

## ORIGINAL PAPER

## PHARMACOTHERAPY AS A FALL RISK FACTOR

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**Abstract**

**Aim:** To determine the correlation between pharmacotherapy and high risk of fall based on the Morse Fall Scale (MFS score  $\geq 45$ ) in acute and long-term care settings. **Design:** A quantitative cross-sectional descriptive correlation study. **Methods:** The study was conducted at a University Hospital in Martin (UHM) and a selected long-term care facility (LTC) in Martin (Slovakia) June–October 2016. The pharmacotherapeutic data were obtained from the health documentation of the respondents. The fall risk was assessed by using the MFS screening tool within 24–48 hours of admission to the facility. **Results:** For the group of UHM patients ( $n = 63$ ), the mean MFS score for fall risk was high ( $60.6 \pm 22.4$ ), and the correlation ( $p = 0.030$ ) between the number of medications administered in 24 hours and high risk of fall was significant. For the group of LTC patients ( $n = 89$ ), the mean MFS score for fall risk was moderate ( $35.4 \pm 15.9$ ). The correlations were not significant. **Conclusion:** Pharmacotherapy is an important fall risk factor; therefore, it is necessary to determine it within the assessment of overall fall risk. The risk management of pharmacotherapy is an effective and important multifactorial intervention in programmes of fall prevention in acute and long-term care.

**Keywords:** fall, hospital, long-term care, Morse Fall Scale, pharmacotherapy, screening, senior.

**Introduction**

According to the Joint Commission Centre for Transforming Healthcare, an analysis of falls with injury reveals several common factors that increase the number of falls, including, among others, inadequate assessment of risk by patients (Joint Commission, 2015). It is the assessment and identification of individual amenable fall risk factors that facilitates selection and implementation of preventive interventions, significantly reducing the number of falls (Registered Nurses' Association of Ontario, 2011; Watson, Salmoni, Zecevic, 2016). The key, readily identifiable, predictors of fall in acute and long-term care include the presence of chronic disease and polymorbidity, with subsequent polypharmacy and its adverse effects. In connection with pharmacotherapy, there are some indication groups of medications that increase fall risk, such as benzodiazepines, psychotropic medications (antipsychotics, sedatives, hypnotics, anxiolytics, antidepressants), analgesics (paracetamol, NSAIDs, opioids, narcotics), antiepileptics, antiparkinsonians, cardiac medications

(antihypertensives, antiarrhythmics, anticoagulants, diuretics), antidiabetics, and laxatives (Mamun, Lim, 2009; Agency for Healthcare Research and Quality, 2013; Ambrose, Paul, Hausdorff, 2013; National Institute for Health and Care Excellence, 2013; Obayashi et al., 2013; Severo et al., 2014; Callis, 2016; Gu et al., 2016).

Assessment of pharmacotherapy as a separate fall risk factor is a multifactorial and targeted intervention in the programme of fall prevention and fall reduction from admission to the facility, as well as after a fall (Registered Nurses' Association of Ontario, 2011; Agency for Healthcare Research and Quality, 2013; Chu, 2017). This is normally performed in conjunction with use of multiple prescription medications, or use of medications with adverse effects including sedation, confusion, impaired balance, and changes of orthostatic blood pressure, associated with higher risk of fall (Agency for Healthcare Research and Quality, 2013). Screening of pharmacotherapy in connection with fall risk is an effective method of identifying an individual with fall risk, by using a universal tool that contains this item. There is no gold standard, but the most tested tools include the Morse Fall Scale (MFS), which is recommended for an initial assessment of fall risk of adult patients in various

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clinical settings (Kim et al., 2007; Morse, 2009; Registered Nurses' Association of Ontario, 2011; Cumbler et al., 2013; National Institute for Health and Care Excellence, 2013; Severo et al., 2014; Cruz et al., 2015; Joint Commission, 2015; Callis, 2016; Gu et al., 2016; Majkusová, Jarošová, 2017). Competences of interprofessional team members vary, but after screening of fall risk, a nurse should subsequently also be involved in assessing risk pharmacotherapy in cooperation with a physician and a clinical pharmacologist (Centre for Studies in Aging & Health, 2010; Registered Nurses' Association of Ontario, 2011; Agency for Healthcare Research and Quality, 2013; National Institute for Health and Care Excellence, 2013).

## Aim

To determine the correlation between pharmacotherapy (the key fall risk factor) and high fall risk on the Morse Fall Scale (MFS score  $\geq 45$ ) in acute and long-term care settings.

## Methods

### Design

Quantitative cross-sectional descriptive correlation study.

### Sample

The first group of respondents consisted of 63 patients of the Internal and Surgical Clinic of the University Hospital in Martin (UHM), of which 32 were women and 31 were men. The mean age of the whole group was  $68.3 \pm 16.1$  years (min. 21; max. 90).

The second group of respondents consisted of 89 clients of a long-term care facility (LTC), of which 72 were women and 17 were men. The mean age of the whole group was  $82.8 \pm 5.9$  years (min. 70; max. 95).

Most of the respondents in both groups were from the oldest age group (Table 1).

### Data collection

The study was conducted in the clinical settings of UHM (June–August 2016) and in the LTC settings (July–October 2016) in Martin (Slovakia).

The assessment was made within 24–48 hours after admission to the facility, and the data were verified from the health documents of the respondents. The assessment focused on identification of polymorbidity (the number of chronic diseases  $\geq 4$ ) and prescription of pharmacotherapy (use  $\geq 5$  indication medication groups linked to fall risk, and

the number of medications administered orally, as well as by injection, in the course of 24 hours).

Screening for fall risk by means of the MFS tool, which identifies six significant fall risk factors:

1. History of falling (no 0; yes 25); A history of falling was coded if the patient had had a fall in the three months prior to admission/transfer to the unit.
2. Presence of a secondary diagnosis (no 0; yes 15); A secondary diagnosis was coded if the patient had more than one medical diagnosis.
3. Use of an ambulatory aid (none/bed rest/nurse assist 0; crutches/cane/walker 15; furniture for support 30). Ambulatory aids were coded if they were required for mobility.
4. Intravenous (IV) therapy/saline lock (no 0; yes 20); IV therapy was coded if the patient had a continuous IV or a saline lock for intermittent IV therapy.
5. Type of gait (normal/bed rest/wheelchair 0; weak 10; impaired 20). Gait was assessed for normal, weak or impaired gait which required greater assistance.
6. Mental status (oriented to own ability 0; overestimates ability or forgets limitations 15).

**Table 1** Characteristics of sample

Variables	UHM (n = 63) n (%) mean $\pm$ SD (min.–max.)	LTC (n = 89) n (%) mean $\pm$ SD (min.–max.)
<b>Unit</b>		-
internal	37 (58.7)	
surgical	26 (41.3)	
<b>Gender</b>		
female	32 (50.8)	72 (80.9)
male	31 (49.2)	17 (19.1)
<b>Age (year)</b>		
whole sample	$68.3 \pm 16.1$ (21–90)	$82.8 \pm 5.9$ (70–95)
age groups:		
< 65	21 (33.4)	
65–74	14 (22.2)	10 (11.2)
> 74	28 (44.4)	79 (88.8)

UHM – University Hospital in Martin; LTC – long-term care; SD – standard deviation; min. – minimum; max. – maximum

The total score ranges from 0 to 125, whereby low fall risk is  $\leq 20$ , moderate 25–44 and high  $\geq 45$ . The cut-off score  $\geq 45$  identifies patients with high fall risk, and enables the development of targeted preventive interventions to reduce risk of fall. On the basis of this score, the sensitivity of the MFS in the original study by Morse was set at the value of 78%, the specificity was 83%, and the inter-rater reliability was 0.96. The tool is designed for identification

of fall risk factors for older adults, and lies within the competency of nurses (Morse, 2009).

### Data analysis

To process the data, Microsoft Office Excel was used, and to make an analysis of the data, SPSS Statistics 16.0 software was used. The descriptive statistics methods present a frequency distribution of variable values in absolute (n) and relative figures (%), arithmetic mean, standard deviation (SD), minimum (min.) and maximum (max.) values. To test the associations of binary variables, the Pearson's chi-square test ( $\chi^2$ ) was used, and for the continuous variable, the Mann-Whitney test (M-W) was used. Statistical significance was calculated at the level of 5% ( $p < 0.05$ ).

### Results

In the UHM group (n = 63), 40 patients (63.5%) were polymorbid, and polypharmacy was found in 37

patients (58.7%). The most used medication groups included antihypertensives (61.9%), analgesics (54.0%), and diuretics (44.4%). The mean number of administered medications in 24 hours was  $13.9 \pm 4.6$  (min. 7; max. 28). There was a significant correlation ( $p = 0.030$ ) found between the number of administered medications in 24 hours and high risk of fall (Table 2). The mean MFS score of fall risk was high,  $60.6 \pm 22.4$  (min. 15; max. 105) (Table 3).

In the LTC group (n = 89), 86 seniors (96.6%) were polymorbid, and polypharmacy was found in 79 seniors (88.8%). The most used medication groups included antihypertensives (97.8%), anticoagulants (75.3%) and analgesics (47.2%). The mean number of administered medications in 24 hours was  $13.1 \pm 6.2$  (min. 3; max. 31). The correlations between the studied variables were not significant (Table 2). The mean MFS score of fall risk was moderate,  $35.4 \pm 15.9$  (min. 15; max. 105) (Table 3).

**Table 2** Variables in the sample

Variables	UHM (n = 63) n (%) mean $\pm$ SD (min.–max.)	UHM (n = 63) MFS score $\geq$ 45 $p < 0.05$	LTC (n = 89) n (%) mean $\pm$ SD (min.–max.)	LTC (n = 89) MFS score $\geq$ 45 $p < 0.05$
<b>Number of secondary diagnosis <math>\geq</math> 4*</b>		0.924 <sup>a</sup>		0.313 <sup>a</sup>
no	23 (36.5)		3 (3.4)	
yes	40 (63.5)		86 (96.6)	
<b>Medication – type</b>		-		-
Analgesics	34 (54.0)		42 (47.2)	
Antiarrhythmics	8 (12.7)		34 (38.2)	
Antihypertensives	39 (61.9)		87 (97.8)	
Anticoagulants	27 (42.9)		67 (75.3)	
Antidepressants	15 (23.8)		21 (23.6)	
Antipsychotics	19 (30.2)		22 (24.7)	
Antiparkinsonians	2 (3.2)		8 (9.0)	
Benzodiazepines**	24 (38.1)		8 (9.0)	
Digoxin	5 (7.9)		11 (12.4)	
Diuretics	28 (44.4)		28 (31.5)	
Insulin	15 (23.8)		14 (15.7)	
Laxatives	9 (14.3)		3 (3.4)	
Vasodilators	18 (28.6)		13 (14.6)	
<b>Medication <math>\geq</math> 5</b>		0.159 <sup>a</sup>		0.681 <sup>a</sup>
no	26 (41.3)		10 (11.2)	
yes	37 (58.7)		79 (88.8)	
<b>Number/24 hours</b>	13.9 $\pm$ 4.6 (7–28)	0.030 <sup>b</sup>	13.1 $\pm$ 6.2 (3–31)	0.853 <sup>b</sup>

\*item in MFS; \*\*sedatives, hypnotics, anxiolytics; <sup>a</sup>Pearson's chi-squared test; <sup>b</sup>Mann-Whitney test; UHM – University Hospital in Martin; LTC – long-term care; SD – standard deviation; min. – minimum; max. – maximum

**Table 3** MFS score

MFS score	UHM (n = 63) mean $\pm$ SD (min.–max.)	LTC (n = 89) mean $\pm$ SD (min.–max.)
Whole sample	60.6 $\pm$ 22.4 (15–105)	35.4 $\pm$ 15.9 (15–105)
Age groups		
< 65	58.8 $\pm$ 21 (15–95)	-
65–74	63.6 $\pm$ 17.6 (35–95)	38.3 $\pm$ 10.5 (15–50)
> 74	60.4 $\pm$ 25.9 (15–105)	35.1 $\pm$ 16.5 (15–105)

UHM – University Hospital in Martin; LTC – long-term care; SD – standard deviation; min. – minimum; max. – maximum

## Discussion

The results of our study – the prevalence of the female gender, the mean age of the respondents, existence of polymorbidity and polypharmacy in both groups are indicative of the persistent aging of the Slovak population, and their deteriorating health indicators. In the long-term, the most frequent reasons for admission to a health care facility are cardiovascular, gastrointestinal, and oncological diseases (Health statistics yearbook of the Slovak Republic, 2015). Oncological diseases are considered a critical fall risk factor in adult hospitalized patients (Costa-Dias et al., 2014). The fall risk increases with the number of chronic diseases and comorbidities, and subsequent polypharmacy. Meanwhile, medications influencing cognitive, neurosensory, cardiovascular, and musculoskeletal functions may potentially increase fall risk independently of the number of diagnoses (Voyer et al., 2007; World Health Organization, 2007; Centre for Studies in Aging & Health, 2010; Registered Nurses' Association of Ontario, 2011; Marshall, 2012; Ambrose, Paul, Hausdorff, 2013; National Institute for Health and Care Excellence, 2013; Jung, Shin, Kim, 2014). Due to the mean age of our respondents, the incidence of polymorbidity was high in both groups. It is a phenomenon typical of senior populations, and in connection with falls, it becomes an issue with  $\geq 2$  chronic diseases. Weber (2012) defines it as the concurrent presence of several (usually three), often mutually independent diseases either with or without a causal link. The Concept of geriatric health care (Konceptia zdravotnej starostlivosti v odbore geriatrica, 2007) mentions more than five concurrent serious diagnoses of geriatric patients. In our study, we opted for a compromise of between three to five chronic diseases, and we took into consideration number of diseases  $\geq$  four.

The hospital population of patients is more heterogeneous than the population of seniors in LTC, which is a result of the fact that acute diagnoses were concurrent with chronic diagnoses. Such a change in the health condition impairs physical and mental conditions, has an impact on the pharmacotherapeutic regimen, and significantly increases fall risk and iatrogenic complications (Shuto et al., 2010; Callis, 2016). The initial and cumulative effect of a new pharmacotherapy (mainly antihypertensives, anti-Parkinsonian medications, anxiolytics and hypnotics) is linked to significantly higher fall risk than with use of the same therapy in the long term (Shuto et al., 2010; Chung, Coralic, 2016). Strong associations between the use of psychotropic medications and repeated falls (an increase of up to

50%), and the use of antiarrhythmics, digoxin, and diuretics and falls is indicated in the study by Costa-Dias et al. (2014). Although we did not deal with falls during hospitalization in our study, this would probably have been evidenced in the group of hospitalized patients. The number of administered medications in 24 hours ( $13.9 \pm 4.6$ ) in the group of UHM was comparable to that of the group of LTC ( $13.1 \pm 6.2$ ). However, regarding high fall risk, it was significant, and the fall risk on the MFS scale was also substantially higher (Table 3). Regarding item No. 4 in the MFS, the intravenous administration of therapy increases the fall risk score by up to 20, and this method is rarely used in LTC. In LTC, the health conditions of seniors are relatively stable, and the pharmacotherapeutic regimen does not change significantly. As with hospitalized patients, risk of fall increases considerably with the use of psychotropic medications, opioid analgesics, antiarrhythmics, antihypertensives, benzodiazepines, digoxin, and diuretics. Risk is particularly linked to the use of psychotropic medications (Hartikainen, Lönnroos, Louhivuori, 2007; Bloch et al., 2011), which are an independent internal risk factor for falls. The fall risk increases with the first prescription (especially in the first days of use), with higher doses, and with concurrent use of other psychotropic medications, mainly in the presence of other comorbidities and functional disorders (Registered Nurses' Association of Ontario, 2011). Elimination of such pharmacotherapy reduces falls by up to 66% (Department of Health, 2014).

The incidence of adverse effects and reactions increases with age (with age  $\geq 70$  years, they are five to six times more frequent), and with the growing number of diagnoses and pharmacotherapy. The effect of medications can be influenced by concurrent use of several medication groups (medication-medication interaction), the presence of a current disease (medication-disease interaction), or food (medication-food interaction) (Červený et al., 2014). Adverse effects are most often linked to indication groups of medications: cardiac, diuretics, anticoagulants, non-steroidal anti-inflammatory medications, antibiotics, and hypoglycemics (Shah, Hajar, 2012). Adverse effects in relation to risk are different, e.g., sleepiness, dizziness, confusion, altered gait and balance, slow reactions, visual disturbances, orthostatic hypotension, muscle weakness, and changed frequency and urgency of urination (Mamun, Lim, 2009; Registered Nurses' Association of Ontario, 2011; Červený et al., 2014; Callis, 2016; Chung, Coralic, 2016; Komjáthy, 2016). Račanská (2014) points to a higher tendency

to orthostatic hypotension with use of benzodiazepines, which may be manifested by psychomotor attenuation with administration of the usual dose, and thus it may increase the risk of cognitive dysfunction, fall, injury, and hospitalization. Mitro (2014) underlines the problem of underestimation of syncope states of seniors, as they overlap with falls. Changes in pharmacokinetics and pharmacodynamics in seniors can lead to increased sensitivity to effects of medication (Mamun, Lim, 2009; Centre for Studies in Aging & Health, 2010; Červený et al., 2014; Komjáthy, 2016); therefore, in assessing the pharmacotherapy, not only their main but also their adverse effects, the cumulative effect, the number of used medication groups and their interactions need to be considered (Shah, Hajjar, 2012).

There is no consensus on defining polypharmacy; the simultaneous use of two to nine indication groups has been suggested (Shah, Hajjar, 2012), often  $\geq$  three-four groups (Royal College of Nursing, 2004; Ziere et al., 2005; Registered Nurses' Association of Ontario, 2011; Hammond, Wilson, 2013), and also  $\geq$  five, when the fall risk increases (Costa-Dias et al., 2014), and this is the limit we used in our study. Such a number results in a range of medication interactions and is considered to be a high fall risk, particularly in the case of seniors (Centre for Studies in Aging & Health, 2010; Registered Nurses' Association of Ontario, 2011; Carpenito, 2013; Department of Health, 2014). A use of  $\geq$  ten medication groups (Shah, Hajjar, 2012; Weber et al., 2016) is considered excessive. The studies by Costa-Dias et al. (2014) and Shuto (et al., 2010) refer to a mean of 7.4 per patient, whereby psychotropic medications account for a substantial part. Regarding the prevalence of polypharmacy, a range from 5–78% is indicated, depending on the definition used and on the group. It is more common in women, and increases with age (Shah, Hajjar, 2012). Slovak authors (Wawruch et al., 2008) recorded a use of  $\geq$  six medication groups for hospitalized patients aged  $\geq$  65 years (60.3% of patients upon hospital admission, and 62.3% of patients upon discharge). As the number of medication groups used rises, the number of potential medication interactions increases exponentially (Suchopár, Prokeš, 2011). Dangerous interactions include those that cause hypoglycaemia, increase susceptibility to bleeding, and induce arrhythmias, central cramps and hypertensive crises. It follows that oral antidiabetics, oral anticoagulants, cardiac glycosides and antiepileptics (Komjáthy, 2016) pose a particularly high risk. Polypharmacy has been shown to be an independent predictor of one or several falls as a result of an increase in the

additive and synergic effects of medications. When using one group, the fall risk is 25%, and with  $\geq$  six, it increases by up to 60% (Ziere et al., 2005; Registered Nurses' Association of Ontario, 2011). Some authors, however, point out that the number of groups used is not always a good fall predictor, and instead, the use and combination of high-risk groups in relation to falls, and adherence should be focused on (Ziere et al., 2005; Mamun, Lim, 2009; Rajec, 2012; Hammond, Wilson, 2013; Costa-Dias et al., 2014; Komjáthy, 2016).

The total medication consumption of the Slovak population, whether prescription-only medications or over-the-counter medications, has grown steadily over recent years. Consumption is higher than the mean of OECD countries, and when calculated per daily medication doses, more medications for digestive, cardiovascular, nervous, musculoskeletal, and respiratory systems, and more anti-infectives are used. The high consumption of medications compared to that of other countries can be attributed to non-standard prescriptions including insufficient patient management (Ministerstvo financií Slovenskej republiky, Ministerstvo zdravotníctva Slovenskej republiky, 2016). Pharmacotherapy is a modifiable fall risk factor; therefore, its management – revision, optimization, modification, and minimization is an important multifactorial intervention in prevention and reduction of falls (Centre for Studies in Aging & Health, 2010; Registered Nurses' Association of Ontario, 2011; Liu, Shen, Xiao, 2012; National Institute for Health and Care Excellence, 2013; Costa-Dias et al., 2014; Department of Health, 2014; Callis, 2016; Chung, Coralic, 2016; Titler et al., 2016). Pharmacotherapy is on the list of fall risk factors that need to be assessed upon admission to the facility. Fast screening tools (multifactorial assessment tools, MAT) are usually used for stratification of risk, i.e., identification of individuals with low and high fall risks. There is usually a list of items used to control the level and character of risk based on a combined score of several factors that are known to be related to risk of fall. These tools include the MFS (Scott et al., 2007), which, when correctly administered, has established psychometric characteristics (Bóriková et al., 2017) and provides valuable data for planning care according to fall risk (the total score). The items of the MFS, however, also identify individual risk profiles, which makes it possible to tailor interventions to specific risk factors (Morse, 2009; Centre for Studies in Aging & Health, 2010; Registered Nurses' Association of Ontario, 2011). The MFS identifies individuals with high risk of anticipated physiological falls, which account for

approximately 78% of all falls. This concerns falls whose risk factors are identifiable in-advance, including pharmacotherapy (Agency for Healthcare Research and Quality, 2013). Screening is indirectly contained in item No. 2, since, according to Morse (2009), the number of pharmacotherapies is significant in relation to the associated diagnosis. Use of more than one indication group of medications is considered polypharmacy. In addition, in item No. 4, consideration should be given not only to mechanical restriction of intravenous lines with fall risk (Morse, 2009), but also to the fact that some medications can be administered both orally and by injection (Watson, Salmoni, Zecevic, 2016), e.g., antibiotics, diuretics, and hypoglycemics. When fall risk is determined in connection with pharmacotherapy, it is recommended, in combination with the MFS, to use another tool to explicitly assess high-risk pharmacotherapy in relation to fall risk, e.g., the Medication Fall Risk Score and Evaluation Tools, which lies within the competency of nurses and clinical pharmacists (Agency for Healthcare Research and Quality, 2013). It is also possible to use other tools separately or together with the MFS, e.g., the Downton Fall Risk Index (Nyberg, Gustafson, 1996), or the Hendrich II Fall Risk Scale (Hendrich, Bender, Nyhuis, 2003), which, when combined, make it possible to determine fall risk more precisely (Costa-Dias et al., 2014). Revision and modification of pharmacotherapy is crucial in seniors, and the American Geriatrics Society (AGS) Beers Criteria on inappropriately prescribed medication [Beers Criteria for Potentially Inappropriate Medication (PIM) Use in Older Adults] are an important source of information. This explicit list is generally intended for seniors with certain diseases and syndromes, and prescribes reduced doses or the monitoring of therapy and medication-medication interactions in connection with falls and mortality. An alternative to the Beers Criteria in Europe are the STOPP Criteria (Screening Tool of Older People's potentially inappropriate Prescriptions) for medications that might be inappropriate or pose risks, and the START Criteria (Screening Tool to Alert doctors to the Right Treatment) for potentially beneficial treatment in seniors (Červený et al., 2014; American Geriatrics Society, 2015). Applied within 72 hours of admission, the STOPP/START Criteria substantially reduce adverse effects and the mean length of hospitalization of seniors with acute disease by up to three days. The effect of therapy, when calibrated correctly, can continue for another six months after intervention (O'Mahony et al., 2015). Holmerová et al. (2013) emphasizes that these criteria are highly sensitive (they identify the

majority of potentially incorrect prescriptions), but of low specificity; therefore, they cannot be dogma for each geriatric patient. Therapy should be individualized and should correspond not only to clinical diagnoses and syndromes, but also to the values and priorities of the patient (Holmerová et al., 2013). Revision of pharmacotherapy does not mean, however, that it should be abandoned by patients, but it is important to be aware of the risk. There might be cases in which the care provider decides that the medication on the list is the only reasonable option (American Geriatrics Society, 2015).

Risk management of pharmacotherapy is an effective and important multifactorial intervention in fall prevention programs in the case of acute and long-term care. Pharmacotherapy needs to be regularly revised and updated when there are changes in the nursing unit/facility, or medical conditions with subsequent changes in pharmacotherapy, and, in addition, periodically during hospitalization and after a fall. Patients thus identified should be considered patients with risk of fall (Centre for Studies in Aging & Health, 2010; Registered Nurses' Association of Ontario, 2011; Agency for Healthcare Research and Quality, 2013; National Institute for Health and Care Excellence, 2013; Jung, Shin, Kim, 2014).

### **Limitation of study**

Because of the size of the groups, the results of this study cannot be extrapolated to the whole population of hospitalized patients and seniors in LTC. Assessment of pharmacotherapy was performed only once, upon patients' admission to hospital and to LTC. Only risk assessment was conducted. We have no data for the number of falls that occurred during the course of the study. Despite these limitations, the study results indicate the need to address the issue of pharmacotherapy as a risk factor for falls, deserving more attention from competent medical team members.

### **Conclusion**

Team cooperation and a program of regular pharmacotherapeutic management have demonstrated clear benefits for patients and for the organization in terms of reducing the financial burden associated with use of medications and falls. In the Slovak Republic, the assessment of pharmacotherapy as a fall risk factor is included in the reporting of falls as an adverse event. High-risk pharmacotherapy can be detected quickly, and nurses can play an important role in this process of structured assessment. In view of the above, the methodology to assess factors of fall

risk, including screening tools, should be implemented in nursing practice.

### Ethical aspects and conflict of interest

The study is part of an academic project at the Department of Nursing, Jesenius Faculty of Medicine in Martin, Comenius University, focused on the issue of falls in nursing practice. The study was conducted with the approval of the Ethics Commission of UHM, and the management of LTC. The author of the MFS tool, Ms Janice Morse, gave her consent to its translation into Slovak, and to its use for the purposes of the study. The MFS was translated using the reverse-translation method (two independent nurses/experts; any differences in translations discussed until consensus achieved). The respondents were informed about the purpose of the research, and they were asked for their informed consent. For the purpose of collecting data, anonymous forms were used. The authors declare that there is no conflict of interest.

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### Author contribution

Concept and design of the study (IB), data collection, analysis and interpretation (IB, MM), manuscript draft (IB), critical revision of the manuscript (MT, KŽ, MM), final approval of the manuscript (IB, MT).

### References

- Agency for Healthcare Research and Quality. *Preventing falls in hospitals: a toolkit for improving quality of care*. AHRQ Publication. No. 13-0015-EF. 2013. [cited 2017 Aug 8]. Available from: <http://www.ahrq.gov/sites/default/files/publications/files/fallpxtoolkit.pdf>
- American Geriatrics Society 2015. Updated beers criteria for potentially inappropriate medication use in older adults. *Journal of the American Geriatrics Society*. 2015;63(11):2227–2246.
- Ambrose AF, Paul G, Hausdorff JM. Risk factors for falls among older adults: a review of the literature. *Maturitas*. 2013;75(1):51–61.
- Bloch F, Thibaud M, Dugué B, Brèque C, Rigaud AS, Kemoun G. Psychotropic drugs and falls in the elderly people: updated literature review and meta-analysis. *Journal of Aging and Health*. 2011;23(2):329–346.
- Bóriková I, Tomagová M, Miertová M, Žiaková K. Predictive value of the Morse Fall Scale. *Central European Journal of Nursing and Midwifery*. 2017;8(1):588–595.
- Callis N. Falls prevention: identification of predictive fall risk factors. *Applied Nursing Research*. 2016;29:53–58.
- Carpenito LJ. *Nursing diagnosis: application to clinical practice*. 14th ed. Philadelphia: Lippincott Williams & Wilkins, 2013.
- Centre for Studies in Aging & Health. *Bridges to care resource manual: Preventing falls and injuries in long-term care (LTC)*. Centre for Studies in Aging & Health (CSAH) at Providence Care, Kingston, Ontario. 2010. [cited 2017 Jun 8]. Available from: [http://sagelink.ca/sites/default/files/clinical-resources/preventing\\_falls\\_injuries\\_ltc\\_resource\\_manual.pdf](http://sagelink.ca/sites/default/files/clinical-resources/preventing_falls_injuries_ltc_resource_manual.pdf)
- Chu RZ. Preventing in-patient falls: the nurse's pivotal role. *Nursing*. 2017;47(3):24–30.
- Chung H, Coralic A. A multidisciplinary assessment instrument to predict fall risk in hospitalized patients: a prospective matched pair case study. *Journal of Nursing Education and Practice*. 2016;6(6):1–7.
- Costa-Dias MJ, Oliveira AS, Martins T, Araújo F, Santos AS, Moreira CN, José H. Medication fall risk in old hospitalized patients: a retrospective study. *Nurse Education Today*. 2014;34(2):171–176.
- Cruz S, Carvalho AL, Barbosa P, Lamas B. Morse Fall Scale user's manual: quality in supervision and in nursing practice. *Procedia – Social and Behavioral Sciences*. 2015;171:334–339.
- Cumbler EU, Simpson JR, Rosenthal LD, Likosky DJ. Inpatient falls: defining the problem and identifying possible solutions. Part I: an evidence-based review. *The Neurohospitalist*. 2013;3(3):135–143.
- Červený R, Topinková E, Býma S, Fialová D, Jurašková B, Matějovská Kubešová H. *Geriatric. Doporučené diagnostické a terapeutické postupy pro všeobecné praktické lékaře*. Praha: Společnost všeobecného lékařství ČLS JEP Centrum doporučených postupů pro praktické lékaře; 2014. [cited 2017 Aug 8]. Available from: <https://www.svl.cz/files/files/Doporučene-postupy-od-2013/DP-Geriatrie-2014.pdf> (in Czech)
- Department of Health, Western Australia. *Falls prevention model of care*. Perth: Health Strategy and Networks, Department of Health, Western Australian; 2014. [cited 2017 Jun 8]. Available from: [http://www.healthnetworks.health.wa.gov.au/modelsofcare/docs/Falls\\_Model\\_of\\_Care.pdf](http://www.healthnetworks.health.wa.gov.au/modelsofcare/docs/Falls_Model_of_Care.pdf)
- Gu YY, Balcaen K, Ni Y, Ampe J, Goffin J. Review on prevention of falls in hospital settings. *Chinese Nursing Research*. 2016;3(1):7–10.
- Hammond T, Wilson A. Polypharmacy and falls in the elderly: a literature review. *Nursing and Midwifery Study*. 2013;2(2):171–175.
- Hartikainen S, Lönnroos E, Louhivuori K. Medication as a risk factor for falls: critical systematic review. *The Journals of Gerontology Series A, Biological Sciences and Medical Sciences*. 2007;62(10):1172–1181.
- Health statistics yearbook of the Slovak Republic* 2015. Bratislava: Národné centrum zdravotníckych informácií. [cited 2017 Jun 10]. Available from: [http://www.nczisk.sk/Documents/rocniky/2015/rocnika\\_2015.pdf](http://www.nczisk.sk/Documents/rocniky/2015/rocnika_2015.pdf) (in Slovak, in English)
- Hendrich AL, Bender PS, Nyhuis A. Validation of the Hendrich II Fall Risk Model: a large concurrent case/control study of hospitalized patients. *Applied Nursing Research: ANR*. 2003;16(1):9–21.
- Holmerová I, Baumanová M, Vaňková H, Wija P. Geriatrický pacient, geriatrická farmakoterapie a kvalita života. *Praktické lékařství*. 2013;9(3):114–116.



- Joint Commission. Preventing falls and fall-related injuries in health care facilities. *Sentinel Event Alert*. 2015;28(55):1–5.
- Jung D, Shin S, Kim H. A fall prevention guideline for older adults living in long-term care facilities. *International Nursing Review*. 2014;61(4):525–533.
- Kim EA, Mordiffi SZ, Bee WH, Devi K, Evans D. Evaluation of three fall-risk assessment tools in an acute care setting. *Journal of Advanced Nursing*. 2007;60(4):427–435.
- Komjáthy H. Riziká farmakoterapie geriatrických pacientov. *Praktické lekárnictvo*. 2016;6(1):8–12. (in Slovak)
- Koncepcia zdravotnej starostlivosti v odbore geriatrica. Vestník MZ SR, časťka 1-5, 25. januára 2007, roč. 55. (in Slovak)
- Liu H, Shen J, Xiao LD. Effectiveness of an educational intervention on improving knowledge level of Chinese registered nurses on prevention of falls in hospitalized older people: a randomized controlled trial. *Nurse Education Today*. 2012;32(6):695–702.
- Majkusová K, Jarošová D. Validity of tools for assessing the risk of falls in patients. *Central European Journal of Nursing and Midwifery*. 2017;8(3):697–705.
- Mamun K, Lim JK. Association between falls and high-risk medication use in hospitalized Asian elderly patients. *Geriatrics & Gerontology International*. 2009;9(3):276–281.
- Marshall FJ. Approach to the elderly patient with gait disturbance. *Neurology. Clinical Practice*. 2012;2(2):103–111.
- Ministerstvo financií Slovenskej republiky, Ministerstvo zdravotníctva Slovenskej republiky. 2016. *Revízia výdavkov na zdravotníctvo. Priebežná správa*. Bratislava : Ministerstvo financií SR a Ministerstvo zdravotníctva SR. [cited 2017 Jul 20]. Available from: <http://www.finance.gov.sk/LoadDocument.aspx?categoryId=11154&documentId=14822> (in Slovak)
- Mitro P. Synkopy u starých ľudí – špecifické aspekty a kontroverzie. *Via practica*. 2014;11(2):48–51. (in Slovak)
- Morse JM. *Preventing patient falls. Establishing a fall intervention program*. 2nd ed. New York: Springer Publishing Company; 2009.
- National Institute for Health and Care Excellence. *Falls assessment and prevention of falls in older people. NICE Clinical Guideline 161*. London: National Institute for Health and Care Excellence, 2013. [cited 2017 Jul 20]. Available from: <https://www.nice.org.uk/guidance/cg161/resources/falls-in-older-people-assessing-risk-and-prevention-pdf-35109686728645>
- Nyberg L, Gustafson Y. Using the Downton Index to predict those prone to falls in stroke rehabilitation. *Stroke*. 1996;27(10):1821–1824.
- Obayashi K, Araki T, Nakamura K, Kurabayashi M, Nojima Y, Hara K, Nakamura T, Yamamoto K. Risk of falling and hypnotic drugs: retrospective study of inpatients. *Drugs in R&D*. 2013;13(2):159–164.
- O'Mahony D, O'Sullivan D, Byrne S, O'Connor MN, Ryan C, Gallagher P. STOPP/START criteria for potentially inappropriate prescribing in older people: version 2. *Age and Ageing*. 2015;44(2):213–218.
- Račanská E. Špecifiká farmakoterapie insomnie v staršom veku. *Praktické lekárnictvo*. 2014;4(1):9–11. (in Slovak)
- Rajec J. Špecifiká a princípy farmakoterapie v geriatrici. *Onkológia (Bratisl.)*. 2012;7(5):318–320. (in Slovak)
- Registered Nurses' Association of Ontario. *Prevention of falls and fall injuries in the older adult. Nursing best practice guideline*. Registered Nurses' Association of Ontario, Toronto, Canada. Revised 2011. [cited 2017 Jan 10]. Available from: [http://rnao.ca/sites/rnao-ca/files/Prevention\\_of\\_Falls\\_and\\_Fall\\_Injuries\\_in\\_the\\_Older\\_Adult.pdf](http://rnao.ca/sites/rnao-ca/files/Prevention_of_Falls_and_Fall_Injuries_in_the_Older_Adult.pdf).
- Royal College of Nursing. *Clinical practice guideline for the assessment and prevention of falls in older people*. London: The Royal College of Nursing; 2004. [cited 2017 Jun 10]. Available from: <https://www.rcn.org.uk/professional-development/publications/pub-002771>
- Scott V, Votova K, Scanlan A, Close J. Multifactorial and functional mobility assessment tools for fall risk among older adults in community, home-support, long-term and acute care settings. *Age and Ageing*. 2007;36(2):130–139.
- Severo IM, Almeida Mde A, Kuchenbecker R, Vieira DF, Weschenfelder ME, Pinto LR, Klein C, Siqueira AP, Panato BP. Risk factors for falls in hospitalized adult patients: an integrative review. *Revista da Escola de Enfermagem da U S P*. 2014;48(3):540–554.
- Shah BM, Hajjar ER. Polypharmacy, adverse drug reactions, and geriatric syndromes. *Clinics in Geriatric Medicine*. 2012;28(2):173–186.
- Shuto H, Imakyure O, Matsumoto J, Egawa T, Jiang Y, Hirakawa M, Kataoka Y, Yanagawa T. Medication use as a risk factor for inpatient falls in an acute care hospital: a case-crossover study. *British Journal of Clinical Pharmacology*. 2010;69(5):535–542.
- Suchopár J, Prokeš M. Polypragmázie a lékové interakcie. *Vnitřní lékařství*. 2011;57(9):755–759. (in Czech)
- Titler MG, Conlon P, Reynolds MA, Ripley R, Tsodikov A, Wilson DS, Montie M. The effect of a translating research into practice intervention to promote use of evidence-based fall prevention interventions in hospitalized adults: A prospective pre-post implementation study in the U.S. *Applied Nursing Research: ANR*. 2016;31:52–59.
- Voyer P, Verreault R, Mengue P, Azizah G. Prevalence of falls with minor and major injuries and their associated factors among older adults in long-term care facilities. *International Journal of Older People Nursing*. 2007;2(2):119–130.
- Watson BJ, Salmoni AW, Zecevic AA. The use of the Morse Fall Scale in an acute care hospital. *Clinical Nursing Studies*. 2016;4(2):32–40.
- Wawruch M, Zikavská M, Wsolova L, Kuzelova M, Tisonova J, Gajdosik J, Urbanek K, Kristova V. Polypharmacy in elderly hospitalised patients in Slovakia. *Pharmacy World & Science: PWS*. 2008;30(3):235–242.
- Weber P. Polymorbidní senior z pohledu internisty – geriatra. *Medicina pro praxi*. 2012;9:(Suppl A10). (in Czech)
- Weber P, Meluzinová H, Prudius D, Bielaková K. Polyfarmakoterapie nahlížená nejen prizmatem multimorbidity, ale jako další geriatrický syndrom. *Vnitřní Lékařství*. 2016;62(Suppl 3):135–139. (in Czech)
- World Health Organization. WHO global report on falls prevention in older age. Geneva: WHO, 2007. [cited 2017 Sep 10]. Available from: [http://www.who.int/ageing/publications/Falls\\_prevention7March.pdf](http://www.who.int/ageing/publications/Falls_prevention7March.pdf)
- Ziere G, Dieleman JP, Hofman A, Pols HA, van der Cammen TJ, Stricker BH. Polypharmacy and falls in the middle age and elderly population. *British Journal of Clinical Pharmacology*. 2005;61(2):218–223.