Title of master thesis:

LITERATURE REVIEW: Prevalence of falls risk factors among geriatric inpatients

Submitted in partial fulfilment of the requirements for the degree of Master of Medicine

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June 2019

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1. Summary

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Aim — To review literature data on the prevalence of falls risk factors among geriatric inpatients.

Objectives

• To evaluate the effect of socio-demographic variables (such as age, gender, educational status etc) on the rate of falls in geriatric inpatients.
• To review the intrinsic falls risk factors in geriatric inpatients.
• To review the extrinsic falls risk factors in geriatric inpatients.

Methodology

In order to achieve the objectives outlined in this literature review, several scientific databases were used such as PubMed, PMC, MeSH, google scholar, sci-hub and NCBI. Only articles relevant to this topic from the year 1990 and onwards were chosen, and articles in other languages were used provided they had a translated version. A search was conducted using keywords such as “risk factors of falls” “falls in elderly” “causes of falls” “geriatric inpatients” “hospitalised elderly” “in-hospital falls”. Those phrases were then cross-searched with common mesh-terms such as “prevalence” and “incidence”.

Only the articles which filled the above criteria were selected for this literature review. In this literature review I identified the most common risk factors of in-hospital falls among elderly patients (60 years and above). With each risk factor identified, I analysed whether or not it is significantly associated with in-hospital falls, possible reason as to why this risk factor may lead to a fall in the hospital, and it’s prevalence among elderly inpatients.

Results

The incidence of falls varied greatly between studies from 0.3-13 falls per 1000 bed days. The most commonly identified risk factors in the articles reviewed were: history of falls (7 articles), cognitive impairment (6 articles), medications use (especially sedatives(5 articles) and antipsychotics (3 articles)), elimination problems/need for supervision(10 articles), impaired mobility/lower extremity weakness (9 articles). In the geriatrics department, the most prevalent risk factors identified were impaired mobility, history of falls, cognitive impairment, anti-psychotic use and visual impairment affecting 90%, 70%, 55%, 38%, 36% of geriatric inpatients respectively.

Conclusions

• At baseline level, some elderly individuals are more prone to fall during their hospitalisation as socio-demographic factors such as female gender, low socio-economic status and education status have been proven to increase the rate of in-hospital.
The most significant intrinsic factors during hospitalisation reviewed were impaired mobility, cognitive impairments, previous falls and elimination problems. These factors were shown to be prevalent in most elderly individuals during their hospitalisation.

The most common and clinically significant extrinsic risk factors identified were usage of assistive devices, higher patient to nurse ratios, medications such as sedatives and anti-psychotics and prolonged hospitalisation. The prevalence of the identified risk factors varied greatly between departments, therefore falls prevention assessment tools should be adjusted according to the department.

2. Acknowledgements
I would like to express my deepest appreciation to Dr Vita Lesauskaite for her guidance who enabled me through my final year project.

3. Conflict of interest
The author reports no conflict of interest.

4. Abbreviations
BDZ- benzodiazepine  
CI - confidence interval  
CNS- central nervous system  
OR - odds ratio  
PD - patient/days  
PNS - peripheral nervous system  
RR - risk ratio
5. Introduction

The increasing demographic ageing reported in many countries worldwide is a complex matter of global relevance, as it has many implications on the various sectors in society, with healthcare being one. The high prevalence of chronic non-communicable diseases and geriatric syndromes (including falls and their related injuries) among the older adults cause tremendous burden on the healthcare system.

A fall is defined as an move from a higher to a lower level, typically rapidly and without control with a loss of balance. Normal balance and gait is a result of complex interactions of multiple systems such as central nervous system(CNS), Peripheral nervous system (PNS), and vestibular system (1). With advancing age, various physiologic changes occur, such as: decrease in number of muscle cells (Type II more than Type I), decreased ability of the muscle cells to be stimulated by a neuron, increase in susceptibility to orthostatic hypotension and gradual decline in motor functions, including strength, coordination, and endurance (2). These changes can make an elderly person much more susceptible to falls especially in new environment such as a hospital (2). In the hospital setting, falls are not uncommon (affecting 2-17% of inpatients during their hospitalization) (3), and accounting for up to 70% of inpatient accidents (4).

There are many adverse outcomes of falls affecting both the patient and the healthcare system. In elderly patients, falls can lead to physical and emotion damage, prolonged length of stay, admission to long term care facilities as well as increased costs of care for the hospitals (5).

Falls rates during hospitalization vary widely among different studies from 3 to12 falls per 1000 patient days, depending on hospital type and patient population (6). Up to 50% of falls are accompanied by various injuries, and in up to 10% of cases the patients can sustain serious injuries such as bleeding, contusion, fractures, subdural haematoma and even death (7). In the elderly populations, there is number of factors which can facilitate or potentiate a fall. These factors are split into two major groups: extrinsic, environmental factors, and intrinsic: accumulated effects of ageing and co-morbidities (8). However, falls have a multi-factorial etiology and thus these factors tend to intertwine with one another so it is often difficult to report them separately.

The characteristics of falls in community and long-term care facilities have been well documented in various studies. However, there is less known about the risk factors of in-hospital inpatients falls.
And even less is known about the prevalence of falls risk factors among hospitalised older adults (60 and above). Therefore the aim of this study was to review the factors which are most significantly associated with falls in the hospital set-up, and to determine which of these factors are the most prevalent.

6. **Aim** — To review the literature data on prevalence of falls risk factors among geriatric inpatients.

**Objectives**

- To evaluate the effect of socio-demographic variables (such as age, gender, educational status etc) on the rate of falls in geriatric inpatients.
- To review the geriatric inpatient’s intrinsic falls risk factors.
- To review the geriatric inpatient’s extrinsic falls risk factors.
7. LITERATURE REVIEW: RESEARCH METHODOLOGY AND METHODS

In order to achieve the objectives outlined in this literature review, several scientific databases were used such as PubMed, PMC, MeSH, google scholar, sci-hub and NCBI. Only articles relevant to this topic from the year 1990 and onwards were chosen, and articles in other languages were used provided they had a translated version. A search was conducted using keywords such as “risk factors of falls” “falls in elderly” “causes of falls” “geriatric inpatients” “hospitalised elderly” “in-hospital falls”. Those phrases were then cross-searched with common mesh-terms such as “prevalence” and “incidence”.

Only the articles which filled the above criteria were selected for this literature review. In this literature review I identified the most common risk factors of in-hospital falls among elderly patients (60 years and above). With each risk factor identified, I analysed whether or not it is significantly associated with in-hospital falls, possible reason as to why this risk factor may lead to a fall in the hospital, and it’s prevalence among elderly inpatients.
8. RESULTS (LITERATURE REVIEW)

8.1. The influence of socio-demographic factors on the incidence and prevalence of falls

**Incidence of falls.** It is reported that in most developed countries (UK, US, most of European countries), Japan, and Australia etc) and developing countries the number and relative proportion of older adults (especially oldest-old) is rapidly rising. Although the proportion of elderly is greater in developed countries, 65% of elderly people live in developing countries, where they cannot get the adequate healthcare (14).

With the ageing population (especially oldest-old), can be expected that there will be a greater burden on the healthcare system due to falls and fall-related injuries as the frequency and severity of falls increases with age. Therefore it is of utmost importance to implement evidence-based falls prevention interventions as they can reduce the rate and risk of falls.

According to data of studies, the incidence rate of falls in inpatients can be three times greater than in community-dwelling persons (9). There is great differences in the incidence of falls among studies reviewed. The incidence of falls is greatly affected by the type of hospital in which a study was undertaken, whether or not they used proper falls intervention programmes. One study has shown a very high incidence of 12.6 fall per 1000 patient/days. Noteworthy, the only falls intervention programmes used in those hospitals were based on the observation and judgement of the clinicians (10). There were much lower incidence reported in other studies done in Japan (3.8 falls/1000 patient days(PD)) and Italy (6/1000 PD) (11). Those studies were completed in hospitals with proper falls prevention programmes which used validated protocols that identified people at risk and implemented risk reduction actions. Currently, evidence indicates that multifactorial interventions reduce the rates of falls of seniors both in hospital and community settings (falls intervention programmes are beyond the scope of this study).

**Age and gender.** Since the frequency of falls and fall-related injuries increases with age and frailty level, it is important to make the distinction between the different subcategories of old age: young-old (65-74 yrs), old-old (75-84 yrs) and oldest-old (>85 yrs). The majority of studies performed on the prevalence of falls showed that 21-30% of older persons sustained a fall, with higher rates of up
to 60% seen in people aged 85 and above (higher rates of falls seen in UK and Finland as those studies were done only in oldest-old category). The rate of fall recurrence is another factor which can be influenced by age, with studies also showing higher recurrence rates in the oldest-old categories. (75% recurrence in oldest-old category) (10).

It has been proven in several research studies that there is a greater prevalence of falls among females compared to males. This difference could be due to the physiological characteristics, bone and muscle changes as well as hormonal changes attributable to menopause. Some of the differences may be due to gender differences in levels of physical activity and consequent lower muscle strength, or in higher rates of osteoporosis, which makes women more susceptible to more serious fall-related fractures. Paradoxically, there are higher rates of fatal falls in men in all age groups, in spite of having lower rates of falls as a whole. This could be due to men having higher rates of fall-related head injuries as well as suffering from more co-morbid conditions than do women (11).

The influence of living arrangements, marital status and socioeconomic status on falls.

Studies have shown higher rates of falls among the low socio-economic class. Several factors such as –(a) limited access to health and social services, (b) low income, (c) little education, and (d) poor housing environments- are associated with a higher risk of developing chronic diseases, some of diseases are associated with a higher risk of falling (13).

Living alone is independent risk factors for falling, according to some studies it can increase the risk of falling by 20-30%(6). However, living alone and/or being unmarried increased the risk of developing fall related hip fractures, particularly in woman (12). This can be explained by the fact that living alone is linked with social isolation and greater level of frailty, both of which are factors related to falls.

Jae-Soon-Yoo et al has compared the incidence rate and recurrence rate of falls in elderly living in urban and rural areas revealed that both rates were significantly higher among those living in rural areas. This can be explained by lower home environment safety, higher usage of arthritis and painkiller medications, and the significantly higher walking discomfort experienced by frail elderly individuals living in rural areas compared with those living in urban areas.

Education status. There seems to be a correlation between education level and the risk of falls. The results of a cohort prospective study (performed in MidWestern Brazil) showed that low education level is a predicting factor of falls in elderly inpatients (Risk Ratio (RR) = 2.48; 95% Confidence interval (CI) 1.17;5.25) (10). One possible explanation is that older individuals with low lev-
els of education perceive less and worry less about healthcare, and have less ability to engage in health recovery, which results in increased risk of falls (13). Also, it is important to note that several factors such as – (a) limited access to health and social services, (b) low income, (c) little education, and (d) poor housing environments- are associated with a higher risk of developing chronic diseases, some of which diseases are associated with a higher risk of falling (13). Additionally, some studies indicate that spatial awareness of an older individual is affected by the level of education in a way that, when performing visual tasks, individuals with a low education level require more time, reach fewer targets and make more mistakes than individuals of higher education levels (14).

8.2. The most common geriatric inpatients’ intrinsic falls risk factors

Intrinsic factors include age-related physiological changes such as a decline in vision, hearing, musculoskeletal functioning, mobility, and physical activity, and health status-related factors such as the presence of a variety of chronic and acute illnesses, e.g. cognitive deficits and Parkinson’s disease, cataracts etc.

**Impaired mobility.** It is well established that with ageing there is gradual motor decline and decreased muscle strength, affecting work capacity, motor activity, and adaptability to the environment, which contributes to the occurrence of falls. Therefore, factors associated with impaired mobility (such as gait and balance impairment, and lower extremity weakness) can in turn lead to an increased risk of falls (15). There is also a correlation between mobility and cognitive impairment in elderly inpatients. One research article has found that fully-mobile and cognitively intact elderly individuals had low fall rates. Whilst cognitively impaired older individuals who were fully mobile had much higher fall rates comparatively (11).

Gait instability & imbalance were determined by impaired Romberg’s test or tandem gait. Is has been proven in a Brazil study that impaired gait and balance are predictive variables of falls in hospital inpatients (RR = 2.95; 95%CI 1.22-7.14, multivariate Cox regression analysis) (10). There is a strong non-linear association between standing balance and falls. The highest fall rates were reported in patients who could rise from their chair unaided but could not stand unaided. And lowest of those patients who could do neither task unaided (16).

Lower extremity weakness determined by examining resistance strength when extending knee. The most common causes of new onset lower extremity weakness were: new or previous stroke, hypokalemia, fever and chronic renal failure (12). When comparing fallers with non fallers, it was re-
ported that fallers had a higher prevalence of lower extremity weakness 24 hours prior to falling (6). Lower extremity weakness is one of the most significant risk factors of falls (17). One study has shown a very high prevalence of general weakness (81%) and lower extremity problems (38%) such as weakness, loss of sensation and swelling among elderly inpatients who’ve had a fall during their hospitalisation (7).

**Visual impairment.** Visual impairment in elderly can entail many alterations in the eyes resulting from the ageing process such as gradual loss of visual acuity, in addition to decreased peripheral vision, visual accommodation, and depth perception, decreased speed of processing visual information, and difficulties to scan an area. Since the visual system plays a role in balance and postural control, any dysfunction (whether age-related or pathological) can impair the maintenance of balance. One study has shown that decreased visual acuity (as measured by Jaeger card) is a predictor of falls in hospitalised elderly people (RR = 1.92; 95%CI 1.00;3.71) (10).

**Postural hypotension:** decline in systolic and/or diastolic blood pressure of >20 and/or >10 mm Hg, after 1 or 3 min of upright posture. When comparing fallers with non fallers, it was reported that fallers had higher prevalence of postural hypertension 24 h before the event of a fall (12).

**Urinary incontinence.** Urinary incontinence is one of the most prevalent conditions among elderly. It is considered as one of the “geriatric giants” as it affects half of the geriatric population living in long-term care institutions or hospitals (18). There is a clear association of urinary incontinence with falls as some studies demonstrated that it can increase the risk of falls in hospitalised elderly patients by up to 6-fold (6.8 RR, CI 3.3-13.64) (19). One possible explanation is that older people with urinary incontinence go to the bathroom much more often (13). As most falls tend to occur when a patient is unassisted and or getting out of bed, it could be that patients with urinary incontinence have higher fall rates as they’re much more likely to go to the bathroom unassisted (7). Urinary incontinence can also lead to leakage of urine, making the floors more slippery and predisposing a person to slip (20).

**Cognitive impairment.** Dementia is a chronic, progressive cortical and subcortical dysfunction that results in complex cognitive impairment, accompanied by disturbances of mood, behaviour and personality. Types of dementia are preceded by a recognisable phase of mild cognitive decline. The prevalence of dementia in people aged over 65 years is approximately 5%, rising up to 30% in those
aged over 80 years (11). According to one study, an even higher prevalence of cognitive impairment (55%) was seen in those patients who experienced at least one fall during their hospitalization (21).

In contrast to the chronic confusional state of dementia, delirium has been described as a transient decline in attention and cognition, marked by an acute onset and fluctuating disturbances of consciousness, thinking, orientation, sleep–wake cycle and mood. The occurrence of acute or chronic confusion in older patients during hospitalisation often leads to adverse outcomes, including falls, pressure sores, a prolongation of hospital stay, poor functional status, need for institutional care and even higher mortality (11). One study showed a significant relationship between patients who had fallen and those who had experienced confusion during the day before the fall (22).

In studies performed to assess differences in fall rates between cognitively impaired and cognitively intact older community dwelling individuals, it has been shown that fall rates are twice as high in cognitively impaired individuals (11). Also, it has been well documented that cognitive impairment can lead to decline in physical performance, and inversely, physical activity positively influences cognitive abilities. In advanced stages of the dementia, mobility process is hampered increasingly by stride length variability, extra-pyramidal symptoms and contractures. These factors can explain the high rates of falls in cognitively impaired older individuals (11).

However, there have been few studies which have been able to document the frequency and risk factors of falls in older cognitively impaired in-hospital inpatients (11). A retrospective study suggested that one of the independent risk factors for recurrent falls was a history of cognitive dysfunction, and cognitive impairment particularly affecting short-term memory, recall and visuospatial perception. These factors might contribute to recurrent falls in the inpatient population (17).

According to the findings in another study, the participants showing signs of confusion and/or disorientation had a threefold increased risk of falls compared with older cognitively intact patients (Odds ratio (OR) 3.3, CI 2.7–4.1)(11). Confused patients are susceptible to falls as they are usually disoriented in their environment and disorganised in their thoughts and actions, more so if they are hospitalised for long periods of time (22). Another common finding is that when the confused patients are admitted, their confusional state might deteriorate as a result of the side effects of some medications (22).

When comparing falls rates between different departments, fall rates for both groups, (cognitively impaired and intact) were highest in geriatric, psychiatric and neurology wards and lowest in the
urology, ICU and gynecology wards. Also, there was a similar pattern of 2-3 fold increase of fall risk in cognitively impaired among all departments, except for psychiatry department (11). There were similar rates of falls in psychiatry department regardless of cognitive status. However, on multivariate analysis, most of the effects of various departments on the risk of falls disappeared. Large probability numbers are caused rather by patient characteristics such as limited mobility, care dependency and cognitive impairment. In cognitively impaired individuals, fall rates were only significantly associated with impaired mobility (11).

**Previous history of falls.** A previous history of a fall is one of the most significant risk factors of falls in hospitalised elderly (23). Patients with a history of falls (especially injurious falls which resulted in fractures) in the previous year had a higher chance of having another fall (24). This higher rate of fall among previous fallers could be due to a number of factors: fear of falling is an independent risk factor for falls, the same factors which originally caused a fall may recur if not controlled properly. Therefore during falls intervention programmes special attention should be paid to previous fallers.

### 8.3. The most common geriatric inpatients’ extrinsic falls risk factors

Hospitalised geriatric patients are all at a high fall risk from the moment of admission (16). One study which compared the rate of falls between different departments has shown that fall rates (regardless of cognitive status) were highest on geriatric, psychiatric and neurology wards (11).

The results of the above mentioned study (11) was seconded by another study which also compared fall rates among different departments (21). According to this study, a higher proportion of patients fell in the geriatric department (24.8%) than in internal medicine (8.8%) or surgery (1.9%) (p <0.001). The highest proportion of multiple fallers also occurred in the geriatric department (41% of fallers had multiple fallers as compared to 17.7% in surgery department) (21).

When it comes to the consequences of falls, it was found that there was a twofold increase in the proportion of patients who suffered major injuries in the geriatric department compared to the department of internal medicine (21). Another study has shown that higher fall rates seen in the geriatric department could be attributed in part to the higher prevalence of psychotropics use in geriatric patients (37.6% of geriatric patients were using psychotropic agents during their hospitalization compared to 18.4% in surgery patients) (21).
**Patient to nurse ratio.** The more patients a nurse was caring for, the more likely it was that a patient would fall. Some studies have shown higher fall rates in departments with higher patient to nurse staffing ratio. It appears that when patients were unassisted and performed activities such as getting out of bed, walking and attending the toilet, they were at a risk of falling (7). It could be that in such departments with high patient to nurse ratio, the elderly patients were much more likely to leave their beds and ambulate without any assistance, therefore putting themselves at a higher risk of falling (25). The results of the above mentioned studies are confirmed by another study which identified that the “Need assistance/supervision for toileting” is an independent risk factors of falls (26). The rate of falling was also found to be higher in the time as there was less staff working during the night shift compared to day (27). The higher rates of falls during night as reported in many study were due to various reasons: the patients (especially those with urinary incontinence) were attempting to ambulate independently due to bowel or bladder urgency, nocturnal confusion could also be related to a higher incidence of falls at night (22). Conversely, lower fall rates were reported among surgical patients. As in the surgical department, there is a great emphasis on bed rest, and mobilisation only under supervision (21).

On the other hand, having more licensed nurses, higher proportions of registered nurse care, and increased registered nurse hours worked per patient day have been significantly associated with lower fall rates (25). In an individual level, the risk of falls when more than 7 patients were assigned to one nurse was much higher than when less than 3 patients were assigned to one nurse (>7 patients per nurse: an OR, 7.1; 95% CI, 1.5 to 34.2 and 3 > patients per nurse: an OR, 1.6; 95% CI, 1.2 to 2.0) (28). Therefore, increased scheduled assistance from hospital staff could help reduce the number of patients getting out of bed unassisted.

**Usage of assistive devices.** The usage of assistive devices is correlated with an increased risk of falling during hospitalisation (29). There are many reasons which can explain this. One study has shown that less than half of elderly individuals who used assistive devices at home prior to hospitalisation actually used assistive devices in the hospital (30). Additionally, people who currently used assistive devices may have fallen before or been considered frail. Furthermore, people with walking aids are more likely to mobilise independently, which may put themselves at higher risk of falls. Certainly, the possibility of inappropriate use of assistive devices should be considered as well (7).

There seems to be a correlation between wheelchair use and a higher risk of falling. One study which was done in an inpatient rehabilitation centre has shown a very high rate (50% of all falls in
that study) of falling from a wheelchair. It could be that those high rates were due to improper transfer from wheelchair as well as poor conditions of the chairs used in that study (31).

The use of big number or some specific classes of medications is also associated with increased fall risk. In this review, medications are considered extrinsic factors as in most of the studies, the medications were initiated in the departments.

**Polypharmacy (3 or more medications):** The use of multiple medications in older individuals (aged 60 and above) can lead to more falls as it increases the incidence of side effects, drug interactions and drug-disease interactions (32). Using multiple medications also increases the likelihood of introducing a medication which increases the risk of falls. The probability of using a medication which introduces risk, increases from 25% when once medication was used to 60% when 6 or more medications were used (33).

However, even in the absence of polypharmacy, some medications can single-handedly lead to more falls. It was found that the use of antidepressants and sedatives for longer than 4 days was significantly associated with falls. However, only newly prescribed (< 24 hours) sedatives were significantly associated with falls (6).

**Antipsychotics:** Some of the side effects of the usage of antipsychotics are higher incidences of drowsiness, abnormal gait, postural instability, dizziness and loss of consciousness which can explain the higher risk of falls associated with antipsychotic use (12). When comparing the effects of the different classes of antipsychotics, both traditional and atypical antipsychotics were significantly associated with an increased risk of falls (34). This is despite the reported lower incidence of extrapyramidal symptoms associated with atypical antipsychotics (34).

Noteworthy, using psychotropic medication increased the risk of falling in men (OR 3.59, 95% CI 2.00 to 6.47) more than it did in women (OR 1.66 CI 0.97-2.82) (9). Conversely, the use of hypnotic medication (sedatives) increased the risk of falling in women (OR 1.65, 95% CI 1.07 to 2.56) more so than men (OR 1.06 CI 0.61-1.84) (9). Another study has shown that concurrent usage of antipsychotic medications (more than 3 days in a row), as well as higher doses of antipsychotic medications (given anytime) had the highest relation to falls (16). When comparing different departments, the highest prevalence of psychotropics use was in the geriatric department (37.6% of geriatric patients used psychotropic agents during their hospitalization compared to 18.4% in surgery patients) (21). This is important as the highest fall rates among all the departments were reported in
the geriatric departments. Therefore the higher prevalence of psychotropics use in the geriatric department is a contributing factor to the higher fall rates reported in that department (21).

**Hypnotic agents (sedatives).** The effect of sedatives on the rate of in-hospital falls among elderly patients has been well documented. This reported association is due to the common side effects of sedatives such as disorientation, weakness, and unsteady gait (17).

It has also been well established that the use of Benzodiazepines (BDZ) in elderly individuals increases the risk of fall (35). Most studies related to this topic were focused on community dwelling or nursing home residents. However, there seems to be contradicting reports regarding which class of BDZ has the biggest impact on the risk of falls. Some studies show that long acting BDZs were more likely to potentiate a fall (36). Whereas others have shown an increased risk with the use of short acting BDZs in community dwelling (35). One study which focused on hospitalised older individuals, has also shown a stronger association with the initial use of short acting BDZ’s and Zopiclone (37). It is also well known that BDZs can impair reaction time, psychomotor function, sedations and muscle relaxation when taken in higher doses. Therefore, the dose of the prescribed BDZs also plays a significant role in this context (38).

Zopiclone is regarded as a short-acting non-benzodiazepine hypnotic. Although it is chemically unrelated to BDZ and acts on a site closely related but different to BDZ, it can still be regarded as a short acting non-BDZ, that is used most often to treat sleeping disorders (39). Interestingly, one study which compared Zolpidem and Zopiclone, has found Zolpidem to be a higher risk drug (40). It is also important to note that Zolpidem use has been shown to double the risk of fall-related hip fractures (41). And that Zopiclone should be preferred over Zolpidem when there is a need for the use of a hypnotic medication in the elderly (41).

Furthermore, the use of sedatives increased the risk of older individuals sustaining a fall in the evening or night (7). Another study has shown that the use of hypnotic medication increased the risk of falling in women (OR 1.65, 95% CI 1.07 to 2.56) more so than men (OR 1.06 CI 0.61-1.84) (9).

**Antihypertensives.** Antihypertensive agents produce orthostatic hypotension, resulting in an increased risk of falls more than 8-fold when initially prescribed in hospitalised elderly people (OR 8.42 CI 3.12-22.72) (37). It is important to consider the side effects (e.g., unsteady gait, orthostatic blood pressure reaction, etc.) and work to minimise the fall risk when prescribing this class of drugs. The influence of the interaction of the diagnosis and the medication on fall risk is of interest.
as some studies have shown that initial prescription of a drug can immediately alter the fall risk (6). One study has shown that among those who fell during their hospitalisation, 56% were given vasoactive medications in the 24 hours prior to their fall (7).

Among the hypertensive medications used, it appears that candesartan is the most significantly associated with falls in elderly inpatients. Candesartan is a highly selective angiotensin receptor antagonist used for the treatment of hypertension and heart failure. It is a high-risk medication which can trigger the onset of a fall (OR 13.92, CI 1.71-113.69) (37).

Other studies have identified the calcium channel antagonists as high risk medications in the elderly inpatients, as they can increase the fall risk by more than two fold (2.35 OR, 1.16-4.47 CI) (42).

**Antiparkinsonian.** The start of use of antiparkinsonian drugs in a hospital setting can trigger the falls onset (OR 4.18, CI 1.75-10.02)(37). From this class of drugs, biperiden has the most significant association with the rate of falls in elderly inpatients (37). Biperiden is an anticholinergic agent used for the treatment of all forms of Parkinson's disease (such as arteriosclerotic, post-encephalitic and idiopathic) as well as extrapyramidal symptoms from the use of neuroleptic agents (phenothiazines). The use of anticholinergic agents can lead to side effects such as sedation and mental con-
fusion, both of which are proven risk factors of falls. In older hospitalised patients, such side effects can predispose falls, delirium and cognitive impairment.

**Table 1: Prevalence of falls risk factors**

8.4 RESULTS SUMMARY TABLES
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<th>No.</th>
<th>Name of author</th>
<th>Type of study</th>
<th>Most prevalent risk factors</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
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<td>Schweindimann (21)</td>
<td>Prospective cohort study</td>
<td>Impaired mobility, history of falls, use of psychotropics</td>
<td>Fall rates varied among clinical departments due to patient characteristics</td>
</tr>
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<td>2</td>
<td>Takehito Hayakawa (9)</td>
<td>Prospective cohort study</td>
<td>Age, history of falls and need for help with ADL were common risk factors in both men and women</td>
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<td>case-controlled study</td>
<td>Lower limb weakness and poor tandem walk ability</td>
<td>Lower limb weakness and poor tandem walk ability were most predictive risk factors. Falls prevention programs in hospitals should employ these two tests as screening instruments</td>
</tr>
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<td>Anna Czernusenko (44)</td>
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<td>Low brachial index score, age &gt;65, visa-spatial neglect.</td>
<td>Patients with severe stroke-related disability in the early period after stroke are prone to falls during rehabilitation. Multiple falls are most frequent in patients over 65 years of age</td>
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<td>Mami Ishikuro (26)</td>
<td>Prospective observational study</td>
<td>History of falls, inserted tubes, excretion &gt;2 times/night, need for supervision</td>
<td>The identified risk factors will be useful in identifying patients at a higher risk of falls.</td>
</tr>
<tr>
<td>No.</td>
<td>Name of author</td>
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<td>Most prevalent risk factors</td>
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<td>6</td>
<td>Stacey M. Lavsa(34)</td>
<td>Retrospective case control study</td>
<td>Medications (non-bdz, A-Blockers, BDZ, TCA), dementia and Alzheimer’s disease</td>
<td>The identified risk factors are significant predictors of inpatient falls in psycho-geriatric populations.</td>
</tr>
<tr>
<td>8</td>
<td>Hideki Shuto(37)</td>
<td>Case cross-over study</td>
<td>Initial use of medications such as Biperiden, Etiozolam, Candesartan, Zopiclone.</td>
<td>Clinicians should be aware that starting a new medication such as Candesartan and Biperiden can trigger the onset of a fall.</td>
</tr>
<tr>
<td>9</td>
<td>Akihito Nakai ()</td>
<td>Prospective co-hort study</td>
<td>Advanced age, prolonged hospitalisation, admission to surgical,orthopaedic and urology department without planned surgery.</td>
<td>The identified risk factors should be targeted by falls prevention programmes.</td>
</tr>
<tr>
<td>10</td>
<td>Catharine O’hagan(22)</td>
<td>Retrospective audit</td>
<td>High AP levels, night shift, advanced age and confusion.</td>
<td>Further research is required that validates patient falls risk factors in acute-care settings as this information is necessary to form effective falls risk assessment tools.</td>
</tr>
<tr>
<td>11</td>
<td>Kevin M. Terrel(43)</td>
<td>Retrospective case-control study.</td>
<td>Alcohol intoxication, sedatives.</td>
<td>It is necessary to develop an emergency department–specific fall model considering additional factors, such as intoxication and receipt of potentially sedating medications.</td>
</tr>
<tr>
<td>12</td>
<td>Yun-Fang Tsai(17)</td>
<td>Prospective observational study.</td>
<td>Confusion, history of falling, impaired mobility, elimination problems, temperature elevation.</td>
<td>The identified risk factors are useful in identifying people at risk of falling in the psychiatry ward.</td>
</tr>
<tr>
<td>13</td>
<td>Carol van Doorn(29)</td>
<td>Prospective co-hort study</td>
<td>Resident belief that he or she could improve ADLs, stroke history, presence of facility Alzheimer care unit, and number of full-time nursing aide positions per 100 beds</td>
<td>Dementia is an independent risk factor for falling. Nursing home residents with dementia should be considered important candidates for fall-prevention and fall-injury-prevention strategies.</td>
</tr>
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<tr>
<td>14</td>
<td>Duncan B. Acker-man (3)</td>
<td>Retrospective study</td>
<td>Prolonged admission, advanced age, female sex, primary knee arthroplasty.</td>
<td>The identified risk factors should be used to implement fall prevention programme specific to the orthopaedic department.</td>
</tr>
<tr>
<td>15</td>
<td>Efraim Aizen (48)</td>
<td>Prospective cohort study</td>
<td>Vertigo, anti-hypertensives, risk taking behaviour, assistive devices.</td>
<td>Risk factors for falls differ between different groups of rehabilitation patients, and that the selection of type of patients may affect which combination of risk factors is identified.</td>
</tr>
<tr>
<td>16</td>
<td>Ellen Blair(16)</td>
<td>Descriptive study.</td>
<td>Psychoactive drugs, advanced age, ambulation or transferring.</td>
<td>The findings of this study show that patients should be reassessed for fall risk frequently during hospitalisation.</td>
</tr>
<tr>
<td>17</td>
<td>Yu-Chih Chen(6)</td>
<td>Case-control study</td>
<td>Lower extremity weakness, insomnia at admission, history of falls, sedatives, postural hypotension</td>
<td>Further study is needed to organize a comprehensive fall prevention program according to the risk factors identified in this study to reduce in-hospital falls</td>
</tr>
<tr>
<td>18</td>
<td>Jurgen Harlein (11)</td>
<td>Secondary analysis</td>
<td>Cognitive impairment, advanced age, geriatric ward admission, care-dependency,</td>
<td>Cognitively impaired older people constitute a high-risk group for accidental falls in hospitals.</td>
</tr>
<tr>
<td>19</td>
<td>Melissa J. Krauss(28)</td>
<td>Case-control study</td>
<td>Sedatives, diabetes meds, confusion, gait problems, higher patient-nurse ratio, urinary incontinence</td>
<td>Fall prevention programs should target patients with these risk factors and consider using frequently scheduled mobilisation and toileting, and minimising use of medications related to falling.</td>
</tr>
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<td>20</td>
<td>Mounir Rhalimi(40)</td>
<td>retrospective case control</td>
<td>Medications: Calcium channel antagonists, meprobamate, Zolpidem.</td>
<td>Some drugs are associated with an increased risk of falls in the elderly and, when alternatives exist, should be avoided until cohort studies are conducted to confirm or refute these possible increased risks.</td>
</tr>
<tr>
<td>21</td>
<td>Justin Scanlan(8)</td>
<td>Retrospective analysis</td>
<td>Impaired mobility, ambulations/transferring.</td>
<td>Although falls may have been under-reported, this study establishes an analysis framework and baseline data for the monitoring of falls in inpatient psychiatric units.</td>
</tr>
<tr>
<td>22</td>
<td>Buichi Tanaka(26)</td>
<td>Prospective cohort study</td>
<td>History of falls, advanced age, need for assistance.</td>
<td>Taking into account the risk factors identified, we need to devise effective strategies to prevent falls and related injuries.</td>
</tr>
<tr>
<td>23</td>
<td>Magnus Stenhagen(47)</td>
<td>Prospective study</td>
<td>Neuroleptics, impaired mobility, heart failure, nocturia.</td>
<td>There is need for further research on the relation between heart failure and falls in the elderly. The findings of this study may be valuable in the development of intervention programmes aimed at sustainable, long-term reduction of falls in the elderly.</td>
</tr>
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<tr>
<td>24</td>
<td>Ranaweera(46)</td>
<td>Prospective study</td>
<td>History of falls, high disability level,</td>
<td>The high incidence of falls among the elderly reported in this study and the preventable risk factors identify / indicate the necessity and feasibility of their prevention.</td>
</tr>
</tbody>
</table>
9. Discussion

There is a huge disparity in the incidence of falls between the varies studies reviewed, with some studies showing rates between 0.3-1.25 falls per 1000 patient/days (43), whereas other studies report much higher rates of 7-13 falls per 1000 patient/days (44). However, despite these differences, most studies are in concordance regarding the rate of hospital falls being much higher than rates reported in community dwelling older individuals. Hayakawa et al have even reported that the rate of falls during hospitalisation in elderly people are 3 times that of community dwelling older individuals (9).

There are many reasons which may explain this phenomenon. Firstly, older adults are exposed to many age-related physiologic changes which make them less capable of adapting to a new environment. Especially the hospital environment, where the rooms can be difficult to navigate due to the presence of intravenous lines and poles, catheters, and heart rate and oxygen monitors (2).

Secondly, most elderly individuals present to the hospital with all sorts of acute medical conditions such as cognitive impairment (delirium, confusion) (17), impaired mobility (lower extremity weakness, general weakness, impaired gait) (8) . All these factors have been proven to increase the risk of falls during hospitalisation in the various articles reviewed.

Thirdly, upon admission to hospital, they are likely to be given new medications or have their current medication regimen altered. Some of these prescribed medications (anti-psychotics, sedatives, anti-hypertensives etc) have been shown to increase the risk of falls in as little as 24 hours after initial use (35).

Fourthly, there are additional hospital-related factors which can increase the risk of falls such as admission to the geriatric or psychiatry wards, prolonged hospitalisation, higher patient-nurse ratio and lack of supervision especially during the night time where there is less available staff (29). These aforementioned factors vary between different departments, this variation leads to differing fall rates between departments. With the highest rates seen in the geriatric and psychiatry wards and the lowest rates seen in the surgery department (21). Rene Schwendimann et al has found that the highest prevalence of fallers and multiple fallers was in the geriatric department (24% of inpatients had a fall during their hospitalisation). When comparing the patient characteristics between those departments, it was also found that the inpatients in the geriatric department were significantly older than in any other department, hospitalised for longer periods than any other department,
were more likely to use psychoactive medications, and had a higher prevalence of common falls risk factors than in any other department (21). Ellen Blair et al has found that in the psychiatry department, other factors were more prominent such as: psychotropic medications use, depression, confusion, and/or agitation and encouragement to be mobile and active. All the aforementioned factors placed the patient at a higher risk of falls, especially being diagnosed with depression, as chances of falling were more than 30 times greater for patients who were depressed than for patients who were not depressed (11).

Conversely, according to Schwendimann et al, the lowest fall rates were seen among surgical patients. This is due to the surgery department staff placing more emphasis on bed-rest, mobilisation only under supervision, surgical patients may have an increased postoperative surveil lance by nurses during their relatively short length of hospital stay (45).

It is also important to note that socio-demographic factors such as gender, socioeconomic status and education level play a role. Female gender, low socio-economic status and low education levels have been shown in various studies to make a person more predisposed to a fall during their hospital stay.

The prevalence of falls risk factors varied between departments as it has been explain previously. However, the most prevalent risk factors (regardless of department) according to multiple studies were impaired mobility (affecting 90% of hospitalised elderly patients), prior history of a fall in the previous year (up to 70%), polypharmacy and cognitive impairment (up to 50%) (21).
10. Conclusions

• At baseline level, some elderly individuals are more prone to fall during their hospitalisation as socio-demographic factors such as female gender, low socio-economic status and education status have been proven to increase the rate of in-hospital.

• The most significant intrinsic factors during hospitalisation reviewed were impaired mobility, cognitive impairments, previous falls and elimination problems. These factors were shown to be prevalent in most elderly individuals during their hospitalisation.

• The most common and clinically significant extrinsic risk factors identified were usage of assistive devices, higher patient to nurse ratios, medications such as sedatives and anti-psychotics and prolonged hospitalisation. The prevalence of the identified risk factors varied greatly between departments, therefore falls prevention assessment tools should be adjusted according to the department.
11. Bibliography


17. Yun-Fang Tsai NW, Marie Radunzel, and Mary L. Keller. falls in a Psychiatric Unit. 1998.
23. setting LAEotppiaac. Evaluation of the fall prevention program in an acute care setting.
31. 


44. Czernuszenko AC, Anna Czlonkowska, A.C. Risk factors for falls in stroke patients during inpatient rehabilitation. 2009.


