Chronic medical condition associated with increased risk of fall in old people: a review

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ABSTRACT

Background: Falls are defined as unintentional events that happened when a person losing his/her center of gravity leading him/her to fall and without effort to restore balance, or this effort is ineffective [1]. The World Health Organization (WHO) estimates that there are nearly 424,000 fatal fall incidents each year [2]. About 3 million older people per year are treated in emergency departments because of fall injuries, and more than 800,000 patients per year are

Introduction

Falls are defined as unintentional events that happened when a person losing his/her center of gravity leading him/her to fall and without effort to restore balance, or this effort is ineffective [1]. The World Health Organization (WHO) estimates that there are nearly 424,000 fatal fall incidents each year [2]. About 3 million older people per year are treated in emergency departments because of fall injuries, and more than 800,000 patients per year are

Keywords: Elderly, chronic disease, CPST, fall, neurological manifestations risk, visual impairment.
hospitalized because a fall injury, head injury, and hip fracture are the most common causes [3]. Although most of the fall cause no injury, 31% of falls causing injury needs for medical help or activity restriction at least for 1 day which make it a challenging, dangerous, and serious public health problem [4]. In a study conducted in Riyadh city in 2016, 1,182 individuals were included in the study, 49.9% (590) of elderly Saudis had experienced one or more falls during a 12-month period, and 74% of the individuals who experienced falls had post-fall injuries. The most common type of fracture was leg fracture (39%), and the most common place where the fall occurred is homes (77%) [5].

In general, people aged 65 and older have a higher risk of fall from younger population, they fall yearly in an average of 0.65 times, and this rate is even doubled in people older than 75-year-old [6]. Among women and men who fell in the duration of 3 months, there was no difference between them in the incidence of fall (16.4% vs. 15.2%, respectively) although women had more injury because of fall (35.7% vs. 24.6%, respectively) [4]. Older adults fall cost every year for non-fatal injuries and fatal injuries more than $50 billion and $700 million, respectively [7]. There are multiple intrinsic and extrinsic factors, which increase the risk of fall, such as age, co-morbidity conditions, visual impairment, history of previous fall, drugs, and many more [8].

This current review article will represent the most common chronic medical condition associated with a higher risk of fall in elderly people.

**Review**

A review was conducted up to May 2020 using the databases PubMed and Google Scholar. The research terms included elderly, fall, risk, cost, chronic disease, visual impairment, and neurological manifestations. The exclusion criteria include papers published before 2000, papers linking risk of fall in acute medical condition, and papers linking risk of fall in people younger than 65. All duplicates were erased and screened by the title, abstract, and full text.

In recent decades, several epidemiological studies and reviews have investigated the risk factors for falls. However, no literature review specifically summarizes all evidence about chronic diseases and the association with fall risk. The aim is to provide an updated comprehensive review of studies conducted on chronic medical condition that increases the risk of fall in older people. Table 1 shows the chronic medical condition reviewed here.

**Chronic obstructive pulmonary disease (COPD)**

Chronic obstructive pulmonary disease (COPD) is disease of the lung characterized by persistent obstruction of lung airflow that interferes with normal breathing which is not always fully reversible [9]. There are two terms usually named under COPD: first, chronic bronchitis where there is mucus overproduction with hyperplasia of the goblet cell which increases the risk of bacterial colonization and acute exacerbations [10].

Results from a study reveal that COPD is one of the chronic diseases with the highest prevalence of falls among the elderly [11]. Patients on supplementary oxygen appear to be at higher risk of fall compared to those who do not use oxygen [12]. Two prospective studies conducted revealed the incidence rate of falls in COPD patients (1.17-1.20 falls/person-year), which is significantly higher than the rate in healthy older adults (0.24 falls/person-year), the higher risk of fall has multiple explanation, which could be due to prolonged bed rest, and quadricep peak torque was reduced in COPD patients or due to deterioration in gas exchange and hypoxemia, especially in exacerbation episodes [13].

**Anemia**

Anemia is a universal public health issue affecting human health in developing and developed countries that had a diverse impact on the economic development [14]. Anemia is defined as low oxygen-carrying red blood cells measured in unit volume concentrations of hemoglobin (Hb) or hematocrit [15]. According to the WHO, diagnosis of anemia was performed when Hb <13 g/dl for men and Hb < 12 g/dl for women [16]. The prevalence of anemia among elder people (above 65 years) is approximately 11% as reported in the Third National Health and Nutrition Examination Survey [17]. The prevalence rate of anemia among people above 50 years was highly increased with 20% more than in those older than 85 years [18]. It was reported that the prevalence of anemia was 26.7% for patients above 85 years [17]. Most of the anemia in old age is assumed to be due to nutritional deficiencies through a deficiency in the iron percentage, folate or B12, or both. Another reason for anemia related to chronic disease, such as chronic kidney disease (CKD), cancer, rheumatoid arthritis (RA), or due to chemotherapy [18].

Dharmarajan et al. [19] reported 49% of patients with Hb levels between 12.0 and 12.9 g/dl sustained a fall and the

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<th>Table 1. List of chronic medical condition discussed in review.</th>
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<tr>
<td>Anemia</td>
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<td>Diabetes mellitus</td>
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<td>Chronic kidney diseases</td>
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<td>Depression</td>
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<td>Glaucoma</td>
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2003
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percentage of patients experiencing a fall increased as the Hb levels decrease below this range \( p < 0.001 \). 82% of all falls occurred in patients with anemia or borderline anemic patients \(< 1.0 \, \text{g/dl} > \text{the WHO limits}\). Brenda et al. \[11\] found that anemia was associated with twice the incidence of recurrent falls, and this association continues to be significant after adjustment for age, sex, BMI, and various co-morbid conditions \( \text{adjusted relative fall risk 51.92} \).

**Arterial hypertension**

Arterial hypertension is the most prevalent cardiac risk factor in the elderly \[20\]. Most guidelines recommended that arterial hypertension diagnosed when a patient’s systolic blood pressure (SBP) in the clinic is \( \geq 140 \, \text{mmHg} \) and/or diastolic blood pressure (DBP) is \( \geq 90 \, \text{mmHg} \) [21]. A previous cross-sectional study evaluated that the risk of falls among the elderly reported the risk of falls is approximately seven times higher in hypertensive patients than in those who are not affected by this morbidity with \( p \)-value < 0.001 [22]. Furthermore, earlier meta-analyses investigated the association between antihypertensive agents and fall found the use of angiotensin-converting enzyme inhibitors, β-blockers, or calcium channel blockers are associated with a decreased risk of injurious falls among older adults but were not associated with falls and recurrent falls compared with non-users. In comparison, there are no associations between the use of α-blockers, angiotensin receptor blockers, diuretics, injurious and fall’s risk, and recurrent falls in older people [23].

**Orthostatic hypotension (OH)**

Orthostatic hypotension (OH) could be defined as a decrease in the SBP (by at least 20 mmHg) or a fall in DBP by at least 10 mmHg within 3 minutes in the standing position [24]. Its prevalence ranges from 14.8% in patients aged 65-69 years to 26% in those older than 85 years, clearly demonstrating the association between OH and aging [25]. Interestingly, in a study in community-dwelling people, OH was most noticeable in patients with uncontrolled hypertension. In these patients, the risk of falls was 2.5 times higher than in patients with uncontrolled hypertension without OH [26].

**Diabetes mellitus**

It is considered as one of the most metabolic and chronic diseases that associated with high levels of blood glucose, which can cause long-term serious damage to multiple organs such as the heart, blood vessels, eyes, kidneys, and nerves [27]. By increasing the age, the prevalence of diabetes increased. Furthermore, the prediction for the coming decades estimates an increase in diabetes prevalence exceptionally in people older than 65 years [28]. Emerging evidence predicts that complications of diabetes may increase the normal rate of aging in various body systems [29].

A previous study reported that individuals with diabetes had a 67% higher risk of recurrent falls than those without diabetes among older adults [28]. Evelien et al. [28] found that a combination of age >65 years and diabetes increases the risk of falling by 17-fold. On the contrary, other studies reported no association between insulin therapy and antihyperglycemic medication per se which increases the risk of falls in diabetic patients [28].

**Chronic kidney disease**

Chronic kidney disease (CKD) is defined as a kidney damage and affects the function of filtering the wastes from your blood. It is chronic if it continues for 3 months or longer [30]. The risk of fall in CKD patient whom 65-year-old or older is higher compared to people without CKD. It may explain due to many physiological changes that accompanied with CKD, such as uremic neuropathy, weakness, and muscle wasting, as well as changes in bone and mineral metabolism, which lead to brittle, weak bones that may increase the tendency for fall-related injuries in CKD patient, especially those with End stage kidney disease (ESKD) [31].

**Rheumatoid arthritis (RA)**

RA is defined as persistent synovitis, systemic inflammation, and autoantibodies (particularly to rheumatoid factor and citrullinated peptide) [32]. RA presentation is the insidious and progressive onset of pain and swelling involving small joints of hands and feet in a symmetrical fashion [32]. The prevalence of RA is estimated at 0.5%-1.0% globally. Genetic factors are the most common risk of developing RA, and they account for 60% of the risk. Other important risk factors such as female sex, which increases the risk by two-fold, elderly people, and smoking are the main environmental risk [33]. RA is an autoimmune disease, in which the immune system attacks the synovium (lining of the joint). This leads to synovial cell hyperplasia, infiltration by inflammatory cells, and new blood vessel formation. This inflammation led to the destruction of the cartilage, bone erosion, joint misalignment, periarticular osteoporosis, and deformity with subsequent weakness of surrounding tissues and muscles. RA patients experience pain and loss of function, which can affect any synovial joint in the body leading to severe disability [32].

Individuals with RA have been linked with an increased risk for falls. Non-fatal unintentional falls provoked by multiple factors that include the environment and mental status, in addition to the risk factors RA patients, have disease-specific risk factors including increased perception of pain, tender and swollen joints, and medication side effects. All of them can be in disbalance in patients with RA, and the fall frequency in RA patients appears to be age independent [34].
**Parkinson’s disease**

Is a neurological disorder, characterized by the classical motor features of parkinsonism related to Lewy bodies and loss of dopaminergic neurons in the substantia nigra [35]. Parkinson’s disease is a neurodegenerative disease that causes the destruction of dopaminergic neurons in the substantia nigra, causing dopamine deficiency in the basal ganglia, leading to a movement disability that is characterized by classical parkinsonian motor symptoms [36]. Parkinson’s disease is estimated to afflict 0.3% of the general population worldwide, occurring in about 1% in individuals aged 60 years or older and increasing to about 4%-5% of those aged 85 years or older [37]. Gait difficulties and balance problems are disabling in many patients with Parkinson’s disease (PD), with different contributing factors, such as shuffling steps, festinating, postural reflexes’ loss, and freezing of gait (FOG). High prevalence of fall incidents in PD was considered as one of its importance, especially in the latter stages of the disease. FOG is defined as a brief and sudden episode of inability to stepping forward. This phenomenon is associated with falls, and the fall episodes occurred during a dual-tasking or half-turn. The disease progression, falling episodes, and FOG increase as well as the decrease in the dopaminergic therapy’ efficacy increase the symptom’s burden [38].

**Alzheimer’s disease**

Is a degenerative brain disorder and, therefore, the most common explanation for dementia. Dementia is characterized by a decrease in memory, language, solving of problem, and other cognitive skills, which affects the ability to perform everyday activities. This decrease occurs due to the damage of nerve cells in parts of the brain involved in cognitive function [39]. The WHO report estimated that dementia contributed 11.2% of years spent living with a disability in people over 60 years old, more than stroke, cardiovascular disease, and cancer [40].

In 2005, Alzheimer’s Disease International conducted a study on dementia prevalence worldwide, and the study estimated that there were 24.3 million people with dementia in the world in 2001 and predicted that this would rise to 42.3 million in 2020 and 81.1 million by 2040. The countries or regions with the largest number of affected individuals are China and the developing Western Pacific, Western Europe, and the US [40]. People with dementia have a significantly higher risk of falling than those without. The risk is twice as high as community-dwelling people with dementia than in those without dementia. Approximately 60% of older persons’ exercise reduces the number of falls in older adults with dementia. The Finnish Alzheimer Disease Exercise trial showed that a long-term intensive exercise intervention decreased the number of falls in community-dwelling people with AD [40].

**Depression**

Depression is defined as when someone has a sad mood and feeling down for long time which affects the normal daily activity. Depression symptoms include feeling anxious and sad, loss of interest, agitation, changes in sleep and appetite, feeling guilty and tired, physical pain, and suicide ideas. In general, it affects any one at any age [41]. It affects every year around 16 million Americana adults [41]. The prevalence increases in women (10.4%) nearly double the men (5.5%). The prevalence is also high in the elderly about 30% [42]. Depression is an indicator of worsening health states in general [43]. Depression is considered as one of the common risks of falling in the elderly due to it is influence and the enhancing effect on the other chronic diseases. The risk of falling in depressive elderly with cardiovascular or diabetes has a four-fold risk and those with arthritis have nine-fold risk compared to non-depressive elderly with the same conditions [44].

**Glaucoma**

Glaucoma is an eye disease that damages the optic nerve due to increasing pressure of the eye that might result in the loss of vision and blindness. It is the second worldwide cause of blindness. Open-angle glaucoma is the most type, and it is a symptomatic in 50% of people in early disease. The prevalence of open-angle glaucoma increases the double in diabetic people compared to non-diabetic and increases 6-8 times in African Americans compared to white people [45]. The Los Angeles Latino Eye study showed the prevalence of 4.7% in Latinos in the United States [46], whereas, in Asia, the prevalence varies widely may due to broad racial and ethnic categories. Rudnicka et al. [47] documented a range from 1% to 4% in Asia, whereas Ramakrishnan et al. [48] found to be 1.7% in India.

**Conclusions**

In conclusion, the studies found that patients with COPD, anemia, hypertension, orthostatic hypertension, diabetes mellitus, CKDs, RA, Parkinson’s diseases, Alzheimer’s disease, depression, and glaucoma, are at increased risk of a fall by direct and indirect ways. Assessment and fall prevention guidelines should be considered in patients with this chronic medical condition.

**List of Abbreviations**

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<tr>
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<th>Description</th>
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<tr>
<td>AD</td>
<td>Alzheimer’s disease</td>
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<td>BMI</td>
<td>Body mass index</td>
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<td>CKD</td>
<td>Chronic kidney disease</td>
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<td>COPD</td>
<td>Chronic obstructive pulmonary disease</td>
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<td>DBP</td>
<td>Diastolic blood pressure</td>
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<td>ESKD</td>
<td>End stage kidney disease</td>
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<td>FOG</td>
<td>Freezing of gait</td>
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<td>Hb</td>
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