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Master's Thesis

**REDUCING THE RISK OF FALLS IN ELDERLY PATIENTS AND THE
PREVENTION OF FALLS IN AN IN-PATIENT AND OUT-PATIENT
SETTING**

Master of Science in Nursing

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MASTER THESIS ABSTRACT

The need to study the risks and the prevention of falls in elderly patients is obvious, since falls in the elderly are the leading cause of accident-related deaths and the seventh leading cause of death in people over 65 years of age. Falls threaten the autonomy of elderly people, limit their mobility, quality of life, and cause a number of individual and socio-economic consequences. The aim of the study: to investigate interventions aimed at reducing the risk of falls in elderly patients, along with ways to prevent falls in outpatient and in-patient settings. Study objectives: to investigate the specific aspects of falls in elderly patients as a medico-social problem in healthcare facilities and in the home; to identify the patterns and disorders that increase the risk of falls in elderly patients; to investigate the specific effects of drugs that increase the risk of falls in elderly patients; to investigate the living conditions and the hazards that increase the risk of falls in healthcare institutions, residential care facilities, and home in elderly population; to define the ways to prevent falls in elderly patients. The methods of study included the following: obtaining history and physical, medical examination and neurological assessment, clinical assessment, performance testing, laboratory tests, current health conditions, patient observation, data comparison and data analysis, instrumental and imaging tests; analytical method; statistical research methods. The scientific and practical value of the study. During this research study, the author investigated the specific aspects of falls in elderly patients as a medico-social problem in healthcare institutions and at home, detected the patterns and disorders that increase the risk of falls, studied the impact of drugs that increase the risk of falls in elderly, investigated the living conditions and the presence of hazards that contribute to increased risk of falls in healthcare institutions, in residential care facilities or in the home, and defined the ways to prevent falls among elderly.

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INTRODUCTION

The relevance of the study. The need to study the risks [2, 5, 6, 30, 47] and the prevention of falls in elderly patients [7, 8, 57] is obvious, since falls in the elderly [9, 20] are the leading cause of accident-related deaths and the seventh leading cause of death in people over 65 years of age [19]. Every year, 30 to 40% of older people living in the community fall [2, 8]; the statistics also shows that every year, 50% of residents of nursing homes fall, resulting in serious injuries [7] and even fractures [1, 5, 12, 43, 48]. In the US, there were 32,522 deaths from falls in people over 65 years of age in 2020 versus 4,933 deaths from falls in younger people; thus, 85% of deaths due to falls occur in 13% of the population over 65 years of age. In addition to that, falls have become the cause of more than 3 million emergency room visits by the elderly people. The expenditures on health services in non-fatal injuries as a result of falls amounted to approximately \$ 52 billion in 2020 and, according to experts, these expenditures will increase; therefore, the importance of their prevention can hardly be overestimated [3, 11, 21, 34].

Falls threaten the autonomy of elderly people, limit their mobility [42, 44], quality of life [45], and cause a number of individual and socio-economic consequences. However, physicians [21] are often unaware of the falls their patients might have had, especially if the patients do not mention any injuries themselves [5, 43, 48], since routine health history collection and physical examination typically do not include a specific risk of falls assessment [17, 18, 39, 48]. Many older people [6, 10, 11] are reluctant to report their falls, since they attribute falls to aging or are afraid of later being restricted in their activities [42, 44], or being admitted to enclosed-type inpatient facilities [7, 8, 33].

The fact that older people often fall in health institutions [8, 8, 24, 33], in the home [8, 37], and on the street, significantly reduces their autonomy [10, 14, 25] and standards of living. If an elderly person has fallen (even without significant damage), it is recommended to inform their family physician and/or

nurse [7, 24, 33, 34, 35] in order to obtain advice on ways to prevent falls in the future [22, 27, 28, 29].

Patients and their families should know that falls can be prevented [43, 51, 54, 57, 58] by using the strategies [54] and recommendations, which may help maintain a high level of personal safety both in the home and outdoors [29, 54].

The aim of the study: to investigate interventions aimed at reducing the risk of falls in elderly patients, along with ways to prevent falls in outpatient and in-patient settings.

Study objectives.

1. To investigate the specific aspects of falls in elderly patients as a medico-social problem in healthcare facilities and in the home.
2. To identify the patterns and disorders that increase the risk of falls in elderly patients.
3. To investigate the specific effects of drugs that increase the risk of falls in elderly patients.
4. To investigate the living conditions and the hazards that increase the risk of falls in healthcare institutions, residential care facilities, and home in elderly population.
5. To define the ways to prevent falls in elderly patients.

The object of research. Elderly patients with various health problems that increase the risk of falls in out-patient and in-patient settings, and the specific features of living conditions in elderly patients, which increase the risk of falls.

The subject of research. The role of organizing observation for and prevention of falls in elderly patients with various health problems; the specific features of nursing observation and assistance in these patients, and the living conditions of elderly patients that increase the risk of falls.

The methods of study included the following: obtaining history and physical, medical examination and neurological assessment, clinical assessment, performance testing, laboratory tests, current health conditions, patient

observation, data comparison and data analysis, instrumental and imaging tests; analytical method; statistical research methods. Laboratory assessments shall be ordered based on health history and other assessments; they help to rule out various etiologies and include, among others, the following: a complete blood count to check for anemia or leukocytosis, a test of blood glucose level to rule out hypoglycemia or hyperglycemia, and electrolytes to monitor for dehydration and renal impairment. Tests such as electrocardiography (ECG), Holter monitoring, and echocardiography are only recommended when cardiac dysfunction is suspected. X-ray imaging, computed tomography (CT) or magnetic resonance imaging (MRI) of the spine and/or head are only indicated when present history and physical examination suggest neurological abnormalities.

The scientific and practical value of the study. During this research study, the author investigated the specific aspects of falls in elderly patients as a medico-social problem in healthcare institutions and at home, detected the patterns and disorders that increase the risk of falls, studied the the impact of drugs that increase the risk of falls in elderly, investigated the living conditions and the presence of hazards that contribute to increased risk of falls in healthcare institutions, in residential care facilities or in the home, and defined the ways to prevent falls among elderly.

CHAPTER 1

FALLS IN ELDERLY PATIENTS AS A MEDICO-SOCIAL PROBLEM

(REVIEW OF LITERATURE)

A fall is defined as a state of a previously standing or walking human resting on the ground or on a still lower level; sometimes, body parts hit against an object cushioning the fall [2, 7, 9, 20, 57]. As a rule, the cases caused by generalized weakness [23, 42], pain [37], mental disorders, such as dementia [49], osteoporosis [13, 45] nervous system disorders (such as stroke [28], epileptic seizure, Parkinson's disease [41], alcoholism [40] and gait disorders [4]), musculoskeletal disorders [13], cancers or the consequences of their treatment [15, 20, 36], polypharmacy in the long-term treatment of various diseases [39], or the presence of overwhelming environmental hazards (e.g. being hit by a moving object) are also considered falls [2, 7, 57] for the purposes of considering this problem and the options for its solution.

Etiologies of falls in the elderly people. A previous fall is a strong predictor of falls [7, 20]. However, falls in the elderly rarely have a single cause or a single risk factor. The fall is usually the result of a complex interaction between various factors:

- Intrinsic factors (age-related functional decline, disease, side effects of drugs [12, 32, 39]);
- Extrinsic factors (hazards from the environment);
- Situational factors (related to the specific activity being performed, such as moving fast to the bathroom).

Intrinsic factors for falls in older people.

Age-dependent changes may affect the systems involved in maintaining balance and stability (e.g., standing, walking, or sitting [4]) and increase the risk of falls [31, 39]. The changes reported include reduced visual acuity and contrast sensitivity, depth perception, and adjustment to darkness. The changes in the activation of muscles, their structure and their ability to generate sufficient

muscle strength and speed may affect the ability to maintain or restore balance in response to disturbances (for example, stepping on an uneven surface or bumping into something) [13]. In reality, muscle weakness of any type is the main indicator of falls.

Chronic and acute disease, as well as the use of drugs are the main risk factors of falls [9, 28, 37]. The risk of falls increases in proportion to the number of the drugs taken by the patient. Psychotropic drugs are the most commonly mentioned as those increasing the risk of falls and fall-related injuries [49].

Extrinsic factors for falls in older people.

Environmental factors themselves may also increase the risk of falls or, more importantly, when they interact with intrinsic factors. The risk is greatest when the environment requires greater postural control and mobility (for example, when moving on slippery surfaces) and being in an unfamiliar environment (for example, when moving to a new home).

Situational factors for falls in older people.

Certain activities or decisions may increase the risk of falls and injuries associated with falls [7, 9, 20]. Examples include talking or being distracted by multiple tasks at the same time, with the resulting inability to notice danger from the environment when walking outdoors (e.g. curb or ledge), moving fast to a bathroom (especially at night, when the person “has not woken up completely” or when lighting is insufficient), or rushing to answer a phone call.

Complications of falls in older people.

Falls, in particular repeated falls, increase the risk of injury [5, 12, 43], hospitalization [7, 8] and mortality [19], especially in frail older people with comorbidities (such as osteoporosis [13, 45]) and reduced performance in everyday life (e.g., urinary incontinence). Delayed complications may include reduced motor function [42, 44] and the fear of falls. It is reported that more than 40% of patients with falls require medical care in the home.

More than 50% of falls in elderly people end up in sustaining an injury [7, 38]. Although the majority of injuries are not serious (e.g. bruises, abrasions),

fall-related injuries account for about 5% of hospital admissions among patients over 65 years of age [7, 8, 24, 33]. Approximately 5% of falls end up in fractures of the humerus, wrist, or pelvis [1, 2, 5, 12, 43, 48]. Approximately 2% of falls end up in hip fractures. Other serious injuries (for example, head injuries, trauma of internal organs, cuts) occur in approximately 10% of all cases of falls. Some cases of injuries are ultimately fatal [19]. Up to 5% of older people with hip fractures die during hospitalization. The all-cause mortality rate 12 months after sustaining a hip fracture ranges from 18% to 33%.

Approximately half of older people who are prone to falls cannot stand up without assistance. Staying on the floor for more than 2 hours after a fall increases the risk of dehydration, pressure ulcers, rhabdomyolysis, hypothermia and pneumonia.

The functioning and the quality of life of the patient may rapidly deteriorate after the fall [38]; at least 50% of older people who were observed on an outpatient basis after the hip fracture are unable to restore their previous level of mobility [42, 44]. After the fall, elderly people may develop a fear of repeated falls. As a result, their mobility is often reduced due to lack of confidence. It is because of this fear that some people may even avoid certain activities (e.g., shopping, cleaning and mopping, etc.). Reduced activity may enhance a cluster of changes in the musculoskeletal system [13], weakness [23, 42] and further decline in mobility.

In order to prevent falls [27, 43, 51, 54], and also after a fall, the health team should assess the risk of a next fall [2, 25, 31].

In terms of prevention, the focus should be on eliminating or reducing the number of subsequent falls, fall-induced injuries, complications, while maintaining as much patient functioning and autonomy as possible. At regular medical examinations [7, 24, 33, 35] or prophylactic assessments, the patients should be asked about any falls or problems with balance and ambulation in the past year.

Patients who report a single fall and do not have balance or gait problems on the Get Up and Walk Test or equivalent should be given general information about reducing the risk of falls. This information should include the safe use of drugs [12] and the reduction of the harmful effects of the environment, the possibility of using physical therapy [35], optimizing physical activity [6, 16, 26, 44, 52, 56], diet [5, 31], the use of vitamin D [1, 50, 55, 59, 60] and omega acids [59].

For older female [5] and male [23] patients who report more than one fall or have problems with balance or gait [4], a fall assessment should be performed to identify risk factors and opportunities for risk reduction.

It is also necessary to make a checklist on living conditions specifying the hazards that increase the risk of falls.

Physical therapy and physical exercise [35].

Patients who have had falls more than once and had problems during the initial balance and gait test should be transferred to a physical therapy or exercise therapy program. If patients have limited mobility, physical therapy [35] and treatment programs [6, 16, 26, 44, 52, 56] may be performed in the home.

Physical therapists administer training programs to improve balance and gait and to rectify certain problems, which contribute to fall risk.

More general therapeutic exercise programs in hospitals or community settings can also improve balance and gait [4]. For example, a Tai chi program can be effective and can be done either independently or in groups. The most effective fall risk reduction programs are those that:

- Selected individually depending on the specific problem
- Provided by a qualified professional
- Includes enough exercises to train balance and coordination
- Performed over a long period of time (e.g. ≥ 4 months).

Many senior citizen centers, Christian youth organizations, or other health clubs offer free or low-cost group exercise classes tailor to the needs of senior

citizens [6, 16, 26, 44, 52, 56], and these activities can help with accessibility and adherence to physician's orders [21]. The cost savings associated with reduction in falls outweigh the direct costs of these programs.

Assistive devices.

Some patients may benefit from the use of assistive devices (e.g., canes, walkers, etc.). Using a cane may be adequate for patients with minimal unilateral loss of muscle strength and joint weakness, while walkers (especially wheeled walkers) are best suited for patients with increased risk of falls, weakness in both lower extremities, or impaired coordination (wheeled walkers can be dangerous for patients who are unable to control themselves adequately). Physical therapists [35] may help the patients select the shape and size of the device and teach them how to use it.

Medical management of patients at risk of falls [12, 54].

The use of the drugs, which may increase the risk of falls in the elderly [15, 39, 46], should be evaluated for gradual dose reduction [10, 12, 14, 25]. Patients should be evaluated for osteoporosis and, if osteoporosis is diagnosed, the patients should be treated to reduce the risk of potential future fractures from falls.

If any other specific disorder is identified as a risk factor, targeted interventions are required. For example, medicinal products [12] and physical therapy [35] may reduce the risk for patients with Parkinson's disease. Pain management in patients with arthritis may consist of physical therapy and sometimes joint replacement surgery. Replacing current vision correction with suitable matching lenses (the use of bifocals or trifocals is not recommended) or eye surgery, especially cataract removal, can help patients with visual impairments.

A recent meta-analysis of randomized controlled trials suggested that the use of vitamin D supplements [1, 50, 55, 59, 60] can significantly reduce the incidence of falls.

Environmental modifications to reduce the risk of falls.

Eliminating harmful environmental factors at home can reduce the risk of falls. Patients should also be given advice on how to reduce the risk due to situational factors. For example, shoes should have flat heels, ankle support and hard non-skid midsoles. Many patients with chronic mobility limitations (e.g., those caused by severe arthritis or paresis) may benefit from a combination of medical, rehabilitation, and environmental strategies [54]. Wheelchair accommodations (e.g., a removable footrest reduces the risk of tripping during transfers, an anti-tip lock to prevent tipping backwards), removable straps, and a wedge-shaped cushion can prevent falls when sitting or moving around in patients with poor sitting balance or severe weakness.

Restraints can lead to subsequent falls and other complications and are generally not used. Ongoing supervision is more efficient and safe. Motion detectors can be used, but in such cases a caregiver must be present to promptly respond to an alarm.

Hip protectors (padding sewn into special underwear) reduce the risk of fractures in high-risk patients in nursing care facilities, but they are less effective in elderly people living in the home. In addition to that, many patients are reluctant to wear their prostheses for an indefinitely long time. A resilient floor (e.g., hard rubber) can help cushion the potential impact, but a floor that is too springy (e.g., soft foam) may destabilize the patient.

Patients should also be trained by nurses [7, 24, 35] and physicians [21] on what they should do if they fall and cannot get up [15, 39, 46]. Helpful maneuvers include turning from supine to prone, getting on all fours, crawling towards a secure support on the surface, and pulling up. Frequent contact with family members or friends, a phone that can be reached while the patient is on the floor, a remote alarm, or a wearable emergency response device can reduce the likelihood of remaining on the floor over a long period of time after a fall.

Based on the review of scientific literature, the following conclusions can be drawn:

1. In general, it is known from scientific sources that every year, falls occur in 30% to 40% of elderly people living in the community and in 50% of residents of nursing care facilities.
2. The causes of falls are multi-factorial and include age- and disease-related decline in function, hazards in the environment and the side effects of drugs.
3. It is necessary to assess the patient for predisposing factors and evaluate the home environment for any potentially harmful effects.
4. Inasmuch as possible, the health care personnel should treat the causative disorders, modify or discontinue the medications that may cause falls, and correct any environmental hazards.
5. Patients who have had falls more than once and had problems during the initial balance and gait test should be transferred to a physical therapy or exercise therapy program. Patients with risk factors for falls should also learn how to get up off the floor and consider using wearable emergency response devices.
6. All these methods should be promoted in healthcare institutions and in outpatient settings to address the problem of falls in the patients.

CHAPTER 2

THE OBJECT OF RESEARCH AND METHODS OF STUDY

The object of research involved elderly patients with various health problems that increase the risk of falls in out-patient and in-patient settings, and the specific features of living conditions in elderly patients, which increase the risk of falls.

Overall, 149 elderly patients were enrolled in our research study.

The elderly patients at high risk of falls should have the following studies:

- Clinical assessment
- Performance testing
- Clinical pathology

After completion of treatment for fall-related injuries, the assessment should aim to identify the risk factors and the appropriate interventions in such a way as to reduce the further risk of falls and fall-related injuries.

Some falls are recognized immediately either because there is an obvious fall-related injury, or there is a concern about potential damage. However, since older people often fail to report falls or other problems with mobility, they should be asked about such problems at least once a year.

The patients who reported one fall should be assessed for maintaining balance or gait disturbances using the Get Up and Walk Test.

During this test, the patients are observed as they rise from a standard chair, walk 3 m (10 ft) in a straight line, turn around, return to the chair and sit down. The observation can reveal weakness in the lower extremities, imbalance when standing or sitting, and/or unsteady gait. Sometimes the test is timed. If the time the patient needs to complete the test exceeds 12 seconds, this suggests a greatly increased risk of falls.

A more complete assessment of risk factors of falls includes the patients who:

- Have difficulty taking the Get Up and Walk Test

- Report frequent falls during the screening
- Are being evaluated after a recent fall (after sustaining a severe injury, which was detected and treated)

Collection of history and physical examination.

When there is a need for a more comprehensive assessment of fall-associated risk factors, the emphasis is on identifying intrinsic, extrinsic and situational factors, which can be reduced by the respective targeted interventions.

Patients are asked direct questions about their most recent fall(s), followed by more specific questions about when and where the fall(s) occurred and what the patients were doing at that time. The witnesses of the accident (if any) are asked identical questions. Patients should be asked if they had previous or fall-related symptoms (such as rapid heartbeat, shortness of breath, chest pain, dizziness) and whether the patient had lost consciousness.

Patients should also be asked if any obvious extrinsic or situational factors may have been involved. History collection should include questions about past and present medical problems, the use of prescription and over-the-counter drugs, and alcohol use.

Since it may not be possible to eliminate all the risks for subsequent falls, patients should be asked if they were able to stand up unaided after the fall and whether they had any injuries. The goal is to reduce the risk for complications potentially caused by subsequent falls.

The physical examination should be comprehensive enough to rule out any obvious intrinsic causes of falls. If the fall is recent, the patient's temperature should be taken to determine if fever could be a risk factor for the fall.

The nurse should assess pulse rate and cardiac rhythm to determine obvious bradycardia, tachycardia at rest or arrhythmia. In order to rule out orthostatic hypotension, blood pressure should be measured first in the supine position and after the patient has been in a standing position for 1-3 minutes. Many types of heart valve defects can be detected on auscultation.

In patients wearing corrective lenses, visual acuity should be assessed with lenses if necessary. Problems with visual acuity may require a more detailed eye examination by an ophthalmologist. The neck, the spine, and the extremities (especially the legs and the feet) should be assessed for weakness, deformities, pain and limitation in range of motion.

A neurological assessment should be performed; it includes checking muscle strength and tone, sensations (including proprioception), coordination (i.e. cerebellar function), as well as stationary balance and gait. With the help of the Romberg test (during which patients stand in the position "legs closed, eyes alternately open/closed") the health specialist will assess basic postural control and proprioceptive and vestibular systems.

Tests to determine high-level balance function include observation of the patient in a standing position on one leg and tandem gait. If patients can stand on one leg for 10 seconds with their eyes open and have an accurate 3-meter (10-foot) tandem gait, any intrinsic postural control deficit is likely to be minimal. The physicians should assess positional vestibular function and mental condition of the patient.

Performance tests.

Performance-oriented motion assessment or conducting a timed Get Up and Walk Test may detect problems of impaired balance and stability when walking and with other types of movements and suggest increased risk of falls. These tests are especially helpful if the patient is experiencing difficulties with the Get Up and Walk Test.

The Movement Performance Test measures various aspects of balance and gait and takes 10 to 15 minutes to complete. As a rule, low scores suggest an increased risk of falls.

Laboratory investigations (clinical pathology).

There is no standard diagnostic evaluation to accurately determine the cause of a fall. The testing, which should be based on history and investigations, helps rule out various causes:

- Complete blood count (CBC) to detect anemia or leukocytosis
- Measurement of blood glucose levels to detect hypoglycemia or hyperglycemia
- Electrolyte test to check for dehydration, renal problems and homeostasis.

Such tests as electrocardiography (ECG), ambulatory electrocardiographic monitoring of cardiac activity (Holter monitoring) and echocardiography are only recommended when cardiac dysfunction is suspected.

X-ray imaging, computed tomography (CT) or magnetic resonance imaging (MRI) of the spine and/or head are only indicated when present history and physical examination suggest new neurological abnormalities.

In addition to the above methods, we used scientific methods such as comparison, analysis and statistical methods.

CHAPTER 3

IDENTIFICATION OF PATTERNS AND DISORDERS THAT INCREASE THE RISK OF FALLS IN ELDERLY PATIENTS

One in three elderly persons falls at least once a year; at the same time, a substantial portion of falls leads to fractures. In the first series of the study, we have performed a practical assessment of some of the health problems that increase the risk of falls. We have also noticed certain seasonal patterns. Injuries in the elderly more often occur in winter. Winter is a time of increased risk associated with the traumatic effect of cold on the body and with mechanical injuries. According to statistics, "winter" injuries constitute up to 15% of morbidity with temporary disability and are the cause of disability in 20% of cases. Due to the roadway conditions in winter, motor vehicle accidents increase to 3% compared to the usual 1%. As a result, they become not only more frequent, but also more severe, often fatal.

Table 3.1. Seasonal distribution of elderly patients who sustained injuries due to falls

Time of the year (season)	The number of elderly patients who sustained injuries due to falls	%
Winter	64 patients	42.95%
Spring	23 patients	15.44%
Summer	34 patients	22.82%
Autumn	28 patients	18.79%
Total	149 patients	100%

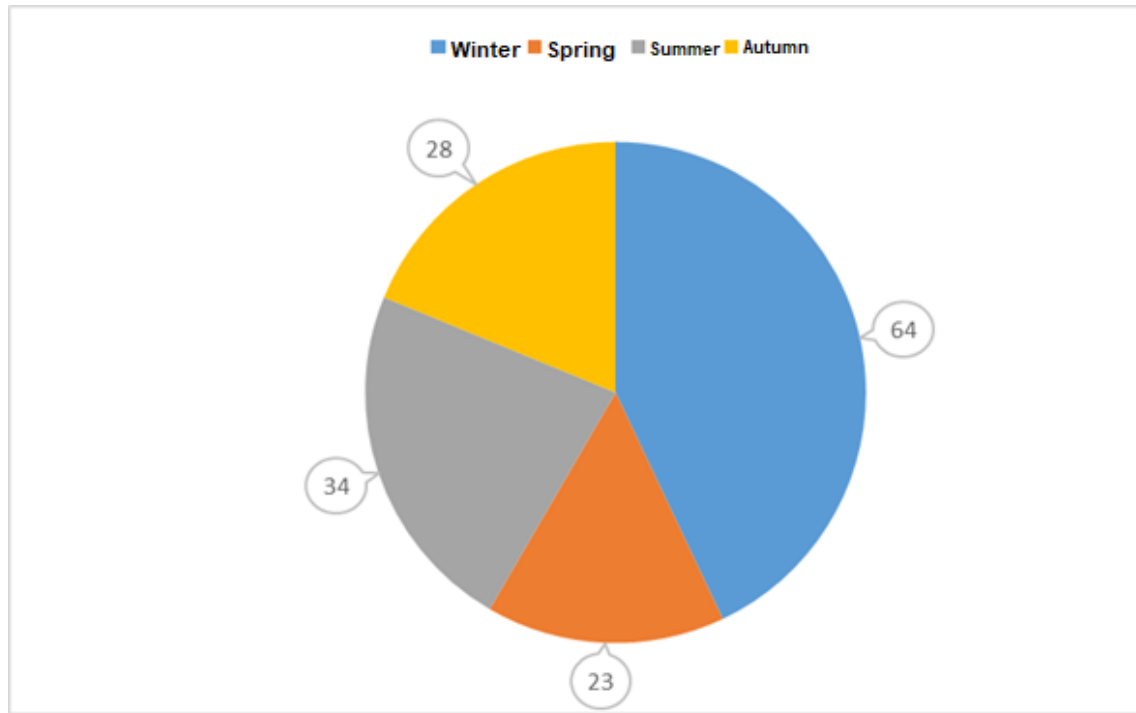


Figure 3.1. Graphic distribution of the total number of elderly patients who sustained injuries due to falls, depending on the season.

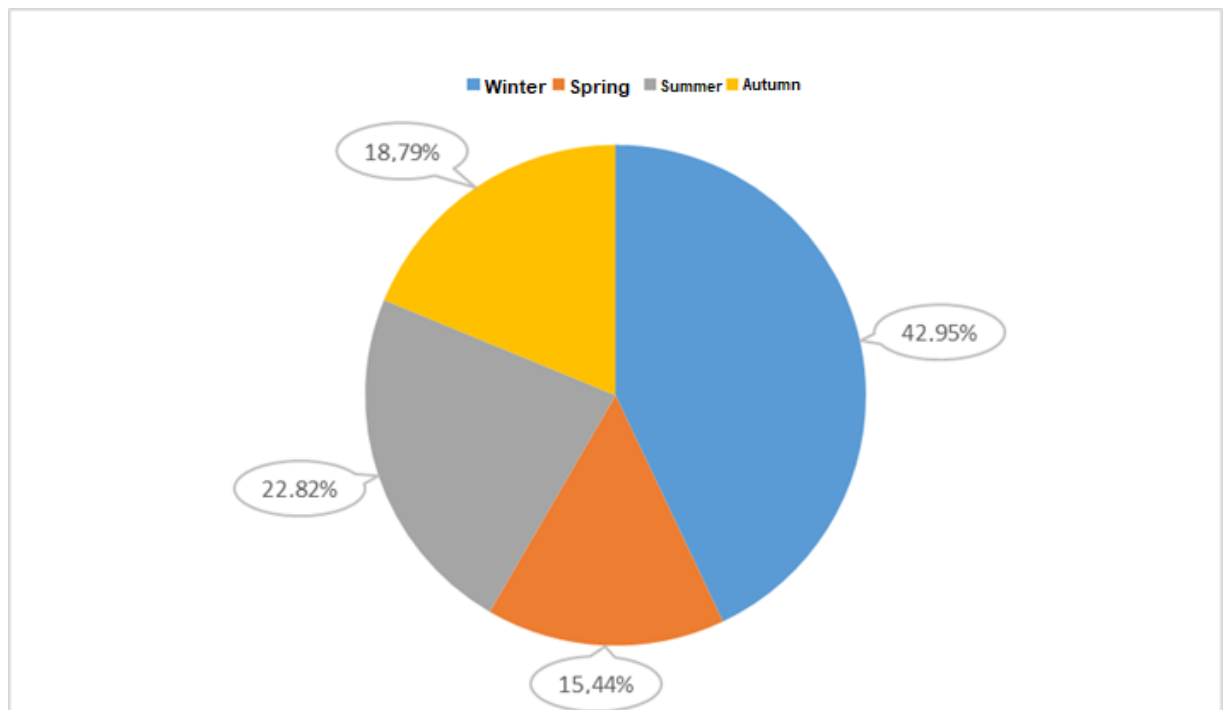


Figure 3.2. The percentage ratio of elderly patients who sustained injuries due to falls, depending on the season.

The analysis of the results obtained showed that among 149 patients (i.e. the total number of elderly patients, who sustained injuries due to falls), 64 patients were injured in the winter, which amounted to 42.95% and suggested winter as the most injury-intense season.

Injuries represent a serious threat to the health and life of people of all age groups. Millions of people worldwide sustain injuries and become disabled and lose their lives every year.

The main causes of falls and injuries in the elderly may include the cardiovascular and neurological disease characteristic of old age. These diseases are often accompanied by dizziness. Impaired vision and pain in the joints also contribute to injuries. Special caution is required in stroke survivors with motor disorders and other neurological problems.

Reduced physical activity also has a certain effect. Those who have been on bed rest for extended time, are substantially more likely to fall in the recovery period. Moreover, the feeling of anxiety that appears after such a fall, and the fear of a repeated fall make a person restrict their mobility even more, which means that the risk of falls and injuries becomes greater.

Unfortunately, some drugs used in geriatric practice may lead to such accidents. When starting to take new medicines, the patient should be especially careful and watch out for their potential side effects.

An elderly person may sustain an injury under a variety of circumstances: this may happen at any time: in the street or in an entryway, in the bedroom when getting out of bed, or on a slippery bathroom floor. It is estimated that a third of older people fall at least once, up to two to three times a year. One in five falls results in a bone fracture; more frequent injuries include soft tissue injury or a hematoma.

The risk of falls is high in people who are in an upright position for less than 4 hours a day, and also in those who are unable to sit down and stand up without assistance, in people with depression, and in people with syncopal states (short-term blackouts of consciousness). Therefore, prevention of falls may

include physical activity, creating a safe environment and taking other required steps.

Equally important are such factors as iced surfaces in the winter, uneven road surface, poor lighting, lack of assistance from other people in patients who need it, etc.

In 50% of cases, falls occur at home, especially in the bathroom and in the bedroom. Many elderly people sustain injuries when there are no witnesses around, which deprives them of being promptly helped.

In addition to that, common causes of falls include the following:

- dangerous sites in the home;
- reduced stability and balance;
- decreased muscle strength and muscle mass (sarcopenia);
- spontaneous weight loss;
- visual and/or hearing impairment;
- side effects of drugs.

We have also reviewed some health problems in older people that increase the risk of falls.

Table 3.2. Some disorders that increase the risk of falls

Functional impairment	Condition	Number of patients
Control of blood pressure	Anemia Arrhythmias Cardioinhibitory carotid sinus hypersensitivity COPD (chronic obstructive pulmonary disease) Dehydration Infections (e.g., pneumonia, sepsis)	106 patients

	Metabolic disorders (e.g., diabetes, thyroid disease, hypoglycemia, hyperosmolar conditions) Neurocardiogenic inhibition after voiding Postural hypotension Postprandial hypotension Valvular heart disorders	
CNS-associated disorders	Delirium Dementia Stroke	39 patients
Gait	Arthritis Foot deformity Muscle weakness	93 patients
Postural and neuromotor function	Cerebellar degeneration Myelopathy (e.g., due to cervical or lumbar spondylosis) Parkinson's disease Peripheral neuropathy Stroke Vertebrobasilar insufficiency	14 patients
Proprioception	Peripheral neuropathy (e.g., due to diabetes) Vitamin B12 deficiency	24 patients
Otolaryngological function	Acute labyrinthitis Benign paroxysmal vertigo Hearing loss Meniere disease	19 patients
Vision	Cataract Glaucoma	32 patients

	Macular degeneration (age-related)	
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All of these disorders are important and health care personnel should pay attention to their timely elimination or correction.

CHAPTER 4
 INVESTIGATING THE CHARACTERISTIC EFFECTS OF DRUGS THAT
 INCREASE THE RISK OF FALLS IN ELDERLY PATIENTS

In the second series of the study, we performed a practical assessment of specific aspects related to the side effects of drugs that increase the risk of falls in elderly patients. To this end, we were studying various drugs and their fall-conducive mechanisms of action. Among the total number of elderly patients whom we have assessed and who sustained injuries due to falls (149 patients), we have identified the patients who were taking drugs that potentially increased the risk of falls. (Table 4.1).

Table 4.1. Certain drugs that contribute to the risk of falls and the mechanisms of their action

Medicinal products	The mechanism of action of the drug that contributes to higher risk of falls	Number of patients
Aminoglycosides	Direct damage to the vestibular organ	8 patients
Analgesics (especially opioids)	Reduced alertness or slowing down the function of the CNS	93 patients
Antiarrhythmic drugs	Reduced cerebral perfusion	45 patients
Anticholinergic drugs	Confusion/delirium	17 patients
Antihypertensive drugs (especially vasodilators)	Reduced cerebral perfusion	106 patients

Antipsychotics	Extrapyramidal syndromes, other antiadrenergic effects, reduced mental alertness or deterioration of brain function	14 patients
Diuretics (especially when the patient is dehydrated)	Reduced cerebral perfusion	36 patients
Loop diuretics (in high doses)	Direct damage to the vestibular organ	28 patients
Psychotropic drugs (especially antidepressants, antipsychotics, and benzodiazepines)	Reduced alertness or slowing down the function of the CNS	45 patients

In order to limit polypharmacy in elderly, physicians and nurses should use current evidence based practices of drug prescription analysis (drug rationality index, anticholinergic load scale) and pharmacotherapy optimization methods using the least "restrictive" lists (Beers criteria, STOPP/START criteria), which will allow reducing the number of errors when using drugs, and make pharmacotherapy in elderly patients as effective and safe as possible.

In particular, the STOPP criteria (Screening Tool of Older People's Prescriptions), which are intended for assessment of the rationale for prescribing drugs in people older than 65 years in outpatient and inpatient healthcare institutions in order to minimize suboptimal drug administrations, list the criterion "drugs that increase the risk of falls in the elderly" in order to prevent falls in elderly patients in outpatient and inpatient settings.

The use of the STOPP criteria in hospitalized elderly patients is known to improve the quality of pharmacotherapy; when the criteria are used within the first 72 hours after hospitalization, this reduces hospital stay in elderly patients by 3 days.

The use of STOPP criteria during assessment of the validity of drug prescriptions in the elderly allows optimizing their drug therapy. This suggests that preventing falls in the elderly and polypharmacy is presently one of the important tasks when providing medical care. This dictates the need to develop the strategy aimed at a maximally effective and safe use of drugs in management of elderly patients, which will improve the quality of health care and reduce the number of falls and other undesirable consequences of using a large number of medicinal products.

Since falls in an older age are a multi-factorial syndrome, which consists of a complex interaction of biological, behavioral, environmental and socio-economic factors. All of these factors can be divided into non-modifiable factors (e.g., older age, gender, dementia) and modifiable factors (e.g. orthostatic hypotension, vitamin D deficiency, anemia, etc.).

One of the serious modifiable risk factors of falls is polypharmacy, a simultaneous administration of many drugs.

Polypharmacy, in addition to increased risk of falls and fractures, is associated with such geriatric syndromes as depression, decreased physical functioning, cognitive impairment and delirium, which also indirectly increase the risk of falls.

It is well known that polymedication leads to increased frequency of drug interactions: the greater the quantity of drugs taken, the more likely drug interactions are.

Falls occur more often when prescribing 5 or more drugs is involved. Moreover, the more drugs the patient takes, the higher the risk of falls.

CHAPTER 5
 INVESTIGATING LIVING CONDITIONS AND THE HAZARDS THAT
 INCREASE THE RISK OF FALLS IN HEALTHCARE INSTITUTIONS, IN
 RESIDENTIAL CARE FACILITIES FOR THE ELDERLY AND IN THE
 HOME

For patients who report more than one fall or have problems with balance or gait, a fall assessment should be performed to identify risk factors and opportunities for risk reduction.

Among the overall number of our study subjects (i.e. 149 elderly patients who sustained injuries due to falls, we identified those patients who reported the risks from tables below from the groups of general living conditions (37 patients), in the kitchen (53 patients) and in the bathroom (46 patients); some of these patients reported risk when using staircases (28 patients).

Table 5.1. The types of disturbances of living conditions that contribute to the increased risk of falls, as well as their correction and substantiation (the group of general living conditions)

Positioning	Hazard	Correction	Substantiation
Lighting	Too dim	Provide all areas in the place of residence with sufficient lighting	Improves visual acuity and contrast sensitivity
	Too straight, creating glare	Reduce reflection of light with an even distribution of light; create indirect lighting or translucent dusk	Improves visual acuity and contrast sensitivity

	Inaccessible electrical switches	Install night lights or touch-activated light Install electrical switches in accessible locations directly at the entrance to the room, or install light-activating motion sensors	Reduces the risk of tripping or bumping into invisible obstacles in the dark
Carpets, rugs, linoleum	Torn carpetting	Repair or replace a torn carpet/rug	Reduces the risk of tripping or slipping, especially for people who have difficulty walking
	Slippery	Provide non-slip surfaces	Reduces the risk of slipping
	Folded edges	Anchor the folded edges of the carpeting or linoleum, or apply self-adhesive tape to the underside of the carpeting to prevent curling Replace the carpeting or the linoleum	Reduces the risk of tripping
Chairs, tables	Unstable chairs and	To ensure a stable position of the	Increases the

and other items	other furniture	furniture able to bear the weight of a person leaning against the table tops, armrests and backrests Do not use chairs on wheels or swivel chairs Strengthen wobbly legs	support of people with weakened balance and helps with movement
	Chairs without armrests	Ensure that there are chairs with armrests that are sufficiently advanced forward to allow for comfortable lifting and squatting	Helps people with proximal muscle weakness and helps with mobility
Arrangement of items	Blocked passages	Arrange the furniture in such a way as to keep the passages free Remove superfluous items from the hallway	Reduces the risk of tripping or bumping into obstacles, making it easier and safer to move around the house, especially for people with peripheral vision impairment
Wires and cords	Stretched out in the passages	Anchor the cords that run on the floor or are under floor coverings	Reduces the risk of tripping

Table 5.2. The types of disturbances of living conditions that contribute to the increased risk of falls, as well as their correction and substantiation (the group of conditions in the kitchen)

Positioning	Hazard	Correction	Substantiation
Cabinets, shelves	Are hanging too high	Keep frequently used household articles at waist level Install shelves and cabinets at an accessible height	Reduces the risk of falls, which are due to frequently reaching for something or climbing a ladder, or standing on a chair
Floors	Wet or slippery	Place a rubber mat on the floor next to the sink Wear rubber-soled shoes in the kitchen Use non-slippery floor cleaners	Reduces the risk of slipping, especially for people with gait problems

Table 5.3. The types of disturbances of living conditions that contribute to the increased risk of falls, as well as their correction and substantiation (the group of conditions in the bathroom)

Positioning	Hazard	Correction	Substantiation
Bathroom or	Slippery floor in	Attach anti-slip strips to the	Reduces the risk

shower	the bathroom or shower	<p>surface of the bath tub or place a rubber mat on the bottom of the tub</p> <p>Use shower shoes or a bath seat (the bath seat provides the people with visual and balance impairments with a normal position when taking a bath)</p>	of slipping in a wet tub or on the shower floor
	The need to use the side of the tub for supporting the person or for moving them	<p>Install handrails in the shower</p> <p>Place a portable support stand (support rails) on the edge of the tub</p> <p>Take the support stand (support rails) to the trips</p>	Helps with movement
Towel rail, sink top	Unstable when used as a support when transferring from the toilet, tub or shower	Fix the handrails with wall fasteners	Helps with movement

Toilet seat	Too low	Use an elevated seat	Helps with getting into and out of the seat
Doors	Locks	Remove the locks from the bathroom doors or use the locks that open on both sides	Allows other people to enter the room if the person in the room falls down

Table 5.4. The types of disturbances of living conditions that contribute to the increased risk of falls, as well as their correction and substantiation (the group of conditions when using staircases)

Positioning	Hazard	Correction	Substantiation
Height	Adjust step height	The suitable step height is not more than 15 cm	Reduces the risk of tripping or slipping, especially for people who have difficulty walking
Handrails	Absent	Install and reinforce the handrails on both sides of the stairway Use cylindrical railings fixed 2.5–5 cm from the wall	Provides support and helps people grab the railing with either hand
	Too short and not	Extend the railing	This signals that

	having a marked end	beyond the upper and lower steps, and turn the ends inside the step	the upper or lower step was passed
Configuration	Too steep or too long	Install staircase landings on the staircases if possible, or select a residence with staircases equipped with staircase landings	Provides a rest stop, especially for people with heart or lung disorders
Condition	Slippery	For safety reasons, place non-slip pads on all steps	Prevents slipping
Lighting	Insufficient	Install normal lighting both at the top and at the bottom of the stairway Provide nightlights or place brightly colored light strips on the steps to clearly indicate the step	Indicates step position, especially for people with weak sight or perception

The analysis in this study series has shown that among the total number of elderly patients in our study who sustained injuries due to falls (149 subjects),

certain special characteristics of falls in female and male patients have been identified (see Table 5.5). Some patients reported having several risk conditions at the same time.

Table 5.5. The specific features in distribution of risk of falls conditions among the total number of female and male patients who sustained injuries due to falls.

	Total number of patients	females	males
The group of general living conditions	37	25	12
The group of household conditions in the kitchen	53	36	17
The group of household conditions in the bathroom	46	21	25
The group of conditions when using staircases	28	15	13

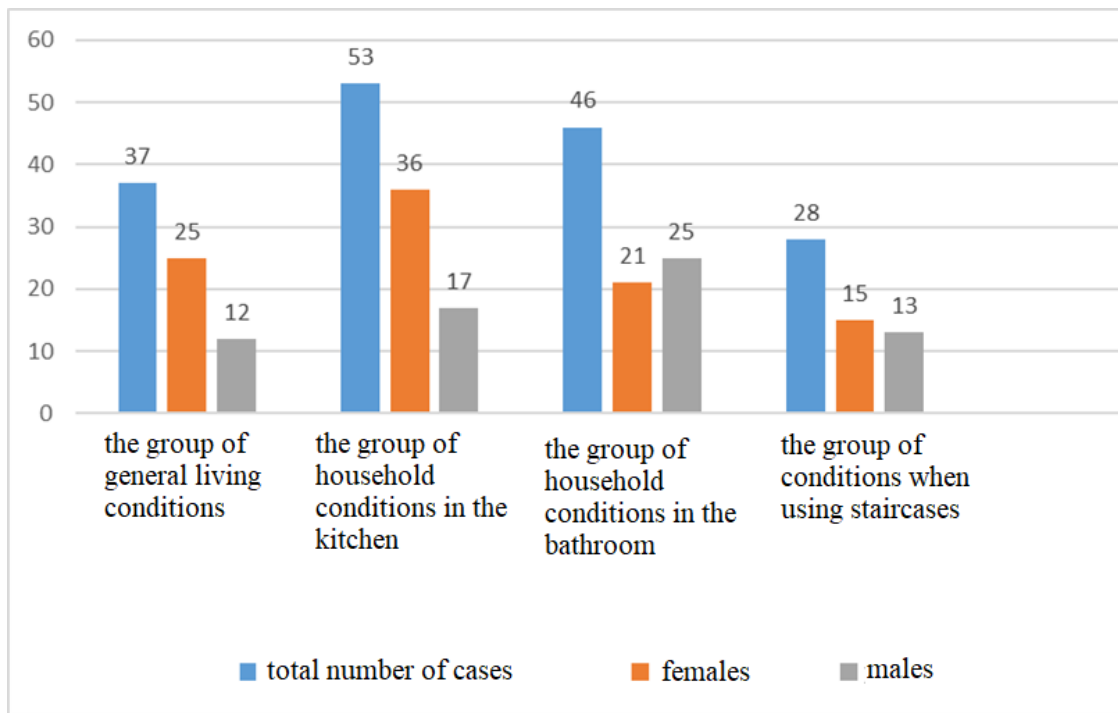


Figure 5.1. The types of disturbances of living conditions that contribute to the increased risk of falls among the patients in our study

In order to increase the level of safety in a healthcare institution or in the home, the patient should use the following guidelines to help improve their personal safety. Preferably, the patient should consult a specialist in the field.

In order to increase the level of safety in the bathroom and in the toilet, the patient will need to:

- whenever possible, the patient should prefer shower cabin to a tub because the former is safer;
- it is advisable to use liquid soap, because solid soap can fall out of the patient's hands and lead to a fall;
- it is preferable that the patient wipes themselves dry using a towel before leaving the shower cabin or a bathroom;
- in order to prevent slipping, the wet floor should be wiped immediately;

- ask the patient not to close the door to the bathroom from the inside, so that the patient can be assisted if necessary. It is preferable that the door open to the outside.

The following safety aids should be used whenever possible:

- an adhesive rubber mat should be placed inside the shower cabin or tub to prevent falls;
- an adhesive rubber mat should also be placed at the exit from the shower cabin or bathroom;
- it is preferable to lay slip resistant tiles on the entire floor of the bathroom;
- For patient's safety, install stable handles in the shower, in the bathroom and near the toilet that the patient can hold on to. For proper and safe placement of the handles, it is important to consult an occupational therapist, physiotherapist or other rehabilitation specialist who has received special training in this matter;
 - when using a shower cabin or when taking a shower in a tub, it is preferable that the patient sit on a steady plastic shower chair;
 - if necessary, the patient should use a stable toilet step to help the patient sit on and stand up from the toilet seat.

In order to increase the level of safety in living rooms (salon, bedroom, etc.), the patient's family will need to ensure the safe arrangement of items, ensure that there is sufficient lighting in the room, and ask the patient to move carefully.

Safe arrangement of items in living rooms includes the following:

- it is necessary to remove things from the floor, including electrical and telephone cables to prevent the patient from stumbling on them and falling;
- If the patient uses a landline phone, it should be installed in an accessible and convenient location. It is preferable to use a cordless phone;

- attach carpets to the floor with a special adhesive, or refrain from using carpets at all, because the patient may stumble on the edge of the carpet and fall;
- the furniture should be situated in such a way as not to impede passage;
- it is also important to close the drawers and doors of the cabinets and to use sturdy furniture.

The safety precautions for ensuring a sufficient lighting in the room include the following:

- the light should be sufficiently bright, but not blinding;
- an easy-to-switch lamp should stand by the bedside;
- night lights should be on in the passages and in the toilet;
- it is especially important to make sure the passage from the bedroom to the toilet is free and lighted at night time.

The patient should remember to move carefully and stand up from the bed or chair slowly. If the patient stands up rapidly, they may have dizziness and may fall down.

in order to increase the level of safety in the kitchen, the following safety precautions and rules should be followed:

- place the things that the patient is using on a daily basis in such a way as to keep them within reach;
- remind the patient to ask for assistance from other people if they need to reach high; advise the patient against unassisted attempts to stand on a ladder or a chair;
- in order to prevent slipping, the wet floor should be wiped dry and any remnants of food should be discarded immediately;
- the patient should be careful when preparing and warming food in order to avoid accidents and burns.

In order to increase the level of safety when using staircases (both in the home and out of home), the patient should keep the following rules:

- the steps should have stability and integrity (any broken steps should be promptly repaired);
- no foreign objects should be on the steps at any time;
- the steps should be with stable railing, preferably installed on both sides;
- the steps should be well-lighted, with edges painted with a noticeable color.

The patient should remember to move carefully, avoiding hurry when going up or down the stairs; when the patient is going down the stairs, they should remember to take off their reading glasses.

By using these simple fall precautions, patients can avoid falls in most cases.

CHAPTER 6

THE WAYS TO PREVENT FALLS IN ELDERLY PATIENTS

Fall prevention programs may contribute to the reduction in the number of people who experience falls, as well as the incidence of such cases. The greatest promise is seen with the targeted strategies that aim to change behavioral patterns and modify risk factors among the individuals living in the home. Effective results have been obtained with implementation of integrated action programs, which include risk factor assessment and screening. At the same time, well-defined screening mechanisms for use in different countries have not been developed; therefore, it is necessary to continue work in this direction.

The use of physical and pharmacological restraints leads to even more serious injuries from falls. The use of comprehensive interventions in patients with cognitive impairment hospitalized after cases of falls did not yield positive results. However, the investigators noted the efficacy of targeted prophylactic measures in patients with cognitive impairment who are the residents of specialized care institutions. It appears that fall prevention programs may be cost-effective; however, further research is needed.

Methods to protect elderly patients from falls:

- improve home safety;
- engage in regular physical activity;
- maintain proper nutrition and sufficient fluid intake;
- consult the physician concerning proper medication intake;
- monitor vision and hearing;
- use safety aids.

It is necessary to consult a doctor for advice and for the diagnosis of possible diseases in the following cases:

- if the patient fell more than twice in the past year;

- if the patient was in need of medical care (including hospitalization) after the fall;
- if the patient has trouble walking and/or maintaining balance; in case this was not the case before or if difficulties with walking or maintaining balance have aggravated.

This will help the patient to preserve their autonomy and the high quality of life.

Physical activity. It is recommended to engage in physical activity for at least 30 minutes at a time, and at least 5 times a week.

The recommended types of physical activity include the following:

- walking;
- the exercises to maintain muscle tone, flexibility and the ability to maintain balance;
- Tai chi exercise has been demonstrated to be of special value in preventing falls;
- other activities the patient may enjoy, such as dancing and swimming.

In order not to fall while walking, the patient should wear comfortable and stable shoes, closed at the back, with wide and low heels and non-slip soles.

For guidance on increasing mobility, maintaining balance and maintaining muscle tone, it is advisable to consult a physiotherapist or other specialist in this field.

The advantages of physical activity are as follows:

- it has a positive influence on the general condition of the body;
- it strengthens muscles and bones;
- it improves the sense of well-being and increases the quality of life.

Elderly patients should engage in regular physical activity, since it is the best protection from falls.

They or their family should also make sure they are getting proper nutrition and maintaining a sufficient fluid intake. To improve their health, the patients will need to eat a variety of foods from all food groups (grains, legumes, vegetables and fruits, fish, poultry and meat, eggs, milk and dairy products, fats). The patients should be advised not to skip meals (because this can cause weakness and dizziness), drink 8-10 glasses of water or other healthy non-alcoholic drink per day, especially on hot days, and avoid alcoholic beverages.

Elderly patients need to take medicines correctly. They should take their medicines wisely, tell their doctor about all medicines they are taking (including over-the-counter medicines and "natural" medicines), ask the doctor if all medicines are necessary, if the medicines have side effects, and if it is dangerous to combine different medicines. If the older person is taking medicines that cause dizziness or drowsiness, they should not engage in activities that may lead to falls.

Also, vision and hearing should be monitored:

- the patients should check their vision at least once every two years, since poor eyesight may lead to falls;
- the patients should check if they need (new) glasses;
- the patients will need to check if they have some other eye problems, such as cataract or glaucoma;
- the patients should check their hearing at least once every two years;
- hearing impairment may be dangerous if, for instance, the elderly person is crossing the road and does not hear the approaching vehicles. If they have a hearing aid, they should not forget to wear it.

The safety aids for the mobility of elderly patients include multiple aspects; therefore, they must be clarified to the elderly people and their family.

The following advice can be used:

- when moving, the patients should use special appliances to increase their level of safety;

- if their walking is unsteady, they should use a stick or a walker;
- the patient should consult a physical therapist concerning the suitable height of the stick or walker;
- the patient should keep an eye for the rubber at the tip(s) of the stick, cane or walker to be whole and not worn out;
- as of today, there is a large number of various appliances, which may help the patient put on their clothes and shoes, work in the kitchen, etc.
- for additional information and selection of the required appliances, consult an occupational therapist;
- the patient will need to write down important phone numbers in advance using large, legible handwriting, and keep this list near the phone;
- the patient's family may need to install an emergency alert system in the home and have the patient wear a key-chain with the activation button on their neck or wrist to be able to press it if they fall;
- if the patient falls, they should not hurry to get up on their feet; first, they will need to check if they're injured;
- summon help if required.
- tell the patient not to let their fear of falls prevent them from living an active lifestyle, since leading an inactive lifestyle increases the likelihood of falls.

Recommendations for elderly people how to prevent falls.

Prevention of injuries and falls in an older age greatly depends on the person, their lifestyle, behavior and attention. In this regard, timely detection and treatment of cardiovascular disease, joint disease and osteoporosis is recommended. Periodic hearing and vision checks should be made to order hearing aids or stronger glasses in a timely manner.

Performing exercises in the home for balance and muscle training as prescribed by the physician, as well as daily walks. Maintaining optimal temperature in residential premises, since significant changes in ambient

temperature affect blood supply to the brain, which leads to impaired motor coordination.

All dangerous places where an elderly person may sustain a fall, such as stairs, corridors, bedroom and bathroom, etc. should be well-lighted. The electrical switch in the bedroom should be installed so that the patient can reach it without getting out of bed. It is advisable to cover the polished handles of the furniture with cloth covers so that the patient's hand does not slip when the patient is standing up. The entrance hall and the bathroom should be equipped with special-purpose handrails.

An important role is played by the furniture in the room where the elderly person is living. Thus, the bed should be at least 60 cm high, the chairs should be shallow and soft, the backs of the chairs should be high, with sufficient head support. The patient should avoid sudden movements when getting up from bed.

Quite frequently, an injury may be sustained when washing clothes or bathing. The bathroom should be equipped with handrails, a support and a special bench attached on the edge of the tub. A rubber mat should be spread on the bathroom floor.

The telephone should be placed in such a way that even if a person falls, the telephone should be within reach and the person may call an ambulance or call a significant other.

It is important to select footwear correctly. It should be loose-fitting, but not over-sized; soft and with grooved soles. It is advisable to wear shoes with flat soles or with low square heels. It is better if the sole is with large ribbing that does not slip.

In icy conditions, the patient will need to walk in a special way, as if sliding a little, or as if on small skis. It is preferable to walk as slowly as possible. The patient should be advised to avoid sliding on ice on purpose, this increases the icing of the sole. The faster the step, the greater the risk of fall.

The most injury-prone older people are recommended to attach special anti-skid plates to the soles of their habitual footwear.

Regular walks, swimming and light exercise help retain vivacity and mobility.

It is undesirable to leave the house at night, in very cold weather and/or when it is snowing and slippery. In winter, in order to prevent falls while walking, it is advisable to use a support cane with an anti-slip device, and walk accompanied by relatives; the latter is especially important when crossing the street, when going down the stairs and when climbing the stairs.

In order not to slip on ice, the patient may stick an ordinary adhesive medical plaster on the soles of their shoes. However, this low-budget DIY trick is not very durable. When returning from shopping, it is important not to carry the bags with both hands, leaving at least one hand free for balance. The main advice in glazed frost/black ice is to watch one's step and, when seeing a potentially fall-hazardous stretch, circumvent it or ask for assistance.

When returning home at night, it is preferable to do so when accompanied by family or friends, while choosing a route through crowded and illuminated places.

Reducing injuries in elderly people is possible not only through public safety programs for this demographics, but also if senior citizens are attentive to their health and safety themselves.

If an elderly person is suffering from a disease that may provoke falls in the elderly, there is no reason to delay a visit to a cardiologist, a neurologist, or an orthopedist. Expert advice will help avert trouble.

Elderly patients need to avoid sudden movements (e.g., if a doorbell or a telephone rings); if they rush, they may harm themselves.

CONCLUSIONS

1. The authors have investigated the specific aspects of falls in elderly patients as a medico-social problem in healthcare facilities and in the home.
2. The patterns and disorders that increase the risk of falls in elderly patients have been identified.
3. The authors have investigated the specific aspects of the characteristic effects of drugs that increase the risk of falls in elderly patients.
4. The authors have investigated the living conditions and the hazards that increase the risk of falls in healthcare institutions, in residential care facilities for the elderly and in the home.
5. The ways to prevent falls in elderly patients have been identified.

REFERENCES

1. [A call for action: standard of care guidelines to assess vitamin D status are needed for patients with hip fracture.](#) Holick MF. Am J Clin Nutr. 2020 Sep 1;112(3):507-509. doi: 10.1093/ajcn/nqaa202.
2. [A prospective cohort study of the risk factors for new falls and fragility fractures in self-caring elderly patients aged 80 years and over.](#) Zhou J, Liu B, Qin MZ, Liu JP. BMC Geriatr. 2021 Feb 10;21(1):116. doi: 10.1186/s12877-021-02043-x.
3. [A Randomized Trial of a Multifactorial Strategy to Prevent Serious Fall Injuries.](#) Bhasin S, Gill TM, Reuben DB, et al. STRIDE Trial Investigators.N Engl J Med. 2020 Jul 9;383(2):129-140. doi: 10.1056/NEJMoa2002183.
4. [A Two-Stage Fall Recognition Algorithm Based on Human Posture Features.](#) Han K, Yang Q, Huang Z.Sensors (Basel). 2020 Dec 5;20(23):6966. doi: 10.3390/s20236966.
5. [Adherence to the Mediterranean Diet and Bone Fracture Risk in Middle-Aged Women: A Case Control Study.](#) Palomeras-Vilches A, Viñals-Mayolas E, Bou-Mias C, et al. Nutrients. 2019 Oct 18;11(10):2508. doi: 10.3390/nu11102508.
6. [Association between everyday walking activity, objective and perceived risk of falling in older adults.](#) Jansen CP, Klenk J, Nerz C, et al. Age Ageing. 2021 Sep 11;50(5):1586-1592. doi: 10.1093/ageing/afab037.
7. [Association of Use of Contract Nurses With Hospitalized Patient Pressure Injuries and Falls.](#) Ferguson A, Bradywood A, Williams B, Blackmore CC.J Nurs Scholarsh. 2020 Sep;52(5):527-535. doi: 10.1111/jnu.12572.
8. [Barriers and Facilitators to Older Adults Participating in Fall-Prevention Strategies After Transitioning Home from Acute Hospitalization: A](#)

[Scoping Review](#). Tzeng HM, Okpalauwaekwe U, Lyons EJ. Clin Interv Aging. 2020 Jun 25;15:971-989. doi: 10.2147/CIA.S256599.

9. [Cardiovascular Autonomic Dysfunction and Falls in People With Multiple Sclerosis: Is There a Link? An Opinion Article](#). Zanutto T, Hernandez ME, Medrano CN, et al. J. Front Neurosci. 2020 Dec 7;14:610917. doi: 10.3389/fnins.2020.610917.

10. [Clinical Practice Guidelines for Managing Frailty in Community-Dwelling Korean Elderly Adults in Primary Care Settings](#). You HS, Kwon YJ, Kim S, et al. Korean J Fam Med. 2021 Nov;42(6):413-424. doi: 10.4082/kjfm.21.0162.

11. [Design and Evaluation of an Augmented Reality-Based Exergame System to Reduce Fall Risk in the Elderly](#). Chen M, Tang Q, Xu S, et al. J Environ Res Public Health. 2020 Oct 1;17(19):7208. doi: 10.3390/ijerph17197208.

12. [Effects of anticholinergic and sedative medication use on fractures: A self-controlled design study](#). Shmuel S, Pate V, Pepin MJ, et al. J Am Geriatr Soc. 2021 Nov;69(11):3212-3224. doi: 10.1111/jgs.17377.

13. [Epigenetic Regulation of Skeletal Tissue Integrity and Osteoporosis Development](#). Chen YS, Lian WS, Kuo CW et al. Int J Mol Sci. 2020 Jul 12;21(14):4923. doi: 10.3390/ijms21144923.

14. [Evaluation of an ambulatory geriatric rehabilitation program - results of a matched cohort study based on claims data](#). Kiel S, Zimak C, Chenot JF, Schmidt CO. BMC Geriatr. 2020 Jan 29;20(1):30. doi: 10.1186/s12877-020-1415-5.

15. [Evaluation of geriatric assessment and management on the toxic effects of cancer treatment \(GAP70+\): a cluster-randomised study](#). Mohile SG, Mohamed MR, Xu H, Culakova E, et al. Lancet. 2021 Nov 20;398(10314):1894-1904. doi: 10.1016/S0140-6736(21)01789-X.

16. Exercise for preventing falls in older people living in the community: an abridged Cochrane systematic review. [Sherrington C, Fairhall N, Wallbank G, et al.](#) Br J Sports Med 54(15):885-891, 2020.
17. [Factors Associated With Insidious and Noninsidious Disability.](#) Gill TM, Murphy TE, Gahbauer EA, Leo-Summers L, Han L.J Gerontol A Biol Sci Med Sci. 2020 Oct 15;75(11):2125-2129. doi: 10.1093/gerona/glaa002.
18. [Factors associated with screening positive for high falls risk in fragility fracture patients: a cross-sectional study.](#) Rotondi NK, Beaton DE, Sujic R, et al. BMC Musculoskelet Disord. 2020 Jun 12;21(1):372. doi: 10.1186/s12891-020-03410-2.
19. [Fall-related deaths among older adults in British Columbia: cause and effect of policy change.](#) Joshi A, Rajabali F, Turcotte K et al. Inj Prev. 2020 Oct;26(5):412-416. doi: 10.1136/injuryprev-2019-043280.
20. [Falls in older adults with cancer: an updated systematic review of prevalence, injurious falls, and impact on cancer treatment.](#) Sattar S, Haase K, Kuster S, Puts M, et al. Support Care Cancer. 2021 Jan;29(1):21-33. doi: 10.1007/s00520-020-05619-2.
21. [Falls prevention at GP practices: a description of daily practice.](#) Meekes WMA, Leemrijse CJ, Weesie YM, et al. BMC Fam Pract. 2021 Sep 21;22(1):190. doi: 10.1186/s12875-021-01540-7.
22. [Group-based exercise to prevent falls in community-dwelling older adults : Update of the 2009 recommendations of the German Federal Initiative to Prevent Falls.](#) Jansen CP, Gross M, Kramer-Gmeiner F, et al. Z Gerontol Geriatr. 2021 May;54(3):229-239. doi: 10.1007/s00391-021-01876-w.
23. [Higher Fatigue Prospectively Increases the Risk of Falls in Older Men.](#) Renner SW, Cauley JA, Brown PJ, et al. Innov Aging. 2020 Nov 27;5(1):igaa061. doi: 10.1093/geroni/igaa061.
24. Impact of level of nurse experience on falls in medical surgical units. Bowden V, Bradas C, McNett M. J Nurs Manag. 2019 May;27(4):833-839. doi: 10.1111/jonm.12742. Epub 2019 Jan 9. PMID: 30565782.

25. [Implementation and Evaluation of a Fall Risk Screening Strategy Among Frail Older Adults for the Primary Care Setting: A Study Protocol.](#) Meekes WMA, Leemrijse CJ, Korevaar JC, et al. Clin Interv Aging. 2020 Sep 9;15:1625-1636. doi: 10.2147/CIA.S254864.
26. [Improving centre-based group exercise participation of older adults using the behaviour change wheel.](#) Kwok BC, Wong WP, Remedios L. BMJ Open Qual. 2021 Feb;10(1):e001078. doi: 10.1136/bmjopen-2020-001078.
27. [Interventions for preventing falls and fall-related fractures in community-dwelling older adults: A systematic review and network meta-analysis.](#) Dautzenberg L, Beglinger S, Tsokani S, et al. J Am Geriatr Soc. 2021 Oct;69(10):2973-2984. doi: 10.1111/jgs.17375.
28. [Interventions for preventing falls in people after stroke.](#) Denissen S, Staring W, Kunkel D, et al. Cochrane Database Syst Rev. 2019 Oct 1;10(10):CD008728. doi: 10.1002/14651858.CD008728.
29. [Interventions to Prevent Falls in Older Adults: Updated Evidence Report and Systematic Review for the US Preventive Services Task Force.](#) Guirguis-Blake JM, Michael YL, Perdue LA, Coppola EL, Beil TL. JAMA. 2018 Apr 24;319(16):1705-1716. doi: 10.1001/jama.2017.21962.
30. ['I've always done what I was told by the medical people': a qualitative study of the reasons why older adults attend multifactorial falls risk assessments mapped to the Theoretical Domains Framework.](#) Racine E, Soye A, Barry P, et al. BMJ Open. 2020 Feb 18;10(2):e033069. doi: 10.1136/bmjopen-2019-033069.
31. [Malnutrition Risk, Rurality, and Falls among Community-Dwelling Older Adults.](#) Eckert C, Gell NM, Wingood M, et al. J Nutr Health Aging. 2021;25(5):624-627. doi: 10.1007/s12603-021-1592-8.
32. [Modification of Potentially Inappropriate Prescribing Following Fall-Related Hospitalizations in Older Adults.](#) Walsh ME, Boland F, Moriarty F, Fahey T. Drugs Aging. 2019 May;36(5):461-470. doi: 10.1007/s40266-019-00646-z.

33. [Multilevel factors influencing falls of patients in hospital: The impact of nurse staffing.](#) Kim J, Kim S, Park J, Lee E.J Nurs Manag. 2019 Jul;27(5):1011-1019. doi: 10.1111/jonm.12765.
34. [Nurses' knowledge, attitude, and fall prevention practices at south Korean hospitals: a cross-sectional survey.](#) Cho MY, Jang SJ.BMC Nurs. 2020 Nov 24;19(1):108. doi: 10.1186/s12912-020-00507-w.
35. [Older Adults' Perceptions Regarding the Role of Physical Therapists in Fall Prevention: A Qualitative Investigation.](#) Vincenzo JL, Patton SK, Lefler LL, et al. J Geriatr Phys Ther. 2021 Mar 23:10.1519/JPT.0000000000000304. doi: 10.1519/JPT.0000000000000304.
36. [Oncology clinic nurses' attitudes and perceptions regarding implementation of routine fall assessment and fall risk screening: A survey study.](#) Sattar S, Haase KR, Milisen K, et al. Can Oncol Nurs J. 2021 Nov 1;31(4):367-375. doi: 10.5737/23688076314367375.
37. [Pain and recurrent falls in the older and oldest-old non-institutionalized population.](#) Gálvez-Barrón C, Formiga F, Miñarro A, et al. BMC Geriatr. 2020 Jan 14;20(1):15. doi: 10.1186/s12877-020-1412-8.
38. [Patient-Reported Outcome Measures \(PROMs\) to Support Adherence to Falls Prevention Clinic Recommendations: A Qualitative Study.](#) Tai D, Li E, Liu-Ambrose T, et al. Patient Prefer Adherence. 2020 Oct 30;14:2105-2121. doi: 10.2147/PPA.S269202.
39. [Persistent polypharmacy and fall injury risk: the Health, Aging and Body Composition Study.](#) Xue L, Boudreau RM, Donohue JM, et al. BMC Geriatr. 2021 Dec 15;21(1):710. doi: 10.1186/s12877-021-02695-9.
40. [Potentially serious alcohol-medication interactions and falls in community-dwelling older adults: a prospective cohort study.](#) Holton A, Boland F, Gallagher P, et al. Age Ageing. 2019 Nov 1;48(6):824-831. doi: 10.1093/ageing/afz112.

41. [Predictive Value of Verbatim Parkinson's Disease Patient-Reported Symptoms of Postural Instability and Falling.](#) Javidnia M, Arbatti L, Hosamath A, et al. *J Parkinsons Dis.* 2021;11(4):1957-1964. doi: 10.3233/JPD-212636.
42. [Preserving Mobility in Older Adults with Physical Frailty and Sarcopenia: Opportunities, Challenges, and Recommendations for Physical Activity Interventions.](#) Billot M, Calvani R, Urtamo A, et al. *Clin Interv Aging.* 2020 Sep 16;15:1675-1690. doi: 10.2147/CIA.S253535.
43. [Preventing Fragility Fractures: A 3-Month Critical Window of Opportunity.](#) Howenstein A, Wally M, Pierrie S, et al. *Geriatr Orthop Surg Rehabil.* 2021 Jun 22;12:21514593211018168. doi: 10.1177/21514593211018168.
44. [Promoting mobility and healthy aging in men: a narrative review.](#) Ebeling PR, Cicuttini F, Scott D, Jones G. *Osteoporos Int.* 2019 Oct;30(10):1911-1922. doi: 10.1007/s00198-019-05080-w.
45. [Quality Measures and Quality Improvement Initiatives in Osteoporosis-an Update.](#) French S, Choden S, Schmajuk G. *Curr Osteoporos Rep.* 2019 Dec;17(6):491-509. doi: 10.1007/s11914-019-00547-5.
46. [Revisiting the Instrumented Romberg Test: Can Today's Technology Offer a Risk-of-Fall Screening Device for Senior Citizens? An Experience-Based Approach.](#) Gallamini M, Piastra G, Lucarini S, et al. *Life (Basel).* 2021 Feb 20;11(2):161. doi: 10.3390/life11020161.
47. [Risk Factors for Falls, Falls With Injury, and Falls With Fracture Among Older Men With or at Risk of HIV Infection.](#) Erlandson KM, Zhang L, Ng DK, Althoff KN, et al. *J Acquir Immune Defic Syndr.* 2019 Aug 1;81(4):e117-e126. doi: 10.1097/QAI.0000000000002074.
48. [Risk factors for femoral fracture in lateral decubitus direct anterior approach total hip arthroplasty using conventional stems: a retrospective analysis.](#) Sun G, Yin Y, Ye Y, Li Q. *J Orthop Surg Res.* 2021 Jan 30;16(1):98. doi: 10.1186/s13018-021-02253-4.

49. [Safety and feasibility of a Dalcroze eurhythmics and a simple home exercise program among older adults with mild cognitive impairment \(MCI\) or mild dementia: the MOVE for your MIND pilot trial.](#) Fischbacher M, Chocano-Bedoya PO, Meyer U, et al. *Pilot Feasibility Stud.* 2020 Jul 15;6:101. doi: 10.1186/s40814-020-00645-7.
50. [Sex-specific 25-hydroxyvitamin D threshold concentrations for functional outcomes in older adults: PROject on Optimal Vitamin D in Older adults \(PROVIDO\).](#) Shardell M, Cappola AR, Guralnik JM, et al. *Am J Clin Nutr.* 2021 Jul 1;114(1):16-28. doi: 10.1093/ajcn/nqab025.
51. [Social Marketing Intervention to Engage Older Adults in Balance Workshops for Fall Prevention: A Multicenter Quasi-Experimental Protocol Study.](#) Goethals L, Barth N, Hupin D, et al. *Front Public Health.* 2021 Jul 14;9:614119. doi: 10.3389/fpubh.2021.614119.
52. [Social marketing interventions to promote physical activity among 60 years and older: a systematic review of the literature.](#) Goethals L, Barth N, Hupin D, et al. *BMC Public Health.* 2020 Aug 28;20(1):1312. doi: 10.1186/s12889-020-09386-x.
53. [Strategies to Prevent Serious Fall Injuries: A Commentary on Bhasin et al. A Randomized Trial of a Multifactorial Strategy to Prevent Serious Fall Injuries. *N Engl J Med.* 2020;383\(2\):129-140.](#)
54. [The Effect of Electronic Health Record Usability Redesign on Annual Screening Rates in an Ambulatory Setting.](#) Pierce RP, Eskridge BR, Rehard L, et al. *Appl Clin Inform.* 2020 Aug;11(4):580-588. doi: 10.1055/s-0040-1715828.
55. [The Effects of Four Doses of Vitamin D Supplements on Falls in Older Adults : A Response-Adaptive, Randomized Clinical Trial.](#) Appel LJ, Michos ED, Mitchell CM, et al. STURDY Collaborative Research Group. *Ann Intern Med.* 2021 Feb;174(2):145-156. doi: 10.7326/M20-3812. Epub 2020 Dec 8.

56. [The efficacy and safety of exercise for prevention of fall-related injuries in older people with different health conditions, and differing intervention protocols: a meta-analysis of randomized controlled trials.](#) Zhao R, Bu W, Chen X. BMC Geriatr. 2019 Dec 3;19(1):341. doi: 10.1186/s12877-019-1359-9.
57. [The Efficacy of Fall Hazards Identification on Fall Outcomes: A Systematic Review With Meta-analysis.](#) Ziebart C, Bobos P, Furtado R, MacDermid JC, Bryant D, Szekeres M, Suh N. Arch Rehabil Res Clin Transl. 2020 Jun 20;2(3):100065. doi: 10.1016/j.arrct.2020.100065
58. US Preventive Services Task Force, Interventions to Prevent Falls in Community-Dwelling Older Adults: US Preventive Services Task Force Recommendation Statement. Grossman DC, Curry SJ, Owens DK, et al. JAMA. 2018 Apr 24;319(16):1696-1704. doi: 10.1001/jama.2018.3097. PMID: 29710141.
59. [VITamin D and OmegA-3 Trial \(VITAL\): Effects of Vitamin D Supplements on Risk of Falls in the US Population.](#) LeBoff MS, Murata EM, Cook NR, et al. J Clin Endocrinol Metab. 2020 Sep 1;105(9):2929-38. doi: 10.1210/clinem/dgaa311.
60. Vitamin D supplement on prevention of fall and fracture: A meta-analysis of randomized controlled trials. [Thanapluetiwong S, Chewcharat A, Takkavatakarn K, et al.](#) Medicine (Baltimore) 99(34):e21506, 2020.