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Association between Physical Functioning and Fear of Falling with Balance in Elderly Diabetic Individuals

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Abstract

Background: Diabetes mellitus is a highly prevalent metabolic disease, particularly in the elderly population. Diabetic peripheral neuropathy (DPN), the most common complication, is present in up to half of the people with diabetes, leading to sensory and autonomic motor impairment, and possibly increasing the risk of falling. DM is also associated with geriatric conditions falls, incontinence, low body mass index, dizziness, vision, hearing and cognitive impairments and dependence on activities of daily living. Balance is one of the major factors which associated with falls in the elderly population. Diabetes in addition may cause further damage to the nervous system thereby resulting in impaired balance leading to increased risk of falls. It is essential to investigate relationship between balances and falls in diabetic individuals.

Material and methods: After getting approval from institutional ethical committee, 100 elderly patients (50 diabetics and 50 non-diabetics) were examined for balance. Mini mental status examination, body mass index, berg balance scale, modified falls efficacy scale, time up and go test was taken. For balance assessment Berg Balance Scale is used to test static and dynamic balance it includes 14 balance related task. For functional mobility assessment Timed up and go test is used and requires both static and dynamic balance. For falls assessment Modified falls efficacy scale is used. It has a 14 activity questionnaire.

Result: In diabetic subjects mean and standard deviation for MMSE 28.2+1.799 and for non-diabetic 29.2+1.3, BBS non-diabetic 51.9+6.22 and for diabetic 46.2+9.04, MFES non-diabetic 9.96+0.28 and diabetic 9.92+0.39, tug test non-diabetic 9.42+1.17 and for diabetic 10.8+1.82. So here, correlation between balance, functional mobility and falls are assessed. In correlation test it was noted that in diabetic mellitus subjects there is a positive correlation between berg balance scale and modified falls efficacy scale. In non-diabetic subjects there is negative correlation between berg balance scale and modified falls efficacy scale. In diabetic subjects there positive correlation in modified falls efficacy scale and timed up and go test. In non-diabetic mellitus subjects there is negative correlation between modified falls efficacy scale and timed up and go test. In diabetic mellitus subjects, there is positive correlation between Body mass index and berg balance scale, modified falls efficacy scale and timed up and go test. In non-diabetic mellitus subjects, there is negative correlation between body mass index and modified falls efficacy scale, timed up and go test, berg balance scale.

Conclusion: From the study it is concluded that there is significant correlation between BMI balance and functional mobility and perception about fall with the help of modified falls efficacy scale.

Keywords: Diabetes mellitus; Diabetic peripheral neuropathy; Dizziness; Body mass index

Introduction

Diabetes mellitus is a highly prevalent metabolic disease, particularly in the elderly population. Diabetes in the elderly is emerging as one of the most important public health problems of the 21st century [1]. Diabetic peripheral neuropathy (DPN), the most common complication, is present in up to half of the people with diabetes, leading to sensory and autonomic and motor impairment, and possibly increasing the risk of falling [2].

DM is also associated with geriatric conditions falls, incontinence, low body mass index, dizziness, vision, hearing and cognitive impairments and dependence on activities of daily living [2]. Diabetic peripheral neuropathy (DPN) was the most common complications of elderly diabetic, occurring in up to 60% of elderly diabetic leading to the decreased sensitivity of proprioceptive and vestibular function, slower reaction times and greater postural instability and altered walking patterns, which could contribute to an increased risk of falling [3].

Diabetes affects nearly 20.8 million people in the US. In India, prevalence of diabetes mellitus was 13.0% [1]. Balance is ability to move or to remain in a position without losing control or falling [4]. Peripheral neuropathy results in somatosensory changes of the peripheral nerves results in gait and balance problems [5].

Diabetes in addition may cause further damage to the nervous system thereby resulting in impaired balance leading to increased risk of falls [4]. For balance assessment BBS and TUG test are used. Balance is one of the major factors which associated with falls in the elderly population.

Falls are defined as unintentionally coming to the ground or some lower surface and not as a consequence of sustaining a violent blow, loss of consciousness and sudden paralysis as in a stroke incident or epileptic seizure [6]. Falls are a major problem in the elderly because they cause significant morbidity and mortality [6]. Risk of falling increases due to decrease in reaction time to external stimuli, such as changes in decubitus or shifts in gait, may be associated with changes in insulin action which lead to constant changes in blood glucose concentrations, affecting cerebral function [6].

For falls assessment MFES is used. It is a 14 activity questionnaire. It could be a useful addition in the comprehensive assessment of older people with balance disturbance or falls [7]. Higher score reflect more confidence, less fear of falling and lower score reflect less confidence and more fear of falling. Falls efficacy was rated on a 10-point visual analogue scale for each activity [7]. Thus the total rating (0-140) and divide by 14 to get each subject MFES score. Scores of <8 indicates fear of falling, 8 or greater indicate lack of fear.

For functional mobility assessments timed up and go test is used to assess person's mobility and requires both static and dynamic balance [4]. It is a simple test used to access a person's mobility. It uses the time that a person takes to rise from a chair, walk 3 meters, turn around, walk back to chair and sit down. During test person is expected to wear their regular footwear and uses any mobility aid that they normally require [4]. Obesity is also one of factor which leads to falls. Obese individuals are typically sedentary as there is an inverse relationship between BMI and activity levels. Obesity is an important factor related to falls in the elderly, as it negatively impacts balance and postural sway, thereby increasing the risk of functional limitations that lead to falling [8].

An increase in BMI which could possibly lead to impaired balance and an increased risk of falls. The obese group reported a higher prevalence of falls, than the normal weight group. Hence from study reviewed it is hypothesized that, there may exist correlation between balance, functional mobility and fear of falls. It is essential to investigate relationship between balances and falls in diabetic individuals. Hence aim of our study is to investigate if any correlation exists between balance, functional mobility and fear of falls.

Methodology

This is a cross-sectional study, conducted in the Dr. Vithalrao Vikhe Patil foundations college of physiotherapy. The study was conducted in accordance with the guidelines of the institutional research ethics committee. All participants signed an "informed consent" of which the procedures adopted comply with the ethical principles for medical research on human beings.

Procedure and selection criteria

Elderly individuals above the age of 60 years were included in the study. The participants were divided into two groups: diabetic and non-diabetic groups. Total 100 participants from them 50 diabetic and 50 non-diabetic participants. All participants were screened for any cognitive impairment with the help of mini mental status examination scale. The Inclusion criteria was Age 60-80 years, diabetes patients (for diabetic group), non-diabetic patient (non-diabetic group), both male and female, subject with sound cognition, subjects who are able to walk at least 10 meters. Participants with neurological condition or severe musculoskeletal disorders in lower extremity, subjects with uncontrolled diabetes were excluded.

Subjects underwent an initial assessment for the data related to demographic (age, sex, body mass index) and postprandial blood glucose data. Patients were assessed for balance using Berg Balance Scale, for functional mobility timed up and go test and for falls modified falls efficacy scale.

For functional mobility assessment Timed Up and Go Test is used and requires both static and dynamic balance. It is a simple test used to access a person's mobility. It uses the time that a person takes to rise from a chair, walk 3 meters, turn around, walk back to chair and sit down. During test person is expected to wear their regular footwear and uses any mobility aid that they normally require. Time required for performance was noted trials of test with sufficient rest in between were conducted and mean noted [3].

Result

There were 100 subjects in the study. In non-diabetic group there were 37 males and 13 females. In diabetic group there were 36 males and 14 females. Tables 1 and 2 shows demographic data, mean value of MMSE, berg balance scale, MFES, TUG test are described in Tables 3 and 4:

	Mean Value and Standard Deviation	
	Non-diabetic Individual	**Diabetic Individual**
Age	67 ± 5.31	68.5 ± 6.94
Body Mass Index	25.5 ± 3.81	26.2 ± 3.106
No of Males	37	36
No of Females	13	14

Table 1: Demographic data of participants.

	Mean Value and Standard Deviation			
	Non- Diabetic Individual		**Diabetic Individual**	
	Male (n=37)	Female (n=13)	Male (n=36)	Female (n=14)
Age	68.16 ± 5.129	63.76 ± 4.531	69.95 ± 7.155	64.94 ± 4.68
BMI	27.64 ± 2.862	21.73 ± 2.508	26.89 ± 2.739	24.30 ± 1.44

Table 2: Gender wise distribution of age and BMI in diabetic and non-diabetic individual.

	Mean Value and Standard Deviation			
	Non- Diabetic Individual		**Diabetic Individual**	
	Male (n=37)	Female (n=13)	Male (n=36)	Female (n=14)

Mini Mental Status Examination	29.13 ± 1.31	29.30 ± 1.316	28.44 ± 1.88	27.64 ± 1.44
Berg Balance Scale	50.72 ± 6.83	54.84 ± 1.994	44.25 ± 9.14	50.92 ± 7.38
Modified Falls Efficacy Scale	9.94 ± 0.328	9.86 ± 0.55	9.46 ± 0.83	9.92 ± 0.28
Time Up And Go Test	9.24 ± 1.150	9.917 ± 1.107	11.01 ± 1.88	10.39 ± 1.62

Table 3: Gender wise distribution of MMSE, BBS, MFES and TUGT in diabetic and non-diabetic individual.

	Mean Value		P value
	Non-diabetic Individual	**Diabetic Individual**	
Mini Mental Status Examination	29.2 ± 1.3	28.2 ± 1.799	0.0015 (Very Significant)
Berg Balance Scale	51.9 ± 6.22	46.2 ± 9.04	0.0002 (Extremely Significant)
Modified Falls Efficacy Scale	9.96 ± 0.28	9.92 ± 0.39	0.0039 (Very Significant)
Time Up And Go Test	9.42 ± 1.17	10.8 ± 1.82	<0.0001 (Extremely Significant)

Table 4: Overall mean value of MMSE, BBS, MFES and Tug Test.

In correlation test it was noted that in diabetic mellitus subjects there is a positive correlation between berg balance scale and modified falls efficacy scale. In non-diabetic subjects there is negative correlation between berg balance scale and modified falls efficacy scale.

In diabetic subjects there positive correlation in modified falls efficacy scale and timed up and go test (Table 5).

In non-diabetic mellitus subjects there is negative correlation between modified falls efficacy scale and timed up and go test. In diabetic mellitus subjects, there is positive correlation between body mass index and berg balance scale, modified falls efficacy scale and timed up and go test.

In non-diabetic mellitus subjects, there is negative correlation between body mass index and modified falls efficacy scale, timed up and go test, berg balance scale (Table 6).

Correlation	**BBS-MFES**	**MFES-TUG**	**BMI-BBS**	**BMI-MFES**	**BMI-TUG**
Correlation Coefficient (R)	0.7417	-0.6296	-0.5458	-0.3211	0.3866
	Extremely significant	significant	Extremely significant	significant	Significant

Table 5: Correlation of various parameters in patients with diabetes.

Correlation	**BBS-MFES**	**MFES-TUG**	**BMI-BBS**	**BMI-MFES**	**BMI-TUG**
Correlation Coefficient®	-0.04814	-0.04035	-0.4964	0.0989	-0.2554
	Non-significant	Non-significant	Extremely significant	Non-significant	Non-significant

Table 6: Correlation of various parameters in non-diabetic patients.

Discussion

From the present study, it is evident that in diabetic subjects there is positive correlation between berg balance scale and modified falls efficacy scale. Were as in non-diabetic patient there is negative correlation between BBS and MFES. In berg balance scale below 41 indicates fall risk and in modified falls efficacy scale scores below 8 indicate is fear of fall. So a positive correlation indicates that if balance is affected there is higher fear of fall.

As study of Tabassom et al. on Functional balance in elderly with diabetic neuropathy concluded that Distal Sensorimotor Polyneuropathy leads to functional imbalance thus danger of falling during daily activities increases and becomes more severe as the severity of neuropathy aggravates [9]. Distal Sensorimotor Polyneuropathy (DPN) is one of the most common long-term complications of diabetes mellitus which leads to high risk for falling [9].

Study of Felipe et al. on Static balance in patients presenting diabetes mellitus type 2 with and without diabetic polyneuropathy concluded that in closed eye condition patients with Diabetic polyneuropathy (DPN) has worse static balance than patients without DPN [10]. Furthermore, the higher the rating in diabetic neuropathy

examination, the stronger the displacement of Centre of Pressure, which may be associated with higher risk of falls [10].

Study of Ryan et al. on a growing troubling triad: diabetes, aging and falls concluded that fall is associated with decreased sensorimotor function, musculoskeletal, neuromuscular deficits, foot and body pain, pharmacological complications. So, there is a significant and troubling link between diabetes (DM) and falls in the elderly [11].

Study of Helene et al. on evaluation of postural stability in elderly with diabetic neuropathy concluded that change in Centre of Pressure Centre of mass can detect a very small change in postural stability and could be helpful in identifying elderly with DNP at risk of falling [12]. Study of Ann et al. on older women with diabetes have a higher risk of falls concluded that poor balance is a factor in between diabetes and increased risk of falling [13].

In diabetic subjects there is positive correlation between modified falls efficacy scale and timed up and go test, in non-diabetic patient there is negative correlation. Study of Bruno et al. on the geriatric depression scale and the timed up and go test predict fear of falling in community-dwelling elderly women with type 2 diabetes mellitus: a cross-sectional study concluded that the fear of falling is associated with frailty, depressive symptoms and dynamic balance, functional mobility and gait deficits in community dwelling elderly women [11]. Furthermore, both the GDS-15 and the TUG test predict a fear of falling in this population. Therefore, these instruments should be considered during the assessment of diabetic older women with fear of falling [14].

Study of Alessandra et al. on "Risk of falls in people with diabetes mellitus" in 61 subjects of both genders divided into the control group CG (n=32), diabetic neuropathy group DNG (n=18) and diabetic neuropathy vasculopathy group (DNVG) (12) [2]. There is progressive and significant time taken to perform the TUGT. In DNVG compared to the DNG followed by least time taken in the CG and the DNG compared to the CG [2].

Study of Renata et al. on "Factors associated with functional balance and mobility among elderly diabetic outpatients" was concluded, on 91 elderly subjects mobility was evaluated by the Timed Up and Go Test (TUGT) and the balance, by the Berg Balance Scale (BS). From the study it was concluded that there was a significant positive relationships between TUGT and age and ADL/IADL. It was also found that step strategy and proprioceptive sensitivity had a significant positive correlation with TUGT [15].

In Hee et al. on impairment of balance in elderly subjects with type 2 diabetes in this study balance was assessed by a computerized device and subjects was in standing. It indicates that those type 2 diabetic patients were at high risk of falls, increased postural sway and presence of diabetes are major risk factors for falling [16]. Study of Berna et al. on balance performance and fear of falling in older patients with diabetics: a comparative study with non-diabetic elderly this study was conducted on 100 subjects with diabetes mellitus and non-diabetic 101 subjects. Fear of falling (Falls Efficacy Scale-International (FES-I)), neuropathic pain [leeds assessment of neuropathic symptoms-signs (lanss), mobility [timed up and go test (tug)], balance [berg balance scale (bbs)], one-legged stance test (olst), disability status [modified barthel index (mbi)], depression [beck depression inventory (bdi)] and anxiety [beck anxiety inventory (bai)] was assessed. They concluded that in older patients with DM, fear of fall is increased and they have more balance disturbances compared to age matched individuals without DM [17].

In diabetic mellitus subjects, there is positive correlation between Body mass index and berg balance scale, modified falls efficacy scale and timed up and go test. If BMI is more than balance is affected and risk of fall is more and subjects take longer time to perform TUG test. Study of Cecilie et al. on "The influence of obesity on falls and quality of life" concluded that there was higher prevalence of falls and ambulatory stumbling in obese individual as compared to normal group. Also in middle aged and older men and women due to these higher prevalence there was a low score in multiple domains of health related quality of life [8].

Study of Rossi-Izquierdo et al. on "Impact of obesity in elderly patients with postural instability" found that postural instability, timed taken to perform TUGT more in obese individuals in this Patients with obesity took longer to perform the modified TUG and required more steps. In essence, there results indicate that obesity interferes in the balance of elderly patients with postural instability, putting them at a greater risk of fallings, performing worse dynamic tasks and feeling more disabled [18].

Study of Hooker et al. on "Obesity and falls in a prospective study of older men: the osteoporotic fractures in men study" found that oldest and highest bmi men had a higher fall rate as compared to youngest normal weight men [19]. Obesity was associated with a 24% to 92% increased fall risk in men below 80. Only adjustment for dynamic balance test altered the BMI-falls association substantially [19]. This association may be the result of Narrow walk time which is a measure of gait stability [19].

Study of Hannah et al. on "Biomechanical Effects of Obesity on Balance" concluded that obesity leads to compromised balance during various day to day activities when subject needs to maintain stability. Thus any impairment in disability to maintain balance increases risk of fall for obese individuals [20]. Study of Herrera-Rangel et al. on "Influence of the body mass index on the occurrence of falls in patients with type 2 diabetes mellitus" in this the occurrence of falls was related to BMI, gender and age. Compared to patients with no falls, patients with falls had a greater BMI [21].

Study of Bogdan et al. on "The impact of diabetic neuropathy on balance and on the risk of falls in patients with type 2 diabetes mellitus: A cross-sectional study in this the presence of DN was associated with significant decreases in the BBS score and SLS time, respectively increases in TUG time and FES-I score [22]. In the multivariate regression model, it was observed that patient's age, DN severity and depression's symptoms acted as independent, significant predictors for the risk of falls in patients with T2DM [22].

Study of M Sue et al. on diabetes in older adults concluded that people with diabetes of longer duration have lower muscle strength per unit of muscle mass than BMI and age matched people without diabetes and then those whose disease is of shorter duration or under better glycemic control [23].

Study of Shankar et al. on prevalence of diabetes and hypertension among geriatric population in a rural community of Tamil Nadu concluded that there is association seen among diabetes and BMI and it showed that a maximum prevalence of diabetes was seen in the population with BMI 30 and above [24].

This is conclusion of our study that, in non-diabetic mellitus subjects, there is negative correlation between body mass index and modified falls efficacy scale, timed up and go test, berg balance scale. Increased body weight might affect functional mobility hence time

required to complete TUG test is more. Also increased body weight may impaired balance of an individual which is shown by the extremely significant negative correlation between BMI and berg balance scale.

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