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ORIGINAL ARTICLE

Comparison of fatigue and functional status in elderly type 2 diabetes patients versus age and gender matched individuals

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Abstract

Introduction: Fatigue is a common yet not frequently explored complication of diabetes. There are fewer studies available on the impact of diabetes on the severity of fatigue and the functional status of patients.

Methods: Fifty individuals meeting the inclusion criteria were included. The individuals were divided into two groups: group A (diabetic elderly individuals) and group B (nondiabetic age and gender-matched individuals). An observational analytical study was conducted. Outcome measures used were: fatigue severity scale (FSS), lower extremity functional scale (LEFS), 6-minute walk distance (6MWD), and 30-second chair stand test. SPSS 16 was used to analyze data.

Results: As per the normality test, a between-group comparison of fatigue severity scale (FSS) score, chair stand test score, and LEFS score was carried out by a nonparametric Mann–Whitney test, which showed a statistically significant difference between the groups ($P < 0.05$). Between-group comparison of 6MWD was carried out by parametric unpaired *t* test. The results showed a statistically significant difference in the distance walked by both groups.

Conclusion: Higher levels of fatigue and impaired functional status along with reduced strength and function of lower limbs was seen in elderly patients with type 2 diabetes Inclusion of symptom assessment and strategies to reduce the burden of fatigue in diabetes patient should be incorporated.

KEYWORDS
diabetes mellitus, fatigue, lower limb function

1 | INTRODUCTION

Diabetes mellitus (DM) is a group of metabolic diseases characterized by hyperglycemia resulting from defects in insulin secretion, insulin action, or both. Glucose metabolism disorder results from a defect in insulin secretion by the pancreas, insulin action on the target tissues (or insulin resistance), or both. In the elderly population, type 2 DM (T2DM) is prevalent due to common reasons like genetic background, long life expectancy leading to a decrease in insulin secretion, and the modification of some environmental factors responsible for central obesity and change in lifestyle. The exact definition of elderly is a subject of controversy. In general, a person is considered as old if his/her age is ≥ 60 or 65 years.[1]

Chronic hyperglycemia in diabetes leads to long-term damage, dysfunction, and failure of various organs, especially the eyes, kidneys, nerves, heart, blood vessels, and muscles. The aging process

is associated with a progressive loss of skeletal muscle mass and strength, also known as sarcopenia. Diabetes is known to accelerate the aging process. Presence of diabetes in an elderly patient causes a decline in skeletal muscle mass and strength and impairs functional performance, leading to an increased level of dependence and greater morbidity.[2]

As all the systems deteriorate, the elderly patients with diabetes tend to feel fatigued easily compared to normal age and gender matched individuals. Fatigue is a condition characterized by a lessened capacity for work and reduced efficiency of accomplishment, usually accompanied by a feeling of weariness and tiredness. Fatigue is a continuous and distressing complaint in people with DM.[3] Fatigue is a common yet not frequently studied complication of DM. The importance of fatigue may be higher in the geriatric population with diabetes due to complex and extensive management strategies. There are fewer studies available on the influence of diabetes on the severity of fatigue and functional status of elderly patients.

Poor muscle quality and weak muscles may explain part of the declined functional status seen in diabetes. The American Thoracic Society defines functional status as a person's ability to perform normal day-to-day activities required to meet basic needs, fulfill usual roles, and maintain health and well-being. Functional status is an important part of the quality of life for older adults and their caregivers. Worsening physical function among older adults with T2DM has been linked with glucose control, diabetic neuropathy, obesity, and participation in < 30 minutes/day of moderate physical activity.[4]

DM is associated with several impairments and literature has shown that T2DM is associated with a loss of mobility. This limited mobility disrupts a wide range of daily activities. Limited mobility affects the independence of an individual's basic activities of daily living, such as getting up from a chair, walking on stairs, and doing self-care functions are impaired. Given these facts, consideration of the problems the general elderly population is facing in the management of diabetes is essential. Recent research has shown that older patients with type 2 diabetes are often affected by skeletal muscle impairment, leading to reduced muscle strength and physical function.[5]

This study aimed to compare fatigue and functional status in elderly patients with DM and age and gender-matched individuals and also to compare lower limb strength and lower limb function between them.

2 | MATERIALS AND METHODS

An observational analytical study was conducted in the Physiotherapy department, in a college of Physiotherapy, Endocrine, and Medicine Department of the General Hospital and Community of Ahmedabad. The study was approved by the Institutional Review Board (PTC/IEC/28/2019–20). Patients meeting the inclusion criteria were explained details about the study. Written informed consent was obtained from the participants. The data of the present study were analyzed using SPSS version 16.

2.1 | Subjects

Sampling was done using the convenience sampling method, it was calculated keeping the power of study at 80%. Two groups of patients were formed group A: patients with diabetes, and group B: nondiabetic age and gender-matched individuals. Inclusion criteria for group: A (diabetic individuals) included: men and women aged => 60 years diagnosed with type 2 diabetes by the medicine/endocrine department and having diabetes for ≥ 5 years. Group B (nondiabetic individuals) had men and women aged => 60 years without any history of diabetes. Patients with a severe musculoskeletal condition, malignancy, presence of any neurological condition, like hemiplegia, and unable to ambulate were excluded.

The outcome Measures used were

2.1.1 | Fatigue: Fatigue severity scale

Fatigue was measured by the fatigue severity scale (FSS). Gujarati version of the FFS was used. Concurrent validity of the Gujarati version of the FSS is 0.81, internal consistency is 0.76, test–retest reliability is 0.78, and intraclass correlation coefficient (ICC) value is 0.81. The higher the score, the more severe the fatigue is and the more it affects the person's activities.[6]

2.1.2 | Functional status: 6-minute walk test

Functional status was evaluated by the 6-minute walk test, a common field test shown to be reliable, valid, and safe in adults (including elderly adults) with a variety of medical conditions, including diabetes (ICC => 0.92 for elderly patients with diabetes). This is a submaximal exercise test. The 6-minute walk test was performed according to the American Thoracic Society guidelines.[7]

2.1.3 | Lower extremity strength: Chair stand test

Lower extremity muscle strength was evaluated with the chair stand test, which is a commonly used test to check lower limb muscle strength in elderly (ICC => 0.92 for elderly patients with diabetes). From the sitting position, the subjects were asked to stand completely up, then completely back down, and this was repeated for 30 seconds. If the subject completed a full stand from the sitting position when the time had elapsed, the final stand was counted in the total. The total number of complete chair stands (up and down once = one stand) was counted. The score is the number of completed chair stands in 30 seconds.[7]

2.1.4 | Lower extremity function: Lower extremity functional scale

Lower limb function was evaluated by Lower Extremity Functional Scale (LEFS; Gujarati version). The LEFS is a questionnaire containing 20 questions about a person's ability to perform everyday tasks. A higher score indicated better lower extremity function. LEFS has high internal consistency (Cronbach's $\alpha = 0.809$) and test–retest reliability (ICC = 0.809, 95% confidence interval = 0.58, 0.94).[8]

3 | RESULTS

Fifty individuals meeting the inclusion criteria were included from a general hospital in Ahmedabad. The individuals were divided into two groups: group A (diabetic elderly individuals) and group B (nondiabetic age and gender-matched individuals). As per the normality test results, the appropriate tests were applied. Demographic data of the participants are shown in Table 1. Comparison of FSS score, chair stand test score, and LEFS score was carried out by the nonparametric Mann–Whitney test between groups, which showed a statistically significant difference between the groups ($P < 0.05$; Table 2). The FSS score difference between the groups was statistically significant ($P < 0.05$; Table 2).

TABLE 1 Demographic details of participants.

Variables	Group A (diabetics) ($n = 25$) (Mean ± SD)	Group B (nondiabetics) ($n = 25$) (Mean ± SD)
Age, y (Mean ± SD)	69.2 ± 5.16	69.2 ± 6.09
Gender (male:female)	18:7	14:11
BMI (kg/m^2) (Mean ± SD)	26.4 ± 3.21	24.7 ± 3.77

Abbreviation: BMI, body mass index.

The difference in scores of 30-second chair stand test was also found to be statistically significant between both the groups ($P < 0.05$; Table 2). Comparison of LEFS scores between both the groups also showed a statistically significant difference between group A and B ($P < 0.05$). Between groups comparison of 6-minute walk distance (6MWD) was carried out by parametric unpaired *t* test. The results showed a statistically significant difference in the distance walked by both groups (Table 3).

4 | DISCUSSION

The present study aimed to compare fatigue, functional status, lower limb strength, and function in elderly patients with type 2 diabetes with age and gender-matched individuals. Fifty participants were included in the study. Fatigue was observed to be higher in group A participants (patients with diabetes) compared to the nondiabetic group B participants, which are in line with the study results of Fritschi et al.[9] Fatigue was higher in diabetic women compared to normal healthy norms. Fatigue was found to be related to diabetes symptoms, diabetes emotional distress, depressive symptoms, body mass index (BMI), and low physical activity. Similar results were also found in a study done by Singh et al.[3] The duration of onset of fatigue and work done was significantly higher in non-diabetic subjects than patients with diabetes. Normal nondiabetics subjects could do more work without getting fatigued easily. Patients with diabetes got tired rapidly.[10] Fatigue was one of the primary complaints of African American women with type 2 diabetes, which according to them hampered their daily life activities.[11] Australian women with type 2 diabetes reported limited participation in social activities due to fatigue.[12] Day to day activities like preparation of food and other household chores along with self-care were affected due to fatigue as reported by a study performed on community-dwelling adults with type 2 diabetes.[13]

Physiological factors, such as huge variations in blood glucose levels, and postprandial glucose fluctuations, may contribute to the

TABLE 2 Between groups comparison of median of FSS, 30-second chair stand test, and LEFS.

Outcome measures	Group A		Group B		*U* value	*P* value
	Median	IQR	Median	IQR		
FSS	34	26	17	11	149.5	0.002
30-second chair stand test	8	2	9	2	194	0.048
LEFS	34	15	55	24	147	0.001

Abbreviations: FSS, fatigue severity scale; IQR, interquartile range; LEFS, lower extremity functional scale.

TABLE 3 Between groups' comparison of mean of 6MWD.

Outcome measures	Group A, mean ± SD	Group B, mean ± SD	*t* value	*P* value
6MWD, min	313.1 ± 80.6	316.7 ± 32.65	0.197	0.009

Abbreviation: 6MWD, 6-minute walk distance.

development of fatigue and may be causing an elevation in pro-inflammatory markers. Psychological factors, such as emotional stress or depression, can also lead to fatigue. A sedentary lifestyle and obesity are commonly associated with type 2 diabetes.[10] Diabetes comes with multiple complications involving multiple organs which logically predisposes to fatigue.

A survey of participants found that hypertension and neuropathy were the most common comorbidities resulting from diabetes. Both high blood pressure and neuropathy can be responsible for tiredness and fatigue. In the present study, several patients showed symptoms of neuropathy on clinical assessment (Table 4). Neuropathy was the most common complication observed in a survey of patients with diabetes, and foot pain (due to neuropathy) has been previously found to be positively correlated with symptoms of general fatigue in adults with diabetes.[13] Cuellar et al.[14] conducted a study assessing fatigue, sleep, glycemic control, and depression in subjects with type 2 diabetes, both with and without restless leg syndrome (RLS). The FSS mean was observed to be higher in patients with RLS. These results may be relevant to the current study because patients with diabetes often have similar symptoms resulting from neuropathy.

In the present study, the distance walked by group A (patients with diabetes) participants during the 6MWD was significantly less than that of group B (nondiabetics) which is consistent with the results of a study by IJzerman et al.[15] in which both diabetic groups (diabetic controls and patients with diabetic polyneuropathy) showed a decreased mobility compared to the healthy controls group. Singh et al.[3] also observed similar decline in 6MWD in patients with type 2 diabetes. Several possible mechanisms have been suggested for the compromised physical function status in adults with T2DM. Kalyani et al.[16] found that aging adults with diabetes had reduced quadricep strength and power and that this was related to slower walking speeds. Reduction in functional capacity due to fatigue is common in subjects with other chronic disorders, like cancer and Parkinson's disease. Fatigue may play a similar role by reducing the functional capacity of individuals with type 2 diabetes, owing to low cardiorespiratory fitness, low physical activity levels, and high BMI. Studies have also revealed that sleep quality, BMI, and pain were the strongest explanatory factors for fatigue in patients with type diabetes.[3]

Diabetes is known to reduce regular functional capacity. The exercise capacity of patients with diabetes (assessed by the 6MWD) evaluated by Adeniyi et al.[17] was found to be far below what was documented as reference values for relatively healthy adults. It was also found that elevated fasting blood glucose, advanced age, high waist circumference, and waist-hip ratio, and higher BMI was related to lower exercise capacity in subjects with type 2 diabetes based on the 6MWD. Janevic et al.[18] found a significant reduction in the distance covered during the walking test performed on elderly women with diabetes (> 60 years old) with concomitant heart failure. Lower limb strength and function was found to be highly impaired in the diabetic older individuals in the present study analyzed using chair stand test and LEFS, respectively. This is similar to study results by Leenders et al.[2] using different outcome tools. Kalyani et al.'s[16] study showed that diabetes was related to lower quadricep strength and power. Patients with diabetes, especially insulin users, showed significantly reduced quadriceps strength and power along with a reduction in gait speed. Among the elderly patients with diabetes, progressively longer diabetes duration was significantly and negatively associated with age-adjusted quadriceps muscle strength and power, especially in those 50–69 years. This can be justified by data from the health, aging, and body composition study, which suggests that diabetes leads to excessive loss of muscle mass, especially in women. Computed tomography scans of patients with diabetes revealed that rapid loss of thigh muscles can be related to T2DM.[19] Diabetes may result in functional impairments due to declined muscular function of the lower extremities. Muscle quality also gets compromised more rapidly in the elderly patients with type 2 diabetes.[20] Literature indicates that type 2 diabetes is associated with reduced muscle strength, quality, and power, which is more severe in the lower limbs than in the upper limbs.[21] Studies also found a marked reduction in lower limb muscle strength which was correlated with decreased mobility in patients with and without diabetic polyneuropathy.[15] Leenders et al.'s[2] study observed a significantly longer sit-to-stand time in the group with type 2 diabetes than in the normoglycemic group, which is similar to the results of the present study. In addition, handgrip strength was significantly lower in the group with type 2 diabetes when compared with the normal controls. The results of the present study are also in line with the findings for leg extension strength which was significantly lower in the group with type 2 diabetes compared with the normoglycemic control group. A study by Orlando et al.[21] showed muscle strength in the upper body was similar among groups (diabetic vs nondiabetic adults), whereas in the lower body, it was significantly reduced in patients with type 2 diabetes compared with the controls. Moreover, the endurance time in both the upper and lower body is found to be significantly reduced.

A study by Kalyani et al.[22] found that high HbA1c, a marker of chronic diabetes, was associated with lower muscle strength compared to normoglycemia. The significant associations of hyperglycemia with lower muscle strength over time were independent of potential confounders, like demographics, anthropometrics, and physical activity. The impact of hyperglycemia on mitochondrial dysfunction and protein degradation in skeletal muscle may be the key factors leading to decreased muscle strength, compromised mobility, and increased dependence. In addition to that, complaints like fatigue and weakness are major debilitating factors

TABLE 4 Diabetic complications (in group A participants)

Complications	Participants of group A
Neuropathy	14
Foot ulcers	1
Retinopathy	10
Others	8

that negatively affects the quality of life of an elderly patient with diabetes.

4.1 | Limitations of the study

The sample size for this study was limited, future studies can be done on a larger number of subjects. Correlation of fatigue with diabetic complications was not found in the present study, it can be studied as the results may be useful to plan the management strategies.

5 | CONCLUSION

The results of the present study, show the presence of higher levels of fatigue in elderly patients with type 2 diabetes along with strength and functional impairments in lower limbs, supporting the need for the inclusion of symptom assessment in patients with diabetes. The patients may not bring the fatigue issues during their visits to health care providers, with acute issues taking priority during their visit. It is important for health care providers treating patients with type 2 diabetes to address their fatigue issues. Health care providers should use complaints of fatigue as a starting point for further evaluation of comorbid conditions. Results from the present study suggest that intervention strategies should be developed to reduce the burden of fatigue in individuals with type 2 diabetes.

AUTHOR CONTRIBUTIONS

Research question formation: Bhatt and Sheth. *Data collection:* Bhatt. *Data analysis:* Bhatt. *Manuscript writing:* Bhatt. *Manuscript revision:* Bhatt. *Research guidance:* Sheth. *Manuscript modification:* Sheth.

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CONFLICT OF INTEREST STATEMENT

None.

ETHICS STATEMENT

The study was approved by Institutional Review Board (PTC/IEC/28/2019–20).

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