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Original Research

Association of medication use with falls among older adults

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Abstract

Introduction: Falls are an increasing public health problem because of ageing populations worldwide. One-third of people aged over 65 years live with comorbidities and take five or more regular medicines (polypharmacy). There is clear evidence that polypharmacy and the use of psychotropic drugs as well as in combination with cardiovascular medications increase the risk of falls. **Objective:** The aim of this study was to explore how polypharmacy, defined by the number of medications used is associated with the incidence of falls and related consequences and to examine associations with fall risk-increasing drugs (FRIDs) use with falls. **Methods:** We performed a cross-sectional study of 125 residents from nursing homes. Data collection and clinical assessments for the present study was conducted between June 1 2024 and October 15 2024. The participants were interviewed using a structured questionnaire, which contained questions on demographic, lifestyle, and medical variables. Participant characteristics were described for the whole group and subgroups were categorized according to fallers and non-fallers. Primary outcome measures were incidence of falls as well as numbers of FRIDs in fallers and non-fallers. **Results:** The mean age of the participants was 76.52 (SD 7.83) years and 66% of included patients were women. The most frequent number of falls within the previous 6 months was 1 (IQR 1–2). Twenty-six percent of these patients reported at least one fall in the six months prior to the evaluation. More women (N = 49) reported falls during the past six months as compared to men (N = 18), but this difference was not significant, $\chi 2$ (4, N = 125) = 6.79, p = .15. A multiple linear regression analyses showed positive associations between the number of FRIDs and the total number of prescribed drugs and falls. **Conclusion:** Older age and medications were associated with increased incidence of falls. Fallers had a higher number of FRIDs. Numbers of FRIDs were associated with the total number of drugs dispensed and falls.

Kew words: falls, elderly, nursing homes, medications, FRIDs

INTRODUCTION

Due to the higher prevalence of age-related physiological changes, delayed functional recovery and comorbidities older adults are more vulnerable to injury. This can result in further deconditioning and an increased risk of falls. [1] Additionally, as the world's population ages and more people live longer, falls are becoming a bigger public health concern. This is because there are more older adults and longer life expectancies. [2, 3]

One-third of those aged 65+ years worldwide fall at least once annually increasing to 50% among those aged 80+.[4] One-third of people aged over 65 years live with comorbidities and take five or more regular medicines (polypharmacy), increasing to 50% in over 85 year olds. [5, 6] Polypharmacy in older people is associated with increased risk of serious adverse clinical outcomes including falls, cognitive impairment, urinary tract infections, functional decline and death. [7] Some researchers suggest a stronger link between the types of medications taken and falling beyond polypharmacy alone. [8]

There is substantial data to suggest that polypharmacy and the use of psychotropic drugs as well as in combination with cardiovascular medications increase the risk of falls. [9, 10] Common fall-risk-increasing drugs (FRIDs) include antihypertensives, antihistamines, sedatives-hypnotics, antipsychotics, antidepressants, opioids and non-steroidal anti-inflammatory drugs. [11] A meta-analysis of interventions intended to prevent falls in older adults showed that gradual withdrawal of FRIDs significantly reduced the risk of falls. [12] Falls and fall-related injuries are highly prevalent but are preventable. [13] Some observational studies and randomized controlled trials have shown that medication management interventions, especially those with a larger goal of minimizing polypharmacy and/or potentially inappropriate prescribing, in different settings may lower the risk of falls. [14]

The aim of this study was to explore how polypharmacy, defined by the number of medications used is associated with the incidence of falls and related consequences and to examine associations with fall risk-increasing drugs use with falls.

MATERIALS AND METHODS

Study design

We performed a cross-sectional study of residents from

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nursing homes. Two nursing homes from two municipalities were randomly selected.

Participants

One hundred and twenty-five residents were recruited to the trial. Eligibility criteria included age 65 years and older. Eligible participants were not admitted if they had unstable cardiovascular disease, severe psychiatric or personality disorders, or had other serious diseases that precluded participation in the study. Participants who had fulfilled the eligibility criteria signed and received a copy of the informed consent form followed with the completion of the foreseen procedures.

Data collection

Data collection and clinical assessments for the present study was conducted between June 1 2024 and October 15 2024.

Outcome measures

The participants were interviewed using a structured questionnaire, which contained questions on demographic, lifestyle, and medical variables. Demographic data (name, age, gender, marital status, and education level), and lifestyle factors including smoking (smoker, non-smoker), and alcohol consumption (yes/no), were collected by selfreport.

Medical data as mobility, the number of falls in the previous 6 months, injuries (yes/no), the number of co-morbidities, and the number of medication use were collected from medical records.

Mobility was categorized as follows: 1) I am able to walk normally (without difficulty) 2) I am able to walk with orthopedic assistance, 3) I am wheelchair user, or 4) I am completely bedridden and unable to move about.

Comorbidity was defined as two or more conditions of the 18 conditions recorded in ELSA, including diabetes, hypertension, stroke, myocardial infarction, congestive heart failure, angina, lung disease, chronic obstructive pulmonary disease, asthma, arthritis, osteoporosis, cancer, hearing problems, Parkinson's, Alzheimer's disease, dementia, macular degeneration and glaucoma. [15]

All identified drugs were classified based on the Anatomical Therapeutic Chemical (ATC) classifications developed by the World Health Organization (WHO). [16, 17] Every drug was counted as one with its unique ATC code regardless of the dosage or number of pills for the individual patient. Polypharmacy was defined by the presence of 5–9 regular medications and hyper polypharmacy as the prescription of 10 or more regular medications.

The number and type of FRIDs prescribed for each participant were identified by a researcher.

The severity of cognitive impairment was measured by the Mini Mental State Examination (MMSE). [18] The MMSE contains specific subscales assessing orientation (ten points), registration (three points), attention and calculation (5 points), recall (3 points), language and praxis (9 points). The five subscales were summed to obtain the MMSE score (all 30 points). Scores 24 and higher indicated no dementia, whereas scores ranging from 9 and lower indicated a severe dementia.

Data analysis

The differences in sociodemographic characteristics, number of concomitant medications, comorbidities, and MMSE between groups were assessed using t-tests, Chi-squared tests, and ANOVA. A level of lower than $p < 0.05$ was chosen for determining the significance level. All data were analysed using SPSS (SPSS IBM Corp version 24).

Participant characteristics were described for the whole group and subgroups were categorised according to fallers and non-fallers. Primary outcome measures were incidence of falls as well as numbers of FRIDs in fallers and non-fallers.

Data were analysed using t-test for two-group comparisons, and multiple linear regression analyses. In the two regression analyses FRIDs were used as the respective dependent variables while number of medicine and falls were entered as independent variables.

Statement of ethics

The study protocol was approved by the Ethics Committee of the Faculty of Medicine, University of Prishtina.

RESULTS

Table 1 shows the characteristics of the study population. One hundred and twenty-five participants were included in the study. The mean age of the participants was 76.52 (SD 7.83) years and 66% of included patients were women. The most frequent number of co-morbidities was 1-4 (IQR 3–7) and the most frequent number of medications was 0-4 (IQR 3–8). Thirty-eight percent of participants had polypharmacy and an additional 10% were on hyper polypharmacy. The most frequent number of falls within the previous 6 months was 1 (IQR 1–2). Twenty-six percent of these patients reported at least one fall in the six months prior to the evaluation. More women (N = 49) reported falls during the past six months as compared to men (N = 18), but this difference was not significant, $\chi 2$ (4, N = 125) = 6.79, p =.15.

The percentage of adults aged ≥65 years reporting a fall or a fall-related injury increased with age ($p<0.001$). Among adults aged >85 years, 9.6% reported a fall and 13.9% reported a fall related injury. The rate of falls was 14% higher in people with polypharmacy compared with people without polypharmacy. There were no differences in MMSE between those who reported falls in the past six months, $\chi 2$ (12, N = 125) = 17.04, p = .15, or between those in different age groups, $\chi 2$ (6, N = 125) = 6.77, p = .34. There were no differences between patients who reported falls and those who did not fall during the past six months with regard to age, $F_{(4,120)} = .460$, $p = .765$, total number of drugs, $t_{(4,120)} = 2.384$, $p = .055$, and comorbidities, $t_{(4,120)} = 1.911$, $p = .113$ (see Table 2).

A multiple linear regression analyses with number of FRIDs as dependent variables was performed (Table 3). They showed

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Table 1. Characteristics of the study population by the number of total population and fall experiences.

	Total		Fall experiences		No fallen experiences	
	No	**(%)**	**No**	**(%)**	**No**	**(%)**
Characteristics						
Sex						
Male	42	33.6%	18	26.9%	24	41.1%
Female	83	66.4%	49	73.1%	34	58.6%
Age group (years)						
65-74	56	44.8%	30	44.8%	26	44.8%
75-84	43	34.4%	23	34.3%	20	34.5%
85+	26	20.8%	14	20.9%	12	20.7%
Education						
Primary school	53	42.4%	35	52.2%	18	31.0%
Secondary school	42	33.6%	20	29.9%	22	37.9%
Faculty Diploma	30	24%	12	17.9%	18	31.0%
Marital status						
Single	5	4%	4	6.0%	1	1.7%
Married	54	43.2%	23	34.3%	31	53.4%
Divorced	6	4.8%	1	1.5%	5	8.6%
Widow	60	48%	39	58.2%	21	36.2%
Mobility						
Walk normally	64	51.2%	31	46.3%	33	56.9%
Walk with orthopedic assistance	50	40%	30	44.8%	20	34.5%
Wheelchair user	8	6.4%	4	6.0%	4	6.9%
Completely bedridden and unable to move	3	2.4%	2	3.0%	1	1.7%
Alcohol consumption						
Yes	10	8%	4	6%	6	10.3%
No	115	92%	63	94%	52	89.7%
Smoke						
Yes	30	24%	12	17.9%	18	31%
No	95	76%	55	82.1%	40	69%
No participants with ≥1 falls during the 6 months						
1 fall	33	26.4%	29	43.3%	4	6.9%
2 falls	10	8%	10	14.9%	0	0%
3 falls	7	5.6%	6	9.0%	1	1.7%
4 falls	3	2.4%	3	4.5%	0	0%
Injuries						
Yes	40	32%	38	56.7%	2	3.4%
No	85	68%	29	43.3%	56	96.6%
Medication						
0-4 medication use	65	52%	31	46.3%	34	58.6%
Polypharmacy	48	38.4%	25	37.3%	23	39.7%
Hyper polypharmacy	12	9.6%	11	16.4%	1	1.7%
Comorbidities						
1-4	64	51.2%	32	47.8%	32	55.2%
5-8	59	47.2%	34	50.7%	25	43.1%

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>9	2	1.6%	1	1.5%	1	1.7%
Prescription						
FRID	48	61.6%	27	40.3%	21	36.2%
NO FRID	77	38.4%	40	59.7%	37	63.8%
MMSE						
Severe cognitive impairment	1	0.8%	1	1.5%	0	0%
Moderate cognitive impairment	26	20.8%	16	23.9%	10	17.2%
Mild cognitive impairment	36	28.8%	20	29.9%	16	27.6%
Normal cognition	62	49.6%	30	44.8%	32	55.2%

Table 2. ANOVA results for the differences based on age, medications, and comorbidities in participants with fallen experiences.

	Mean square	F	Sig
Age	0.283	0.46	0.765
Medications	1.003	2.384	0.055
Comorbidity	0.528	1.911	0.113

Table 3. Multiple linear regression analysis with medications and fall as predictors of FRID.

	Unstandardized coefficients		Standardized coefficients
	B	Std. error	Beta
Medications	0.16	0.06	0.21
Fall in the last six months	0.08	0.04	0.17

positive associations between the number of FRIDs and the total number of prescribed drugs and falls. Being female was associated with a higher number of FRIDs (p = 0.04). Participants with polypharmacy (≥5 drugs) were slightly older than participants without polypharmacy (group age: over 85 years, and group age: 65-74 years, respectively).

Table 4 presents the association between age, gender, education level, smoking status, alcohol consumption, and number of falls. Older age and medications were associated with increased incidence of falls. Smoking and alcohol consumption were associated with falls, therefore, present risk factors for falls. Education level was negatively associated with falls, which indicates that increased level of education can decrease risk of falls.

DISCUSSION

Our hypothesis was that the risk of falls in older persons would be influenced by lifestyle factors, polypharmacy, comorbidities, and demographic characteristics. Therefore, we compared these factors between fall and non-fall groups. According to the findings of our study, 26% of the participants had experienced a fall at least once in the previous six months. Our study's findings are consistent with the WHO Global Report on Falls, which states that between 30 and 50 percent of long-term care residents fall every year. [19] The frequency of falls is also in line with other current long-term care research findings. In 2020, 27% of participants in an Italian study fell [20], whereas 56% of the elderlies in a Canadian study fell at least once. [21]

The prevalence of polypharmacy (≥5 medicines) was reported to be between 20 and 33% in the other studies' data, [22-24] which is lower than what we found in our study. Based on the obtained results from our research we can conclude that the prevalence of polypharmacy was 38.4%. According to a 2015 systematic review, 91% of long-term care facility residents, were taking more than five medications. [25] Among our participants, extreme polypharmacy (10%) and polypharmacy (38.4%) were both prevalent. This is significantly lower than in a study from 2015 (26), and in the European SHELTER Study in 2012, [26] where the prevalence of polypharmacy was 50% and for extreme polypharmacy 23%.

According to this study, participants with polypharmacy had 50% greater risk of falls, and 35.3% of those reported having fallen during the previous six months. Our findings are consistent with previously published research showing strong

Table 4. Multiple linear regression analysis with age, gender, alcohol consumption, smoking status and medications as predictors of fall experiences.

	Unstandardized coefficients		Standardized coefficients	
	B	Std. error	Beta	Sig.
Age	.14	.09	.16	.025
Gender	.40	.19	.19	.039
Education	-.18	.12	-.15	.009
Alcohol consumption	.11	.37	.10	.045
Smoking status	.15	.08	.17	.013
Medicine	.16	.14	.11	.021

evidence of an association between polypharmacy and falls. [22, 27-29] Medications known to contribute to falls risk are taken by 65% of elderly patients admitted to local hospitals after a fall. [28] When prescribing pharmaceuticals in long-term care settings, distinct consideration should be given to both the number and kind of drugs. [29] The usage of anticholinergic, opioid, and polypharmacy medications predicted the frequency of falls in long-term care facilities. All-cause mortality was predicted by the usage of more than ten drugs. This cross-sectional study of participants aged 65 years and older revealed that female gender, high levels of co-morbidity, total number of medications, polypharmacy, were all associated with increased use of FRIDs. The outcomes match those of other recent publications. [30-33]

In a cross-sectional investigation, Ziere and colleagues demonstrated that polypharmacy by itself does not increase the risk of falling, unless a fall risk increasing drug is part of the drug regimen. [30] In our study fallers used a higher number of FRIDs, which is in line with the results of related studies. [31-33] The most prevalent forms of FRIDs include drug-induced drowsiness and decreased balance and coordination. These include antidepressants, hypnotics, sedatives, and antipsychotics. [33] Compared to patients who had not reported falling, patients who had fallen were prescribed a greater number of continuous-use FRIDs. [32] This is consistent with other research that found strong evidence of an association among the usage of psychotropic drugs and senior fall risk. [34]

Numerous studies [32, 35, 36] have shown that women are more prone than men to have a fall and fall-related injury because of low bone mass, osteoporosis, and weak muscles. Our study confirmed that women compared to males, were at higher risk of falling, and also, we conclude that the increased number of FRIDs was associated to female gender and this might explain the association with falls. The study findings support the recommendations that healthcare providers should implement comprehensive fall prevention strategies, such as routine fall risk screenings, gait assessments, and medication reviews to minimize FRIDs, in order to lower falls and healthcare costs. Patient education about the use of assistive devices, home modifications, and referral to community-based programs or physical therapy should be given more priority. In order to reduce the anticholinergic burden for patients who are at risk, policymakers should encourage medication adjustments and use electronic prescribing alerts to involve pharmacists in fall prevention initiatives.

Limitations

Despite this study's strengths, there are some limitations that need to be considered when interpreting the findings of this study. A major limitation of the study is the cross-sectional design with collection of retrospective data about falls. Another limitation is that we evaluated data about number of FRIDs regardless of each drug's prescribed daily dosage. More detailed drug information might have provided better understanding of whether drug dosage influences fall risk. All patients were included in the fall evaluation, despite the fact that some of them were not ambulatory. This may have led to some bias, since the wheelchair and bedridden patients were not able to walk freely and may have been less likely to fall.

CONCLUSIONS

We demonstrated that being older and medications were associated with increased incidence of falls. Fallers had a higher number of FRIDs. Numbers of FRIDs were associated with the total number of drugs dispensed and falls. Additionally, we discovered that smoking and alcohol consumption present risk factors for falls while education level was negatively associated with falls, suggesting that a higher level of education may reduce the chance of falling.

In order to increase the success of nursing home fall prevention programs, further research is needed to clarify the impacts of reducing high-risk medications, as well as exercises with optimal intensity for muscular strengthening and balance.

AUTHORS` CONTRIBUTION

AM and DS were observing this research project, had full access of this study's data, in the meantime they took responsibility to show integrity for the data.

Study Design: AM, DS, ZI

Instruction on the use of instruments for the outcome measures used in this study: NA, DK

Analysis and interpretation of data: NA, DK

Manuscript preparation: AM, DS

Statistical Analysis: ZI

CONFLICT OF INTEREST

The authors declare that no conflicts of interest exist.

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