycemic agents and insulin (135). Glycemic control was good, as evidenced by mean haemoglobin A1c level of 7.28% which corresponds to a mean glucose level of approximately 8.8 mmol/L (159mg/dl).

Older People's Quality of Life: In measuring the quality of life of older people, the weakness and possibilities of the measurement should be recognized. In this study, subjective health status, psychological well being and health related well being and health related quality of life as a whole, and several subjects aspects of health related quality of life were consistently and clearly better among normal subjects as compared to diabetics elderly. Coenders etal (2002) conducted QOL- study in Girona, Spain among elderly people of 65 years of age or above from a relatively high socio economic level. The results showed that all elderly people questioned in this survey experience a high objective and subjective QOL. They are all in good or relatively good health were active in different leisure activities, have tight emotional bonds with their families and close friends, have strong religious belief, and are all engaged in different church activities. Their satisfaction with the single parameters, e.g., satisfaction with family bonds, with life as a whole is very high in all of the elderly men and women.

Thus with advancing years, especially after 65 years of age, people have one or more chronic diseases, and have co-morbidities and decline in cognitive status and nutritional status. Elderly people need many kinds of services, including comprehensive arrangements for nutritional care. Following conclusions can be drawn from the results of the study:

Diabetic subjects are more nutritionally vulnerable.
Diabetic subjects do more intellectual errors and have greater cognitive impairment compared to non diabetic subjects.
As the nutritional status deteriorates, performance on mental state test declines.
Most of the diabetic subjects check glucose level and take medication regularly but also indulge into real 'food binges' (not triggered by hypoglycemia) sometimes.
Most of the elderly subjects consider their overall quality of life to be alright on a five point scale ranging from very good to poor.

Adequate nutrition and a well-balanced diet are of vital importance even during old age so as to prevent and control the common hazards of ageing. Many factors like poor income, decreased mobility, social isolation, cognitive impairment and diabetes are known to affect the health, nutritional and cognitive status of elderly. Hence, there is a need to focus on the health, nutrition and cognitive status of elderly before it becomes too late.

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