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# ВЗАИМОСВЯЗЬ РИСКА ПАДЕНИЙ С ОСОБЕННОСТЯМИ КОГНИТИВНОЙ ФУНКЦИИ И ЭМОЦИОНАЛЬНОГО СТАТУСА (СТРАХА ПАДЕНИЙ) У ЛИЦ СТАРШЕГО ВОЗРАСТА

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# The Relationship of the Risk of Falls with the Features of Cognitive Function and Emotional Status (Fear of Falls) in Older People

## Резюме

**Цель.** Оценить частоту падений, связь страха падения и риска падений у лиц в возрасте 60 лет и старше. **Материал и методы.** В открытое одномоментное исследование включены 51 амбулаторный пациент (49 женщин, 2 мужчин) в возрасте от 61 до 90 [70 (67; 75)] лет. Проводился общепринятый физикальный осмотр, клинический и биохимический анализ крови, скрининг старческой астении (опросник «Возраст не помеха»), оценивался риск падений (анамнез, тест «Встань и иди»), страх падений («Краткая шкала оценки страха падений», «Шкала эффективности падений»), когнитивные функции (КФ) (монреальская шкала когнитивной оценки — MoCa-тест). **Результаты.** Высокий риск старческой астении выявлен у 38 %, преастании — у 31% пациентов. Падения в анамнезе наблюдались у 75 %, страх падений — у 78 %, нарушение КФ — у 49 % (24,3±2,9 баллов) пациентов. Установлена взаимосвязь между страхом падений и фактом падений в анамнезе (отношение шансов [ОШ] 9,92, р=0,003, 95 % доверительный интервал [ДИ] 2,20-44,63); между страхом падений и наличием двух и более сопутствующих заболеваний (ОШ 10,86, р=0,013, 95 % ДИ 1,66-71,09); между тестом «Встань и иди» более 10 сек и МОСА менее 25 баллов (ОШ 8,57, р=0,001, ДИ 2,4-30,3); результатом по шкале эффективности падений и МОСА менее 25 баллов (ОШ 5,6, р=0,018, ДИ 1,34-23,36). Оптимальное значение теста «Встань и иди» для предсказания падений составило 10.5 сек и выше (площадь под кривой 0,753±0,083, р=0,019), теста МОСА — 24,5 баллов и менее (площадь под кривой 0,792±0,065, р <0,001); шкалы эффективности падений для предсказания страха падений — 72,5 баллов и более (площадь под кривой 0,743±0,092, р=0,014); теста «Встань и иди» — 9,5 секунд и более (площадь под

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кривой 0, 708±0,098, p=0,036). **Заключение**. Страх падений ассоциировался с фактом падений в анамнезе, коморбидностью, низкой функциональной активностью и снижением КФ, что подтверждает многофакторность происхождения страха падений в пожилом и старческом возрасте и требует учёта при разработке комплексных лечебно-профилактических программ.

*Ключевые слова: пожилые пациенты, падения, факторы риска, страх падений, когнитивные функции, коморбидность*

## Abstract

**Objective**. To assess the frequency of falls, the relationship between fear of falling and the risk of falls in people aged 60 years and older. **Material and methods**. The open cross-sectional study included 51 outpatients (49 women, 2 men) aged 61 to 90 [70 (67; 75)] years. A conventional physical examination, clinical and biochemical blood tests, screening for fragility (the "Age is not a hindrance" questionnaire), the risk of falls (history, the "Get up and go" test), fear of falls ("Short scale for assessing the fear of falls", "Scale of effectiveness falls"), assessment of cognitive function (CF) — Montreal scale of cognitive assessment — MoCa-test). **Results**. A high risk of senile asthenia was found in 38 %, preasthenia — in 31 %, a history of falls — in 75 %, fear of falls — in 78 %, impaired CF — in 49 % (MOCA 24.3±2.9 points) of patients. An association was found between fear of falls and history of falls (odds ratio [OR] 9.92, p=0.003, 95 % confidence interval [CI] 2.20-44.63), 2 or more comorbidities (OR 10.86, p=0.013, 95 % CI 1,66-71,09); between the "Get up and go" test for more than 10 seconds and MOCA less than 25 points (OR 8.57, p=0.001, CI 2.4-30.3); scores less than 25 on the Fall Effectiveness Scale and MOCA (OR 5.6, p=0.018, CI 1.34-23.36). The optimal value of the "Get up and walk" test for predicting falls was 10.5 seconds or more (area under the curve 0.753±0.083, p=0.019), the MOCA test was 24.5 points or less (area under the curve 0.792±0.065, p <0.001); the fall effectiveness scale for predicting fear of falls — 72.5 points or more (area under the curve 0.743±0.092, p=0.014); test "Get up and go" — 9.5 seconds or more (area under the curve 0.708±0.098, p=0.036). **Conclusion**. Fear of falls was associated with a history of falls, comorbidity, low functional activity, and a decrease in CF, which confirms the multifactorial origin of the fear of falls in older age and requires consideration in the development of comprehensive treatment and prevention programs.

*Key words: elderly patients, falls, risk factors, fear of falls, cognitive functions, comorbidity*

AH — arterial hypertension, BP — blood pressure, BMI — body mass index, CF — cognitive function, CHD — coronary heart disease, CI — confidence interval, CKD — chronic kidney disease, GFR — glomerular filtration rate, MOCA — Montreal Cognitive Assessment, OR — odds ratios, VAS — visual analogue scale, WHO — World Health Organization. AUC — area under the curve

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According to the forecasts of the United Nations Organization, the elderly is expected to grow to reach more than 2 billion people by 2050 [1].

Currently, there are more than 30 million elderly and senile people in Russia, and their number increases by about 1 million per year [2]. In this regard, the relevance of predicting complications and their medical and social consequences associated with complex pathology and geriatric syndromes is obvious.

Locomotive falls are common and serious problem in elderly and senile people, regardless of the place and conditions of living. Every year, there are 646,000 fatal falls worldwide [3]. Experts from many countries agree that people 65+ are at high risk of falls, and the fear of falls is recognized as significant health problem and risk factor for falls in elderly age group; it allows to refer this category of patients to a fall risk group [4].

Senile asthenia can contribute to falls, and falls, in turn, cause and accelerate the progression of senile asthenia, therefore creating the "vicious circle".

Due to the consequences of injuries from fall and chronic pain syndrome, patients significantly reduce

their motor activity; it results in their dependence on assistance, maladaptation in everyday life, and the development of fear of a possible fall [5].

One of the important factors that affects the life quality of elderly patients and their functional capacities is the fear of falls. Up to 70 % of individuals shortly before a fall, and up to 40 % of those who had no falls, reported of the fear of falling. Up to 50 % of people who experience the fear of falls limit or completely terminate their social and physical activity. Approximately two-thirds of people experienced such fear after falling, and about a half tried to avoid intense activity in the future due to the fear of falls [6].].

At present, the relationship between the risk of falls and the frequency of falls in elderly people depending on their cognitive and emotional status (fear of falls) has not been adequately studied. A thorough assessment of the history and clinical functioning of elderly people, the analysis of the correlation between the risk of falls and psycho-emotional status will help to stratify patients according to the risk of falls, to improve their clinical condition, quality of life, and to develop preventive measures; it provides the background of this study.

## Objective

To assess the frequency of falls, the correlation between the fear of falls and the risk of falls in people 60+ who are observed on an outpatient basis.

## Materials and methods

This open-label, cross-sectional study included 51 patients (49 females, 2 males) aged 61 to 90 years and observed on an outpatient basis.

*Inclusion criteria:* age 60+; males and females; the ability to understand the study procedure and to sign an informed consent form.

*Exclusion criteria:* age under 60; fatal chronic diseases or life expectancy of less than one year; severe cognitive impairment.

The clinical condition of patients was evaluated taking into consideration history and demographic data and the results of standard physical examination.

Comorbidity was considered if the patient had a combination of at least any two chronic diseases that reduce functional capacities [7].

Obesity was defined according to WHO body mass index (BMI) classification: BMI of 25–29.9 kg/m$^2$ was considered as overweight, 30 kg/m$^2$ and more — as obesity.

The criterion for anemia was decreased hemoglobin level less than 130 g/L in men and less than 120 g/L in women [8]; the criterion for arterial hypertension (AH) was blood pressure (BP) ≥140/90 mm Hg when examining a patient during his/her visit to a physician, with at least three measurements on both arms according to the Russian guidelines for the management of patients with AH-2020 [9].

Pain was assessed using visual analog scale (VAS) [10]. Glomerular filtration rate (GFR) was calculated using the CKD-EPI formula (2011). Chronic kidney disease (CKD) was diagnosed according to the KDIGO guidelines-2012 [11]. The 10-year absolute fracture risk was assessed using the Fracture Risk Assessment Tool (FRAX). [1] Screening of senile asthenia was carried out using "Age is not a hindrance" questionnaire: patients with 3 or more positive answers were considered to have high risk for the presence of senile asthenia [12].

The risk of falls was assessed by collecting history, including clarification about falls, their number, symptoms before falls, the presence of injuries and other consequences of falls. The patients were asked 3 questions: "*Have you had a fall-related injury or non-injury fall during a year? Do you feel instability when you stand up and walk? Are you afraid of falls?*" Patients with a positive answer to at least one of these three questions underwent the "Stand up and go" test; the result of more than 14 seconds indicated the risk of falls [13, 14].

Fear of falls was assessed using Short Scale of Falls Fear Assessment: 7–8 points indicated low, 9–13 points — moderate, and 14-28 points — high fear of falls [15]; the Falls Efficacy Scale was also used which evaluates the grade of fear that the patient experiences when performing everyday activities; fear of falls is determined with points ≥70 [16].

The state of cognitive function (CF) was assessed using the Montreal Cognitive Assessment scale (MOCA-test) [17]. CF was considered to be normal at 25+ points, moderately reduced at 19–24 points, severe cognitive dysfunction was found at less than 19 points.

All patients underwent full blood count and biochemical assay.

All patients signed informed consent form for the voluntary participation in the study. The study was approved by the local Ethics Committee of N.I. Pirogov Russian National Research Medical University (Pirogov Medical University) on May 17, 2021, protocol No. 208.

Patients were enrolled in the study from March 2021 to September 2021 on the basis of the city polyclinic No. 134 of the Moscow Health Department.

Statistical data processing was performed using SPSS 16.0 and Statistica 6.0 software packages.

Descriptive statistical information on continuous quantitative data with a normal distribution is presented as the mean and its standard deviation; in cases of a non-normal distribution — as a median and interquartile range (25th percentile; 75th percentile). Discrete variables are presented as a percentage of the total number of patients in the group. To compare them, we used the analysis of contingency tables using $\chi^2$ criterion adjusted for continuity or Fisher's exact test, when the number of observations in one of the table cells did not exceed 5.

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[1]   URL: https://www.sheffield.ac.uk/FRAX/tool.aspx?lang=rs

The correlation between continuous parameters was assessed using Spearman's rank correlation coefficient. The association between fear of falls and analyzed factors was assessed using odds ratios (OR) and 95 % confidence interval (CI) in multiple logistic regression analysis. Differences were considered significant at two-sided $p < 0.05$.

## Results

The age of patients included in the study was 70 (67; 75) years, the level of systolic BP was 130 (130; 140) mm Hg, of diastolic BP — 80 (80; 90) mm Hg, heart rate was 66 (60; 70) bpm, BMI — 27.2 (22.7; 31.6) kg/m².

49 (96 %) patients had comorbidities: 38 (76 %) had AH, 14 (29 %) — coronary heart disease (CHD), 16 (31 %) — obesity, 15 (30 %) — osteoporosis, 43 (88 %) — osteoarthritis, 8 (16 %) — diabetes mellitus, 22 (41 %) — CKD; no patients demonstrated any signs of anemia. 35 (92 %) patients with AH were on constant antihypertensive therapy: angiotensin-converting enzyme inhibitors were taken by 30 patients (85.7 %), angiotensin II receptor antagonists — by 5 patients (14.2 %), slow calcium channel blockers — by 15 patients (42.8 %), thiazide and thiazide-like diuretics — by 16 patients (45.7 %), beta-blockers — by 10 patients (28.6 %), fixed combinations of two or three drug products — by 24 (68.6 %) patients.

A high risk of senile asthenia in accordance with "Age is not a hindrance" scale was identified in 19 (38 %) patients, preasthenia — in 16 (31 %) patients.

Table 1 presents general characteristics of patients.

38 (75 %) patients had a history of falls, with the average number of falls 2.0 (0.0–3.0) per person in the past year (Table 2).

30 patients (59 %) had fall-related injuries, or falls without injury during the past year, 35 patients (69 %) had a feeling of instability when standing up or walking, 40 patients (78 %) had fear of falls.

The result of "Stand up and go" test was 10.7 ± 2.7 seconds: 26 (51 %) individuals completed the test in 10 seconds or less, 15 (29 %) individuals required 11–13 seconds, 10 (20 %) — 14+ seconds. Functional mobility was reduced by 0.8 seconds in patients aged 70–79, and by 1.8 seconds in patients aged 80–99; these results indicate the risk of falls.

According to the Falls Efficacy Scale, the fear of falls was detected in 40 (78 %) individuals; the result corresponded to 72.5 ± 10.0 points.

According to the Short Scale of Falls Fear Assessment, low fear of falls was detected in 13 (25 %) patients, moderate one — in 17 (33 %), and high — in 21 (41 %) patients.

Impaired CF was present in 25 (49 %) patients; the result on the MOCA scale corresponded to 24.3 ± 2.9 points. Correlation analysis of the fear of falls with a number of parameters is presented in Table 3.

In individuals with the history of multiple falls (3 or more), a correlation was established with a decrease in MOCA questionnaire score (p = 0.023, r = 0.37).

A correlation was found between decreased CF by MOCA and the fear of falls (according to the results of the "Stand up and go" test) (p < 0.001, r = 0.49), according to the results of the Short Scale of Falls Fear Assessment (p = 0.028, r = 0.46) and of Falls Efficacy Scale (p = 0.012, r = 0.35) — with a decrease in hemoglobin level (p = 0.014, r = 0.40). Parameters that are associated with the fear of falls in elderly and senile patients are presented in Table 4.

A correlation was found between the "Stand up and go" test with more than 10 seconds and MOCA result of less than 25 points (OR 8.6, p = 0.001, 95 % CI 2.4–30.3); between Falls Efficacy Scale score and MOCA of less than 25 (OR 5.6, p = 0.018, 95 % CI 1.3–23.4).

**Table 1.** *General characteristics of the included patients*

| Indicator | Number of patients, n |
|---|---|
| Elderly | 35 (69 %) |
| Senile age | 15 (29 %) |
| Centenarians | 1 (2 %) |
| Men | 2 (4 %) |
| Women | 49 (96 %) |
| Higher education | 26 (51 %) |
| Disability group | 19 (37 %) |
| Working patients | 6 (12 %) |
| Marital status married / married | 37 (73 %) |
| Bad habits | 2 (4 %) |
| Availability of a social worker | 3 (6 %) |
| Lives at home with family | 45 (87 %) |
| Family history of cardiovascular disease | 30 (58 %) |
| History of skeletal fractures | 21 (41 %) |

**Table 2.** *Fall characteristics Indicator Number of patients, n*

| Indicator | Number of patients, n |
|---|---|
| History of falls | 38 (75 %) |
| Pre-fall symptoms: dizziness | 18 (47 %) |
| Pre-fall symptoms: palpitations | 2 (4 %) |
| Pre-Fall Symptoms: Chest Pain | 2 (5 %) |
| Circumstances of falls: slippery | 24 (63 %) |
| Circumstances of falls: dark | 14 (37 %) |
| Place of fall: at home | 12 (32 %) |
| Place of fall: outdoors | 26 (68 %) |

**Table 3.** *Fear of falling: correlation analysis Spirmen*

| Indicator | r | |
|---|---|---|
| History of falls | 0,46 | 0,001 |
| Number of falls in history | 0,47 | 0,001 |
| Two or more comorbidities | 0,40 | 0,004 |
| Dizzy before falling | 0,32 | 0,050 |
| Time to pass the «Get up and go» test | 0,28 | 0,048 |
| High risk of frailty | 0,45 | 0,001 |

*Table 4.* *Indicators associated with fear of falls in elderly and senile patients*

| Indicator | Odds ratio | Confidence interval | p |
|---|---|---|---|
| History of a fall | 9,92 | 2,20-44,63 | 0,003 |
| Two or more comorbidities | 10,86 | 1,66-71,09 | 0,013 |
| Get up and walk test over 10 sec. | 6,02 | 1,16-31,88 | 0,032 |

The optimal result of the "Stand up and go" test for predicting falls in patients 60+ was 10.5 seconds or more according to the analysis of the ROC curve (AUC 0.75 ± 0.08, p = 0.019, 95 % CI 0.59–0.92), with a sensitivity of 77 % and a specificity of 63 %.

The optimal result of the MOCA test for predicting falls in patients 60+ was 24.5 points or less (AUC 0.792 ± 0.065, p < 0.001, CI 0.66–0.92) with a sensitivity of 72 % and a specificity of 77 %.

The optimal result of the Falls Efficacy Scale for predicting the fear of falls was 72.5 points or more (AUC 0.743 ± 0.092, p = 0.014, 95 % CI 0.56–0.92) with a sensitivity of 72.5 % and a specificity of 72.7 %, and of the "Stand up and go" test — 9.5 seconds or more (AUC 0.708 ± 0.098, p = 0.036, 95 % CI 0.52–0.89) with a sensitivity of 70 % and a specificity of 73 %.

## Discussion

The objective of this study was to assess the frequency of falls, the fear of falls and to analyze the correlation between the fear of falls and the risk of falls in outpatients aged 70 (67; 75). Most of the patients were elderly (69 %), female (96 %), had a higher education (51 %), were married (78 %), had comorbidities (96 %) with the predomination of osteoarthritis (88 %) and AH (76 %). High risk of senile asthenia was found in 38 %, falls — in 38 (75 %), history of fractures — in 41 % of patients.

Obtained results are consistent with the data obtained by other researchers. According to a study involving 628 patients aged 76.9 ± 15.5, falls in the past year were observed in 56.5 % of individuals. Women fell statistically significantly more frequently (58.62 % of cases, 95 % CI 80.2–88.6) compared to men. The highest frequency of falls (61.36 %, 95 % CI 10.5–21.8, p < 0.001) occurred in patients aged 85+ [18, 19].

Currently, a fall is considered to be a complex multifactorial phenomenon. To understand the mechanism of falls, one should be remember the basic mechanisms that are responsible for normal gait. Cerebellum and basal ganglia are the main subcortical nuclei, which, in interaction with cerebral cortex, carry out motor and cognitive functions of brain. Normal functioning and effective coordination of the musculoskeletal system, proper processing of sensory information (while maintaining vision, hearing, proprioception, etc.) along with adequate cognition and concentration, are also required to prevent falls and to maintain normal gait [20]. It is not surprising that many of these functions at least somewhat decline with age increasing the risk of falls. For example,

balance problems are one of the most common cause of falls, and the corresponding complaint in patients with falls is dizziness.

According to the Falls Efficacy Scale, the fear of falls was found in 78 % of patients who participated in our study. At the same time, according to the Short Scale of Falls Fear Assessment, low fear of falls was detected in 25 % of patients, moderate — in 33 %, high — in 41 % of patients. In a study of 5,560 patients aged 65+, the fear of falls was found in people who had fallen in the previous year (48.8 % vs 24.8 %, p < 0.001) and in individuals with recent falls (previous month: 46.8 % vs 31.0 %, p < 0.001). Regardless of the time of the fall, the fear of falls remains almost the same [21].

In a study of 125 geriatric patients (110 females, 88 %) aged 75.66 ± 7.98 years who had at least one fall in the past year, the risk of falls was assessed using the Morse scale and the self-assessment risk scale for falls. The number of falls during one year was 2.42 ± 1.90 per person, 71 (56.8 %) individuals had more than 2 falls. Falls partially occurred at home (44.8 %), about the same number — outdoors (42.4 %), in 12.8 % of cases, patients fell both outdoors and at home. According to the Scale of Self-assessment of the Risk of Falls, high risk was revealed in 104 (83.2 %) cases, and low one — in 21 (16.8 %) cases [5]. Moreover, the prevalence of comorbidity and polypharmacy that contribute to the risk of falls increases with age; logistic regression analysis revealed an association between the fear of falls and comorbidity (OR 10.86, p = 0.013).

Gait normally changes with age; the changes include decline in gait speed and stride length, as well as decreased strength of lower extremities. These changes are most pronounced when elderly people walk on uneven surfaces. Falls are usually the result of an interaction between long-term or short-term predisposing factors and short-term triggers (such as travel, acute disease, or adverse drug reaction) in the person's environment. According to our study, slippery roads (63 %) and poor lighting (37 %) were the common causes of falls, with most falls occurred outdoors (68 %), not at home (32 %).

Analysis of the place of falls in 355 patients aged 65+ revealed that patients aged 65–74 more often (in 66.25 % of cases) fall outdoors; patients aged 75–84 fall at home and outdoor with a frequency of 34.88 and 48.84 %, respectively; and patients aged 85+ fall more often at home [22].

In a study of 655 patients (81 % female) aged 75.1 ± 8.2 years, it was demonstrated that 33.1 % of patients fell at home, 44.6 % — outdoors, the other –both at home and

outdoors. As the immediate cause of their fall, patients considered balance problems (2 %), dizziness (4.2 %), instability when walking (8.1 % slipped, 7.7 % stumbled), loss of consciousness (2.4 %), joint pain (3 %), dangerous environment (ice on road) (1.8 %); 69 % of patients could not determine the cause of their fall [23].

According to our data, most of the falls occurred outdoors, possibly due to the younger age of the patients included in the study (69 % of patients aged 60–75 years); this fact indicates their adequate activity.

Our study confirmed the contribution of decreased CF and altered emotional status (the fear of falls) into the occurrence of falls. The association of the fear of falls and the very fact of falls in history (OR 9.92, p = 0.003) confirms the contribution of the fear of falls to the development of the latter. The most vulnerable group of elderly patients in regard to the development of the fear of falls includes individuals with low functional mobility based on the results of the "Stand up and go" test (OR 6.02, p = 0.032).

The association between the time to complete the "Stand up and go" test and the MOCA score less than 25 points (OR 8.6, p = 0.001), as well as the results on the Falls Efficacy Scale and MOCA score less than 25 points (OR 5.6, p = 0.018) allows us to consider decreased CF as the most important risk factor for the fear of falls.

The optimal result of the "Stand up and go" test for predicting falls was 10.5 seconds or more, of the MOCA test — 24.5 points or less; and a cut-off value of the Falls Efficacy Scale of 72.5 points or more, with a sensitivity of 72.5 % and a specificity of 72.7 %, may indicate the fear of falls in outpatients 60+.

A study performed by Levedan A. et al. (2002) revealed that patients 75+ with a history of falls were 2.5 times more likely to have the fear of falls than those who had not fallen in the past year. It was found that patients with the fear of falls are predominantly female, with comorbidity, functional limitations, symptoms of depression, however, in contrast to our results, there was no association with a worse cognitive status [24]. However, an association between the fear of falls and cognitive impairment was previously reported in a study with age-matched participants [25].

The fear of falls should not be considered as just a consequence of the falls themselves. The fear of falls is a predictor of future falls [26]; it has a significant adverse effect on the quality of life, reduces activity, physical and cognitive functioning, increases the risk of disability and should be considered as an separate factor for specific measures.

## Conclusion

75 % of outpatients aged 60+ had a history of falls; they were predominantly female (96 %) and those living at home with their families (87 %). Most of them had comorbidities (96 %), every third had a high risk of senile asthenia (38 %), 49 % had decreased CF,

59 % — fall-related injuries or falls without injury during the past year. Slippery roads (63 %) and poor lighting (37 %) were common causes of falls; most part of falls occurred outdoors (68 %). 78 % of patients had the fear of falls: 25 % — low; 33 % — moderate; 41 % — high.

The fear of falls was associated with a history of falls, comorbidities, low functional activity, and decreased CF.

The results of the "Stand up and go" test of 10.5 seconds or more and of the MOCA test of 24.5 points or less can be considered for fall risk stratification; 72.5 points or more on Falls Efficacy Scale — for the fear of falls in outpatients 60+.

The fear of falls is a psychological problem, however, the origin of such fear in elderly patients is multifactorial. The associations with comorbidity, senile asthenia, decreased mobility, and CF demonstrated in our study should be taken into account when developing comprehensive treatment and prevention programs for elderly patients with falls.

**Вклад авторов:**
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