Original Article

Relationship between Frailty, Glycemic Control, and Nutritional Status among the Elderly with Diabetes Mellitus Residing in an Urban Community of Mysuru

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Abstract

Background: In India, the elderly (aged 60 and above) constitute 8.2% of the total population and are expected to increase to 10% by the year 2020. Globally, around 450 million people are suffering from diabetes mellitus. Frailty is regarded as a predisability state and, therefore, if identified early, may avert many adverse health outcomes in the elderly. Diabetes and frailty are found to be close associates. **Materials and Methods:** This community-based cross-sectional study was conducted among 104 elderlies with diabetes mellitus residing in an urban slum situated in Mysuru for a period of 6 months. Pretested structured questionnaire was used to collect the information on sociodemographic characteristics and details of diabetes. The Tilburg's Frailty Scale was used to assess frailty, and the Mini Nutritional Assessment Scale was used to assess the nutritional status. **Results:** The prevalence of frailty among the study population was 53.8%. 51% of the subjects were found to have their glycemic status under control, 16.3% were malnourished, and 70.2% were at risk of malnutrition (RMN). The majority of the subjects with malnourishment were frail (76.5%) followed by those at RMN, 36 (49.3%). Gender, marital status, engaging in occupation, socio economic status, poor glycemic control were found to be significantly associated with frailty. **Conclusion:** The prevalence of frailty is significantly higher among elderly diabetics. The poorer glycemic control is a significant factor associated with frailty, and malnourished elderlies are more at risk of developing frailty.

Keywords: *Diabetes mellitus, elderly, frailty, glycemic control, nutritional status*

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Introduction

In India, the elderly (aged 60 and above) constitute 8.2% of the total population and are expected to increase to 10% by the year 2020.[1] The American Geriatrics Society describes frailty as *"a state of increased vulnerability to stressors due to age-related declines in physiologic reserve across neuromuscular, metabolic, and immune systems*." Undernutrition is not only associated with cognitive impairment or functional loss, but it also predisposes to frailty.[2]

Globally around 537 million adults (20–79 years) are living with diabetes mellitus. The total number of people with diabetes is predicted to rise to 643 million (1 in 9 adults) by 2030 and 784 million (1 in 8 adults) by 2045.[3] Studies from various parts of India report the prevalence of type 2 diabetes mellitus between 2% and 5% among rural and between 5 and 15% among urban populations.[4]

Diabetes and frailty are found to be close associates. Their association is of importance because both are commonly encountered in the elderly; they share several

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pathophysiological mechanisms; effective glycemic control is associated with slower progression toward frailty; diabetes accelerates the aging process and therefore places the individual at greater risk of frailty; and finally, the presence of frailty in diabetic patients increases the likelihood of complications, functional deterioration, and mortality.[5]

Frailty is regarded as a predisability state and, therefore, if identified early, may avert many adverse health outcomes in the elderly such as cognitive impairment, depression, falls, prolonged hospitalization, and disability leading to positive physical and mental health as well as the satisfactory quality of life.[6]

There are very few community-based studies available on exploring the determinants of frailty among the elderly with diabetes in India. In this background, the present study will be conducted to assess the relationship of two important modifiable risk factors such as glycemic control and nutritional status on frailty among the elderly with diabetes in an urban community.

Materials and Methods

This community-based cross-sectional study was conducted in the urban field practice area of the Department of Community Medicine, JSS Medical College, Mysuru, for the period of 6 months from April to September 2021 after obtaining clearance from the Institutional Ethics Committee of JSS Medical College, Mysuru (EC letter no. JSSMC/IEC/220121/17STS/2020-21 dated January 25, 2021). Based on the reported prevalence of frailty among the elderly in India to be 38.8%[6] with 10% absolute allowable error and alpha level of 5%, the sample size calculated for the study was 94. Considering a 10% nonresponse rate (9.4–10), the final sample size was calculated to be 104. The urban field practice area of JSS Medical College catering to 10,500 population was divided into 6 blocks. The number of elderlies to be included from each of these blocks was calculated based on the probability proportionate to size technique. After visiting these blocks, each house with an elderly with diabetes satisfying inclusion and exclusion criteria was included until the desired sample size for the block was achieved. All the elderly (≥60 years) individuals who are permanent residents (≥1 year) of the study area and self-reported diabetes mellitus and on treatment for last more than 1 year were included in the study. The elderly who are critically ill or mentally unstable to respond and those who are not consenting to participate in the study were excluded.

A pretested structured pro forma with five sections was used to collect the details. Section 1 included the details regarding sociodemographic characteristics such as age, gender, education, occupation, socioeconomic status, marital status, staying with the spouse, type of family, and economic dependence. Section 2 included details on diabetes mellitus such as age of onset, duration of diabetes, place of treatment, adherence to the therapy, probable reasons for irregular treatment, and frequency of follow-up visits. Section 3 included details of frailty assessed through the Tilburg Frailty Indicator[7] – a self-reported schedule for assessment of frailty through its three important components, such as physical, phycological, and social. This tool consists of eight questions regarding the physical component, four questions on the psychological component, and three questions on the social component. The total attainable score ranges from 0 to 15. An individual with a score of ≥6 was considered frail. Section 4 included details of glycemic control which was by the random blood glucose levels measured using a standardized glucometer. The details of the most recent glycosylated hemoglobin (HbA1C) levels were collected from the records of the study subjects. Section 5 included details of nutritional status assessed through the Mini Nutritional Assessment Scale (MNA). The participants were classified as normal nutritional status, at risk of malnutrition (RMN), or malnourished based on the Malnutrition Indicator Score.[8] As a part of MNA, anthropometric measurements such as height, weight, mid-arm circumference, and calf circumference were taken using a stadiometer, weighing scale, and measuring tape, respectively, following standard procedures.

Statistical analysis

Data collected were entered in MS Excel-2010 and analyzed using IBM Corp. Released 2019. IBM SPSS Statistics for Windows, Version 26.0. Armonk, NY: IBM Corp. Descriptive statistical measures such as percentage, mean and standard deviation were applied. Inferential statistical tests such as the Chi-square test, Fisher's exact test, and Student's *t*-test were applied. The associations and differences were interpreted as statistically significant at $P < 0.05$.

Results

Sociodemographic characteristics

Out of 104 participants included in the study, 75 (72.1%) were females and 29 (27.9%) were males. More than half of the study participants were in the age group of 60–65 years, 67 (64.4%). The majority of them were illiterate, 47 (45.2%), and not employed. A majority, 49 (47.1%), of the participants were living in three-generation families, 55 (52.9%) were married, and 47 (47.1%) were widow/widower. A majority,

34 (32.7%), of the subjects were staying with their spouse and children and 33 (31.7%) were staying with only children. Fifty-nine (56.7%) subjects were partially economically dependent on their family members and 30 (28.8%) were fully economically dependent [Table 1].

Details of diabetes mellitus

The mean age of onset of diabetes was 56.76 ± 6.97 years, and the mean duration of diabetes was 7.87 ± 4.48 years. The duration of diabetes among 51 (49.0%) subjects was between 6 and 10 years. The majority of the participants followed the diabetic diet (61.5%), 90 (86.5%) were consuming oral hypoglycemic drugs, and 84 (80.8%) were adherent to treatment. Eighty-nine (85.6%) subjects were getting the treatment from private hospitals and 44 (42.3%) were visiting the hospital for follow-up once in 3 months. Apart from diabetes, participants had other comorbidities such as hypertension, 24 (23.5%); coronary heart diseases, 6 (5.7%); and stroke chronic obstructive pulmonary disease, 4 (3.8%) [Table 2]. Only one study participant was on calcium and Vitamin D supplements.

Table 1: Sociodemographic profile of study subjects

Sociodemographic character	Category	Frequency (%)
Age	60-65	67 (64.4)
	66-70	19 (18.3)
	>70	18 (17.3)
Gender	Female	75 (72.1)
	Male	29 (27.9)
Educational status	Illiterate	47 (45.2)
	Primary	6 (5.8)
	Middle	20 (19.2)
	Secondary	24 (23.1)
	Preuniversity/diploma	4 (3.8)
	Degree and above	3 (2.9)
Occupation	Retired	47 (45.2)
	Unskilled	33 (31.7)
	Semiskilled	8 (7.7)
	Skilled	9 (8.7)
	Clerk/Sho/Farm	4 (3.8)
	Semiprofessional	1 (1)
	Professional	2 (1.9)
Type of family	Nuclear	30 (28.8)
	Three generation	49 (47.1)
	Joint	25 (24)
Marital status	Married	55 (52.9)
	Widow/widower	49 (47.1)
Stay	Alone	8 (7.7)
	With children	33 (31.7)
	With spouse	29 (27.9)
	With spouse and children	34 (32.7)
Economic dependency	Fully	30 (28.8)
	No	15 (14.4)
	Partially	59 (56.7)
Socioeconomic status	BPL	78 (75.0)
	APL	26 (25.0)

BPL: Below poverty line, APL: Above poverty line

Frailty

Out of 104 study participants, 56 (53.8%) had features suggestive of frailty. Thus, the prevalence of frailty among the study population was 53.8%. Frailty was more common in the age group of 66–70 years 11 (57.9%), females 48 (64.0%), residing in joint families 16 (64.0%) not engaged in work currently 47 (60.3%), staying alone 5 (62.5%) followed by staying only with the children 21 (63.6), among those who were partially economically dependent on their family members 35 (59.3%) and below poverty line 66 (84.6%). The association between frailty and gender, marital status, engaging in occupation, and socioeconomic status was found to be statistically significant [Table 3].

Relationship between frailty, glycemic status, and nutritional status

Among 104 subjects included in the study, 53 (51.0%) and 47 (49.0%) were found to have their glycemic status under control and uncontrolled, respectively.

Table 2: Distribution of study subjects based on details about diabetes mellitus

Details	Category	Frequency (%)
Duration of diabetes in years	<5	36 (34.6)
	6-10	51 (49.0)
	11 and above	17 (16.3)
Follow diabetic diet	No	40 (38.5)
	Yes	64 (61.5)
Type of treatment	Alternative system of medicine	2 (1.9)
	Both	9 (8.7)
	Insulin	3 (2.9)
	Oral hypoglycemics	90 (86.5)
Adherence to treatment	Nonadherent	20 (19.2)
	Adherent	84 (80.8)
Place of treatment	Government hospital	15 (14.4)
	Private hospital	89 (85.6)
Frequency of follow-up	Monthly	32 (30.8)
	Once in 3 months	44 (42.3)
	Once in 6 months	21 (20.2)
	Once in a year	7 (6.7)
Comorbidities	Hypertension	24 (23.1)
	Coronary heart disease	6 (5.7)
	COPD	4 (3.8)
	Stroke and TIA	4 (3.8)
	Chronic kidney disease	2 (1.9)
	Others*	6 (5.7)

*Others: Mass in the breast (1), ureteric stone (1), benign prostatic hypertrophy (1), rheumatoid arthritis (1), asthma (1), and inflammatory bowel disease (1). COPD: Chronic obstructive pulmonary disease, TIA: Transient ischemic attack

Table 3: Sociodemographic factors associated with frailty among study subjects

Factor	Category	Frailty		Total	χ^2	*P*
		Nonfrail (48)	Frail (56)			
Age	60-65	32 (47.8)	35 (52.2)	67 (64.4)	0.216	0.92
	66-70	8 (42.1)	11 (57.9)	19 (18.3)		
	>70	8 (44.4)	10 (55.6)	18 (17.3)		
Gender	Female	27 (36.0)	48 (64.0)	75 (72.1)	11.15	0.001*
	Male	21 (72.4)	8 (14.3)	29 (27.9)		
Type of family	Nuclear	15 (50.0)	15 (50.0)	30 (28.8)	1.373	0.529
	Three generation	24 (49.0)	25 (51.0)	49 (47.1)		
	Joint	9 (36.0)	16 (64.0)	25 (24.0)		
Marital status	Married	33 (60.0)	22 (40.0)	55 (52.9)	9.00	0.002*
	Widow/widower	15 (30.6)	34 (69.4)	49 (47.1)		
Engaged in occupation	Yes	17 (65.4)	9 (34.6)	26 (25.0)	5.159	0.02*
	No	31 (30.6)	47 (60.3)	78 (75.0)		
Staying	Alone	3 (37.5)	5 (62.5)	8 (7.7)	3.730	0.298
	With spouse	13 (44.8)	16 (55.2)	29 (27.9)		
	With children	12 (36.4)	21 (63.6)	33 (31.7)		
	With spouse and children	20 (58.8)	14 (41.2)	34 (32.7)		
Economically dependent	Fully	14 (46.7)	16 (53.3)	30 (28.8)	3.255	0.207
	Partially	24 (40.7)	35 (59.3)	59 (56.7)		
	No	10 (66.7)	5 (33.3)	15 (14.4)		
Socioeconomic status	BPL	12 (15.4)	66 (84.6)	78 (75.0)	27.54	0.001*
	APL**	18 (69.2)	8 (30.8)	26 (25)		

Figures in parenthesis indicate percentages. BPL: Below poverty line, APL: Above poverty line

It was observed that 37 (72.5%) subjects with uncontrolled glycemic status and 19 (35.8%) with controlled glycemic status were found to have frailty. Frailty was more common in the subjects with the duration of diabetes 11 years and more, 13 (76.5%); nonadherent to diabetes treatment, 17 (85.0); and not following diabetes diet, 30 (75.0%). Undernutrition as per body mass index (BMI) was 15.4%. The association between frailty, uncontrolled glycemic status, age of onset of diabetes, duration of diabetes, adherence to treatment, and following of diabetic diet was found to be statistically significant. The overall prevalence of overweight and obesity among study subjects as per Asian classification of BMI was 14.4% and 4.8%, respectively. More number of frail participants fell under the category of undernutrition and normal BMI compared to nonfrail counterparts. However, the association between BMI and frailty was not found to be statistically significant [Table 4]. The mean levels of glycosylated hemoglobin level, random blood glucose levels, and duration of diabetes were significantly higher among frail subjects compared to their nonfrail counterparts [Table 5].

As per nutritional status is concerned, 17 (16.3%) were malnourished followed by 73 (70.2%) who were at RMN and 14 (13.5%) had normal nutritional status according to the Mini Nutritional Assessment (MNA) scale. The majority of the subjects with malnourishment were frail, 13 (76.5%), followed by those at RMN, 36 (49.3%), and a small proportion of subjects with normal nutritional status were frail, 14 (13.5%). The majority of subjects with malnourishment had uncontrolled glycemic status, 10 (58.8%), followed by subjects at RMN, 36 (49.3%), and 5 (35.7%) subjects with normal nutritional status had poor glycemic control [Table 6].

Discussion

India is witnessing an increase in the percentage of older adults due to the demographic transition.[9] This demographic transition of increased life expectancy is associated with the burden of several age-related disorders, including frailty.

In the present study, the prevalence of frailty among the elderly was 53.8%. The age between 66 and 70 years, female gender, being widow or widower, not being engaged in any occupation, and lower socioeconomic status were significant sociodemographic factors associated with frailty among study subjects. The results of the present study are similar to those observed by Kendhapedi and Devasenapathy[10] in a rural community at Thanjavur district of South India where 63% of the elderly had frailty with multidomain definition. Similarly, age, female, lower education, lower socioeconomic status, and minimum physical activity in routine work were independently associated with frailty irrespective of the frailty definitions. On the other hand, the prevalence is almost double the one reported by Shalini *et al*.[11] in

Table 4: Association between frailty, diabetes-related factors, glycemic status, and nutritional status

Factor	Category	Frailty		Total	χ^2	*P*
		Nonfrail	Frail			
Duration of diabetes in years	<5	23 (63.9)	13 (36.1)	36 (34.6)	8.566	0.014
	6-10	21 (41.2)	30 (58.8)	51 (49.0)		
	11 and above	4 (23.5)	13 (76.5)	17 (16.3)		
Adherence to treatment	No adherent	3 (15.0)	17 (85.0)	20 (19.2)	9.670	0.002
	Adherent	45 (53.6)	39 (46.4)	84 (80.2)		
Follow diabetic diet	No	10 (25.0)	30 (75.0)	40 (38.5)	11.704	0.001
	Yes	38 (59.3)	26 (40.7)	64 (61.5)		
Glycemic control	Controlled	34 (64.2)	19 (35.8)	53 (51.0)	14.08	0.001
	Uncontrolled	14 (27.5)	37 (72.5)	51 (49.0)		
BMI (kg/m^2)	Underweight <18.5	5 (31.2)	11 (68.8)	16 (15.4)	5.005	0.171
	Normal 18.5-22.9	30 (44.1)	38 (55.9)	68 (65.4)		
	Overweight (23.0-24.9)	9 (60.0)	6 (40.0)	15 (14.4)		
	Obese ≥30	4 (80.0)	1 (20.0)	5 (4.8)		
Nutritional status	Malnourished	4 (23.5)	13 (76.5)	17 (16.3)	4.118	0.128
	At risk of malnutrition	37 (50.7)	36 (49.3)	73 (70.2)		
	Normal	7 (50.0)	7 (50.0)	14 (13.5)		

Figures in parenthesis indicate percentages. BMI: Body mass index

Table 5: Difference in various parameters related to diabetes between frail and nonfrail subjects

Parameter	Nonfrail	Frail	*t*	*P*
HbA1C	6.66±1.38	8.25±1.68	5.172	0.001
Random blood glucose value	172.88±45.99	222.05±89.18	3.446	0.001
Age at diagnosis of diabetes	58.13±7.40	55.59±6.41	1.872	0.064
Duration of diabetes	6.4±3.3	9.14±4.9	3.253	0.002

HbA1C: Glycosylated hemoglobin

an urban community in South India, where 20% of the elderly were found to be frail. They also reported that female gender and lower educational and socioeconomic status were associated with increased risk of frailty among study subjects similar to the present study. Similarly, Chaudhary and Chowdhary[12] in their study observed the prevalence of prefrail and frail to be 55% and 20%, respectively. They reported higher chances of frailty among the elderly in higher age groups and belonging to lower socioeconomic status. The variation in the prevalence of frailty across different studies might be due to different scales or methods employed in the assessment of frailty. In the present study, we have adapted the Tilburg's Frailty Assessment Scale which is a widely used scale for detecting frailty among the elderly. One of the other reasons for the present study to report a higher prevalence of frailty could be that we have included only the elderly population with diabetes and diabetes itself is an independent major risk factor for the development of frailty.

A study conducted by Bhat and Sheth[13] in Ahmedabad reported the prevalence of frailty among diabetic elderlies to be 61.6%. Frailty was found to be highly correlated with the severity of diabetes (HbA1C) but showed no correlation with chronicity of diabetes and the BMI of the individuals. Similarly, Chode *et al*.[14] in their study found that the prevalence of frailty was higher in middle-aged diabetics than nondiabetic middle-aged people and diabetics with high BMI were likely to be frail and were less physically active. The results of this study were similar to our study, where we have observed the elderly with uncontrolled glycemic status to have an association with frailty.

In the study of Zaslavsky *et al*.,[15] the average glucose levels <160 mg/dl and >180 mg/dl were related to an increased risk of frailty. This showed an apparent U-shape association between glucose levels and frailty in diabetes patients. Similarly, in the present study, frail subjects were found to have higher mean random blood glucose and HbA1C levels compared to the nonfrail subjects.

In the present study, it was observed that the majority of the subjects with malnourishment were frail, followed by those at RMN, and a small proportion of subjects with normal nutritional status were frail. The results were similar to Valentini *et al*.[16] in their study on frailty and nutritional status in older people using the Mini Nutritional Assessment Tool found that, among frail subjects, 65% were at RMN and 10% were malnourished. The prevalence and RMN were progressively diminished in the prefrail group and not frail group. Another study conducted by Shalini *et al*.[11] observed that the prevalence of frailty was higher in the lowest tertial of most of the food groups

Table 6: Association between nutritional status and glycemic control

Nutritional status	Glycemic control		Total	χ^2	*P*
	Controlled	Uncontrolled			
Malnourished	7 (41.2)	10 (58.8)	17 (16.3)	1.648	0.439
At risk of malnutrition	37 (50.7)	36 (49.3)	73 (70.2)		
Normal	9 (64.3)	5 (35.7)	14 (13.5)		
Total	53 (51.0)	51 (49.0)	104		

Figures in parenthesis indicate percentages

and nutrient intake compared to the highest tertial, thus providing evidence that inadequate intake of nutrients is independently associated with frailty. Although the results of the present study on the association of frailty with malnutrition and at RMN were similar to other studies, we have not found statistical significance, probably due to a lower sample size.

Conclusion

Thus, the present study concludes that the prevalence of frailty is significantly higher among elderly diabetics. The poorer glycemic control is a significant factor associated with frailty, and malnourished elderlies are more at risk of developing frailty. Thus, early detection of frailty through screening procedures, emphasizing glycemic control, and counseling for adequate dietary consumption should be the integral aspects of geriatric care services at all levels.

Limitations

In the present study, the most recent HbA1C levels were collected from the records of the participants. As the participants had visited different health facilities, the instruments used to analyze the HbA1C levels are different. Considering the feasibility related issues, the prevalence of sarcopenia was not assessed in the present study.

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Conflicts of interest

There are no conflicts of interest.

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