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Original research article

## Physical Activity as Prediction of Functional Ability Among Elderly

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### Abstract

**Aim:** Falling can have serious consequences for older persons, but fear of falling is also a current problem. The aim of the study is to assess the incidence of falls and fear of falling among older adults, as well as to study the connection of falls and fear of falling with functional ability, body mass index (BMI) and age.

**Methods:** The participants of this study are older persons (> 60 years) who live in the city of Rijeka, are mobile and have no symptoms of dementia. The relationship between falls, fear of falling, body mass index (BMI) and functional ability was measured using various indicators. Assessment of physical functioning and pain relief was made using the COOP/WONCA questionnaire. Falls and fear of falling were assessed using questions with different response options.

**Results:** The results of the study showed that participants who reported experiencing fear of falling (FoF) had a higher BMI ( $p = 0.018$ ) and did not feel physically healthy (70%). Participants who lived with a partner reported experiencing FoF at a lower rate (36.4%). The most frequently reported functional problems were visual problems (46.2%) and walking difficulties (40.0%).

**Conclusions:** A large percentage of older persons struggle with the effects of aging, which include various health problems that can increase the risk of falling and FoF. Prescription of physical activity and engaging in it could improve functional ability and have an important effect on healthy aging. This could be the starting point from which key stakeholders can plan different types of public health interventions, prescribing physical activity to maintain functional ability that enables well-being in old age.

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## Introduction

The aging process brings with it many physiological changes that can subsequently lead to the development of risk factors and chronic diseases. According to the World Health Organization, most changes begin after the age of 60 and usually include functional impairment (such as hearing loss, visual impairment, reduced mobility) and the onset of non-communicable diseases (heart disease, stroke, chronic lung disease, malignancies and dementia) (1). All these conditions lead to functional impairment and consequently cause dependence.

Falls are a major cause of morbidity and mortality in older persons. It is estimated that 30–40% of persons over the age of 65 fall at least once a year (2). The number of fall-related deaths in persons over 75 years of age in the US increased from 8613 to 25189 from 2000 to 2016, which means that the number of older persons who died due to falling nearly tripled in 2016. Several studies in Europe report a similar increase in the number of deaths among older persons due to falling (3, 4). Despite this, most falls in the general population do not endanger the individual's life, but 37.3 million falls per year require some form of medical intervention (5) and 70% of these result in some degree of disability (6). Falling can lead to moderate to severe musculoskeletal injuries, loss of independence and even death. However, one of the most important psychological consequences of falls is the appearance of fear of falling (FoF) (2).

FoF leads to physical, functional, psychological and social changes in older persons, which are associated with a decrease in physical activity and health. Falls could also be a consequence of FoF. According to a 2013 study, persons who have fallen in the past year are usually over 85 years old, have cataracts, significant circulatory, respiratory, musculoskeletal and nervous system disorders, take four or more different medications, use walking aids and are overweight (6). Obesity is associated with a 25% higher risk of falling than in persons of normal

weight. This information is explained by the fact that being overweight affects the postural stability of older persons, which can lead to more frequent falls (7). Despite all these facts, there is a simple way to prevent most of these conditions. Physical activity has significant health benefits for hearts, bodies and minds. Regular physical activity provides significant benefits for health and can improve muscular and cardiorespiratory fitness, improve bone and functional health, reduce the risk of hypertension, coronary heart disease, stroke, diabetes, various types of cancer (including breast cancer and colon cancer) and depression, reduce the risk of falling as well as hip or vertebral fractures and help maintain a healthy body weight (1, 8).

The aim of this article was to show the functional ability of elderly persons who engage in physical activity, as well as to study and establish a relationship between risk factors that influence the possibility of falling and the prevalence of fear of falling in the elderly as a function of functional ability.

## Materials and Methods

The survey is retrograde and cross-sectional and takes into account the first measurements of functional status of the elderly from 2016. The sample includes respondents/elderly persons who participated in group exercise sessions which were organized as part of the Urban Health Centres Europe project and were maintained as continuation of the project. The group exercise sessions were organized twice a week and lasted for one hour. The exercises were led by physiotherapy students who were trained to lead exercise sessions for the elderly. Older persons also participated in educational programs for active and healthy aging.

### Participants

The participants in this study are older persons (over 60 years old) who live in the city of Rijeka, are mobile, live independently and have no dementia symptoms. Recruitment was organized during project activities, and visiting nurses recruited participants based on the

inclusion criteria. All participants were informed about the study and signed an informed consent form in order to participate in the study. Confidentiality was maintained in the storage, retrieval and analysis of the data. The study was approved by the Ethics Committee for Biomedical Research of the Faculty of Medicine, University of Rijeka.

## Methods

The Dartmouth Functional Health Assessment Charts (COOP/WONCA questionnaire) were used to assess physical functioning and pain. The COOP questionnaire is used for a quick subjective assessment of the subjects' functional health. The COOP charts reflect the patient's assessment of their functional capacity (9). The instrument consists of six charts. For this study, we used physical functioning and pain charts. Respondents rated the intensity of physical activity they had been capable of in the last two weeks on a scale of 1 to 5, where 1 is very heavy activity and 5 is very light activity. In addition, participants rated the intensity of pain in the last four weeks on a scale of 1 to 5, where 1 means that there was no pain and 5 means that the pain was severe. Participants' height and weight were measured at baseline and BMI was calculated as weight (in kilograms) divided by the square of height (in meters) ( $\text{kg}/\text{m}^2$ ). In order to detect falls in the past 12 months, respondents were asked "Have you fallen in the last 12 months?", where the answer that could be given was yes or no. If the answer was yes, another question was asked, "How many falls did you have in the last 12 months?". FoF was measured by asking the question "In the last months, did you worry about falling down?" The responses were yes or no, and we classified it as a binary variable.

Measurements of restrictions on daily activities and data on the use of medical devices such as walking sticks, glasses etc. were collected.

## Sociodemographic data

Information on age group, gender, education, marital status and living arrangements were collected. Results were analyzed in terms of experience of falls, demographic characteristics (age, gender and marital status) and personal perceptions of health and functional ability.

## Statistical analysis

Statistical analysis included a descriptive analysis of participants' baseline characteristics. Pearson's chi-squared test and Fisher's exact test were used to compare the characteristics of those with and those without fear of falling, as reported. These tests were used to determine the level of statistical significance at the 0.05 (5%) level. For  $p \leq 0.05$ , the difference in arithmetic mean is considered significant. Data were processed using Statistica (version 13.5.0.17, 1984–2018 TIBCO Software Inc) and Microsoft Office Excel 2016.

## Results

Sixty-five older persons participated in the study, of whom 93.9% ( $N = 61$ ) were women and 6.1% ( $N = 4$ ) were men. The mean age of the participants was 69.8 ( $\pm 7.3$ ) years, with the youngest participant being 60 years old and the oldest 92 years old. Subjects were divided into three age groups: younger than 65, 66 to 70 and over 70 years old. The average BMI of the subjects was 27.5 ( $\pm 3.5$ )  $\text{kg}/\text{m}^2$ ; for men, it was 28.8 ( $\pm 4.7$ )  $\text{kg}/\text{m}^2$  and for women, it was 26.6 ( $\pm 3.3$ )  $\text{kg}/\text{m}^2$ . Half of the subjects were classified as pre-obese. Most of the respondents live with a partner (Table 1).

Of the health problems observed in the lives of the respondents, visual impairment (46.2%) and walking difficulties (40.0%) were the most frequently reported. In addition, almost 40.0% of respondents reported problems in everyday life due to physical fatigue. Problems with balance (15.4%) and hearing (12.3%) were mentioned less frequently (Table 1).

**Table 1. Characteristics of the study population groups**

	Overall	Male	Female
<b>N</b>	65 (100.0)	4 (6.1)	61 (93.9)
<b>Average age</b>	69.83 (± 7.3)	81 (± 7.3)	69.17 (± 6.7)
<b>Age group</b>			
Younger than 65	20 (30.8)	-	20 (32.8)
65 to 70	18 (27.7)	-	18 (29.5)
Older than 70	27 (41.5)	4 (100.0)	23 (37.7)
<b>BMI (kg/m<sup>2</sup>)*</b>	27.5 (± 3.5)	28.8 (± 4.7)	26.6 (± 3.3)
Normal weight	22 (34.4)	1 (25.0)	21 (35.0)
Pre-obesity	32 (50.0)	2 (50.0)	30 (50.0)
Obesity class I	10 (15.6)	1 (25.0)	9 (15.0)
<b>Marriage status*</b>			
Unmarried	-	-	-
Married	34 (53.1)	3 (75.0)	31 (51.7)
Extramarital union	1 (1.6)	-	1 (1.7)
Divorced	9 (14.1)	-	9 (15.0)
Widow/widower	20 (31.2)	1 (25.0)	19 (31.6)
<b>Household composition**</b>			
Living alone	22 (34.9)	1 (25.0)	21 (35.6)
Living with a partner, no children	26 (41.3)	2 (50.0)	24 (40.6)
Living with a partner and children	6 (9.5)	1 (25.0)	5 (8.5)
Living without partners and children	6 (9.5)	-	6 (10.2)
Living in a household that I share with others	3 (4.8)	-	3 (5.1)
<b>Problems in everyday life resulting from</b>			
Walking difficulties	26 (40.0)	3 (75.0)	23 (37.7)
Balance problems	10 (15.4)	2 (50.0)	8 (13.1)
Impaired hearing	8 (12.3)	1 (25.0)	7 (11.5)
Impaired vision	30 (46.2)	1 (25.0)	29 (47.5)
Hand weakness	23 (35.4)	3 (75.0)	20 (32.8)
Physical fatigue	25 (38.5)	3 (75.0)	22 (36.1)

\* one subject did not respond \*\* two subjects did not respond

FoF is present in half of the respondents and increases with age. For example, more than 60.0% of respondents over 70 years of age reported FoF, while FoF was present in 25.0% of respondents under 65 years of age. Less than a quarter of the respondents reported experiencing a fall in the past year. There was no difference in the presence of FoF between the respondents who had experienced a fall in the past 12 months and those who had not ( $p < 0.05$ ).

The results of the study showed that the respondents who reported experiencing FoF had a statistically significantly higher BMI than those who did not report experiencing this fear ( $p = 0.018$ ). Despite the higher BMI among subjects who reported experiencing a fall in the past 12 months compared to those who did not, this difference was not statistically significant. Subjects who were married reported experiencing FoF at a significantly lower rate (36.4%) than those who were unmarried (63.3%).

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They also reported falling at a lower rate (20.6%) compared to the unmarried respondents (26.7%). However, no statistically significant difference

was found between the subjects in that regard (Table 2).

**Table 2. Comparison of functional ability, falls and fear of falling in the study group**

	Fear of falling*			Fall in the last 12 months		
	Present N (%)	Not present N (%)	p	Present N (%)	Not present N (%)	p
<b>Participants</b>	32 (50.0)	32 (50.0)		15 (23.1)	50 (76.9)	
Male	3 (75.0)	1 (25.0)		1 (25.0)	3 (75.0)	
Female	29 (48.3)	31 (51.7)		14 (23.0)	47 (77.0)	
<b>Age group</b>						
Younger than 65	5 (25.0)	15 (75.0)		5 (25.0)	15 (75.0)	
65 to 70	10 (58.8)	7 (41.2)		2 (11.1)	16 (88.9)	
Older than 70	17 (63.0)	10 (37.0)		8 (29.6)	19 (70.4)	
<b>BMI (kg/m<sup>2</sup>)</b>	27.7 (± 3.6)	25.6 (± 3.1)	< 0.05	27.2 (± 3.7)	26.6 (± 3.4)	
<b>Marriage status*</b>						
Married	12 (36.4)	21 (63.6)	< 0.05	7 (20.6)	27 (79.4)	
Other	19 (63.3)	11 (36.7)		8 (26.7)	22 (73.3)	
<b>Perception of physical health N (%)</b>						
Feel physically healthy	25 (46.3)	29 (53.7)		14 (25.5)	41 (74.5)	
Do not feel physically healthy	7 (70.0)	3 (30.0)		1 (10.0)	9 (90.0)	
<b>Pain in everyday life N (%)</b>						
Do not report pain or report mild pain	17 (39.5)	26 (60.5)	< 0.05	7 (15.9)	37 (84.1)	< 0.05
Moderate to severe pain	14 (70.0)	6 (30.0)		8 (40.0)	12 (60.0)	
<b>Problems in everyday life resulting from: N (%)</b>						
Walking difficulties						
Present	17 (65.4)	9 (34.6)	< 0.05	5 (19.2)	21 (80.8)	
Not present	15 (39.5)	23 (60.5)		10 (25.6)	29 (74.4)	
Balance problems						
Present	9 (90.0)	1 (10.0)	< 0.05	3 (30.0)	7 (70.0)	
Not present	23 (42.6)	31 (57.4)		12 (21.8)	43 (78.2)	
Impaired hearing						
Present	5 (62.5)	3 (37.5)		3 (37.5)	5 (52.5)	
Not present	27 (49.1)	29 (52.7)		12 (21.1)	45 (78.9)	
Impaired vision						
Present	20 (66.7)	10 (33.3)	< 0.05	8 (26.7)	22 (73.3)	
Not present	12 (35.5)	22 (64.7)		7 (20.0)	28 (80.0)	

\* one subject did not respond

Subjects who felt physically unwell reported experiencing FoF at a higher percentage (70.0%) compared to subjects who felt physically healthy (46.3%). FoF occurs significantly more often in subjects reporting moderate to severe

pain in everyday life (70.0%) compared to subjects reporting no pain or mild pain. In addition, subjects reporting moderate to severe pain reported a significantly higher percentage of falls (40.0%) compared to subjects reporting



no pain of this intensity in everyday life (15.9%). Subjects reported a significantly higher percentage of falls when they had problems with walking (65.4%), balance (90.0%) and vision (66.7%) in everyday life compared to subjects who reported no such problems (Table 2).

## Discussion

According to the results of our study, the presence of FoF is associated with several factors. Elderly persons with FoF have higher BMI, are not married, live alone, have moderate to severe pain and functional problems in everyday life, have a negative perception of their physical health and are of advanced age. The risk factors for FoF occurrence are interrelated and interdependent. Studies have shown that the annual incidence of falls in older persons is between 30 and 40% (2), but it was less than 25% in our study population. We can assume that the reason for this could be the participation in group exercise sessions twice a week.

The association between female gender and more frequent falls is frequently mentioned in the literature (10, 11). In our study, the small number of male subjects must be taken into account, along with their higher average age compared to the female subjects. A higher incidence of falls is also associated with older age (12). A psychological consequence of the fall could be the appearance of FoF, and on the other hand, FoF could be the reason for the fall. Falls occurred significantly more often in those subjects who suffer from moderate to severe pain in everyday life. Older persons who report pain in everyday life are more likely to report experiencing a fall in the past 12 months than those who report no pain. The results of our study show that respondents with moderate to severe pain reported a higher percentage of falls in the past 12 months compared to those who did not report such pain. The study associated an increase in the incidence of falls with pain affecting activities of everyday life (13). A 2018 study states that pain is one of the most important factors in the occurrence of moderate to severe mobility impairment in older persons (14).

Elderly women who live alone are more likely to suffer from FoF, which is associated with impaired quality of life and reduced functionality in performing activities of everyday life. We can say that less than 40% of older persons limit their activities due to FoF. FoF can occur before a person experiences a fall (12). Non-married respondents have a significantly higher incidence of FoF than married respondents; they also report a higher percentage of falls. This is consistent with the findings of a 2010 study, which found that persons who live alone are at higher risk of falling than persons who live with family (15).

Walking is one of the basic activities of everyday life. The presence of gait instability can be a significant risk factor for the occurrence of falls, especially in older persons (16, 17). The results of our study show that persons who reported problems with gait difficulty were less likely to have fallen in the past 12 months than persons who reported no such difficulties. We can assume that they are more careful in their everyday movements, but the results show that FoF occurs in more than 65% of respondents who reported walking difficulty. The findings can be explained by a 2017 study which found that postural instability and gait problems associated with FoF are linked to a higher incidence of falls in older persons. Research has shown that the occurrence of FoF only predicts future falls in persons with postural instability and gait problems (18).

In 2014, Hoang et al. associated FoF with previously experienced falls, poor balance and negative perceptions of physical health (19). In our study, results also showed that FoF was more common in subjects who had previously experienced a fall. The subjective feeling of balance problems in everyday life is more pronounced in persons who have a fear of falling. According to our research, 90% of persons who reported balance problems have FoF. The results suggest that persons who have a negative perception of their physical health are more likely to report experiencing FoF than persons who have a positive perception of their health, which is related to the study by Hoang et

al. (19). FoF was present in 70% of subjects with a negative perception of health.

FoF and its frequency are associated with visual and hearing impairments (20, 21), especially when a person has both, together with balance problems (22). In addition, persons who perceive their hearing impairment as a significant disability are at higher risk of experiencing two or more falls within five years than persons who do not have hearing problems (21). Participants who reported having hearing problems reported a higher percentage of falls in the past 12 months. Choi and Ko published a paper in 2015, in which they found that persons with vision problems fall more often than persons who do not have such problems (12). The reason for this could be a reduced perception of environmental signs. In addition, subjects who perceived problems related to visual impairment reported a higher percentage of FoF when performing functional activities of everyday life. Studies show that visual impairment is an independent risk factor for the occurrence of falls, their recurrence and the occurrence of fractures (20, 21, 23, 24).

Obesity is associated with an increased risk of falls, as well as a higher risk of disability in activities of everyday life following falls in older adults (25). In addition to the incidence of falls and disability, obesity is associated with a greater likelihood of pain and reduced mobility after falls when compared to peers with normal body weight (26). A 2011 study found no significant difference between fall experiences in individuals with normal weight and overweight individuals (27), in contrast to a 2017 study, which found that undernourished and obese individuals had a higher percentage of falls compared to individuals with normal weight and overweight individuals (28). Older persons who have postural instability and are obese are at higher risk of falling because obesity affects balance and performance of dynamic tasks (29). Some studies state that older women who are obese have less postural stability than those with normal body weight, which increases the fear of falling (30). The results of our study showed that subjects who reported

experiencing a fall in the past 12 months had, on average, a higher BMI than those who did not report experiencing a fall. Furthermore, FoF increased with increasing BMI, meaning that subjects who reported experiencing a fall had a higher BMI on average. Research suggests that obese persons are at increased risk of falling, but that such falling does not necessarily lead to serious injury. In such cases, obesity becomes a protective factor against musculoskeletal injuries (6, 25, 27, 30). A disadvantage of this study is the small number of subjects and the disproportionate number of male and female subjects, as well as the fact that the severity of falls, the number of falls and the severity of FoF were not considered.

FoF is higher in subjects reporting problems in everyday life related to walking difficulty, balance problems, vision problems, BMI and moderate to severe pain, which is consistent with the published literature. The falls themselves are more likely to occur in persons who report moderate to severe pain. Physical activity can improve balance and thus prevent the possibility of falls and increase the self-confidence of the elderly and reduce the incidence of fear. The findings and data from other studies suggest that a large percentage of older persons struggle with the effects of aging, which includes various comorbidities and health problems that can increase the risk of falling and FoF. The results of the research showed that both previous falls and fear of falling are important predictors of functional ability. They equally impact the development of everyday activity limitations. Physical activity can help the elderly stay physically independent.

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