

# Falls in elderly patients with diabetes mellitus on insulin therapy and/or oral hypoglycemic drugs

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(Submitted: 06 December 2018 – Revised version received: 22 December 2018 – Accepted: 13 January 2018 – Published online: 26 March 2019)

**Objectives** Falls are a major cause of disability and a preventable cause of death in older people. Diabetes mellitus prevalence increases with age. A study by the Agency for Healthcare Research and Quality in America found that in 2010, diabetes-related Emergency Department visit rates were highest for patients aged 65 and older. The complications of diabetes may lead to an increased risk of falls in older diabetic patients.

**Methods** This is a descriptive cross-sectional study to describe the prevalence of falls among diabetic elderly and to compare the prevalence between patients on insulin therapy and patients on oral hypoglycemic drugs in Sulaymaniyah, Iraqi Kurdistan for 1 year from 1<sup>st</sup> of July 2014 to 31<sup>st</sup> of June 2015.

**Results** One hundred and fifty elderly diabetic patients with history of fall were included in this study, 88 (59%) were females and 62 (41%) were males. Their ages ranged between 65 and 90 years, mean age was  $77.7 \pm 7.11$  years, and the mean duration of diabetes mellitus was  $15.12 \pm 7.36$  years. The prevalence of falls increased significantly with increasing age, longer duration of diabetes, treatment with insulin therapy and sulfonylurea, patients with poor diabetic control, patients on polypharmacy, those requiring assistance with mobility, for those mobile with a stick and frame, those who had suffered peripheral neuropathy, osteoarthritis, retinopathy, cardiac problems, previous stroke, patients who live in institution, those living alone, smokers and alcoholics.

**Conclusion** Poorly controlled diabetes, treatment with insulin therapy and to some extent sulfonylurea, and conditions associated with complications of diabetes are associated with an increased risk of falling in older people. **Keywords** hepatitis B virus, HBsAg, infections, populations

**Keywords** elderly, diabetes mellitus, falls, insulin therapy, oral hypoglycemic drugs

## Introduction

Fall defined as an event, which results in a person coming to rest inadvertently on the ground or other lower level.<sup>1</sup> Although falls can occur at all ages, the frequency and severity of fall-related injuries increases with age, the term “older person” has been used to refer to people aged 65 years and older.<sup>2</sup> Approximately 1 in 10 falls resulting in a serious soft tissue injury, traumatic brain injury or fracture. Even non-traumatic falls carry serious consequences including decreases in social and physical activities, physical decline, disability, loss of independence and institutionalization.<sup>3</sup>

The significance of the relationship between aging, diabetes mellitus (DM), and falls has been highlighted by previous work that found the annual incidence of falls in elderly individuals with DM to be 39%.<sup>4</sup> There are a number of mechanisms by which DM may contribute to falls. Decreased sensory-motor function, musculoskeletal/neuromuscular deficits, foot and body pain, pharmacological complications, and specialty (offloading) footwear devices. Diabetic peripheral neuropathy is common among the DM population, and its prevalence increases with age and duration of diabetes.<sup>5</sup> Diabetic polyneuropathy patients with diminished plantar sensation on their feet have been observed to exhibit increased postural sway along with significant loss of postural control, loss of proprioceptive feedback.<sup>6</sup>

Reduced muscle strength has also been shown to result in reduced walking speeds, and an increased double support phase of the gait cycle. Studies have shown increased double support time to be a significant factor for falls especially in people with postural instability.<sup>7</sup> One of the hazards of

managing diabetes is the increased risk for experiencing unexpectedly low blood glucose levels and symptomatic hypoglycemia. Hypoglycemic episodes can occur with oral hypoglycemic and/or insulin use and frequently result in a state of dizziness, confusion, and postural instability which increases ones' risk for a fall accident.<sup>8</sup>

Therefore, unfortunately there are plenty of opportunities for elderly adults with DM to experience a fall. Accordingly, numerous investigations regarding improving balance, strength, and gait in order to reduce falls have been conducted.<sup>9</sup> Insulin and sulfonylurea should be used with caution because the risk of severe or fatal hypoglycemia increases exponentially with age.<sup>10</sup>

Finally, elderly patients with diabetes are at increased risk for falls and fractures, and insulin therapy increases this risk, although the mechanism for this effect is unclear.<sup>11</sup>

The aims of this study were to determine the prevalence of falls in elderly patients with diabetes and to compare the prevalence of falls between patients on insulin therapy and those on oral hypoglycemic drugs, to establish the implication of glycemic control on falls in elderly diabetic and identify other risk factors for falls among elderly diabetic patients.

## Patients and Methods

This study is a descriptive cross-sectional study to describe the prevalence of falls among elderly diabetic patients and to compare the prevalence between patients on insulin therapy and patients on oral hypoglycemic agents. The data were collected

by direct interview between the researcher and patients (person-to-person questionnaire) in the diabetic center and Emergency Department of Teaching Hospital, Shar Hospital in Sulaymaniyah, Iraqi Kurdistan region over the period from 1<sup>st</sup> of July 2014 to 31<sup>st</sup> of June 2015; 150 patients  $\geq 65$  years were collected. They were asked questions relating to the duration of diabetes, monitoring, their perception of occurrence of hypoglycemic episodes, symptoms and signs of postural hypotension, type of treatments they take for diabetes, history of falls and occurrence of falls within the past 12 months (How many times, if at all, have they had a fall in the last year?), also asked about consequence of falls whether non-traumatic, soft tissue injury and bruises, fractures or head injury, they were asked about their perception of visual impairment and peripheral neuropathy, past medical history and medications, polypharmacy, social history whether living in institution or live alone or with family, mobility whether they are walking independently or they use walking aids as sticks or frames, questions about smoking and alcohol drinking. A fall was defined as 'An event, which results in a person coming to rest inadvertently on the ground or other lower level' this was explained to the patient. Information was sought regarding contact with other medical specialties. We collected data about other risk factors for falls in diabetic elderly.

### Inclusion criteria

1. Elderly-age  $\geq 65$  years old.
2. Diabetic elderly on medical treatment.
3. History of fall.

### Exclusion criteria

1. Age  $< 65$  years.
2. Elderly diabetic without medical treatment.
3. Elderly diabetic without history of fall.
4. Mechanical falls (e.g., accidents).
5. Patients with dementia (documented after consultation with a neurologist), blindness and immobility and those who were unable to give informed consent were exclude from this study.

All patients were sent for the following investigations:

1. Random blood sugar.
2. HbA1c.
3. Blood pressure measurement.
4. Monofilament score test as a screening test for peripheral neuropathy and electromyography and nerve conduction study for those with sever peripheral neuropathy.
5. Ophthalmologist consultation for suspected visual impairment, retinopathy, glaucoma and cataract.
6. ENT consultation for those with ear problems and vestibular disease.
7. ECG and Echo for cardiac problems.
8. Chest X-ray for COPD.
9. Joints X-ray for osteoarthritis.
10. Brain CT-scan without contrast.

### Statistical analysis

The collected data were organized, tabulated, and statistically analyzed using Statistical Package for Social Sciences (SPSS) version 21 by an independent statistician. Values were expressed as mean  $\pm$  standard deviation (SD).

## Results

There was an increased incidence of falls with increasing age, mean age of the study population was  $77.7 \pm 7.11$  and 95% confidence interval (CI) was 63.7–91.6 as in Fig. 1.

Female gender was more than male in fall incidence (59% were females and 41% were males); the female to male ratio was 1.4:1 as shown in Fig. 2.

As shown in Fig. 3 with an increased duration of DM there were increased falls frequency, the mean duration of diabetes mellitus in the study population was  $15.12 \pm 7.36$  and 95% CI was 0.692–29.54.

Out of 150 patients, 20.7% patients with falls on insulin + sulfonylurea, 18.6% were on insulin + sulfonylurea + biguanide and 8% patients on biguanide as shown in Fig. 4.

Percentage of falls were higher in patients with HbA1c  $\geq 7$  as shown in Fig. 5.

Figure 6 shows 57 patients with two episodes of falls, 49 patients with one episode and 44 patients with three or more episodes.

There were 57% with single fall and 43% with two episodes of falls in the last year as shown in Fig. 7.

Non-traumatic consequence of falls was more prevalent and head injury was the least prevalent as shown in Fig. 8.

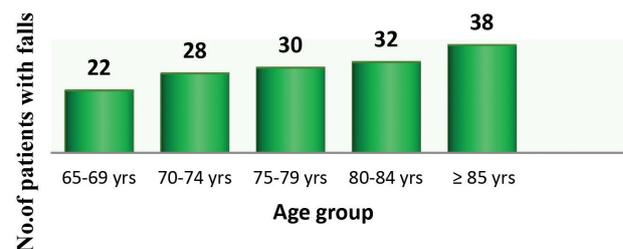


Fig. 1 Distribution of falls in diabetic elderly according to age groups.

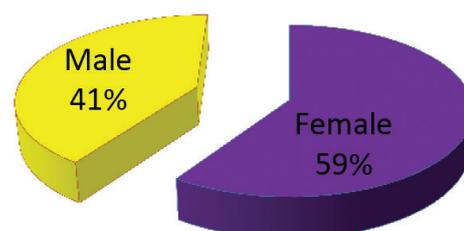


Fig. 2 Distribution of falls in diabetic elderly according to gender.

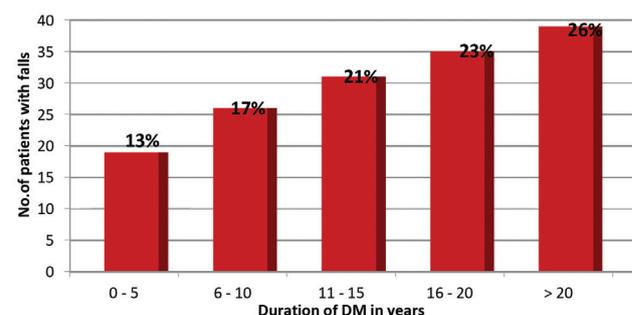


Fig. 3 Distribution of falls among diabetic elderly according to duration of DM.

As shown in Fig. 9 diabetic neuropathy, osteoarthritis and diabetic retinopathy were the most significant risk factors for falls in diabetic elderly.

Figure 10 shows 61% of patients with fall were on polypharmacy.

Regarding social history, 46.4% of patients live alone, 41% live with family and 12.6% live in institution as shown in Fig. 11.

As shown in Fig. 12 patients with walking aids had higher incidence (53.3%) of falls.

Out of 150 patients, 55% were smokers and 45% were non-smokers as shown in Fig. 13.

In this study, 11% of patients were mild-moderate drinkers and 8% with sever alcohol drinkers (alcoholic) as shown in Table 1.

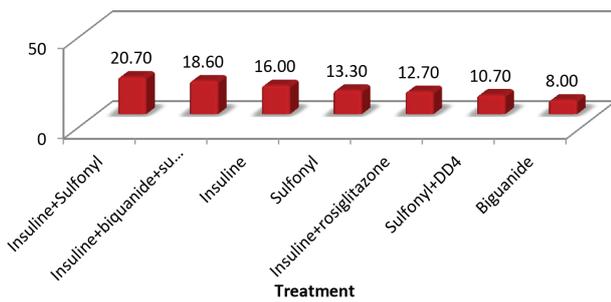


Fig. 4 Distribution of falls among diabetic elderly according to treatment.

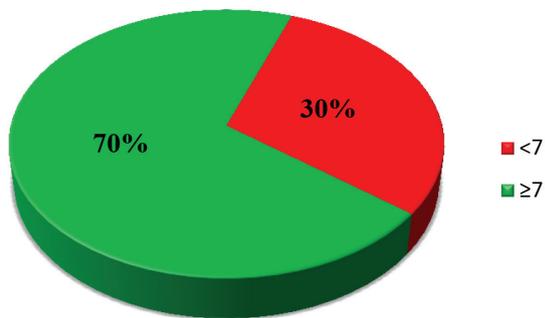


Fig. 5 Distribution of falls among diabetic elderly according to HbA1c.

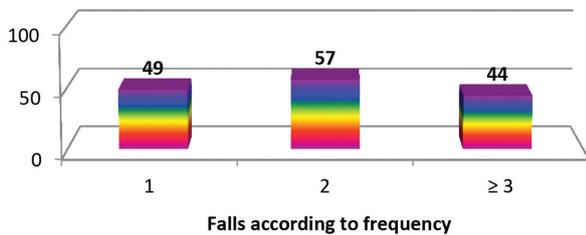
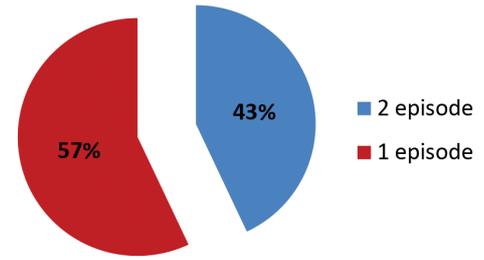


Fig. 6 Distribution of falls among diabetic elderly according to frequency of falls.



Frequency of falls/last year

Fig. 7 Distribution of frequency of falls in the last year among elderly diabetic.

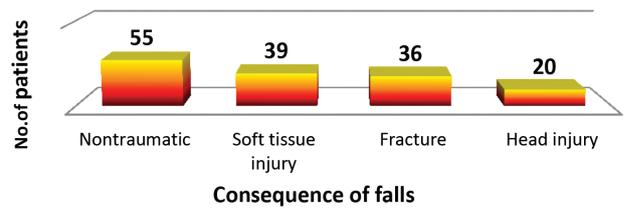


Fig. 8 Distribution of falls among diabetic elderly according to consequence of falls.

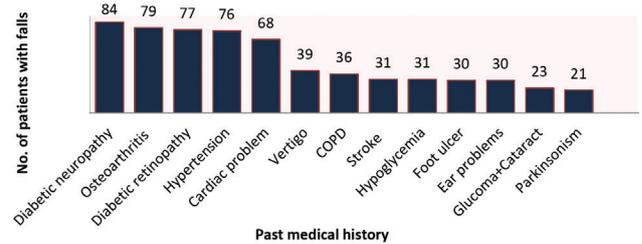


Fig. 9 Distribution of falls in diabetic elderly according to past medical history.

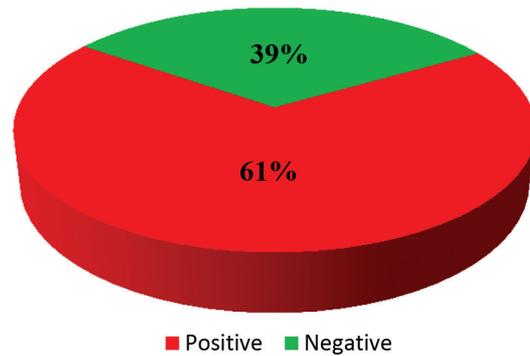


Fig. 10 Distribution of falls in diabetic elderly according to polypharmacy.

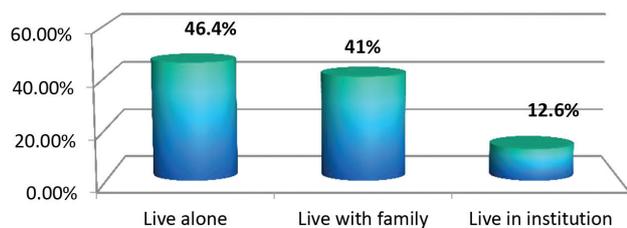


Fig. 11 Distribution of falls in diabetic elderly according to social history.

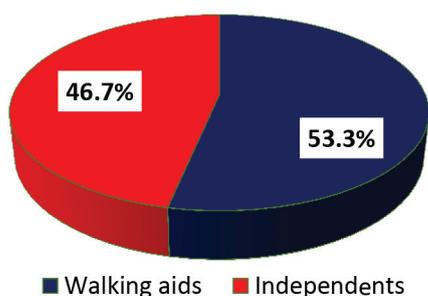


Fig. 12 Distribution of falls in diabetic elderly according to mobility.

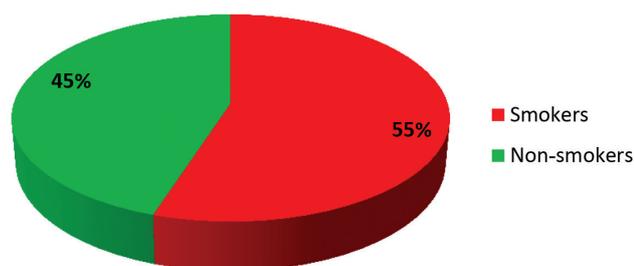


Fig. 13 Distribution of falls among diabetic elderly according to smoking.

Alcohol drinkers	Mild-Moderate	Severe	Total
No. of patients (%)	11	8	19

Monofilament test shows 83.3% were positive peripheral neuropathy test, as mild (28%), moderate (37.3%) and severe (18%) respectively as shown in Fig. 14 (For severe peripheral neuropathy we have done nerve conduction study and EMG).

## Discussion

Diabetes mellitus and falls are common in the older population and can therefore be considered as 'geriatric giants'. Diabetes in older adults is linked to higher mortality, reduced functional status, and increased risk of institutionalization.<sup>12</sup> Each year, approximately one in three community-dwelling older adults aged 65 or above suffers one or more falls.<sup>13</sup> Older women with diabetes are 1.6 times more likely to have fallen in 1999 in USA and twice as likely to have had injurious falls.<sup>14</sup>

Diabetes mellitus has been identified as a risk factor for falls, and fall-related injuries and fractures in a number of

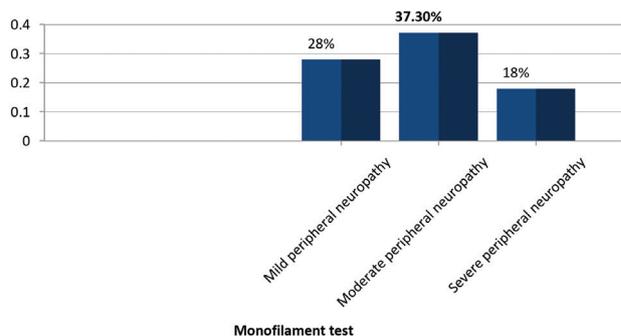


Fig. 14 Distribution of falls according to mono filament test.

prospective studies. A study in Spain found that the prevalence in people over age 65 is higher in women.<sup>15-17</sup>

In this study, age was significantly related to falls, we identified an increased risk in the older subset of diabetic patients as 38 patients (25.3%) of the studied population above 85 compared with 22 patients (14.7%) of the studied population who are in age group (65-69 years) reported at least one incident of falling during the last year, these finding is supported by a study in Europe done in 1989 by Health Evidence Network.<sup>18</sup>

We found in this study that there were an increased fall frequency with an increased duration of DM, 13% compared with 26% for duration (up to 5 years) and (above 20 years) respectively, which is due to diabetic micro- and macro-vascular complications, this is in agree with results found by Tilling et al.<sup>4</sup> in a study done in 2006.

In this study, we found a significant relationship between falls and those on insulin therapy and sulfonylurea, 20.7% were on insulin with sulfonylurea, 16% on insulin, 13.3% on sulfonylurea and on the other hand, 8% on biguanide which is the most safe drug in diabetic elderly with normal renal function, in line with a number of studies done previously.<sup>11,19,20</sup>

Tilling et al.<sup>4</sup> reported increased risk of falls with poor glycaemic control (HbA1c > 7%). This goes with this study, where 70% of participants had got uncontrolled HbA1c.

Recurrent falls, was significantly higher particularly among women who were treated with insulin. Polypharmacy also had a significant role in recurrent falls.<sup>21,22</sup>

Out of participants in this study, 56% were complaining from peripheral neuropathy, 52.7% from osteoarthritis, 51.3% from diabetic retinopathy, 50.7% from hypertension, 45.3% from cardiac problems and 26% from vertigo, 24% from COPD, all are risk factors for fall in elderly diabetic, it is in line with previous studies: A study by Victorian Quality Council proves that a common cause of somatosensory loss is peripheral neuropathy, often associated with diabetes, this includes the sense of light touch and awareness of joint positions that are important for safe mobility and function.<sup>23</sup>

Reduced somatosensory sensation results in balance disturbance and increased risk of falling. Visual impairments: visual acuity, visual field, cataract, and macular degeneration all contribute to risk of falls.<sup>24</sup> We used mono filament test in this study as a screening test for peripheral neuropathy and we found out 83.3% of patients with positive tests as 28%, 37.3%, 18% for mild, moderate, severe peripheral neuropathy respectively. For those with severe peripheral neuropathy we confirmed the diagnosis by doing nerve conduction study and EMG for them.

Regarding social history, previous studies show that older people who are living in nursing homes fall more often than those who are living in the community, approximately 30–50% of people living in long term care institutions fall each year, and 40% of them experienced recurrent falls.<sup>25</sup> A study in Europe by WHO Regional Office for Europe shows: approximately 50% of older people in residential care facilities fall at least once a year; up to 40% fall more than once a year. The incidence of falls in institutional settings is 1.5 falls per bed per year.<sup>26</sup> Our finding in this study is comparable with these studies except that regarding prevalence of falls in institutionalized participants who are under estimated in our study because of small numbers of diabetic elderly who attended the institution in Sulaymaniyah, Iraqi Kurdistan.

As we noted in our study smoking is a risk factor for falls among patients enrolled in the study, about 55% of them were smokers. This is supported by previous studies noted that smoking has been shown to be associated with low bone mass and risk of fall and fracture.<sup>27</sup> Also smoking is a leading cause of heart disease and stroke which are risk factors for falls in elderly diabetic patients.

In this study, as noted out of 150 patients enrolled, 19% of them were alcohol drinkers and from this group 8% were alcoholic (sever alcohol drinkers) which is parallel to previous study done in 1996 who stated that alcohol may cause a number of problems which predispose to falls and even modest social alcohol consumption may compound or exacerbate other risk factors for falls, intoxication causes acute instability. Older persons are particularly vulnerable to falls

with alcohol consumption and predisposed to falls when reserve in postural support mechanisms is lost. Alcohol impairs balance and judgment, and the diuretic effect of alcohol may cause orthostasis. Some chronic alcoholics develop myopathy, and strength is often impaired. A decrease in sensory input and foot drop can occur with peripheral neuropathy, which along with cerebellar damage causes the classically described wide-based ataxic gait.<sup>28</sup>

In summary the results of this study found that elderly diabetic patients especially females who are poorly controlled, treated with insulin therapy and to some extent sulfonylurea and who have complications of diabetes like peripheral neuropathy, arthritis, poor vision and diabetic patients with cardiovascular disease, polypharmacy and those using walking aids and living in institution are at high risk of falls. Avoiding the use of sulfonylureas and insulin unless it is necessary and using oral hypoglycemic agents that are least likely to cause hypoglycemia like metformin and/or dipeptidyl peptidase inhibitors unless contra indicated should be the first choice of therapy in diabetics aged 65 years or above in order to decrease the risk of falls and therefore the complications of these falls.

## Funding

The authors received no funding for this study.

## Conflicts of Interest

None. ■

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