

Primary Health Center Banja Luka, Republic of Srpska, Bosnia and Hercegovina¹
 Medical Faculty, University of Banja Luka, Bosnia and Hercegovina²
 University Clinical Center of Republic of Srpska³

Original study
Originalni naučni rad
 UDK 616-001-02-053.9:616.89-008.454
 UDK 616-001-02-053.9:616.894
 UDK 613.98:614.821
<https://doi.org/10.2298/MPNS1812368S>

EFFECTS OF DEPRESSION AND DEMENTIA ON THE RISK OF FALLS IN THE ELDERLY TREATED AT THE HEALTH CENTER BANJA LUKA

UTICAJ DEPRESIJE I DEMENCIJE NA RIZIK OD PADA KOD STARIJIH OSOBA LEČENIH U DOMU ZDRAVLJA BANJA LUKA

Kosana STANETIĆ^{1,2}, Vesna KEVIĆ¹ and Mirko STANETIĆ^{2,3}

Summary

Introduction. The number of people over 65 is increasing in the world, and falls are rather common among them. The objective of this research was to examine the impact of depression, dementia, the number of chronic diseases and the number of used medications in the risk of falls in the elderly. **Material and Methods.** We carried out a prospective study during the period from March 20 to May 20, 2016. The patients were interviewed, and data were also obtained from medical records. The data collection included a socio-demographic questionnaire, the Tinetti Gait and Balance Instrument, Beck Depression Inventory and the Folstein Mini-Mental State test to assess cognitive functions. **Results.** The study included 208 patients older than 65 years, 81 men, 127 women. The Tinetti Gait and Balance tool revealed that one-third (63) of patients were at a high risk of falls, 35 patients at a moderate risk, and 110 patients presented with a low risk of falls. The results of our study showed a statistically significant association between dementia ($p = 0.000$) and depression ($p = 0.000$) as the risks of falling. Patients with some chronic diseases and patients continuously taking various drugs were also at higher risk of falls. **Conclusion.** Timely detection and treatment of depression and dementia may contribute to reducing the risk of falls in the elderly. Patients' medication lists should be reviewed to decrease the number of medications or modify the dose. Family physicians play a major role in preventing falls in the elderly.

Key words: Depressive Disorder; Dementia; Accidental Falls; Risk Factors; Cognition; Walk Test; Postural Balance; Chronic Disease; Therapeutics

Introduction

Old age (third age) is a stage of life, not a disease. Aging is a biological process associated with maturation, a continuing process that lasts a lifetime. It is related with decline in all vital functions that makes it susceptible to diseases and injuries. The United Nations defined the elderly as people who are > 60 years old. Most developed countries have adopted a definition that the elderly are people aged

Sažetak

Uvod. U svetu kontinuirano raste broj osoba preko 65 godina, a povećava se i broj padova kod ovih osoba. Cilj rada je ispitati uticaj depresije, demencije, broja hroničnih bolesti i broja korišćenih lekova na rizik od pada kod starijih osoba. **Materijal i metode.** Istraživanje je obavljeno po tipu prospektivne studije i sprovedno je u periodu od 20. marta do 20. maja 2016. godine. Pacijenti su anketirani, a uzimani su i podaci iz zdravstvenih kartona. Kao instrumenti za prikupljanje podataka korišteni su: socio-demografski upitnik, *The Tinetti Gait and Balance Instrument*, *Beck Inventory* za procenu depresivnosti i kratki orijentacijski test *Folstein Mini Mental State* za procenu kognitivnih funkcija. **Rezultati.** Istraživanjem je obuhvaćeno 208 pacijenata starijih od 65 godina, muškaraca 81, žena 127. *Tinetti* upitnik za procenu hoda i ravnoteže pokazao je da jedna trećina pacijenata ima visok rizik od pada (63), umeren rizik ima 35, a nizak rizik 110 pacijenata. Rezultati našeg istraživanja pokazuju statistički značajnu povezanost između demencije ($p = 0,000$) i depresije ($p = 0,000$) sa rizikom od pada. Pacijenti sa većim brojem hroničnih bolesti i koji koriste veći broj lekova u kontinuiranoj terapiji su u većem riziku od pada. **Zaključak.** Blagovremeno otkrivanje i lečenje depresije i demencije može doprineti smanjenju rizika od pada kod starijih osoba. Pacijentima bi trebalo pregledati lekove koje koriste sa ciljem smanjenja broja korišćenih lekova ili modifikacije doze. Doktor porodične medicine ima veliku ulogu u prevenciji padova kod starijih osoba.

Glavne reči: depresivni poremećaji; demencija; slučajni padovi; faktori rizika; kognicija; test hoda; ravnoteža; hronično oboljenje; terapija

65 and over. In addition to age, as a criterion for the definition of the elderly, there are also changes related to old age: changes in social roles (e.g. working methods, adult children, menopause), and impairment of abilities (disability, senility, mental changes). The changes in social roles are the most important criterion for the definition of old age [1, 2].

The population of elderly is growing much faster than the general population. In the general population, percentage of the elderly has increased from 9.2% in

Abbreviations

MMSE	– Mini Mental State Examination
ACE	– angiotensin-converting enzyme
AD	– Alzheimer's disease

1990 to 11.7% in 2013, and it is expected to grow to 21.15% by 2050 (from 841 million in 2013 to two billion in 2050). In developed countries, the number of older persons has already exceeded the number of children, and it is considered that this number will double by 2050. Currently, two-thirds of the elderly population in the world lives in developing countries. Considering that the older population grows faster in less-developed countries, it is expected that in 2050 eight in ten older people will live in developing or less developed countries. The elder population is dominated by women. People over 80 years of age account for 14% of the elder population, and it is believed that in 2050 19% will be older than 80 [3].

Falls are more common among the elderly than in the general population. More than one-third of people older than 65 falls each year, and half of them are repeated falls [4, 5]. Approximately one in ten falls results in severe injuries, such as hip fracture, other fractures, subdural hematoma, other serious soft tissue injuries or head injuries [6–8].

The most common mental disorders in the elderly are depression and dementia, which are a significant public health problem, although they are diagnosed and treated in little less than 20% [9].

According to the previous researches worldwide, the prevalence of depression in the elderly population varies significantly and estimates that can be found in the literature range from 3% to 35% [10, 11]. Depressive disorder is the fourth leading cause of the global disease burden and it is the second most common health problem in women. The number of persons suffering from depressive disorder is in constant rise since the beginning of the last century to the present day in all industrialized countries, so that 20% of women and 10% of men develop at least one depressive episode during their lifetime [12].

Depression is not an unavoidable consequence of aging. The Croatian Society for Gerontology and Geriatrics has confirmed that loneliness is a major problem in the elderly. The elderly are prone to social isolation due to permanent immobility and it is consequently associated with depression. Most geriatric patients rarely contact their family doctor in relation to this issue, and members of their close family consider that depressive mood is a normal part of getting older. Older age is associated with several health problems, financial difficulties, stress, alienation, dissatisfaction, retirement, loss of a spouse, family members or friends, being left by children, reduced need and motivation for activities that used to be a normal part of life, so it all makes the elderly susceptible to depression [13]. Depression in the elderly can be treated successfully, and the elderly respond to treatment as well as the young [14].

Dementia is a syndrome of global and progressive impairment of acquired cognitive abilities,

caused by organic disease of the central nervous system, with preserved consciousness, which particularly damages memory, learning, abstract thinking, orientation and understanding of visual-spatial relations [15]. Dementia is a disorder of mental functions in at least three of the following five mental activity domains: cognition, memory, language, visuospatial skills and personality [16]. It is a clinical syndrome characterized by deterioration of previously acquired intellectual functions, which lead to reduction or inability to perform daily activities. It is also an important factor for development of other geriatric problems such as falls, incontinence and others. Considering that the number of older adults, who are at higher risk of falls, is continuously increasing in our country, our goal was to study the impact of depression, dementia and other factors on the risk of falls in the elderly.

Material and Methods

A prospective study was carried out during the period from March 20 to May 20, 2016. The patients were interviewed, and data were obtained from electronic or written medical records. The study included outpatients aged 65 and older who were treated by family physicians in Banja Luka. Their medical histories were reviewed to obtain data on patients who had falls in the past five years and whether falls were associated with any fracture.

The study included 208 randomly selected patients from three teams of family physicians of the Health Center Banja Luka. Using the patient registry, every third patient who was ≥ 65 years old, regardless of gender, was included in the study. Out of a total of 724 patients older than 65, registered in these three teams, 241 patients were asked to participate in the study. Of these 241 patients, the research included 208 patients (response rate 86.3%). Patients who did not take part in the study were unable to respond or did not want to participate in the study. All patients were informed about the research objectives and signed informed consent forms. The study was conducted in compliance with the Helsinki Declaration on medical research and the principles of good scientific practice. A consent was also obtained from the Ethics Committee of the Health Center in Banja Luka.

The instruments for data collection were a general questionnaire on socio-demographic data, conditions of residence, education level, marital status, chronic diseases and current therapy, and the Tinetti Gait and Balance Instrument [17] which was designed to determine the risk of falls in the elderly in the next year. We conducted a physical examination of patients and set up a state of their balance for which we calculated a special record, as well as stroke patients for which we have also calculated the score and eventually got the final score based on which the risk of falls in the next year was assessed. Beck Depression Inventory was used to evaluate depression [18]. The patients' task was to read multiple-choice questions carefully, and choose the statement that best described

how they felt that week and that day. Each claim was assigned to appropriate number. The obtained score was a basis to determine the presence or absence of depression. A short, Folstein Mini Mental State Examination (MMSE) [19] was used for the assessment of cognitive impairment. This questionnaire tested orientation of the patient, current memory, attention and mental calculation, memory and language. By summing all the individual scores we obtained the final score, indicating the patients' cognitive level.

After entering the gathered data into the Excel database, they were statistically analyzed. The results were analyzed using the Statistical Package for the Social Sciences (SPSS) 11.5 on several levels. Data were processed using different statistical tests: the descriptive analysis of frequencies and percentages for the whole reviewed sample and each question individually. Differences between particular categories of subjects (age, gender, household size, qualifications, etc.), scales (mental status, depression and the risk of falling) were analyzed using Chi-square test. A t-test was used to compare the average value of two groups. Significance levels were set at 0.05 and 0.01.

Results

The study included 208 patients older than 65 years. There were 38.9 % of male and 61.1% of female subjects. The average age of patients was 73.7 years. Most patients (36.5%) were 65 to 70 years old, and 14.9% patients were 81 years old or older. Most subjects (61.1%) were married, and 35.1% of patients were widows/widowers. Of the total number, 82.7% of patients lived in urban, and 58.2% lived in rural area. A small number of subjects lived alone (27.4%), 41.8% lived with a spouse, and one-third of the subjects lived in large families with three or more family members. The households were generally (86.5%) with no children under 18 years of age. Most patients had secondary education (40.4%), 7.2% of patients had no formal schooling, while only 5.8% of patients had an academic title (**Table 1**).

In the past five years, 110 (52.9%) patients had no falls, and 98 (47.1%) had one or more falls. Most patients (N = 59) reported one fall (28.4%), two or three falls were reported by 14 patients (6.7%), five falls were reported by six patients (2.9%), and six falls were reported by 3 patients.

The Tinetti gait and balance test revealed that the one-third (63) of patients were at high risk of falling (30.3%), 35 patients were at a moderate risk (16.8%), and low risk was observed in 110 (52.9%) patients.

Results of the MMSE showed that most of the subjects had normal cognitive functions 149 (71.6%), 44 (21.2%) patients had borderline cognitive functions, and 15 (7.2%) patients had impaired cognition.

The Beck Depression Inventory found that almost half of patients - 102 (49.0%) had elements of depression, mild depression was observed in 55 (26.4%), and moderate in 51 (24.5%) patients.

The results of our study showed a statistically significant association between dementia and the risk of falling ($p = 0.000$). Most patients (86.4%) at a low risk of falling also had normal cognitive functions, 13.6% of patients had borderline cognitive functions, and in this group, there were no patients with impaired cognition. In the group of patients at high risk of falling, 28 patients were with normal cognitive functions, 22 were with borderline, and 13 patients were with impaired cognitive functions (**Table 2**).

The degree of depression was statistically significantly associated with the risk of falling ($p = 0.000$). Patients at high risk of falls showed moderate depression (58.8%), and only 16.7% of patients had no depression. In the group of patients at low risk of falling, 45.5% had mild depression, and 15.7% had moderate depression (**Table 3**).

During the study, we examined the impact of the number of chronic diseases and the number of medications used continuously on the risk of falling. There was a statistically significant correlation ($p = 0.000$) between the number of chronic diseases and the risk of falling; chronic diseases were related with a larger risk of falling. The most common chronic diseases were hypertension in 192 patients (92.3%), congestive heart failure (CHF) in 41 (19.7%), osteoarthritis (OA) in 56 (26.9%), diabetes mellitus in 49 (23.6%), and visual disorders in 63 (30.3%) patients. In the group of patients at high risk of falling, 52.5% patients were suffering from three or more diseases, 20.8% were suffering from three concurrent diseases, and 13.3% of patients had up to two diseases. In the group of patients at low risk of falling, 69.3% of patients had up to two, 58.5% suffered from three concurrent diseases, and 33.8% of patients had four or more disease (**Table 4**).

The number of medications used continuously significantly affected the risk of falling ($p = 0.000$), i.e., the greater the number of medications, the higher the risk of falls. The most commonly used medications were angiotensin-converting enzyme (ACE) inhibitors by 135 (64.9%), ACE inhibitor + diuretics by 69 (33.2%), beta-blockers by 72 (34.6%), calcium-channel blockers by 52 (25.0%), nitrates by 43 (20.7%), diuretics by 37 (17.8%), oral antihyperglycemic agents by 37 (17.8%), insulin by 14 (6.7%), benzodiazepines by 64 (30.8%) and nonsteroidal anti-inflammatory drugs (NSAIDs) by 72 (34.6%) patients. In the group of patients at high risk of falls, 50.5% used four or more drugs, while in the group of patients at low risk of falls 69.0% used two or fewer drugs (**Table 5**).

Discussion

Our research shows that the degree of depression has a statistically significant influence on the risk of falls ($p = 0.000$). It suggests that the greater the degree of depression, the greater the risk of falls, and it is in agreement with numerous studies that have been conducted around the world.

Kamel et al. [20] conducted a study in Egypt including 340 subjects confirming that the level of

Table 1. Socio-demographic data of the participants
Tabela 1. Sociodemografski podaci ispitanika

Variable <i>Varijabla</i>	Number of patients (N = 208) <i>Broj pacijenata</i>	Percentage (%) <i>Procenat</i>
Gender/Pol		
Male/ <i>Muški</i>	81	38.9
Female/ <i>Ženski</i>	127	61.1
Age/Dob (Years/Godine)		
65 - 70	76	36.5
71 - 75	56	26.9
76 - 80	45	21.6
≥ 80	31	14.9
Marital status/Bračno stanje		
Married/ <i>U braku</i>	127	61.1
Single/ <i>Neoženjen/neudata</i>	5	2.4
Divorced/ <i>Razveden/razvedena</i>	3	1.4
Widowed/ <i>Udovac/udovica</i>	73	35.1
Place of living/Mesto življenja		
Village/ <i>Selo</i>	36	17.3
City/ <i>Grad</i>	172	82.7
Dwelling house/Mjesto stanovanja		
Apartment building/ <i>Zgrada</i>	87	41.8
House/ <i>Kuća</i>	121	58.2
Number of persons in the household/Broj osoba u domaćinstvu		
One person/ <i>Jedna osoba</i>	57	27.4
Two persons/ <i>Dve osobe</i>	87	41.8
Three and more/ <i>Tri i više osoba</i>	64	64.8
Number of children in the family/Broj dece u porodici		
Childless/ <i>Bez dece</i>	180	86.5
One child/ <i>Jedno dete</i>	14	6.7
Two children/ <i>Dvoje dece</i>	13	6.3
Three and more children/ <i>Troje i više dece</i>	1	0.5
Education level/Stepen obrazovanja		
No formal schooling/ <i>Bez škole</i>	15	7.2
Four grades of elementary school/ <i>Četiri razreda osnovne škole</i>	25	12.0
Eight grades of elementary school/ <i>Osam razreda osnovne škole</i>	44	21.2
High school/ <i>Srednja i viša škola</i>	112	53.9
University degree/ <i>Fakultet</i>	12	5.8

depression and the risk of falling were significantly associated. The same results were also confirmed by Dubljanin-Raspopović et al. [21] in their study, noting that more than 90% of subjects also had some degree of cognitive impairment.

The depressive symptoms that are statistically significantly associated with risk of falls in the elderly are also reported by Eggermont et al. [22] in a sample of 722 adults, aged 78.3 years on average.

Kwan et al. [23] conducted a two-year study in five randomly selected villages in Taiwan. The study included 260 people aged 65 to 91, the average age 74.9. None of the subjects used antidepressants. Of the total of 260 subjects, 174 (66.9%) experienced no fall, 51 (19.6%) fell once, and 35 (13.5%) fell twice or more. Depressive symptoms were sig-

nificantly more commonly reported among the subjects who fell several times (40.0%), those with one fall (27.5%) and in subjects without falling these symptoms were reported only by 16.1% patients. It was concluded that depressive symptoms are often present in old Taiwanese that are significantly associated with the risk of falling.

Also, an extensive study was conducted in Japan in 2010. It was carried out by Tanaka et al. [24]. The study included 563 subjects aged 65 and over, villagers of Kumamoto Prefecture in Japan. To establish the level of depression and risk of falls, Geriatric Depression Scale - Short Form and the Simple Screening Test for Risk of Falls were used. Also, different factors were considered, including age, gender, chronic diseases, use of hypnotics, cognitive

Table 2. Association between dementia and the risk of falls
Tabela 2. Povezanost između demencije i rizika od pada

Risk of falls <i>Rizik od pada</i>	Folstein Mini-Mental State Examination / <i>Folstajnov mini kognitivni test</i>			χ^2 test	p*
	Normal/ <i>Normalno</i> N (%)	Borderline/ <i>Granično</i> N (%)	Impaired/ <i>Oslabljen</i> N (%)		
High/ <i>Visok</i>	28 (44.4)	22 (34.9)	13 (20.6)	42.255	0.000
Moderate/ <i>Umeren</i>	26 (74.3)	7 (20.0)	2 (5.7)		
Low/ <i>Nizak</i>	95 (86.4)	15 (13.6)	0 (0.0)		

*Statistically relevant difference at $p < 0,05$

Tabela 3. Association between depression and the risk of falls
Tabela 3. Povezanost između depresije i rizika od pada

Risk of falls <i>Rizik od pada</i>	Beck Inventory/ <i>Beckov indicator depresije</i>			χ^2 test	p*
	No depression <i>Nema depresije</i> N (%)	Mild depression <i>Blaga depresija</i> N (%)	Moderate depression <i>Umerena depresija</i> N (%)		
High/ <i>Visok</i>	17 (16.7)	16 (29.1)	30 (58.8)	53.359	0.000
Moderate/ <i>Umeren</i>	8 (7.8)	14 (25.5)	13 (25.5)		
Low/ <i>Nizak</i>	77 (75.5)	25 (45.5)	8 (15.7)		

*Statistically relevant difference at $p < 0.05$

functions and their association with falls. Of all, 395 subjects had a significant cognitive impairment, and a statistically significant relationship between depression and risk of falls.

In Boston, an extensive study was conducted including 763 patients aged 70 and over. It was done by Quach et al. [25] in the period from 2005 to 2009. The entry criteria were at least 70 years of age, being able to communicate in English, walk independently around the small room, either with or without a cane or a walker and no significant cognitive impairment, i. e. Mini-Mental State Examination scores ≥ 18 . The results of this study showed that depression increases the risk of falling both inside and outside the home. This was confirmed by the research of Kelsey et al. [26].

In our study, 71.6% of patients had normal cognition, 7.2% had impaired cognition, and 26.4% of patients showed signs of mild depression, and 24.5% had elements of moderate depression. Slightly more than half of the patients showed evidence of depression. In their study, carried out at the Health Center Čuprija in 2010, including 100 patients aged 65 - 84 years, Urošević et al. [27] showed that older people who were treated in primary care presented with a high percentage (55.0%) of depression. There is accumulating evidence to suggest that depression may be a risk factor for the development of dementia [28].

The results of our study showed a statistically significant association between dementia and the risk of falling ($p = 0.000$). There was no patient at low risk of falling and impaired cognition.

By studying the correlation of mental status and the risk of falling Kamel et al. [20] found that 47.1% of the surveyed population had impaired cognitive functions, and 32.3% of them have experienced a fall. The statistically significant association between cog-

nitive impairment and the risk of falling was observed, being in agreement with our results.

However, in a study conducted in Poland, Kamin-ska et al. [29] have not found a statistically significant association between dementia and risk of falls.

Eggermont et al. [22] carried out an extensive 18-month long study, including 722 patients aged 70 and over, in Boston and five surrounding cities not further than 5 miles in radius. The average age of patients was 78.3, and their mental status was measured using the Mini-Mental State Examination. The results of the study showed that the mental status of patients was significantly associated with the risk of falling.

Gleason et al. studied the risk of falls in older people who showed less severe cognitive impairment at a multimedia test in comparison to the control group and showed that the risk of falling increases with higher cognitive impairment. The study included 172 elderly patients over a period of 12 months [30].

Borges et al. examined the fear of falls and falls in older patients with secondary cognitive impairment and Alzheimer's disease (AD) and found a large number of falls in this group of patients compared to the control group. Elderly patients with cognitive impairment were more likely to report fear of falling than those with AD [31].

In their study, Muir et al. demonstrated a strong association between dementia in the elderly and the risk of falls [32].

Stark et al. conducted a prospective cohort study over 12 months in 125 patients, mostly women, 96% of them were Caucasian and the average age of 74.4. The phenomenon of falling in people who probably suffered from preclinical AD was observed. It has

Table 4. The impact of the number of chronic diseases on the risk of falls**Tabela 4.** Uticaj broja hroničnih bolesti na rizik od pada

Risk of falls Rizik od pada	Number of chronic diseases/Broj hroničnih bolesti			Total Ukupno N (%)	χ^2 test	p*
	≤ two diseases ≤ dve bolesti	three diseases tri bolesti	more than three diseases više od tri bolesti			
	N (%)	N (%)	N (%)			
High/Visok	10 (13.3)	11 (20.8)	42 (52.5)	63 (30.3)	32.378	0.000
Moderate/Umeren	13 (17.3)	11 (20.8)	11 (13.8)	35 (16.8)		
Low/Nizak	52 (69.3)	31 (58.5)	27 (33.8)	110 (52.9)		

*Statistically relevant difference at $p < 0.05$

been shown that the preclinical form of AD was a likely risk of falling in the elderly [33].

Out of a total of 208 patients who participated in our study, most were patients suffering from three or more diseases – 80 (38.5%), while 75 (36.1%) suffered from two or less diseases. There is a statistically significant correlation ($p = 0.000$) between the number of chronic diseases and the risk of falling; the higher the number of chronic diseases, the larger the risk of falling. In the group of patients at high risk of falls, 42 (52.5%) were patients suffering from three or more diseases, and only 10 (13.3%) patients were with up to two diseases. In the group of patients at low risk of falling, 52 (69.3%) were patients suffering from up to two, 31 (58.5%) were suffering from 3 concurrent diseases, and 27 (33.8%) suffered from three or more diseases.

The analysis of chronic diseases in the study group showed that congestive heart failure ($p = 0.001$), depression ($p = 0.035$), cerebrovascular diseases ($p = 0.009$), osteoporosis ($p = 0.017$), and osteoarthritis ($p = 0.000$) significantly increased the risk of falls. It also showed that hypertension, diabetes mellitus and vision problems of the elderly do not affect significantly the risk of falls.

In their study, Stanetić et al. [34] showed that hypertension and diabetes, as isolated diseases, have no significant effects on the risk of falls in the elderly, but considering that patients suffering from these diseases are mainly associated with comorbidity, the risk of falling increases with age. All patients suffering from diabetes mellitus also had hypertension. In their study, the greatest risk of falling was found in patients suffering from cardiovascular diseases, such as cardiac arrhythmia, coronary artery disease and heart

failure. One chronic disease was diagnosed in 21 patients (14.0%), two were diagnosed in 36 patients (24.0%), three in 45 (30.0%), four in 24 (16.0%) and five chronic diseases were diagnosed in 14 (9.3%) patients. Using Pearson's coefficient of linear correlation, it has been proven that patients suffering from several chronic diseases at the same time have a higher risk of falls that was also confirmed in our study.

Kamel et al. [20] pointed out that the most common chronic diseases in Egyptian patients who had experienced falls were as follows: one-third of patients (30.0%) had diabetes mellitus, one-third (29.7%) had hypertension and 18.5% patients had osteoarthritis.

Lo Alexander et al. [35] pointed out that in patients who participated in the study in Alabama it was confirmed that the increasing number of chronic diseases increased the risk of falls.

Dubljanin-Raspopović et al. [21] found that the largest number of patients who were hospitalized due to a fall-related hip fracture, suffered from depression 161 (47.1%), followed by vascular diseases 61 (18.0%), chronic obstructive pulmonary disease 22 (6.5%), arthritis 8 (2.4%), neurological diseases (cerebrovascular accident with neurologic deficit - Parkinson's disease) 45 (13.16%) and visual impairment 199 (58.2%). In our research, vision problems had no significant effect on the risk of falling. This can be explained by the fact that patients who have a vision problem cautiously move in their environment.

Yu PL et al. examined the incidence of falls in 1,512 persons during one year. They examined the influence of various chronic diseases and the occurrence of falls in patients older than 60 years. The research has shown that people suffering from de-

Table 5. The impact of the number of used medications on the risk of falls**Tabela 5.** Uticaj broja korištenih lekova na rizik od pada

Risk of falls Rizik od pada	Number of medications/Broj lijekova			Total Ukupno N (%)	χ^2 test	p*
	≤ two drugs ≤ dva leka	three drugs tri leka	four and more drugs četiri i više lekova			
	N (%)	N (%)	N (%)			
High/Visok	8 (11.3)	9 (19.6)	46 (50.5)	63 (30.3)	35.461	0.000
Moderate/Umeren	14 (19.7)	6 (13.0)	15 (16.5)	35 (16.8)		
Low/Nizak	49 (69.0)	31 (67.4)	30 (33.0)	110 (52.9)		

*Statistically relevant difference at $p < 0.05$

mentia, depression and who have more than two chronic diseases are at higher risk of falls [36].

A study conducted in Korea in 2011 investigated the risk factors of falls in the elderly Koreans showed that patients suffering from diabetes mellitus, osteoarthritis, osteoporosis, urinary incontinence, cataracts, depression and stroke were at high risk of falls. People with hypertension were at low risk of falls [37].

Out of a total of 208 patients in our study, most of them - 91 (43.8%) took 4 or more medications, and 71 (34.1%) used two or fewer drugs. The results of our research suggest that the number of medications that patients use in continuous treatment significantly affect the risk of falls ($p = 0.000$), i.e. the greater the number of drugs, the higher the risk of falls. In the group of patients at high risk of falls, 46 (50.5%) used four or more drugs, 9 patients (19.6%) used three drugs, and only 8 (11.3%) patients used two or fewer drugs. In the group at low risk of falls, there were 49 (69.0%) patients using two or fewer drugs, and 30 (33.0%) patients used four or more drugs.

The analysis of the impact of certain medications used by patients in the study group showed that diuretics ($p = 0.000$), nitrates ($p = 0.011$), benzodiazepines ($p = 0.000$) and NSAIDs ($p = 0.000$) statistically significantly increase the risk of falls.

Stanetić et al. [34] pointed out that the greatest risk of falls was associated with diuretics and NSAIDs that coincides with our results. Benzodiazepines were used by 50 (33.3%) patients, and it did not affect significantly the risk of falls, which is opposite to our results. In their study, more than half of the subjects used more than three drugs continuously, which certainly increased the risk of falls.

In their study, Leipzig et al. [38] confirmed that older people who use more than three or four drugs are at higher risk of falls.

Matović et al. [39] conducted a study at the Community Health Center Foča and found that eight out of 300 patients, who reported at least one fall during the 12 months, used more than three drugs. A large number of authors have confirmed that using multiple drugs carries a risk of adverse interactions that may increase the risk of falls [40–42].

Dubljanin-Raspopović et al. performed a research at the Department of Orthopedic Surgery, Clinical Center of Serbia, found that more than a third of patients 124 (36.3%) who sustained a hip fracture after a little trauma, used more than four drugs [21].

Quach et al. conducted a study including 763 patients aged 70 years or more, reported that the risk of falls increased in patients taking antidepressants compared to those without depression and using no drugs for depression [25].

Kamel et al. conducted a study in Egypt including 340 patients, aged 60 years and over; 78.5% of

them used medications and 51.2% of them had at least one fall. This could be explained by drug interactions that affected mental alertness and motor coordination. About a third of the studied population used NSAIDs and half of them hypoglycemic agents [20]. Ziere et al. pointed out that the risk of falls increases with the number of daily used drugs. Using more than three drugs per day increases the risk of falls in the elderly [43].

Many studies, including studies conducted by Wang and de Vries et al., have shown a significant association between the use of benzodiazepines and falls or fractures. The risk of falls is highest with the initial doses and after a prolonged usage of drugs [44, 45].

Benzodiazepines are still the most frequently prescribed hypnotic sedatives in the elderly. Our study found that one-third of the patients used benzodiazepines, and in the group of those who have experienced falls one third used benzodiazepines. These drugs should be prescribed for a short time, not more than a few weeks, but the research shows that nearly 80% of old people used them continuously for more than two years [46].

The important role of a family physician is early diagnosis and treatment of patients with depression and dementia. A large number of authors made recommendations for prevention of falls in older people, because those are the most effective and efficient interventions. The preventive measures include health promotion, review of medications that patients use, physical exercise and creation of security at home and in the home environment. Other authors recommend professional training for establishing gait and balance, a gradual reduction in the use of psychotropic substances (benzodiazepines, hypnotics, neuroleptics, antidepressants) and modification of risky behavior. Specific recommendations in the literature include wearing safe and comfortable shoes, slippers (slip resistant), using light at night and making additional steps. All older patients should periodically review their medications, including over-the-counter medications, reduce the number of drugs or modify the doses. The family physician has a significant role in prevention of falls in the elderly [47, 48].

Conclusion

In the studied group of patients, 30.3% were at high risk of falls (measured using Tinetti questionnaire). The Folstein Mini-Mental Status test revealed that 7.2% of patients had impaired cognitive functions. Beck Inventory showed that 26.4% of patients had mild depression and 24.5% had moderate depression. Dementia and depression significantly affect the risk of falling in the elderly.

References

1. World Health Organization. Proposed working definition of an older person in Africa for the MDS Project [Internet]. 2013 [cited 2015 Apr 12]. Available from: <http://www.who.int/healthinfo/survey/ageingdefnolder/en/>.
2. Milanović P, Milošević DP, Davidović M. Padovi u starosti. In: Milošević DP, Davidović M, editors. Medicinska gerontologija. Beograd: Davidović M, Milošević DP; 2007. p. 81-90.
3. United Nations. World population ageing 2013 [Internet]. New York: United Nations; 2013 [cited 2015 May 18]. Available from: <https://www.un.org/.../population/.../ageing/WorldPopulationAgeingReport2013.shtml>.
4. Tinetti ME. Clinical practice. Preventing falls in elderly persons. *N Engl J Med*. 2003;348(1):42-9.
5. American Geriatric Society, British Geriatrics Society, American Academy of Orthopaedic Surgeons Panel on Falls Prevention. Guideline for the prevention of falls in older persons. *J Am Geriatr Soc*. 2001;49(5):664-72.
6. Parker MJ, Gillespie LD, Gillespie WJ. Hip protectors for preventing hip fractures in the elderly. *Cochrane Database Syst Rev*. 2001;2:CD001255.
7. Stevens M, Holman CD, Bennett N. Preventing falls in older people: impact of an intervention to reduce environmental hazards in the home. *J Am Geriatr Soc*. 2001;49(11):1442-7.
8. Jovanović Z. Mehanizmi neurodegeneracije kod Alchajmerove bolesti. *Med Pregl*. 2012;65(7-8):301-7.
9. Woolcott JC, Richardson KJ, Wiens MO, Patel B, Marin J, Khan KM, et al. Meta-analysis of the impact of 9 medication classes on falls in elderly persons. *Arch Intern Med*. 2009;169(21):1952-60.
10. Scheffer AC, Schuurmans MJ, van Dijk N, van der Hoof T, de Rooij SE. Fear of falling: measurement strategy, prevalence, risk factors and consequences among older persons. *Age Ageing*. 2008;37(1):19-24.
11. Cole MG, Bellavance F, Mansour A. Prognosis of depression in elderly community and primary care populations: a systematic review and meta-analysis. *Am J Psychiatr*. 1999;156(8):1182-9.
12. Maj M, Sartorius N, editors. Depressive disorders [monograph on the Internet]. Chichester: John Wiley & Sons; 2002 [cited 2015 May 18]. Available from: <http://www.al-edu.com/wp-content/uploads/2014/05/MajSartorius-eds-Depressive-Disorders.pdf>.
13. Martinčević-Ljumanović R. Zdrava i sretna starost: suvremena gerontologija i gerijatrija. Zagreb: Spektar; 1985.
14. Blazer DG. Depression in late life: a review and commentary. *J Gerontol A Biol Sci Med Sci*. 2003;58(3):249-65.
15. Brayne C, Gao L, Dewey M, Matthews FE. Dementia before death in ageing societies - the promise of prevention and the reality. *Plos Med*. 2006;3(10):e397.
16. Pavlović DM, Pavlović AM. Demencije. *Engrami*. 2002;24(3-4):9-28.
17. Tinetti ME, Doucette J, Claus E, Morottoli RA. Risk factors for serious injury during falls by older persons in the community. *J Am Geriatr Soc*. 1995;43(11):1214-21.
18. Beck AT, Guth D, Steer R, Ball R. Screening for major depression disorders in medical inpatients with the Beck Depression Inventory for Primary Care. *Behav Res Ther*. 1997;35(8):785-91.
19. Folstein MF, Folstein SE, McHugh PR. "Mini-mental state". A practical method for grading the cognitive state of patients for the clinician. *J Psychiatr Res*. 1975;12(3):189-98.
20. Kamel MH, Abdulmajeed AA, Ismail Sel-S. Risk factors of falls among elderly living in urban Suez-Egypt. *Pan Afr Med J*. 2013;14:26.
21. Dubljanin-Raspopović E, Denić Marković Lj, Tulić G, Grajić M, Tomanović S, Kadija M, et al. Prevencija preloma kuka u gerijatrijskoj populaciji – neiskorišćena prilika. *Vojnosanit Pregl*. 2012;69(5):420-4.
22. Eggermont LH, Penninx BW, Jones RN, Leveille SG. Depressive symptoms, chronic pain and falls in older community-dwelling adults: the MOBILIZE Boston Study. *J Am Geriatr Soc*. 2012;60(2):230-7.
23. Kwan MM, Lin SI, Close JC, Lord SR. Depressive symptoms in addition to visual impairment, reduced strength and poor balance predict falls in older Taiwanese people. *Age Ageing*. 2012;41(5):606-12.
24. Tanaka M, Kusaga M, Ushijima K, Watanabe C. Association between depression and fall risk among elderly community residents. *Nihon Ronen Igakkai Zasshi*. 2012;49(6):760-6.
25. Quach L, Yang MF, Berry SD, Newton E, Jones RN, Burr JA, et al. Depression, antidepressants and falls among community-dwelling elderly people: the MOBILIZE Boston Study. *J Gerontol A Biol Sci Med Sci*. 2013;68(12):1575-81.
26. Kelsey JL, Berry SD, Procter-Gray E, Quach L, Nguyen US, Li W, et al. Indoor and outdoor falls in older adults are different: the maintenance of balance, independent living, intellect and Zest in the Elderly of Boston Study. *J Am Geriatr Soc*. 2010;58(11):2135-41.
27. Urošević J, Davidović M, Odović G, Alexopoulos CG, Mitrović Lj. Učestalost depresije kod starih osoba. *PONS medicinski časopis*. 2010;7(4):144-9.
28. Lovretić V, Mihaljević-Pešić A. Je li poremećaj kognitivnih funkcija u depresiji put u demenciju. *Socijalna psihijatrija*. 2013;41(2):109-17.
29. Kamiska MS, Brodowski J, Karakiewicz B. Fall risk factors in community-dwelling elderly depending on their physical function, cognitive status and symptoms of depression. *Int J Environ Res Public Health*. 2015;12(4):3406-16.
30. Gleason CE, Gangnon RE, Fischer BL, Mahoney JE. Increased risk for falling associated with subtle cognitive impairment: secondary analysis of a randomized clinical trial. *Dement Geriatr Cogn Disord*. 2009;27(6):557-63.
31. Borges Sde M, Radanovic M, Forlenza OV. Fear of falling and falls in older adults with mild cognitive impairment and Alzheimer's disease. *Neuropsychol Dev Cogn B Aging Neuropsychol Cogn*. 2015;22(3):312-21.
32. Muir SW, Gopaul K, Montero Odasso MM. The role of cognitive impairment in fall risk among older adults: a systematic review and meta-analysis. *Age Ageing*. 2012;41(3):299-308.
33. Stark SL, Roe CM, Grant EA, Hollingsworth H, Benzinger TL, Fagan AM, et al. Preclinical Alzheimer disease and risk of falls. *Neurology*. 2013;81(5):437-43.
34. Stanetić K, Marković B, Tešanović G, Savić S, Šukalo M, Kremenović Z. Assessment of risk for falls in elderly. *Opšta medicina*. 2014;20(1-2):25-34.
35. Lo AX, Brown CJ, Sawyer P, Kennedy RE, Allman RM. Life-space mobility declines associated with incident falls and fractures. *J Am Geriatr Soc*. 2014;62(5):919-23.
36. Yu PL, Qin ZH, Shi J, Wu ZL, Sun ZQ. Study on the relationship between chronic diseases and falls in the elderly. *Zhonghua Liu Xing Bing Xue Za Zhi*. 2009;30(11):1156-9.

37. Choi EJ, Kim SA, Kim NR, Rhee JA, Yun YW, Shin MH. Risk factors for falls in older Korean adults: the 2011 Community Health Survey. *J Korean Med Sci.* 2014;29(11):1482-7.

38. Leipzig RM, Cumming RG, Tinetti ME. Drugs and falls in older people: systematic review and meta-analysis: II. Cardiac and analgesic drugs. *J Am Geriatr Soc.* 1999;47(1):40-50.

39. Matović J, Pejović V, Račić M. Sveobuhvatna gerijatrijska procjena pacijenata u ambulantama porodične medicine Doma zdravlja Foča. *Biomedicinska istraživanja.* 2013;4(1):13-25.

40. Berdot S, Bertrand M, Dartigues JF, Fourrier A, Tavernier B, Ritchie K, et al. Inappropriate medication use and risk of falls - a prospective study in a large community-dwelling elderly cohort. *BMC Geriatr.* 2009;9:30.

41. Fick DM, Cooper JW, Wade WE, Waller JL, Maclean JR, Beers MH. Updating the Beers criteria for potentially inappropriate medication use in older adults: results of a US consensus panel of experts. *Arch Intern Med.* 2003;163(22):2716-24.

42. Laroche ML, Charms JP, Merle L. Potentially inappropriate medications in the elderly: a French consensus panel list. *Eur J Clin Pharmacol.* 2007;63(8):725-31.

43. Zieler G, Dieleman JP, Hofman A, Pols HA, van der Cammen TJ, Stricker BH. Polypharmacy and falls in the middle age and elderly population. *Br J Clin Pharmacol.* 2006;61(2):218-23.

44. Wang PS, Bohn RL, Glynn RJ, Mogun H, Avorn J. Hazardous benzodiazepine regimens in the elderly: effects of half-life, dosage and duration on risk of hip fracture. *Am J Psychiatry.* 2001;158(6):892-8.

45. de Vries OJ, Peeters G, Elders P, Sonnenberg C, Muller M, Deeg DJ, et al. The elimination half-life of benzodiazepines and fall risk: two prospective observational studies. *Age Ageing.* 2013;42(6):764-70.

46. Passaro A, Volpato S, Romagnoni F, Manzoli N, Zuliani G, Fellin R. Benzodiazepines with different half-life and falling in a hospitalized population: the GIFA study. *Gruppo Italiano di Farmacovigilanza nell'Anziano. J Clin Epidemiol.* 2000;53(12):1222-9.

47. Stanetić K, Tešanović G. Influence of age and length of service on the level of stress and burnout syndrome. *Med Pregl.* 2013;66(3-4):153-62.

48. Stanetić K. Padovi kod starih. U: Tešanović G, Stanetić K, Petrović V, Savić S. *Porodična medicina.* Banja Luka: Medicinski fakultet; 2014.

Rad je primljen 27. II 2018.

Recenziran 24. IV 2018.

Prihvaćen za štampu 29. XI 2018.

BIBLID.0025-8105(2018):LXXI:11-12:368-376.