Arcada Working Papers 1/2019
ISSN 2342-3064
ISBN 978-952-5260-96-0

Evaluating factors associated with the fear of falling in older adults using The Falls Efficacy Scale International (FES-I)

Joachim Ring, Thomas Hellstén, Jyrki Kettunen

www.arcada.fi

Arcada Working Papers 1/2019
ISSN 2342-3064
ISBN 978-952-5260-96-0

Evaluating factors associated with the fear of falling in older adults using The Falls Efficacy Scale International (FES-I)

Joachim Ring[i], Thomas Hellstén[ii], Jyrki Kettunen[iii]

Abstract

The fear of falling is common among elderly, even among those who haven´t had a fall. The fear of falling can result in increased feelings of vulnerability that, over time, might lead to restricted mobility, and impaired performance. Through early identification, subjects who are concerned about falling, may be able to avoid fall related injuries and disability through preventive interventions. The aim of our study was to investigate factors associated with the fear of falling among older, physically active, people that are independently living at home. Twenty-six healthy elderly subjects between 67 and 82 years of age completed a questionnaire, and participated in clinical measurements in 2018. Subjects completed the 16-item FES-I questionnaire to assess their level of fear regarding falling along with divulging the number falls they had experienced during previous year. In addition, respondents reported their health status and physical activity by answering specific questions relating to: grip strength, balance, physical function, and walking speed. The results of our study showed that the only factor associated with the fear of falling was brisk walking speed, explaining 27 % of its variation. The subjects with a low falling concern walked faster than the ones with a moderate or high falling concern. Therefore, the evidence indicates that among physically active elderly people, a brisk walking performance test can aid in the identification of subjects who are concerned about falling. However, the validity of the brisk walking test for such purpose merits additional investigation.

Keywords: elderly, fear of falling, FES-I, walking speed

[I] Arcada University of Applied Sciences, Finland, Health and Welfare [ringnikl@arcada.fi]
[ii] Arcada University of Applied Sciences, Finland, Health and Welfare [thomas.hellsten@arcada.fi]
[iii] Arcada University of Applied Sciences, Finland, Health and Welfare [jyrki.kettunen@arcada.fi]

1 INTRODUCTION

Falls among elderly are common and the consequences may be serious. Despite the fact that most of the fall related injuries are mild, five to ten percent of them result in severe consequences (Nevitt et al., 1991, Tinetti et al., 1988). Estimates show that over the next few years, falls and injuries caused by falls will become more common due to the increased number of elderly people. Indirectly, a fall might cause or increase the fear of falling, which leads to restricted mobility and impaired performance, which, in turn may affect an elderly person's mobility (Kaatumisten ja kaatumisvammojen ehkäisyn fysioterapiasuositus, 2017).

Poor postural balance or stability is one of the risk factors for falling, and the control of balance in narrow base stance, may be an important tool when trying to identify elderly fallers. (Melzer et al., 2004) In their review, Piirtola and Era (2006) critically evaluated findings of prospective studies where force platforms had been used as a tool to measure postural balance. Their results indicated that certain aspects of force platform data might have predictive value for subsequent falls, but because of the small number of studies available, definitive conclusions were difficult to draw. Various indicators of the lateral control of posture, especially related to the medio-lateral (ML) movement of the COP, showed significant associations with future falls; however, additional research seems prudent.

Over the years, many physical performance measures to determinate person's functional capacity have been created. One example of an easily implemented test in clinical settings is gait speed. It serves as a standard clinical evaluation tool for elderly persons (Guralnik et al., 2000). In addition, it is a quick, inexpensive and reliable measure of functional capacity with high interrater and test-retest reliability (Studenski et al., 2003).

Studenski and co-workers (Studenski et al., 2011) evaluated the possible relationship between gait speed and survival, using individual data from 34 485 community-dwelling older adults aged 65 years or older. They found that gait speed was associated with survival in older adults. Rochat and co-workers (Rochat et al., 2010) found, in their study that in well-functioning older people, fear of falling was associated with reduced gait performance and increased gait variability, independent of health and functional status. The authors concluded that early interventions targeting the fear of falling might potentially help to prevent harmful consequences related to mobility and function in well-functioning older people.

The Falls Efficacy Scale-International (FES-I) questionnaire has been designed primarily to assess the fear of falling among elderly living in homes, but it can also be used to evaluate the fear of falling among elderly with very poor condition or impaired memory. The FES-I has been developed and validated by the Prevention of Falls Network Europe (ProFaNE). It is a 16-item self-report questionnaire including different items on activities of daily living, providing information about an individual's level of concern about falls. Each question has four alternatives, from one (not at all concerned) to four (very concerned). Summed item scores provide an overall index from 16 to 64 points. The higher the index is the more a person is concern about having a fall daily activities. (Delbaere et al., 2010)

Delbaere et al. (2010) have defined FES-I categories that indicate the extent to which a person is worried that they may fall. The categories are based on one study material (N=500), and therefore they recommend to use their grading as a reference only. In their study, the following FES-I categories were reached: low concern: 16 to 19 points, moderate concern: 20 to 27 points and high concern: 28 to 64 points. If the cutoff point is set between low and high concern, they defined it as 16 – 22 points for low concern and 23 – 64 points for high concern.

Overall, the fear of falling is common among elderly and significantly increases the vulnerability of having a fall. The fear of falling occurs even among elderly who haven´t had a fall. It is important to identify risk factors, which means that risk evaluations, performed regularly allow for implementation of preventive actions designed for the individual. We need to understand that falling is a complex phenomenon with both intrinsic and extrinsic risk factors that must be evaluated. (Kaatumisten ja kaatumisvammojen ehkäisyn fysioterapiasuositus, 2017)

The aim of our study was to investigate the factors associated with the fear of falling among older physically active people living at home independently.

2 MATERIAL AND METHODS

Our present study is part of a wider follow-up project of older adults. We included in the study, well-functioning older people aged 65+, who were able to walk independently without walking aids. Twenty-seven elderly subjects between 67 and 82 years of age participated in clinical tests at Arcada University of Applied Sciences located in Helsinki, during the month of February 2018. The enrolled subjects received information about the test procedure. Prior to testing, the participants gave written consent to use their health and physical activity data for scientific purposes. The participants also completed a standard pre-test health-screening questionnaire (Thompson et al., 2013). Based on the results of this questionnaire, none of the subjects had to be excluded.

Documentation for each subject included the age, sex, height, weight and body mass index (BMI, kg/m^2). In addition, subjects self-rated their functional capacity and leisure time physical activity using an ordinal scale from 0 to 10.

We calculated a leisure time activity metabolic equivalent (MET) index (cumulative leisure MET hours/week) by assigning a multiple of resting metabolic rate to activity, and by calculating the product of intensity x frequency x times of activity. (Kujala et al., 1999, Waller et al., 2008)

The number of self-reported falls during the previous year was asked, and thereafter the "falls-variable" was dichotomized as follows; 0 = no fall and 1 = at least one fall during the previous year. The subjects completed the 16-item FES-I questionnaire to assess the fear of falling. It is a valid and reliable tool to investigate the fear of falling for research and clinical purpose (Delbaere et al., 2010).

Also assessed, was the self-reported physical function using the following question: "How do you manage to carry 5-kg load at least 100 m" (Aromaa and Koskinen, 2002).

To test balance we used the balance test from the Short Physical Performance Battery (SPPB) were the person stands in three different positions *i.e.* feet-to-feet, semi-tandem and tandem stance, for 10 seconds (Guralnik et al., 1994). Each stance was shown to the participants before the test, and the participants were allowed to test each stance to make sure they understood the test correctly. Corrective movements with arms and the body were allowed, but the feet should adhere to the platform at all times. At the semi-tandem and tandem stance, the participants were allowed to choose which foot was placed in front of the other. No shoes were allowed during the different phases. In our study the SPPB balance test and measurement was performed using a standard strain gauge force plate [HUR balance platform (model B4)]. The balance instrument is a portable plate, weighing 12 kg, and is movable. The instrument measures the weight distribution between the feet, the antero-posterior sway, the medio-lateral sway and the speed of the sway. In present study, the distance (mm) in medio-lateral sway had the highest correlation between balance and fear of falling. Therefore, it was used as balance variable in regression analysis.

The third performed test was the "Timed-Up & Go"- test (TUG). The test measures the time it takes for the subject to get up from an armchair, walk a three-meter distance back and forth, and then sit back down on the chair. The TUG test is developed as a clinical measure of balance and as a short test to evaluate basic mobility. (Podsiadlo and Richardson, 1991)

The fourth test done in this study was five times sit to stand (FTSS) test. It is a test, commonly used to measure function and mobility in older adults. The test was performed as described by Guralnik et al. (1994), that is, participants were asked to stand up and sit down five times as fast as possible without using their hands to push up from the chair. A handheld stopwatch was used to measure the time taken to perform the task, and the time stopped when the person stands the fifth time.

The last two tests were comfortable (natural) and fast gait speeds. Gait speed was calculated for each participant by dividing the test distance in meters by the time required to traverse it in seconds. Photocells was used to time subjects as they walked over a 10 meters expanse of floor indoors. From a standing start, subjects were provided with 4 meters to accelerate and 4 meters to decelerate before and after the test distance. For the usual pace walking trial, they were instructed to walk at their normal comfortable speed. For the maximum speed walking trial, they were asked to walk as fast as they could safely without running.

The ethical committee of the Hospital District of Helsinki and Uusimaa (HUS) approved this study.

The statistical analysis was done with a Statistical Package for the Social Sciences 25.0 (Norusis/SPSS, Inc., Chicago, IL). Descriptive data are presented as means and standard deviations (SD). Pearson's correlation coefficient was used to analyze the relationship between FES-I, and different covariates. In the present study, the distance (mm) in medio-lateral sway had the highest correlation of different balance variables and therefore

it was used as “the balance variable” in regression analysis. We used a multiple linear regression analysis to investigate the factors explaining the variation in FES-I.

3 RESULTS

There was no gender differences in age, BMI, health related factors (Table 1), function or physical activity (Table 2) of the subjects. One subject of the original cohort was excluded from the present study due to a chronic disease possibly affecting physical function tests.

Sixty percent of female and forty percent of male subjects had at least one physician-diagnosed chronic disease. However, the results of the clinical measurements indicate on average good health and function of our female and male subjects (Tables 1 and 2).

Table 1. Characteristics of the subjects at follow-up clinical examination in 2018.

	Female	Male	P-value
	n=13	n=14	
Age; years, mean (SD)	74.0 (3.0)	74.1 (4.0)	0.919
BMI*, mean (SD)	24.6 (4.0)	25.3 (2.9)	0.579
State of health**, mean (SD)	8.2 (0.6)	8.3 (1.1)	0.957
Health related quality of life***, mean (SD)	8.5 (0.9)	8.1 (2.0)	0.595
At least one physician-diagnosed chronic disease, % (n)	60 (9)	40 (6)	0.273
*BMI: Body Mass Index, kg/m².			
**Self-reported state of health with a scale from 0 to 10, where 10 is the best possible health.			
***Self-reported health related quality of life with a scale from 0 to 10, where 10 is the best possible quality of life.			

Table 2. Function and physical activity of the subjects in 2018.

	Female (N=13)	Male (N=14)	Difference
	mean (SD)* or % (n)	mean (SD)* or % (n)	mean (95% CI)* or P-value
Timed up and go (TUG); seconds	8.9 (1.0)	9.4 (1.3)	-0.6 (-1.51 to 0.35)
Walking speed; (m/s)	2.0 (0.3)	2.2 (0.3)	-0.2 (-0.46 to 0.03)
Able to carry 5 kg load at least 100 m; % (n)	85 (11)	100 (14)	0.127
METh/week***	31.9 (23.1)	24.3 (17.3)	7.5 (-8.5 to 23.6)
*SD: Standard deviation			
**CI: Confidence intervals			
***METh/wk: Metabolic equivalent hours in week			

During the previous year 31 % (4/13) of the female, and 43 % (6/13) of the male subjects reported that they had fallen at least once (P=0.420 between genders). According to Delbaere et al. (2010) scoring, 73 % (N=19) of the subjects had a low, and 27 % (N=7) moderate or high concern of falling.

According to our correlation analysis between the fear of falling and different factors, the factors that correlated with the fear of falling were distance in medio-lateral sway (r=.440, P=0.024), normal walking speed (r=.445, P=0.023), and brisk walking speed (r=.560, P=0.003). Furthermore, 5-squats time had a tendency for correlation (r=.354, P=0.076).

Age, gender, at least one fall in previous year, medio-lateral sway (balance), normal walking speed, brisk walking speed, and 5-squat time were entered into the model. According to the linear regression analysis, the only factor that was significantly associated with the fear of falling was brisk walking speed, explaining about 27 % of its variation. To analyze the walking speed in different FES-I categories we had to combine the categories moderate or high concern of falling because of the low number of subjects. Mean brisk walking speed was 2.3 m/s (SD 0.3) in those with low, and 1.9 m/s (SD 0.1) in those with moderate or high concern about falling (mean difference 0.4 m/s, 95 % CI 0.24 to 0.62, P<0.001).

4 DISCUSSION

The aim of the study was to find out factors associated with the self-reported fear of falling among older physically active people. Only brisk walking speed explained the variation in the fear of falling among those subjects. The subjects with low concern about falling walked faster than the ones with moderate or high concern about falling.

The number of elderly people, as we know, will increase during the coming years and by that the amount of falls. The fear of falling is common, even among those who haven´t had a fall. To prevent falls and fall related injuries, it is important to identify elderly people who might be at risk to have a fall, and those, whose fear of falling causes limitations to their daily activities.

Our subjects represented a rather healthy population of community dwelling elderly, and our small sample did not include subjects in poor health condition. In addition, the number of subjects who were concerned of falling were small. The high number of rather healthy subjects in our sample may partly explain the results that most of the factors used in our study did not associate with a fear of falling when measured using FES-I. For example, in their review Schoene et al. (2013) concluded that the TUG-test is not useful for discriminating fallers from non-fallers in healthy, high-functioning older people but is of more value in less-healthy, lower-functioning older people. Normal walking speed correlated with the fear of falling, but in regression analysis, brisk walking speed as a physically demanding activity was the only factor explaining a variation in the fear of falling when measured with FES-I. Our result indicate that besides normal walking speed, the walking test should be performed also with the maximum walking speed among physically active elderly people. However, the test should be conducted in a safe environment.

The Five times sit-to-stand (FTSS) test is a commonly used test of functioning among elderly. Sit-to-stand is a task, frequently performed every day and mechanically de-

manding, causing difficulties among many older adults. It requires good lower limb muscle strength, skills to generate sufficient speed of movement and an ability to co-ordinate multiple segments with correct timing to maintain balance. The time taken to complete the FTSS-test has been shown to predict mobility problems and risk of falling. (Tiedemann et al., 2008) However, in the present study only a tendency for correlation between FTSS-test and FES-I was seen.

With novel technologies (smart watches, smartphones), it is possible to record daily activities, such as walking speed and changes in walking speed over time. A change in a person's daily activity, *e.g.* a slowdown in walking speed, may also be a sign of a change in a person's concern for falling. In the future, objective measured follow-up data can be linked to a person's own health data (Omakanta in Finland). In addition, the usability of such follow-up data to screen people at risk (of falling) should be studied in the future.

Our present study is part of a wider follow-up project of older adults. We have added the FES-I questionnaire in our follow-up study in 2018, and we calculated the self-reported number of falls during the previous year. Therefore, we are unable to answer the questions "has a fall during the follow-up period increased fallers' concern about falling" or have these subjects been worried about their risk of falling already before a fall has occurred. Therefore, we will continue the research by continuing to follow our cohort.

In conclusion, brisk walking speed is associated with the fear of falling among rather healthy elderly subjects. The subjects with low concern of falling walked faster than the ones with moderate or high concern of falling. The validity of a brisk walking speed test to identify elder subjects who are concerned about falling should be investigated in more detail.

Acknowledgements

We wish to thank Mrs. Denise Villikka, for the final correction of the language of the manuscript.

REFERENCES

AROMAA, A. & KOSKINEN, S. 2002. Health and functional capacity in Finland. Baseline results of the Health 2000 health examination survey. (In Finnish: Terveys ja toimintakyky Suomessa - Terveys 2000 tutkimuksen perustulokset). Kansanterveyslaitoksen julkaisuja B3.

DELBAERE, K., CLOSE, J. C. T., MIKOLAIZAK, A. S., SACHDEV, P. S., BRODATY, H. & LORD, S. R. 2010. The Falls Efficacy Scale International (FES-I). A comprehensive longitudinal validation study. Age and Ageing, 39, 210-216.

GURALNIK, J. M., FERRUCCI, L., PIEPER, C. F., LEVEILLE, S. G., MARKIDES, K. S., OSTIR, G. V., STUDENSKI, S., BERKMAN, L. F. & WALLACE, R. B. 2000. Lower extremity function and subsequent disability: consistency across studies, predictive models, and value of gait speed alone compared with the short physical performance battery. J Gerontol A Biol Sci Med Sci, 55, M221-31.

GURALNIK, J. M., SIMONSICK, E. M., FERRUCCI, L., GLYNN, R. J., BERKMAN, L. F., BLAZER, D. G., SCHERR, P. A. & WALLACE, R. B. 1994. A short physical performance battery assessing lower extremity function: association with self-reported disability and prediction of mortality and nursing home admission. J Gerontol, 49, M85-94.

KAATUMISTEN JA KAATUMISVAMMOJEN EHKÄISYN FYSIOTERAPIASUOSITUS. Hyvä fysioterapiakäytäntö 2017. Suomen Fysioterapeutit - Finlands Fysioterapeuter ry:n asettama työryhmä. Saatavilla internetissä: http://www.terveysportti.fi/dtk/sfs/avaa?p_artikkeli=sfs00003.

KUJALA, U. M., SARNA, S., KAPRIO, J., KOSKENVUO, M. & KARJALAINEN, J. 1999. Heart attacks and lower-limb function in master endurance athletes. Med Sci Sports Exerc, 31, 1041-6.

MELZER, I., BENJUYA, N. & KAPLANSKI, J. 2004. Postural stability in the elderly: a comparison between fallers and non-fallers. Age Ageing, 33, 602-7.

NEVITT, M. C., CUMMINGS, S. R. & HUDES, E. S. 1991. Risk factors for injurious falls: a prospective study. J Gerontol, 46, M164-70.

PIIRTOLA, M. & ERA, P. 2006. Force platform measurements as predictors of falls among older people - a review. Gerontology, 52, 1-16.

PODSIADLO, D. & RICHARDSON, S. 1991. The timed "Up & Go": a test of basic functional mobility for frail elderly persons. J Am Geriatr Soc, 39, 142-8.

ROCHAT, S., BULA, C. J., MARTIN, E., SEEMATTER-BAGNOUD, L., KARMANIOLA, A., AMINIAN, K., PIOT-ZIEGLER, C. & SANTOS-EGGIMANN, B. 2010. What is the relationship between fear of falling and gait in well-functioning older persons aged 65 to 70 years? Arch Phys Med Rehabil, 91, 879-84.

SCHOENE, D., WU, S. M., MIKOLAIZAK, A. S., MENANT, J. C., SMITH, S. T. & DELBAERE, K. 2013. Discriminative ability and predictive validity of the timed up and go test in identifying older people who fall: systematic review and meta-analysis. J Am Geriatr Soc, 61.

STUDENSKI, S., PERERA, S., PATEL, K., ROSANO, C., FAULKNER, K., INZITARI, M., BRACH, J., CHANDLER, J., CAWTHON, P., CONNOR, E. B., NEVITT, M., VISSER, M., KRITCHEVSKY, S., BADINELLI, S., HARRIS, T., NEWMAN, A. B., CAULEY, J., FERRUCCI, L. & GURALNIK, J. 2011. Gait speed and survival in older adults. Jama, 305, 50-8.

STUDENSKI, S., PERERA, S., WALLACE, D., CHANDLER, J. M., DUNCAN, P. W., ROONEY, E., FOX, M. & GURALNIK, J. M. 2003. Physical performance measures in the clinical setting. J Am Geriatr Soc, 51, 314-22.

THOMPSON, P. D., ARENA, R., RIEBE, D. & PESCATELLO, L. S. 2013. ACSM's new preparticipation health screening recommendations from ACSM's guidelines for exercise testing and prescription, ninth edition. Curr Sports Med Rep, 12, 215-7.

TIEDEMANN, A., SHIMADA, H., SHERRINGTON, C., MURRAY, S. & LORD, S. 2008. The comparative ability of eight functional mobility tests for predicting falls in community-dwelling older people. Age Ageing, 37, 430-5.

TINETTI, M. E., SPEECHLEY, M. & GINTER, S. F. 1988. Risk factors for falls among elderly persons living in the community. N Eng J Med, 319.

WALLER, K., KAPRIO, J. & KUJALA, U. M. 2008. Associations between long-term physical activity, waist circumference and weight gain: a 30-year longitudinal twin study. Int J Obes (Lond), 32, 353-61.