RISK FACTORS OF FALL IN ELDERLY PEOPLE

Dijana Avdi}[1*], D`emal Pecar[1], Emela Muji}-Skiki}[2]

1 Clinics for Orthopaedics and Traumatology, Clinical Centre University of Sarajevo, ^ekalu{a 90, Sarajevo, Bosnia and Herzegovina
2 Physical Medicine & Rehabilitation Department-Rashid Hospital, P.O.Box 4545, Dubai, UAE

* Corresponding author

Abstract

Falls are the leading accidental cause of death among elderly people in their homes. Falls and their consequences are the primary reason in 40% of admissions to hospitals for people older than 65 years. The study population consisted of 77 randomly selected patients of both genders older then 65 years. Each patient was tested in his/her home and was completely informed about the methodology and the goals of investigation. Based on the exclusion criteria, three patients were excluded from the study, which means the investigation was conducted on 27 males (35.06%) and 50 females (64.94%) with the average age being 71.23 ± 5.63 years.
For each patient, a specially prepared questionnaire about risk factors was filled in. The sum of affirmative answers represented a relative index of fall risk. All patients were evaluated through Folstein's Mini-Mental State Examination Test that is suitable for on-sight use in patient's home. The score value over 20 excludes dementias, delirium, schizophrenia and affective disorders.
Considering the values of the risk factor, scores obtained by the questionnaire and MMSE test scores, statistically significant differences were found between males and females ($p < 0.005$, respectively $p < 0.01$), "fallers" and "non-fallers" ($p < 0.001$, respectively $p < 0.01$), while considering the relation to the way of living (alone or with family), there were no statistically significant differences ($p > 0.05$).
Key words: risk factors of fall, elderly people, Mini-Mental State Examination Test.

Introduction

Rapid industrialization and urbanization, as well as a rapid improvement in technology, have put elderly people on periphery of the interest in health institutions. One of the most important problems in this population group is fall, i.e. the consequences of falling. The outcome of falls in the elderly is devastating. Fall is the leading cause of death resulting from different kinds of injures in people older than 65 years, while in people older than 75 years, almost 70% of interventions in emergency centres are related to fall (1). Normal postural control include the control of a relative position of body parts directed by skeletal muscles in relation to gravitation and one opposed to other (2). Falls are more frequently the result of a complex interaction between damaged body functions and surrounding elements. A twisted plank does not represent a problem for a normal, healthy person while the changes in body balance, muscle tonicity and cognition typical for elderly people may be sufficient to cause falling and a hip fracture (3).

The aim of paper

The aim of paper is to explore the most common risk factors that predispose falling in the elderly and to conduct Folstein's Mini-Mental State Examination Test.

Subjects and methods

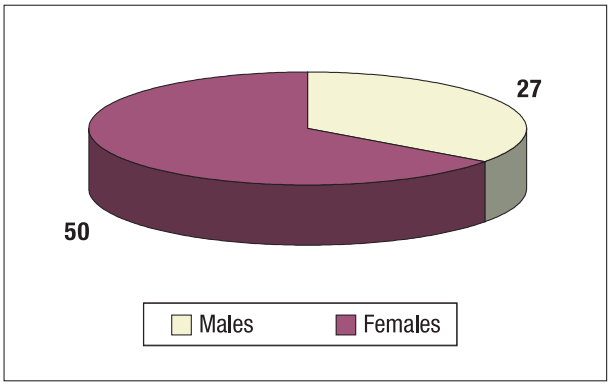
The conducted study is clinical, and it contains manipulative, prospective and control research. The research included 80 randomly chosen patients of both genders and older than 65 years. The criteria for including into the study were: age over 65 years and mobility with or without aids (cane). The exclusion criteria were death of the subjects or occurrence of some disease that could influence the functional ability of the subjects during the period of study. All the subjects have been examined by the physical therapist. For each patient, a specially prepared questionnaire about risk factors was filled in (Appendix 1). The questionnaire contains 22 questions that are scored dichotomically ("yes" or "no"). The sum of affirmative answers represents a relative index of fall risk. This estimation is based on investigators' observation, patients' answers and the data from the accessible medical documentation. All the patients were evaluated by Folstein's Mini-Mental State Examination Test (a test of cognitive functions)4 - Appendix 2. This test was adjusted to the conditions at home. The standardization of test has shown that the score over 20 excludes dementia, delirium, schizophrenia and affective disorders (5).
The results were statistically processed with SPSS program, Version 9.0, and shown in the form of tables and graphs. For each clinical test, distribution, frequency and the measures of central tendency, specificity, sensitivity, positive and negative predictive value, the percent of falsely positive and negative results. With the t test, it has been established that the examined variables significantly differ statistically. With the aim of establishing the in-

dividual variables that predict the fall, a logistic regression analysis has been conducted, and dependent variable was represented by the information about fall (0- no fall, 1 - with fall).

Results

Out of 80 subjects, 3 (3.75%) were excluded from the study: one subject had MMSE test score less than 20, one died, and one had a stroke. The study included 77 subjects, 27 males (35.06%) and 50 females (64.94%). The distribution of examined subjects by gender is shown in Graph 1. The average age was 71.23 ± 5.63 years (range from 65 to 90 years): for females 71.22 ± 5.80 years (range from 65 to 90 years), and for males, 72.67 ± 5.26 years (range from 65 to 82 years). The mean values of age, body weight, and blood pressure are shown in Table 1. Table 1. The mean values of age, weight, height, and blood pressure in subjects

Graph 1. Distribution of subjects by gender



Two subjects (both women) had no any kind of specialist's training, 30 subjects completed primary school only (38.96%), 34 subjects had intermediate specialist's training (44.16%), and 11 subjects had advanced or university-level specialist's training (14.29%). The level of education in relation to gender is shown in Table 2.

In the study period, 21 subjects (27.27%) fell two or more times, while the same number reported about only one fall. Out of 27 males, 4 subjects reported about fall (14.81%) where 1 lives alone and 3 with family. Out of 50 females, 17 reported about fall (34%) where 9 live with family and 8 alone. The data about fall related to gender and the way of living (alone or with family) are given in the Tables 3 and 4.

The mean values of the parameters (age, weight, systolic and diastolic blood pressure related to the information about fall) are given in Table 5. Table 5. The mean values of age, weight, systolic and diastolic blood pressure in relation to the information about fall

Table 1. The mean values of age, weight, height, and blood pressure in subjects

PARAMETER	Males	Females
Age	72.67 ± 5.26 years	71.22 ± 5.80 years
Weight	79.11 ± 9 kg	72.82 ± 12.61 kg
Height	177.07 ± 7.86 cm	162.9 ± 14.89 cm
Systolic blood pressure	149.8 ± 21.5 mmHg	154.5 ± 25.7 mmHg
Diastolic blood pressure	85.2 ± 9.9 mmHg	87.7 ± 11.9 mmHg

Table 2. The level of education in relation to gender

PARAMETER	Males		Females		Total	
	n	%	n	%	n	%
No education	0	0	2	4	2	2.60
Primary school	2	7.41	28	56	30	38.96
Intermediate Specialist's Training	16	59.26	18	36	34	44.16
Advanced or University-level Specialist's Training	9	33.33	2	4	11	14.29
Total	**27**	**100**	**50**	**100**	**77**	**100**

Table 3. Distribution of subjects by the way of living and gender

PARAMETER	Males		Females		Total	
	n	%	n	%	n	%
Lives alone	5	18.52	18	36	27	35.06
Lives with family	22	81.48	32	64	50	64.94
Total	**27**	**100.**	**50**	**100**	**77**	**100**

The mean values of risk factor gained trough questionnaire and MMSE Test results are given in Tables 6-8.
Regarding the values of the risk factor scores gained trough questionnaire and MMSE Test, there are statistically significant differences between males and females, as well as between the subjects who fell and did not fall, while related to the way of living (alone or with family) there are no significant differences (Tables 9-11).

Discussion

In the old age, the psychophysical abilities of humans gradually decrease and the ability to adjust to endogenous and exogenous strains declines as well. In 1987, Harada et al. (6) have established that in the USA, 9.5 million persons have difficulties in performing the activities of everyday life, and 59% (5.6 million) is older than 65 years. In the age group from 65 to 74 years, each 10th person has difficulties, and in the age group of 75 to 84 years, it is every 4th person. For the persons older than 85, this ratio is 3 out of 5 persons.
The study included 77 randomly chosen subjects of both genders and average age 71.73 ± 5.63 years (range 65 to 90 years). Each patient was questioned in his/her own home and was completely introduced to the methodology and the aims of research. The perceptual presence of females was 64.94% (50 subjects), and males 35.06% (27 subjects), which is in accordance to the demographic data about this population group in accordance to our conditions (1). In other studies, the gender structure was different, so Harada et al. (6) observed that females represented 87% of subjects in their research group.
Regarding the age difference, there was no statistically significant difference related to gender. Although the average values of systolic and diastolic pressure in females and males were different clinically, that difference was not statistically significant. The measured values were a bit higher than the normal values, especially in females, which indicate an inadequate medical treatment.
For the body weight parameter, a significant difference

Table 4. Distribution of subject by gender, and in relation to the information about fall

PARAMETER	Males		Females		Total	
	n	%	n	%	n	%
Fall	4	14.81	17	34	21	27.27
Without fall	23	85.19	33	66	56	72.73
Total	**27**	**100**	**50**	**100**	**77**	**100**

Table 5. The mean values of age, weight, systolic and diastolic blood pressure in relation to the information about fall

PARAMETER	Fall	No fall
Age	72.38 ± 5.98 year	71.48 ± 5.52 year
Weight	75.57 ± 13.45 kg	74.82 ± 11.25 kg
Systolic blood pressure	152.1 ± 22.4 mmHg	153.1 ± 25.1 mmHg
Diastolic blood pressure	88.3 ± 13.4 mmHg	86.3 ± 10.4 mmHg

Table 6. Mean values of risk factor and MMSE Test results by gender

PARAMETER	Males	Females	Total
Risk factor score	2.59 ± 3.35	5.32 ± 3.71	4.36 ± 3.80
MMSE Test	28.2 ± 1.8	25.7 ± 2.2	26.6 ± 2.4

Table 7. Mean values of risk factor and MMSE Test results by the way of living

PARAMETER	Lives alone	Lives in a family	Total
Risk factor score	4.87 ± 3.75	4.15 ± 3.83	4.36 ± 3.80
MMSE Test	27.2 ± 2.0	26.3 ± 2.5	26.6 ± 2.4

Table 8. Mean values of risk factor and MMSE Test results by the information about fall

PARAMETER	Fall	Without fall	Total
Risk factor score	8.33 ± 3.07	2.88 ± 2.87	4.36 ± 3.80
MMSE test	25.5 ± 2.5	27.0 ± 2.3	26.6 ± 2.4

has been observed between males and females, which confirms a constitutional, i.e. anthropologic difference. However, the process of osteoporosis in females must not be excluded since none of the examined females was using means to prevent osteoporosis.

Considering education, i.e. the level of education, a statistically significant difference is evident between males and females ($p < 0.001$). Even 56% of females from the examined group had only primary education related to 7.41% of males. The lower level of education in females belonging to the group of elderly people can be observed in the context of social, cultural and sub-cultural circumstances in our geographic areas where it was common that female children were less often sent to school. This was especially present in rural areas where most of our subjects came from. The primary education, in the time when the subjects had to go to school, was not compulsory, so the number of those that had intermediate, advanced or university-level specialist's training was smaller. Thus, for example, 4% of females had advanced or university-level specialist's training in comparison to 33.33% of males from the study group.

Between the subjects who live alone and the subjects who live with family there was no statistically significant difference related to the age group, body weight and the values of systolic and diastolic blood pressure. The results of this study are different from the data in other literature since only 29.87% of the subjects lived alone, while that percent in other studies was two to three times higher (7, 8). The discrepancy can be explained through cultural and economic differences of our society since it is usual in our geographic areas that the younger generations live with parents, which is different from the trend in Western countries, and the lack of the place for living partially imposes such a solution. Furthermore, in our geographical areas there are no conditions that would make the life alone of the elderly easer, which is different from the Western countries. It could be expected that the percentage of the older persons who live alone would be even smaller, but the war contributed migrating of younger generations that led to the increasing in the number of the elderly who live alone.

The mean risk factor score and MMSE Test were significantly statistically different in relation to gender and the data about fall, which is opposite to the data about the way of living. It is interesting that the average score of MMSE Test of the subjects in this study is quite higher than that in the other studies that used this criterion (5, 9, 10, 11, 12, 13) (after adjusting it to the age). Since the test score depends on education, and in the mentioned studies this parameter was not used, it is not possible to make an adequate comparison, and it can only be supposed that the level of education was lower in those studies.

Table 9. Testing the significance of difference of the individual tests between males and females

PARAMETER	t-test value	Levels of freedom	Stat. significance
Risk factor score	3.183	75	$p < 0.005$
MMSE Test	4.989	75	$p < 0.001$

Table 10. Testing the significance of difference of the individual tests between subjects who live alone and with family

PARAMETAR	t-test value	Levels of freedom	Stat. significance
Risk factor score	0.761	75	N.S. $p > 0.05$
MMSE Test	1.486	75	N.S. $p > 0.05$

Table 11. Testing the significance of difference of the individual tests between subjects who fell and who did not fell

PARAMETER	t-test value	Levels of freedom	Stat. significance
Risk factor score	7.298	75	$p < 0.001$
MMSE Test	2.476	75	$p < 0.01$

Conclusions

1. The study included 77 subjects: 27 males (35.06%) and 50 females (64.94%). The average age was 71.23 ± 5.63 years (range from 65 to 90 years): for females 71.22 ± 5.80 years (range from 65 to 90 years), and for males 72.67 ± 5.26 years (range 65 to 82 years).

2. Considering the age difference, there were no significantly statistically differences related to gender. Although the mean values of systolic and diastolic blood pressure were clinically different, that difference was not statistically significant. The measured values were a bit higher than the normal values, especially in females, which indicate an inadequate medical treatment.

3. Considering education or the level of education statistically significant difference is evident between males and females ($p < 0.001$): Even 56% of females from the examined group have a primary education only related to 7.41% of males, while 4% of females had advanced or university-level specialist's training in comparison to 33.33% of males in the research group.

4. Between the subjects who live alone (29.87%), and the subjects who live with family (70.13%) there were no statistically significant difference related to the age group, body weight and the values of systolic and diastolic blood pressure.

5. In the study period, 21 subjects (27.27%) fell two or more times, while the same number reported about only one fall. Out of 27 men, 4 subjects reported about fall (14.81%) where 1 lives alone and 3 in a family. Out of 50 women, 17 reported about fall (34%) where 9 live with family, and 8 alone. 44% of women who live alone fell two or more times in the period of study compared to 20% of men who live alone.

6. Between the subjects who fell and who did not fall there were no statistically significant difference considering age, body weight and the values of systolic and diastolic blood pressure.

7. Considering the risk factor score values, which have been obtained trough questionnaire and the MMSE Test results, there were statistically significant differences between males and females ($p < 0.005$, i.e. $p < 0.01$), as well as in the subjects who did not fall ($p < 0.001$, i.e. $p < 0.01$), while in the case of the way of living (alone or with family) there were no statistically significant differences ($p > 0.05$).

QUESTIONNARE

Name and Surname:
Age: **Gender:**
Body weight: **Body height:** **Blood pressure:**
Lives alone: **Lives in a family:**
Leading diagnosis (the disease group):
Note:

RISK FACTORS

1.	For performing two or more of basic life activities (cooking, washing, clothing, walking, feeding,…), help is needed	YES	NO
2.	For performing of two or more of manipulative activities (shopping, making phone calls, money handling, taking of medicines,…), help is needed	YES	NO
3.	S/he had a fracture or disease of a hip, knee or foot joint	YES	NO
4.	S/he has a visible consequences of the above mentioned conditions on the same joints	YES	NO
5.	S/he uses walking aids (cane, walker, …)	YES	NO
6.	Physical activity limited to basic home activities	YES	NO
7.	Describes oneself as timid person	YES	NO
8.	Complains about vertigo	YES	NO
9.	Complains about difficulties in balance control	YES	NO
10.	Has complaints that could be connected to postural hypotension	YES	NO
11.	Did s/he fall once or two times this year?	YES	NO
12.	Did s/he fall more than two times this year?	YES	NO
13.	Was care necessary after the fall?	YES	NO
14.	Was there a fracture as a consequence of those falls?	YES	NO
15.	Is s/he afraid of falling in general?	YES	NO
16.	Is s/he afraid of falling at home (bathroom, kitchen…)?	YES	NO
17.	Is s/he afraid of falling outside home (public transportation vehicles, stairs, street…)?	YES	NO
18.	Does s/he avoid leaving home because of that fear?	YES	NO
19.	Does s/he have 3 or more health difficulties that require a regular medical control?	YES	NO
20.	Do those health difficulties require home visits of medical workers?	YES	NO
21.	Is there any of the following diseases that influence falling:	YES	NO
	- neurological (i.e. cancer, peripheral neuropathy, multiple sclerosis, lupus, …)		
	- cardiovascular (i.e. postural hypotension)		
	- musculosceletal (i.e. total prosthesis of joints implanted)		
	- sensory (i.e. sight impairment)		
	- other (i.e. amputation, parkinsonism, Alzheimer's)		
22.	Does s/he take medicines dangerous from the aspect of falling	YES	NO
	- hypotensive agents		
	- neuroleptics		
	- hypnotics/anxiolitics		
	- antiarhitmics		
	- antiparkinsonian drugs		
	- analgesics/anti-inflammatory drugs/antirheumatic agents		
	- vasoregulatory agents		

Total number of affirmative answers___

FOLSTEIN MINI MENTAL STATE EXAMINATION

What is today's date?
What season is this?
What year is this?
What month of the year is this?
What day of the week is this?

Maximum score = 5
Score __

Where are we now (street address)?
What floor are we on now?
What country are we in?
What town/city are we in?
What is the name of this part of the city/town?

Maximum score = 5
Score __

Explain to the subject that you are going to name 3 objects that s/he has to memorize. Then say "glass, blanket and pencil" loud and clearly making a pause of 1 second between each word. After you utter all the three words ask the subject to repeat them. If s/he cannot do so, repeat the procedure and ask the subject to repeat. If s/he again is not able to do so, repeat the procedure one more time. Score of 3 points is reserved if the subject repeats the names of all the three objects after you uttered them the first time. Score 2 and 1 is reserved if the subject repeats the words correctly after your second, i.e. third repetition. If the subject is not able to repeat the names after the third repetition, the score is 0.

Maximum score = 3
Score __

The subject is asked to start subtracting 7 from 100. Interrupt him/her after The five correct subtractions have been made (93, 86, 79, 72, 65). For each correct result, one point is given. If the subject is not able or does not want to perform the task, ask him to spell a 5 letter word backwards (for example Tuzla - ALZUT). The number of correct letters is also the number of points given.

Maximum score = 5
Score __

Ask the subject to repeat the previously memorised 3 words (glass, blanket, pencil). Each correct word carries one point.

Maximum score = 3
Score __

Show a watch and a pencil. Ask the subject what they are. Each correct answer carries one point.

Maximum score = 2
Score __

Ask the subject to repeat the following sentence: "No ifs, ands or buts". Only one try is allowed. The score is 0 or 1.

Maximum score = 1
Score __

Give a clean piece of paper (A4 format) to the subject. Ask him/her to listen to the following instruction: Take the paper in your right hand, fold it and give it back to me. For each completed instruction out of 3, one point is given.

Maximum score = 3
Score __

Write the sentence "Close your eyes." on a piece of paper and in letters big enough. Tell the subject: "Read it and do it." If after the reading s/he closes eyes, the score is 1. Otherwise, it is 0.

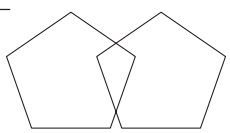
Maximum Score = 1
Score __

Give the subject a pencil and a piece of paper and ask him/her to write a sentence. Score 1 point if the sentence contains a subject, verb and object and makes sense. Ignore spelling errors and handwriting.

Maximum score = 1
Score __

On an empty piece of paper draw two intersecting pentagons. The sides should be around 2,5 cm long. Ask the subject to copy the drawing. If s/he succeeds, the score is 1. All the 10 angles and intersection of the two figures should be visible. Ignore the rotation of the drawing and the influence of tremor on the appearance of lines.

Maximum score = 1
Score __



Folstein's Mini Mental State Examination results in accordance to age and education:

	18-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	65-69	70-74	75-79	80-84	>84
None	22	25	25	23	23	23	23	22	23	22	22	21	20	19
Primary School	27	27	26	26	27	26	27	26	26	26	25	25	25	23
High School	29	29	29	28	28	28	28	28	28	28	27	25	25	26
College	29	29	29	29	29	29	29	29	29	29	28	28	27	27

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