Multifactorial interventions to prevent falls in older adults

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BACKGROUND: Falls are one of the most common syndromes in old age. An estimated 646,000 deaths from falls occur each year worldwide. Moreover, most fatal falls occur in people over 65 years of age. Most falls are the result of the interaction of several factors.

AIMS: To examine the long-term effectiveness of multifactorial interventions in preventing falls in elderly and senile patients.

MATERIALS AND METHODS: A sample of patients territorially attached to the Family Medicine Center of the North-Western State Medical University named after I.I. Mechnikov was established four years ago. Individual fall prevention programs were developed for all study participants ($n = 260$) because they had different falls risk factors. Patient follow-up was continued for 12 months. The results of the multifactorial intervention were evaluated after 12 months and after 3 years, 2 times in total, the last study in a random subsample of patients ($n = 84$). Senile asthenia screening, questionnaires, assessment of emotional status, and presence of sleep disturbances were performed to assess the risk of falls. The effectiveness of multifactorial interventions was assessed based on repeated assessment of risk factors for falls.

RESULTS: Participants with a history of falls were significantly more likely to have symptoms of depression, anxiety, symptoms of frailty, visual and hearing impairment ($p < 0.05$). On average, each participant in the group with falls had 6.1 ± 2.1 risk factors for falls and 3.8 ± 2.3 in the group without falls ($p = 0.000$). During the follow-up period after the interventions, the incidence of falls decreased 9-fold after one year (from 28.5% to 3.1%) and then increased to 23.8%. All patients who fell after the multifactorial intervention had a history of cognitive impairment and falls. In addition, in the group of patients with falls, fall risk factors such as low levels of physical activity, hearing impairment, and the presence of a traumatic environment at home were not eliminated. As a result of the interventions, fear of falls disappeared in 9 patients, 95% CI (2.35–65.89), $p = 0.039$.

CONCLUSIONS: The study demonstrated a decrease in the effectiveness of multifactorial interventions to prevent falls at three years. A less persistent effect was seen in patients with a history of falls. A history of falls, symptoms of frailty, complaints of fear of falls, sleep disturbances, and anxiety symptoms were factors that increased the risk of falls. Individualized fall prevention programs resulted in decreased fear of falls.

Keywords: elderly and senile age; falls; risk factors for falls; multifactorial interventions; fear of falls; depression; anxiety; frailty.

ECO●VECTOR

Многофакторные вмешательства для предотвращения падений у людей пожилого и старческого возраста

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Обоснование. Одним из самых распространенных заболеваний пожилых людей является синдром падений. По некоторым оценкам в результате падений ежегодно в мире умирает 646 000 человек, большинство из которых старше 65 лет. В основном к падению приводит взаимодействие различных факторов.

Цель работы — изучить долгосрочную эффективность многофакторных вмешательств в профилактике падений у пациентов пожилого и старческого возраста.

Материалы и методы. Участниками исследования стали 260 пациентов, территориально прикрепленных к Центру семейной медицины Северо-Западного государственного медицинского университета им. И.И. Мечникова, для которых были разработаны индивидуальные программы профилактики синдрома падений. Наблюдение за пациентами продолжалось в течение 12 мес. Результаты многофакторного вмешательства оценены дважды: по окончании наблюдения и через 3 года после него. Вторая оценка выполнена в подвыборке, сформированной случайным образом. Пациентам провели скрининг старческой астении, анкетирование, оценку эмоционального статуса и диагностику нарушений сна.

Результаты. Участники с падениями в анамнезе чаще имели симптомы депрессии, тревоги, преастении и старческой астении, а также нарушений зрения и слуха ($p < 0,05$). Среднее количество факторов риска падений у участников с опытом падения составило $6,1 \pm 2,1$, а у пациентов без такого опыта — $3,8 \pm 2,3$ ($p = 0,00$). В течение периода наблюдения после многофакторных вмешательств общая частота падений снизилась в 9 раз (с 28,5 до 3,1 %) через год, а затем повысилась до 23,8 % через 3 года. У всех пациентов, испытавших падения после многофакторного вмешательства, были когнитивные нарушения и падения в анамнезе. Кроме того, пациенты с опытом падения не помогли устранить такие факторы риска падений, как низкий уровень физической активности, нарушение слуха, наличие травмоопасной обстановки дома. В результате вмешательств у 9 пациентов исчез страх падений [95 % ДИ 2,35–65,89; $p = 0,039$].

Выводы. Исследование продемонстрировало снижение эффективности многофакторных вмешательств, направленных на профилактику падений, в течение трех лет. Наименее устойчивый эффект от вмешательств был у пациентов с падениями в анамнезе. Однако риск падений повышают не только падения в анамнезе, но и симптомы старческой астении, страх падений, нарушения сна, симптомы тревоги. Индивидуальные профилактические программы снижают страх падений.

Ключевые слова: пожилой и старческий возраст; падения; факторы риска падений; многофакторные вмешательства; страх падений; депрессия; тревога; старческая астения.

BACKGROUND

Falls are one of the most common occurrences in old age. As defined by the World Health Organization, a fall is an event that results in a person lying unintentionally on the ground, floor, or some other lower level. According to some estimates, falls cause lethal outcomes in 646,000 people annually, mostly in those >65-years-old [1].

Nevertheless, less than 10% of older adults people consider this problem important or realize that it can be prevented [2]. Falls represent a serious geriatric syndrome and are not normal in old age.

The probability of a fall increases with the number of interacting biological, behavioral, environmental, and socioeconomic factors. Some of these factors are potentially reversible, including polypharmacy, drug side effects, depression, visual impairment, physical inactivity, excessive alcohol consumption, and smoking. Therefore, falls and related injuries can be prevented by taking action to reduce exposure to fall risk factors.

The clinical guidelines "Falls in older adults" developed by the Russian Association of Gerontologists and Geriatricians and the Russian Association on Osteoporosis were published in 2020 [3]. According to these guidelines, the risk of fall should be assessed using a questionnaire containing the following three key questions for all people >65-years-of-age who seek care in an outpatient or inpatient facility.

1. Have you had a fall-related injury or a noninjured fall during the past year?
2. Do you feel unsteady when getting up or walking?
3. Are you afraid of falling?

A positive answer to one of these questions indicates the risk of falling [3].

An in-depth assessment of the risk factors should be performed using validated geriatric scales, questionnaires, and a physical examination after identifying patients at high risk of falling. Then, an individual prevention program should be prepared.

This study aimed to analyze the long-term efficiency of multifactorial interventions in the prevention of falls in elderly and senile patients.

MATERIALS AND METHODS

Study design. Eighty-four patients residing in an area related to the Family Medicine Center of the North-Western State Medical University named after I.I. Mechnikov (FMC NWSMU) took part in all stages of this study. Patient selection criteria were age ⩾65-years and informed voluntary consent to participate in this study, which was approved by the local ethics committee of the university.

Data collection. A total of 260 of 900 patients >65-years-old, residing in an area related to the FMC NWSMU were included in the study using the randomization method. Stage 1 of the study started in 2017. Individual programs to prevent falls were developed for all participants, including exercises to maintain balance and the correct use of assistive devices, revision of the drugs taken, therapeutic adjustments, and treatment of orthostatic hypotension, selection of corrective optics, surgical treatment of cataracts, and measures on household safety. The total risk of falls was assessed using the Geristeps web application, considering such indicators as a one-time experience of a fall, the history of imbalance, the history of falling more than twice a year, and a history of falling without seeking medical help [4]. The participants were reassessed for the risk factors of a fall 1 year later in phase 2 of the study. After 3 years, the same factors were assessed again in 84 patients randomly selected from the initial sample (37 patients from the group with a history of falls and 47 patients without a history of falls). We estimated the incidence of falls before the pandemic and during the pandemic. Screening occurred in March 2021, and falls were recorded for the entire period since 2018. Figure 1 shows the data collection scheme, where *n* is the number of patients.

Key study parameters. All study participants were screened for symptoms of frailty using the questionnaire "Age is not a problem." The result of 3–4 points indicated suspected prefrailty, and 5–7 points indicated as frail [5].

The patients were then asked two questions.
1. Do you feel unsteady when getting up or walking?
2. Are you afraid of falling?

The details of the falls were determined, including the number, circumstance, place and time, previous symptoms (e.g., dizziness, heart palpitations, or chest pain), concomitant conditions, the presence of injuries, and their severity [3].

The Patient Health Questionnaire was used to identify depressive symptoms in study participants. A score of 3 or more indicated suspected depression [6].

The Geriatric Anxiety Questionnaire was used to assess anxiety symptoms. The anxiety symptoms were recorded with a score of 3 points or more [7].

The diagnostic tests also considered sleep disorders and the use of assistive devices.

Statistical data processing. Mean and standard deviation values were calculated for normally distributed variables. The Mann–Whitney test for independent samples and the chi-square test were used to assess intergroup differences. Multivariate analysis (simple and multiple linear and logistic regressions) was used to assess differences in the results obtained after adjusting for gender, age, and other possible confounders. Statistical analysis was performed using SPSS 20.0 (SPSS Inc., Chicago, IL, USA) and MedCalc11/5/00
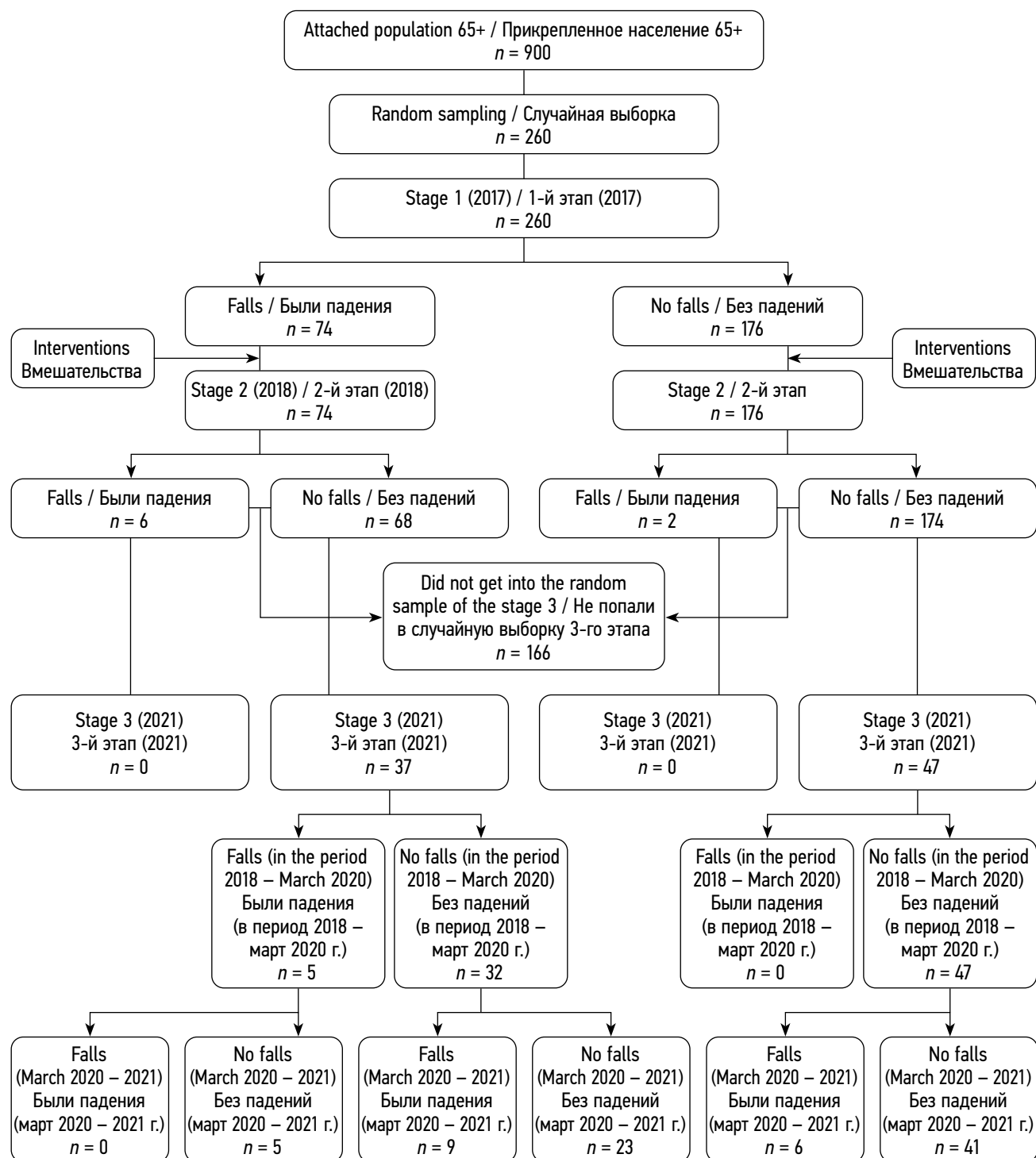
Figure. Data collection in the prospective study
Рисунок. Сбор данных в проспективном исследовании

(Medcalc Software, Oostende, Belgium) software. A *p*-value < 0.05 was considered significant.

RESULTS

Most of the study participants were women (*n* = 65; 77.4%). The average age of the participants was 75.43 ± 5.9 years. All participants were divided into a group without a history of falls (*n* = 64; 76.2%) and a group with a history of falls (over the follow-up period from 2018 to 2021) (*n* = 20; 23.8%). Five (5.9%) cases of falls were registered from 2018 to March 2020 (all patients had a history of falls). Fifteen (17.9%) study participants fell from March 2020 to the time of the examination in 2021 (nine patients had a history of falls and six fell for the first time). In total, 20 (23.8%) cases of falls were recorded. The fracture rate was 3.6%.

Table 1. Characteristics of the groups
Таблица 1. Характеристика групп

Risk factors for falls	Falls in the period from 2018 to March 2021 $n = 20$ (23.8%)	No history of falls in the period from 2018 to March 2021 $n = 64$ (76.2%)	p
Age over 74 years, n (%)	13 (65)	41 (64.1)	>0.05
History of falls before interventions in 2018, n (%)	14 (70)	23 (35.9)	0.0471
Risk of falls according to Geristeps program data, n (%)	19 (95)	47 (73.4)	>0.05
Frailty index according to the questionnaire "Age is not a problem" of not less than 3 points, n (%)	17 (85)	36 (56.3)	0.02
Visual and hearing impairment, n (%)	16 (80)	43 (67.2)	>0.05
Fear of falls, n (%)	16 (80)	13 (20.3)	0.000
Memory impairment, n (%)	14 (70)	38 (59.4)	>0.05
Sleep disorders, n (%)	18 (90)	36 (56.3)	0.0093
Anxiety symptoms, n (%)	11 (55)	18 (28.1)	0.002

Patients who fell from 2018 to March 2021 fell significantly more often ($p = 0.0471$) until 2018. More cases of suspected frailty ($p = 0.02$), complaints for fear of falls ($p = 0.000$), sleep disorders ($p = 0.0093$), and anxiety symptoms ($p = 0.002$) were also recorded in this group (Table 1).

Results of evaluation 1 of the multifactorial interventions. The incidence of falls decreased nine times (from 28.5% to 3.1%) within 12 months of follow-up after the intervention [4]. The fracture rate was 4.2%.

The average number of risk factors for falls in participants with a history of falling was 6.1 ± 2.1 before the multifactorial interventions, and it was 3.8 ± 2.3 ($p = 0.00$) in patients without such experience. Moreover, adding one factor increased the risk of a fall by 50% [relative risk (RR) 1.533; 95% confidence interval (CI) 1.336–1.760; $p = 0.000$].

The risk factors for falls, such as visual and hearing impairment, sleep disturbances, cognitive impairment, urinary incontinence, malnutrition, limited physical activity, danger at home, and social isolation, decreased in participants with a history of falling. All patients with urinary incontinence started to use adult diapers and to leave the house more actively, which reduced their social isolation and increased their physical activity. Nutritional deficiencies were eliminated in 100% of the cases due to dietary recommendations and nutritional support. However, none of the patients with a reported fall made their living conditions safe or increased their level of physical activity. Despite cognitive training, the level of cognitive function in patients with a history of falling remained the same. None of the hearing impaired participants started using a hearing aid (Table 2).

In the initial sample, 59 (22.8%) participants complained of the fear of falling, including 38 (51.4%) patients who fell and 21 (11.4%) patients who did not. During the follow-up from 2017 to 2021, this syndrome disappeared in nine patients

(95% CI 2.35–65.89, $p = 0.039$), and eight did not fall after the interventions. Fear of falling was often associated with symptoms of depression (RR = 5.1; 95% CI 1.3–19.6), anxiety (RR = 3.1; 95% CI 1.2–8.0), preasthenia and frailty (RR = 8.0; 95% CI 2.1–30.1), visual and hearing impairment (RR = 3.5; 95% CI 1.1–11.78), and a history of falling (RR = 15.4; 95% CI 4.3–54.8). This association remained significant after adjusting for gender and age. Three study participants, who had previously been intolerant of falls, developed a fear of falling.

The patients used adult diapers to relieve the social isolation associated with urinary incontinence. Their drug

Table 2. Percentage of patients with falls who had corrected risk factors
Таблица 2. Доля пациентов с опытом падения, у которых удалось уменьшить влияние факторов риска

Risk factors for falls	Reduction of the influence of risk factors for falls in the group with falls, % $n = 20$ (23.8 %)
Reduced visual acuity	45
Impaired hearing	0
Sleep disorder	31.3
Cognitive disorders	0
Sarcopenia	100
Urinary incontinence	100
Depression	11
Risks of falls at home	0
Malnutrition	100
Osteoporosis	16.7
Side effect of drug intake	27
Social isolation	100

therapy was adjusted, malnutrition and sleep disturbances were corrected, the risk of falling at home was eliminated, and cataract surgery was performed. As a result, the participants increased their level of physical activity and decreased their dependence on outside help.

DISCUSSION

In this study, patients with a history of falling had an average of 6.1 ± 2.1 risk factors for falls, and those without any experience of falling had 3.8 ± 2.3 risk factors. As a result of the multifactorial interventions, 2.7 ± 1.4 fall risk factors were eliminated in patients with a history of falling and 1.8 ± 1.1 factors were corrected in the group who had not experienced falling.

The main strategy for reducing the risk of falling is multifactorial interventions, as recommended in several international guidelines. According to the NICE National Institute (UK), this intervention consists of several components aimed at eliminating the risk factors for falls identified in a multifactorial assessment of a person's condition [8].

The NICE National Institute has reviewed a variety of fall prevention programs. The most successful of these programs included the following:
- Training muscle strength and balance;
- Assessment of the home environment for the risk of falling and recommendations to safely arrange the environment (the assessment of risk factors for falls at home is effective only in combination with follow-up and intervention, and not in isolation);
- Assessment of visual acuity and its correction;
- Adjustment or cancellation of the therapy used [8].

We demonstrated that as a result of multifactorial interventions, the incidence of falling in patients after 1 year decreased nine-fold (from 28.5% to 3.1%) [4], and then gradually increased over 3 years to 23.8%.

Many studies have shown a decrease in the incidence of falling in elderly and senile people after the risk of falling was eliminated. A meta-analysis of 41 studies with 19,369 patients aged 72–85 years was conducted in 2020. Multifactorial interventions were performed in patients with two or more modifiable risk factors for falls. The results of the main group of participants were compared with the results of the group of patients who did not receive the intervention and the group of participants who received only recommendations for preventing falls (without individual training, cognitive training, or measures to eliminate risk factors for falls at home) [9].

Data from 20 trials showed that multifactorial interventions reduced the rate of falling (RR 0.79; 95% CI 0.70–0.88; 20 trials; 10,116 participants).

Our study on the long-term efficacy of fall prevention programs showed that the effect of interventions in patients with a history of falling was less consistent, and they fell more often ($p = 0.0471$).

Other studies have confirmed that multifactorial interventions only marginally reduce the risk of recurrent falls in people who have had one or more falls (RR 0.95; 95% CI 0.90–1.00; 30 trials; 13,817 participants) and in patients who have fallen multiple times (RR 0.88; 95% CI 0.78–1.00; 15 trials; 7,277 participants) [9].

In this meta-analysis, the effect of multifactorial interventions on fractures, the need for medical care, or changes in quality of life was either not identified or was insignificant [9]. In our study, the incidence of fractures also tended to decrease over 3 years from 4.2% to 3.6%.

One of the most common (up to 92%) symptoms in elderly and senile people is a fear of falling. In our study, this fear disappeared over the follow-up period in nine participants as a result of changes in certain factors. According to the systematic review, the lower the fear of falls, the higher the quality of life. According to several studies, more than 50% of elderly people without a history of falling have complaints about fear of falls [10]. We recorded three such cases.

Our study revealed that symptoms of depression increase fear of falls by 5.1 times, symptoms of anxiety by 3.1 times, preasthenia and frailty by 8 times, impaired vision and hearing by 3.5 times, and the history of falling by 15.4 times. This is consistent with a study showing that fear of falling is associated with frailty, depression, and cognitive impairment [10].

Our selected patients with registered falls poorly adhered to the recommendations for reducing the risk of falls. They did not use hearing aids, did not follow the recommendations for physical activity, and did not make changes in their home environment. It is important to know that no program can be effective if the patient does not want to participate actively. Therefore, it is necessary to discuss what changes the patient is ready to make. The different needs and preferences of the participants should be considered when preparing a program. In such studies, counseling should include an explanation of the physical and psychological benefits of the changes proposed. Falls often cause a loss of self-confidence and fear. Over time, this can lead to limited physical activity and decreased muscle strength, which further increases the risk of falling [9]. Organizing fall prevention services helps to identify people at risk of falling. Regular follow-ups will contribute to motivation and active engagement of patients in fall prevention programs.

CONCLUSIONS

1. Multifactorial interventions aimed at correcting modifiable risk factors for falls significantly reduced the incidence of falls during a 1-year follow-up. However, efficacy

decreased after 3 years, and the incidence of falls approached the baseline.

2. The effect of the intervention was less consistent in patients with a history of falling.

3. A history of falling, symptoms of frailty, fear of falling, sleep disturbances, and anxiety symptoms are factors that increase the risk of falls.

4. Individual prevention programs reduce the fear of falls.

5. The presence of symptoms of depression, anxiety, preasthenia, and frailty, visual and hearing impairment, and a history of falls are associated with a fear of falls.

ADDITIONAL INFORMATION

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