DIURETICS IN RELATION TO FALLS IN HOSPITALISED GERIATRIC PATIENTS AN ANALYSIS OF PROTOCOLS ON FALLS IN 2016 – 2022

DIURETIKÁ VO VZŤAHU K PÁDOM HOSPITALIZOVANÝCH GERIATRICKÝCH PACIENTOV ANALÝZA PROTOKOLU O PÁDE V ROKOCH 2016 – 2022

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ABSTRACT

Background: Growth of the senior population compared to the working-age population is increasing rapidly every year. The quality of the health care provided has an effect on the elimination of falls of geriatric patients in medical facilities.

Objectives: Through a retrospective analysis, we identified accompanying causes of falls in hospitalised geriatric patients at the Department of Geriatrics and long-term patients at a Faculty Hospital in Trenčín. We assessed gender and age in relation to falls, as well as time and use of diuretics in relation to falls.

Sample: The research set comprised 419 "Patient Fall Protocol" documents on hospitalised geriatric patients who fell in the period 2016 – 2022.

Method: The data were processed using non-parametric statistical tests (Kruskal-Wallis test, Dunn's test), and after verifying the presence of normality and homogeneity of the data (Kolmogorov-Smirnov test; Bartlett's test), parametric tests (ANOVA, Tukey-Kramer test) were also applied. Categorical data were evaluated using contingency tables with the calculation of the chi-square test.

Results: Analysis of the gender and age of 419 (100 %) geriatric patients who fell showed a higher incidence of falls in women (234; 55.85 %) than in men (185; 44.15 %). The occurrence of falls during individual hours was recorded in the nighttime hours between 11:00 p.m. and midnight and from 3:00 a.m. to 4:00 a.m. ($n = 132$, 31.51 %; $p < 0.05$). More than half of the analysed patients (225, 53.6 %) had a positive medical history of diuretics. Correspondence was demonstrated in users of diuretics and psychopharmaceuticals in 18 geriatric patients who fell at 4:00 a.m. and in 14 patients who fell at 10:00 p.m.

Conclusion: In the context of the research findings, we recommend screening each patient on admission using a measurement tool, increase monitoring of at-risk patients, and distribute increased patient supervision among nurses, nurse practitioners – assistants.

Key words: Geriatric patient. Hospitalisation. Falls. Patient Fall Protocol. Diuretics.

ABSTRAKT

Východiská: Nárast populácie seniorov v porovnaní s populáciou v produktívnom veku sa každým rokom rapídne zvyšuje. Kvalita poskytovanej zdravotnej starostlivosti vplýva na eliminovanie pádov geriatrických pacientov v zdravotníckych zariadeniach.

Ciele: Retrospektívnou analýzou sme identifikovali sprevádzajúce príčiny pádov u hospitalizovaných geriatrických pacientov na Oddelení geriatrie a dlhodobo chorých vo Fakultnej nemocnici v Trenčíne. Posudzovali sme pohlavie a vek vo vzťahu k pádu; čas vo vzťahu k pádu, diuretiká vo vzťahu k pádu.

Vzorka: Výskumný súbor tvorilo 419 dokumentov „Protokol o páde pacienta" hospitalizovaných geriatrických pacientov, ktorí spadli v období rokov 2016 – 2022.

Metóda: Dáta boli spracované s pomocou neparametrických štatistických testov (Kruskal-Wallis test, Dunnov test) a po overení prítomnosti normality a homogenity dát (Kolmogorov-Smirnov test; Bartlettov test) boli aplikované aj parametrické testy (ANOVA, Tukey-Krammer test). Kategorické dáta boli hodnotené s využitím kontingenčných tabuliek s výpočtom chí-kvadrátového testu.

Výsledky: Analýza pohlavia a veku u 419 (100 %) geriatrických pacientov, ktorí spadli, preukázala vyššiu incidenciu pádov u žien (234; 55,85 %) ako u mužov (185; 44,15 %). Výskyt pádov počas jednotlivých hodín bol evidovaný v nočných hodinách medzi 23. a 24. nočnou hodinou a od 3. do 4. hodiny rannej ($n = 132$, 31,51 %; $p < 0,05$). Pozitívnu liekovú anamnézu diuretikami malo 225 (53,6 %) pacientov. Preukázala sa zhoda u užívateľov diuretík a psychofarmák u 18 geriatrických pacientov, ktorí spadli v 4. hodine rannej a u 14 pacientov, ktorí spadli v 22. hodine.

Záver: V kontexte výskumných záverov odporúčame vykonávať pri príjme u každého pacienta skríning s využitím meracieho nástroja, zvýšiť monitoring rizikových pacientov, rozdeliť zvýšený dohľad pacientov medzi sestry, praktické sestry – asistentov.

Kľúčové slová: Geriatrický pacient. Hospitalizácia. Pády. Protokol o páde pacienta. Diuretiká.

INTRODUCTION

The share of the world population aged 60 and over rose in 2020 from 1 billion to 1.4 billion. A World Health Organization (WHO) prediction (2022) states that by 2050, the world population of people aged 60 and over will almost double to 2.1 billion.

In 2022, the number of people aged 65 and over living in Slovakia totalled 957,013, comprising 385,423 men and 571,590 women. The National Centre for Health Information of the Slovak Republic (hereafter the NCZI) states in the 2022 Health Yearbook that *"in the structure of the age composition of the population of Slovakia, the population of seniors continues to grow continuously and the population of productive age continues to decline. Over*

the past ten years, the share of residents 65 years old and older increased by 4.31 points, and the share of those 15 – 64 years old fell by 5.08 points." In 2022, 18,462 hospitalisations of geriatric patients due to falls were recorded.

One of the strategies for ensuring quality care for seniors is to focus on the problem of falls, which represent a health, economic and social issue (Teixeira et al., 2019). Globally, 37.3 million falls that are serious enough to require medical attention are reported each year, and both sexes in all age groups are at risk of falling (WHO, 2021).

Risk factors that contribute significantly to falls in geriatric patients include a history of falls, changes in gait, osteoporosis, reduced physical functions, fear of falling, worsening vision, impaired cognitive abilities, urinary incontinence, cardiovascular diseases, fatigue, the external environment around the geriatric patient, fragility, insomnia, malnutrition and polypragmasy. In the scope of polypragmasy in geriatric patients, diuretics are considered drugs that increase the risk of falling (Coulter, et al., 2024; González-Munguía et al., 2023; Xiao, et al., 2023; Ramos et al., 2023; Van Poelgeest et al., 2023).

METHODOLOGY AND RESEARCH SAMPLE

The aim of the research was to identify the relationship between the time of a fall and the use of diuretics in hospitalised geriatric patients by analysing the data in "Patient Fall Protocol" documents. The Patient Fall Protocol is included among the internal documents of the MEDIS hospital information system. A part of the document is mandatory data according to the methodological guideline of the Office for Health Care Supervision of the Slovak Republic – *Methodological guideline no. 03/2014 on introducing systems for reporting errors, mistakes and adverse events in institutional health care*.

The research was conducted in the years 2016 – 2022 at a faculty hospital in Slovakia, at the Department of Geriatrics and Long-term Patients (hereinafter DGLP). In the monitored period, 9,050 geriatric patients were hospitalised at the DGLP, 3,745 of whom were men and 5,332 women. From the total of 9,050 (100 %) hospitalised geriatric patients, 419 (21.59 %) – 185 men and 234 women – experienced a fall (Chart 1).

The age of the geriatric patients who fell during hospitalisation ranged from 65 to 99 years. Of interest is the representation of both sexes in geriatric patients, as the results show a statistically significantly lower average age in men ($\bar{x} = 80.6 \pm 6.8$) compared to women ($\bar{x} = 82.3 \pm 6.4$; $p = 0.009$), and the variability (given by the standard deviation) is very similar in both sexes, likewise also in the case of the range, which is given by the minimum and maximum detected value (Table 1). It can be stated that although the differences in age between the two groups are significant both mathematically and statistically, in terms of nursing care, the differences are found to be without consequences.

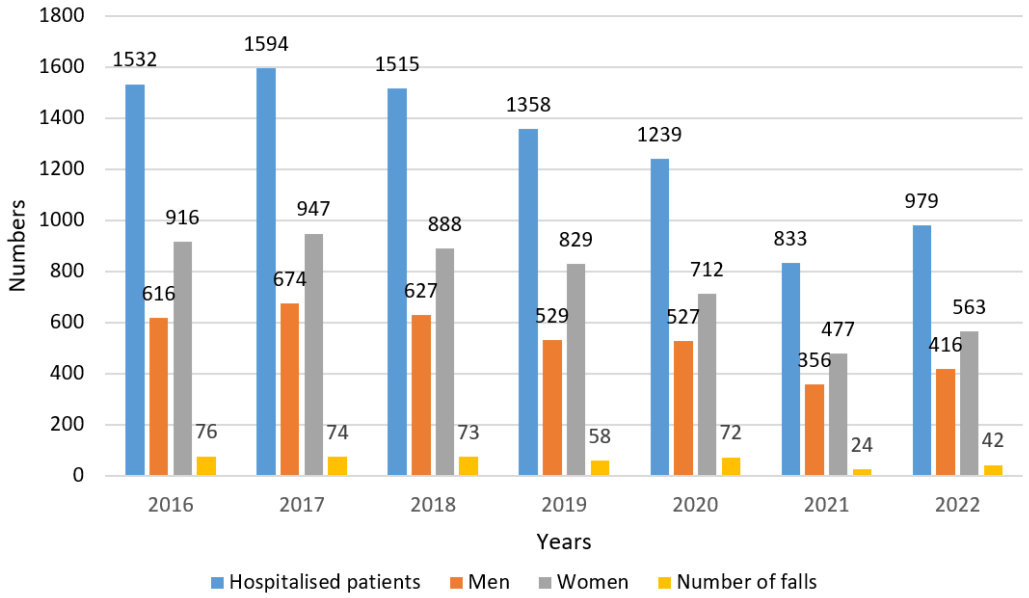

Chart 1 A comparison of the number of hospitalised patients with the number of falls in individual years

Table 1 Average age: a comparison between men and women

Category	*n*	$\bar{x}$	*sd*	x_m	*min.*	*max.*	*p*
Men	185	80.6	6.8	81	66	99	0.009
Women	234	82.3	6.4	82	65	96	

Legend: n – number of patients, $\bar{x}$ – arithmetic mean, *sd* – standard deviation, x_m – median, *min.* – minimum value, *max.* – maximum value, p-value of the test criterion of the t-test

For the statistical processing of numerical data, we mainly used non-parametric tests (the Kruskal-Wallis test followed by Dunn's test) as the interpretive authority, and alternatively we used parametric tests (analysis of variance followed by the Tukey-Kramer test) after the application of the Kolmogorov-Smirnov data normality test and Bartlett's test of homogeneity of the variance to the data for informative verification of the obtained results. Categorical data were processed using a contingency table to calculate the chi-square test. We performed an interpretation of the results of statistical data processing using the conventionally determined *p*-value of the test criterion at the level of 0.05, at which we considered the monitored differences to be non-random, caused in a causal connection with the monitored factors and different with statistical significance. The Statistica®10 software, TIBCO Software, Inc., USA, was used for statistical data processing.

RESULTS

Time of a fall among hospitalised geriatric patients

The overall distribution of falls during the day for the observed period of seven years is presented in Chart 2, from which the hours with the highest cumulative frequency of falls of geriatric patients observed in the analysed years 2016 – 2022 follows.

We subsequently compared the number of incidents (falls) of geriatric patients separately for each year, divided into 24 categories based on the hour of the day of the fall. The highest medians were recorded in the night hours between 11:00 p.m. and 5:00 a.m. (median equal to four or more). The observed maximum number of falls also culminates during this period. Although the non-parametric Kruskal-Wallis test detected the overall statistical significance of the differences between individual time segments in the number of falls, the subsequent Dunn's test was unable to identify among which of the mentioned time intervals the differences were statistically significant. We therefore decided on the additional use of variance analysis, despite the low number of assessed years (n = 7). The Kolmogorov-Smirnov test showed the presence of normality of data distribution ($p > 0.10$) for all 24 categories of time intervals, and after performing calculations of one-factor analysis of variance, Bartlett's test did not confirm heteroskedasticity, i.e., the inhomogeneity of variances ($p > 0.05$) between the individual monitored time intervals. The significance of the differences between individual time segments in the number of falls was identified using the Tukey-Kramer test, which was applied as a subsequent analysis of variance test. The intervals between 11:00 p.m. and midnight at night and 3:00 a.m. and 4:00 a.m. in the morning were identified as having a statistically significantly increased frequency of falls ($p < 0.05$).

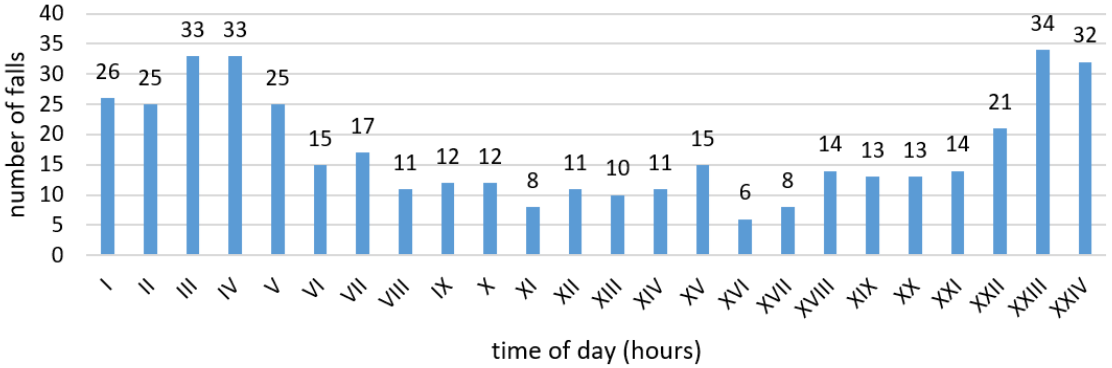

Chart 2 Total frequency of falls of geriatric patients by time of day for the observed period of 2016 – 2022

The frequency of falls during each of the seven observed years is shown in Chart 3 with medians and quartiles presented. The findings show that from the aspect of the risk of falls, there are two exposed times in the night hours: between 11:00 p.m. and midnight and between 3:00 a.m. and 4:00 a.m., when the highest incidence of falls among geriatric patients occurs.

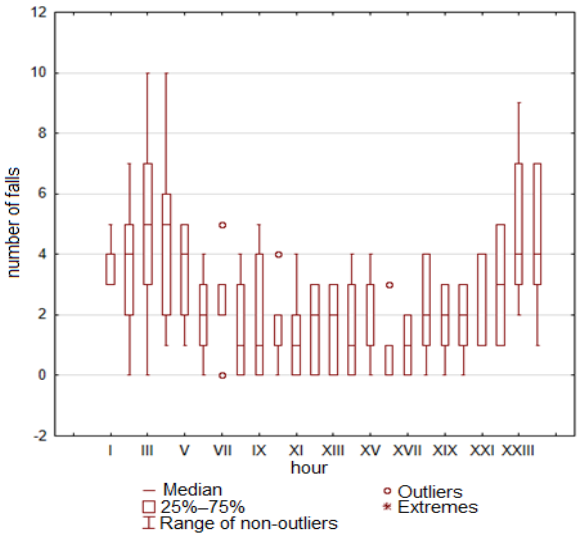

Chart 3 The course of the occurrence of falls during the day – medians

Incidence of falls and pharmacotherapy

Pharmacotherapy of heart failure with diuretics appears to be a major determinant from the aspect of risk factors for falls in geriatric patients. Out of the 419 patients who fell, 225 (53.6 %; Chart 4) had a positive medical history for diuretics.In the group we monitored (n = 419), differences in the use of diuretics between both sexes were statistically tested, and we found the use of diuretics in 110 of 185 men (the expected number was 99) and 115 of the 234 women used diuretics (the expected number of women using diuretics was 126). Statistical processing determined these differences between the observed and expected numbers in the categories as significant (p = 0.039, chi-square test), from which it follows that the risk of falling, the observed frequency of incidents, is higher than expected in men treated with diuretics. Stated simply, the male gender is "riskier".

The interpretation of the percentage representation is also of interest, in that the 110 men using diuretics represent 59.46 % of the total number of individuals (n = 185), and the 115 women using diuretics represent 49.16 % of the total number of women (n = 234). Here, too, the use of diuretics predominates in men.

It follows from the analysed data that, along with diuretics in pharmacotherapy, psychopharmaceutical drugs also affect the time of falls among geriatric patients. The most exposed times of falling when treated with psychopharmaceutical drugs are 2:00, 3:00 and 4:00 in the morning and 10:00 to 11:00 p.m. at night. An interesting fact is that in 18 geriatric patients who fell at 4:00 a.m. and 14 patients who fell at 10 p.m., we recorded agreement in the use of diuretics and psychopharmaceutical drugs (Chart 4).

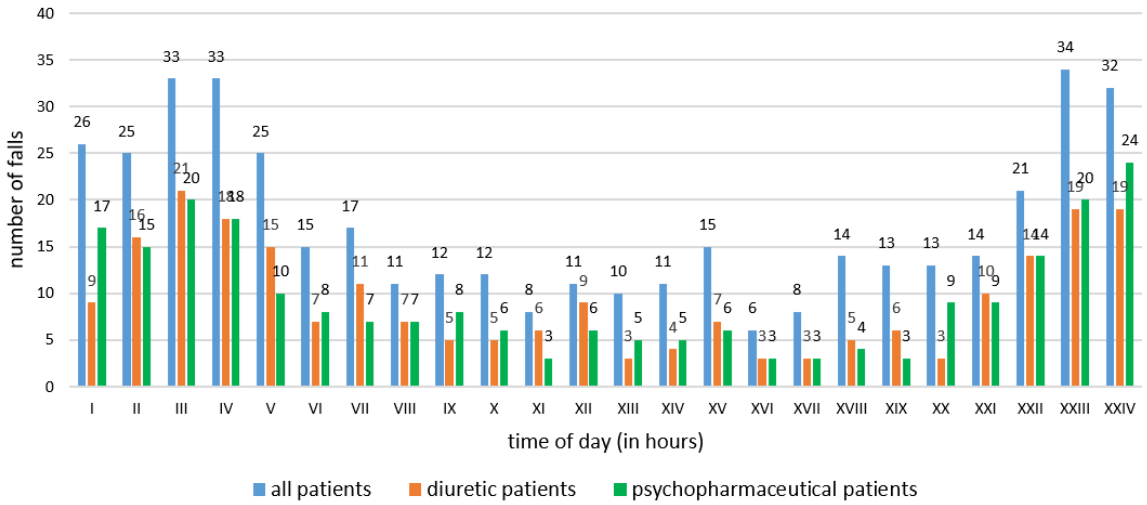

Chart 4 A comparison of the frequency of falls of geriatric patients as users of diuretics and psychopharmaceutical drugs

DISCUSSION

Sex and age in relation to a fall: The average age of patients who had experienced a fall was 82 years old. In the group we analysed (n = 419), more women (234; 55.85 %) than men (185; 44.15 %) had experienced a fall. According to the Health Yearbook of the NCZI of the Slovak Republic for the year 2022, the total number of all hospitalisations was 1,002,907; of which 453,048 were men and 549,859 were women, and 376,106 people over the age of 65 were hospitalised. From the given fact, we can assume that with more hospitalisations of women, falls of women over the age of 65 in medical facilities will be recorded in greater numbers in the future.

The higher risk of falls among geriatric women compared to men is more likely due to lower physical activity, more frequent use of hypnotics and the effect of internal factors, such as vertigo, instability and visual impairment. The falls of men of geriatric age are influenced to a greater extent by external factors, e.g., slipping and tripping on an uneven surface or a lower level of organism functionality (Ardaneh et. al., 2023; Hoffmann et al., 2015; Johansson et al., 2016).

Time in relation to a fall: The highest *number of falls during individual hours* was recorded in the nighttime hours between 11:00 p.m. and midnight and from 3:00 to 4:00 a.m. in the morning hours (n = 132, 31.51 %). The majority of falls occur during the evening and nighttime hours. Long shifts, night work and long working hours during the week can lead to combined changes in the circadian rhythm, which can seriously impact cognitive function. For nurses, a lack of regular sleep as well as stress and fatigue during a night shift can be associated with neurocognitive dysfunction and can affect both work safety and patient safety. In the last 3 – 4 hours of a work shift fatigue increases and productivity decreases (Durán-Gómez et al., 2021; Han et al., 2021; Kim et al., 2021; Ruiz-Fernández et al,. 2020).

Bettering the quality of life of nursing staff can change the perception of patient safety while also avoiding safety-related incidents. Quality of life and favourable working conditions are independent predictors of a positive perception of patient safety. Among the organisations that have proposed the use of sleep in healthcare settings to reduce the serious consequences of fatigue and sleepiness are the Institute of Medicine (2021), the Joint Commission (2018) and the American Nurses Association (2021).

Diuretics in relation to the time of a fall: In our analysed set of 419 (100 %) geriatric patients who had fallen, 225 (53.6 %) had a positive medication history for use of diuretics, thus demonstrating a mutual relationship between the use of diuretics and an increased risk of falls in geriatric patients (compare Atirah Az-Zahra et al., 2021; Nakashima, et al., 2023; Van Poelgeest et al., 2023). The authors also state an association in new users of diuretics, in whom the risk of falling increased during the first 14 days. It has not been proven, however, whether diuretics are a separate trigger. What is likely that in combination with drugs affecting the cardiovascular system the incidence of falls increases several fold. Lee et al. (2021) report that drugs that contribute to falls through their effects on the cardiovascular and central nervous system are called FRIDs – fall-risk increasing drugs – and include antihypertensives, antiarrhythmics, anticholinergics, antihistamines, sedatives, hypnotics, antipsychotics, antidepressants, opiates and non-steroidal anti-inflammatory drugs. They affect geriatric patients in the form of orthostatic hypotension and bradycardia while also causing sleep disorders, confusion and dizziness. In our analysed set, falls occurred more often between 2:00, 3:00 and 4:00 in the morning and between 10:00 p.m. and midnight with the use of psychopharmaceuticals, compared to patients who did not have this pharmacotherapy in their treatment.

A number of studies confirming the relationship between psychopharmaceuticals drugs and patient falls have been published over the last twenty years (Beunza-Sola et al., 2018; Fernandéz et al., 2018; Ham et al., 2014; Park et al., 2015).

CONCLUSION

The occurrence of falls in hospitalised geriatric patients is assessed as an extraordinary event in medical facilities. The occurrence of falls in hospitalised geriatric patients is influenced by diuretics and psychopharmaceuticals drugs, either independently or often in combination. As a way of directing the attention of nurses to hospitalised geriatric patients who are in danger of falling, we recommend introducing visible colour markings on the medication card and increasing the frequency of their monitoring. A possible solution, especially in the night shift, is increased monitoring of at-risk geriatric patients at regular intervals of 20 – 30

minutes, which would reduce the time from the fall to its detection, e.g. in the case of impaired patient mobility and possibly the unavailability of signalling equipment.

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