

Review Article

# Falls Injuries and Type 2 Diabetes: Background and Future Directions

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## Abstract

**Background:** Falls are a serious health concern among older populations. Similarly, type 2 diabetes, a chronic disabling disease is highly prevalent among older individuals. Yet, falls are clearly an important overlooked complication of type 2 diabetes. **Objective:** This editorial was created with a view to emphasizing the importance of acknowledging, as well as intervening upon, those factors associated with type 2 diabetes that raise an elderly patient's falls risk. **Methods:** All relevant peer reviewed articles focusing on the topic and published over the last 2 decades were retrieved and reviewed. **Results:** Increasing numbers of research papers support the view that the older type 2 diabetes patients is at heightened risk for falls and their deleterious outcomes. Several strategies for preventing falls or reducing falls risk among older type 2 diabetes patients are consequently evidenced in the recent literature as well. **Conclusion:** Raising awareness that there is a higher risk of falling among elderly type 2 diabetes patients than the healthy elderly among medical providers and first responders who oversee the care of these patients is highly indicated. Standard guidelines in clinical practice to assess falls risk are highly recommended for this patient population to avert serious and costly health outcomes.

**Keywords:** Elderly; Falls; Fractures; Older people; Type 2 diabetes

## Introduction

Due to the fact falls are a highly common adverse event with serious health and social consequences for older people, as well as for society [1], and that the number of elderly people in any population is increasing worldwide [2], efficacious efforts to reduce the prevalence of falls among the elderly constitute an enormous public health challenge [3].

In this regard, and in light of the irrefutable evidence of the many negative consequences of falls among the elderly, a considerable body of research has been directed towards the identification of remediable or changeable risk factors that can be harnessed to potentially prevent falls among this population. Among these factors, visual impairments, inappropriate eyewear usage [4], psychoactive medication overuse [5], prevailing difficulties with gait and balance [6], comorbid conditions and being underweight [7] or overweight with severe polyneuropathy [8] are highly implicated. Other documented risk factors for falls include physical frailty, physical inactivity, alcohol misuse, cognitive and sensory impairments [9]; poor health and functional status [10].

Diabetes type 2, a common health condition occurring among elderly people, 65 years and above [2] and affecting millions of people globally [11] and associated with damage to the vascular, neurological, visual, and musculoskeletal system may also be an important albeit overlooked risk factor for falls among the elderly as outlined by Macgilchrist et al. [1]. As well, in addition to the risk of falling that comes with aging, research reveals older people with type 2 diabetes, the most common form of diabetes, have a 2.5 fold increased risk of incurring an injury as a result of a fall, as well as having a higher fracture risk [11,12]. In addition to well documented adverse outcomes of a fall that leads to a fracture among the elderly,

one or both of these outcomes is especially problematic for those with type 2 diabetes, as both fractures and injuries take longer to heal in the presence of this health condition, and in the case of the individual requiring surgery for a fracture repair, their risk of infection is heightened [1]. According to Crews et al. [13], the fact that these patients are prone to have more severe problems with falls than non-diabetic individuals, a high fracture risk coupled with poorer rehabilitation outcomes, even though bone density may be normal or high [13], as well as increased numbers of recurrent falls, should be of high concern to all those interested in fostering the wellbeing of older people, and the diabetic patient in particular.

However, even though there is an incremental rise in the aging population worldwide, as well as an anticipated rise in type 2 diabetes prevalence rates [2], and falls injuries clearly pose a major threat to an older person's life quality, most articles on type 2 diabetes and its outcomes do not focus on this topic even though emerging evidence suggests it may be helpful to expose aging adults with type 2 diabetes to a comprehensive falls prevention plan, and to periodically screen them for any physiological changes that can heighten falls risk. While the most common risk factors for falls among healthy older adults also affect those with diabetes type 2, a better comprehension of the specific risk factors occurring in the older diabetic patient constitutes the topic of the present editorial.

In addition, based on an understanding of the risk factors for falling, in general, plus those that are specific to those with diabetes type 2, documented strategies to avert falls and reduce falls risk among this population are highlighted. Diabetes type 2, a non insulin dependent form of diabetes, often starting in late adulthood, and its consequences in light of the co occurring aging process are often less

well documented than those of diabetes type 1, and highly challenging to manage, and thus the focus of this piece is largely on this more common form of diabetes.

To this end and to gain some insight into what can be done to reduce the burden of falls injuries among older adults diagnosed as having type 2 diabetes, related articles located in the ACADEMIC PREMIER COMPLETE, and PUBMED computerized databases over the past 10 years were accessed using key words: falls, diabetes, older adults. In terms of the data collected, only those data sources related to community-dwelling elders with diabetes type 2 were considered. Excluded were studies that took place in nursing homes or that discussed type 1 diabetes.

The results of this search revealed increasing numbers of related papers over the last five years, and themes that emerged from these were the risk factors for falls unique to people with type 2 diabetes, solutions for minimizing the risk of falls in this group in light of these specific risk factors, and the importance of continuing to study this cohort to establish effective prevention strategies.

### **Risk factors for falls among older type 2 diabetes patients**

Among a wide array of risk factors for falls among older people with type 2 diabetes are the use of multiple medications, excess muscle weakness, especially at the ankle, and a host of environmental factors. Specific factors that significantly heighten risk among many with type 2 diabetes are the presence of motor and/or sensory neuropathy [14], which increases the displacement of the center of pressure recordings during static balance tests in a dose dependent manner, the use of insulin, vision impairments, and the level of glycated haemoglobin [1]. Others include lower levels of physical activity, and poor postural control [13] or balance [11,14]. As well, people with type 2 diabetes tend to be older rather than younger [15], and in addition to poor levels of neuromuscular control, may have diabetic foot ulcers [1], and high rates of body pain as well as foot pain that lead to the use of psychotropic medications and polypharmacology [13].

Other factors include high rates of impaired vision, including poor low-contrast visual acuity and poor depth perception [11], lower limb amputations, vitamin D deficiency or treatment with thiazolidinedione therapy [15], and impaired renal function [2]. Other factors include dementia, urinary incontinence, depressive symptoms, and mild cognitive impairment. As well a high consumption of medications, poorer walking performance, and reduced cognitive function, are mediators of falls in diabetics [11]. Chau et al. [16] observed various subgroups of diabetes patients who employed hip strategies rather than more efficient ankle strategies when trying to balance if vision is limited. These altered strategies may explain why people with type 2 diabetes and peripheral neuropathy may exhibit greater postural sway in standing or a slower than average gait velocity, a predictor of falls.

MacGilchrist et al. [1] found that compared to diabetic non fallers, there was not only a greater incidence of peripheral neuropathy among those who fell, but that their ankle muscle strength and walking velocity were diminished significantly. The author's results suggested that the impaired sensation found in the lower extremities of many patients with type 2 diabetes, might predispose them to an increased falls risk. This suggestion is consistent with findings of Chau et al. [16] where diabetic patients with extremely weak ankle

dorsiflexor muscles were 3.7 times as likely to fall as those with more adequate muscle strength. Those who walked extremely slowly were also found to be at greater risk for falling than those who walked more rapidly. The authors concluded that careful screening of the type 2 diabetes patient for these identified risk factors may permit more specific preventive strategies to be implemented early on. Since reduced vibration perception is an important risk factor for falling, perhaps more routine measurements of this sensory pathway may be helpful as well as indicated by findings of Patel et al. [17].

Another risk factor for falls among adults with type 2 diabetes is the actual problem of consistently managing one's blood glucose level. For example, unexpected encounters with low blood glucose levels can produce dizziness, confusion, and postural instability, a factor that raises the risk for falling [13]. In addition, medications that are used by this patient group can foster an increased falls risk. Johnson et al [15] found hypoglycemic events were independently associated with an increased risk of fall-related fractures. According to Horiuchi [18] one of the reasons for the increased risk of falling in diabetics is low cognition, associated with both hyperglycemia and hypoglycemia.

As well as the role played by decreased sensorimotor function, and musculoskeletal/neuromuscular deficits in increasing falls risk among those with type 2 diabetes, Crews et al. [13] reported that individuals with this condition are prone to fall due to the presence of foot and body pain, as well as pharmacological complications. Additionally, there is some concern that the use of offloading devices used to reduce the risk of foot ulceration may increase postural instability and the risk of falling [13]. Oliveira et al [19] who studied a convenience sample of men and women between the ages of 50 and 65 with and without type 2 diabetes found an association between hyperglycemic status and poorer mobility, with an increased fall risk even in younger patients and in those with recent diagnoses.

Reasons why falls may lead to fractures, which are often life threatening, include the presence of microvascular complications, retinopathy, altered body composition, autonomic and peripheral neuropathy, use of medications such as thiazolidinediones, and hypoglycemia [13]. Diabetes also decreases muscle strength that may lead to falls and poor neuromuscular responses [20] and new data reveal that diabetes can impact bone quality [12], and bone toughness detrimentally [21]. As well, even if a fracture is not sustained initially, factors influencing recurrent falls that may lead to severe injuries including fractures are high pain levels, high rates of medication usage, lower strength levels, and cognitive impairment [13].

### **Strategies to prevent falling among people with type 2 diabetes**

Since most falls among the elderly occur while walking, standing, or rising and lowering one self, efforts to mitigate falls in this population often include strategies to improve balance, strength, and gait training. Furthermore, new technologies such as virtual reality proprioceptive training in a safe training environment may be able to reduce this risk among those with diabetes. Footwear such as athletic shoes that provide support and reduce slippage may also help to reduce falls risk in this patient group [13]. As well, specifically addressing the needs and concerns of those type 2 diabetes patients who present with neuropathy as regards footwear concerns, how

footwear affects balance, and the feasibility and acceptability of therapeutic footwear is highly recommended [22].

Tailored programs that focus on systematic medication reviews, a falls risk assessment including balance, gait, and strength tests, as well as tests of cognitive functioning, followed by balance exercises, general exercise programs, including cardiovascular fitness and resistance training of adequate intensity and duration and cognitive training have also been proposed to be efficacious [11].

In this regard, results of a study by Chau et al. [16] suggest that to be effective, a balance training program for people with type2 diabetes and neuropathy should focus on maximizing not only their vestibular competence, but also their visual competence. Regardless of the presence of neuropathy, all should receive balance training that emphasizes the ability to cope effectively in activities of daily living as far as situations such as getting on and off an escalator, where somatosensory inputs are suddenly altered (p. 1979). It also seems frequent medication checks, the careful control of glucose levels, especially avoiding hypoglycemia, and excess alcohol intake that can impact hypoglycemia and cognitions is likely to be beneficial at reducing falls risk [12].

Likewise, careful screening at diabetes clinics [2], including vision screening, skills at glucose control, along with gait, balance, and ankle muscle strength assessments– followed by intervention- as required- [1] are anticipated to minimize the risk of falls and subsequent falls-related fractures in cases of type 2 diabetes [15]. Future work to examine and reduce damage of nerve fibers that control balance and gait also appear promising novel approaches [23].

In another study, Lee and Song [24] who examined the use of whole-body vibration training in elderly patients with diabetic neuropathy, found significant improvements in static balance, dynamic balance, muscle strength and glycosylated hemoglobin in the experimental group. The authors concluded that short term 6 week whole body vibration in combination with and balance exercise program is beneficial in improving these factors in a subgroup of diabetes patients at high risk for falls. Results of other research indicate that in those patients with a disease associated lack of adequate vitamin D and/or calcium levels, supplementation may assist in improving both bone health and resistance to fracture as well as muscle function [12] that can reduce falls risk. Personnel who may be important players in the overall management of type2 diabetes include endocrinologists, who specialize in diabetes care; ophthalmologists; podiatrists; dietitians and diabetes educators who teach the skills needed for daily diabetes management.

## Conclusion

Falls among older people, as well as recurrent falls, a global public health problem of enormous magnitude, is often a neglected topic in the realm of type 2 diabetes treatment and outcome discussions despite increasing publications in this realm [25,26] that draw attention to this association and to explaining disease associated causative factors that lead to this [27-32] as well as directives to avert this negative health outcome [33-35]. This brief review was designed to emphasize the importance of including the topic of falls into mainstream discussions on how to maximize life quality for the older type 2 diabetic sufferer. Briefly discussed were reasons why falls

among the elderly are important in the context of public health, the increasing prevalence of type 2 diabetes in aging populations, what factors are known to enhance falls risk among type 2 diabetes sufferers, the consequences of these falls among this group, and strategies to minimize the impact of a considerable number of changeable factors associated with this health condition that clearly raise the risk for falls, as well as recurrent falls and fractures. Given the burgeoning numbers of young and older adults with type 2 diabetes, and the need to prevent unwarranted disability and their costs among this group [2], it is concluded that more concerted efforts to raise awareness about this adverse health outcome, as well as more programmatic endeavors, plus studies to examine what is the best method of preventing falls in this patient subgroup are urgently needed. At present, in efforts to prevent falls, careful screening, followed by tailored efforts to minimize falls risk factors likely to be present in those with type 2 diabetes such as muscle weakness, low levels of physical activity, poor balance, sensory and cognitive disturbances, low visual acuity, and hyper or hypoglycemia are strongly indicated. Those at highest risk who may be females [36,37], partly because of the increased rates of known fall risk factors [38] such as pain, high body mass index, and poor lower-extremity performance [39], those older than 75 years of age, those with retinopathy [2], diabetics with stroke histories [18] and orthostatic hypotension [2] or complaints [36], which causes dizziness [18], and those with longstanding type 2 diabetes [12] and high diabetic neuropathy ratings [14] should be especially targeted. In addition, diabetics with risk factors for osteoporosis should be targeted [21], as should those reduced peroneal nerve responses, high cystatin-C levels; poor contrast sensitivity; and low A1C in insulin users [40] and men with diabetes residing in rural locations [41].

Conversely, those less likely to fall are those with higher balance and gait scores [2] and who receive relevant prophylactic treatments [21], such as exercise, along with careful screening and periodic follow up assessments.

Given that a significant proportion of falls result in activity limitations, and that maximizing activity levels is very key to effective management of type 2 diabetes, in general, concerted efforts to avert falls among this high risk group by medical practitioners, allied health professionals, patients themselves, as well as public health agencies, and diabetes and gerontology specialists may prevent an ongoing cycle of deleterious outcomes, including a worsening of the severity of type 2 diabetes and its direct and indirect costs. In light of the burgeoning numbers of elderly likely to suffer from type 2 diabetes over the next few decades, it is sincerely hoped the evidence presented in this editorial can not only raise awareness of this often underreported atypical complication, but can serve as a starting point for developing targeted screening practices and prevention strategies in this respect as suggested by findings of Pijpers et al. [26], Agrawal et al. [37] and Yasuda [42]. These include, but are not limited to intensifying self-care to prevent foot lesions, especially for women who are at higher risk for fall related fractures than men with diabetes [43] exercise and balance training, plus education. In addition, efforts to minimize pain, and episodes of hypotension [38], cognitive dysfunction, and depression and to maximize glycemic control [44] may be helpful. As well, encouraging the use of therapeutic footwear [22] and applying short term whole-body vibration training in those with diabetic neuropathy [24], plus recognition that vestibular

dysfunction, a mediator of falls risk, is a newly recognized diabetes-related complication [37] are strongly indicated. Simple measures that may be helpful in identifying required preventive strategies are measures of walking speed, muscle strength, and vision [1].

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