J Nutr Health Aging. 2021;25(4):433-439

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PREVALENCE AND ASSOCIATES OF FEAR OF FALLING AMONG COMMUNITY-DWELLING OLDER ADULTS

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Abstract: *Objectives:* We aimed to study the prevalence of fear of falling (FOF), and its association with physical performance, functionality, frailty, sarcopenia, and a variety of geriatric syndromes including cognitive impairment, depression, quality of life and hearing. *Design:* Retrospective, cross-sectional study. *Setting:* Community-dwelling older adults applied to the geriatric outpatient clinic of a university hospital. *Participants:* A total of 1021community-dwelling older adults >= 60 years of age applying to the geriatric outpatient clinic of a university hospital. *Measurements:* We screened for falls and FOF by single close-ended questions. We performed screening and assessment of probable sarcopenia by SARC-F test and handgrip strength evaluation according to EWGSOP2. We used timed up and go test (TUG), usual gait speed (UGS) for physical performance, and Katz- activities of daily living (ADL) and Lawton-Brody instrumental activities of daily living (IADL) for functional evaluation. We screened anxiety with the Generalized Anxiety Disorder-7 scale. *Results:* The prevalence of FOF was 44.6% and falls, 37.7%. Prevalence of FOF in sarcopenia screening positive participants was 30.1%; in probable sarcopenic (35/20 kg) participants, 43.9%; in those with undernutrition, 45.7%; in fallers, 51.1%; in females, 80.4%; and in prefrail/frail was 74.7% Multivariate regression analyses revealed that female sex (OR=4.1, 95%CI= 2.0-8.4, p<0.001), anxiety (OR=2.7, 95%CI= 1.1-6.5, p=0.03) and ADL limitation (OR=2.5, 95%CI= 1.03-6.3, p=0.04) were independent associates of FOF. *Conclusion:* FOF accompanied by fall experience or not is prevalent in community-dwelling older adults. It is associated with anxiety and ADL limitations apart from the female sex.

Key words: Fear of falling, limitation, anxiety, geriatric syndromes.

Introduction

Falls is a geriatric giant affecting about 1/3 of the community-dwelling older adults (1). It has negative impacts on older adults, including fractures, traumatic injuries, and fear of falling (FOF) (2). Among them, FOF has a unique importance as it causes deconditioning of the individual, making future falls more likely and also causes mood changes such as anxiety and depression (3). Furthermore, FOF has been reported to be associated with cognitive impairment and mortality (4-6). FOF has been studied less than the falls itself so far. In a systematic review that identified 28 relevant studies among the community-dwelling older adults, there was a great variation in the reported prevalence of FAF ranging between 20.8% and 85% (7). FOF may develop after falls or without any fall experience (7, 8). FOF may emerge in older adults that have not suffered from a fall because of real fall risk in those individuals (9) or may develop due to mood problems (10, 11).

Deconditioning due to restriction of activity linked with FOF has the potential to result in loss of muscle strength and mass, development of frailty and disability along with gait and balance problems (12, 13).

It is the chance of the society that FOF may be reversible with interventions (14, 15). Thus, the triggers of FOF and its associates are needed to be documented. While depression, balance or gait problems, polypharmacy, previous falls have been studied for their relationship with FOF in some reports; its relation with anxiety, functional measures, sarcopenia, frailty, and the other geriatric syndromes such as sleep problems, urinary incontinence has been studied in few studies (16). Urinary incontinence may cause FOF as it pushes older adults to walk in a hurry and thereby could cause FOF (17), and sleep problems may end with unrested older adults who may be prone to falls and thereby to FOF (18). Hence, in this study, our primary aim was to look for the prevalence of FOF in the community-dwelling older adults applied to the geriatric outpatient clinic. Our secondary aim was to examine the relationship between FOF and frailty, sarcopenia, malnutrition, physical performance and functional measures, anxiety, urinary incontinence, sleep problems, chronic pain.

Material and Methods

We designed a retrospective, cross-sectional study among community-dwelling older adults aged >= 60 years that were administered to the geriatric outpatient clinic of a university hospital between October 2012 and November 2019. The registration to this clinic could be by the older adults themselves if they are >=60 years of age, or they may be directed from other disciplines for geriatric evaluation. All patients undergo comprehensive geriatric assessment (CGA) if the general condition of the patients is suitable, and there is the available staff. CGA involves the screening for falls, FOF, screening and assessment of sarcopenia, timed up and go test (TUG), usual gait speed (UGS), frailty, activities of daily living (ADL), instrumental activities of daily living

Received September 18, 2020
Accepted for publication October 12, 2020
Published online December 1, 2020, http://10.1007/s12603-020-1535-9

(IADL), nutritional status, inquiry about geriatric syndromes including urinary incontinence and sleep problems and screening for anxiety. We did not include the patients that have co-morbidities that may have an influence on the measurement of HGS, such as cognitive problems, hand osteoarthritis, depression, stroke, neuropathy…etc. The demographic characteristics were noted from the patient files.

We considered a fall as the sudden, involuntary transfer of the body to the ground and at a lower level than the previous one (19). We screened falls within last year by the following question: "Have you ever fallen down last year?". We screened for FOF by a single closed-ended question, "Are you afraid of falling?" with two possible elective responses, i.e., yes or no (8, 13, 20). Chronic pain was screened by questioning whether the patient suffers from any kind of chronic pain that interferes with daily life, maybe mild to severe.

We assessed HGS by a Jamar hydraulic hand dynamometer performed by the same physical therapist who was qualified and applied a validated protocol involving both hands (21, 22). We recorded the maximum grip strength among the three trials. We applied the cut-offs for low HGS as the standard of EWGSOP2, i.e., <27 kg and <16 kg (23). The cut-offs for impaired TUG, UGS were regarded as >=20 s, >=0.8 m/s, respectively (23). UGS was assessed by 4m UGS assessment for which we marked two lines on the floor as indicators of the start

and end of the course, but with a 1 m at both ends of the course to permit to the acceleration and deceleration phases of the usual walking experience. We allowed the use of aids on need and used a stopwatch. Screening of physical frailty was performed by the Frail questionnaire (24). Accordingly, a frail score>=3 was noted as frailty and 1-2, as prefrailty. We screened the nutritional status by mini nutritional assessment-short form (MNA-SF). A short form of MNA has been recommended as a practical version of full MNA with success (25). MNA-SF score <12 was regarded as undernutrition that involves overt malnutrition (<8 scores) and malnutrition risk (8-11 score). We evaluated functionality by Katz-activities of daily living (ADL) and Lawton-Brody instrumental activities of daily living (IADL) (26, 27). We used the SARC-F questionnaire to screen sarcopenia (24).

We screened for anxiety, which may be related to the FOF by the Generalized anxiety disorder-7 scale (GAD-7) (28). Using the threshold score of 10, it has a sensitivity of 89% and a specificity of 82% for generalized anxiety disorder (29). We questioned the sleep problems by asking, "Do you have sleep problems that interfere with your daily activities?". We screened urinary incontinence by the three incontinence questionnaire (3IQ) (30).

Statistical Analysis

We examined the normality of the continuous parameters via visual (histograms and probability plots) and Kolmogorov-Smirnov test. We outlined the continuous variables by mean ± standard deviation or median (minimum-maximum) as appropriate. We showed the categorical variables as frequencies and percentages. We compared two groups by independent sample t-test or Mann Whitney U test. We used the chi-square test with Yates correction or Fisher's exact test for 2X2 contingency tables as appropriate. We ran binary logistic regression analyses to assess the independent variables for associates of FOF. The independent variables were designated by assessment of significant association with FOF in the bivariate analyses. We calculated Odds ratios (OR) with their 95% confidential intervals (CIs). p level less than 0.05 was used to determine statistical significance. We used SPSS (statistical package for social sciences) for Windows 21.0 program while doing the statistical analyses. This study has been approved by the institutional ethical board.

Results

General characteristics

The study population was composed of 1021 participants. The mean age was 74.9±6.9 years, and 67.9% was female. More than 1/3 had suffered from falls within the last year. FOF was present in a higher percentage (44.6%), representing almost half of the study population. The prevalence of probable sarcopenia was 11.6%, prefrail or frail screening phenotype 61.3%, positive depression screening in 11.6%, sarcopenia screening in 18.7%, generalized anxiety screening in 12.5%, undernutrition in 24.1%. About 1/5 of the study participants were doing no physical activity while 47.9% were doing daily. More than half (55.8%) were suffering from chronic pain. Subjective sleep problems were present in 44.9%, positive dementia screening in 5.6%, urinary incontinence in 42.2%. The detailed general characteristics of the study population are shown in Table 1.

Univariate analyses

Table 2 shows the detailed results of the association analyses of FOF with the study parameters. When compared to FOF negative patients, FOF positive patients were significantly older (76.3±6.9 vs. 73.8±6.7 years), less educated (university+ in 8.5% vs 18.4%), higher GDS-SF (5 vs. 2), GAS (3 vs. 1), Frail scores (2 vs. 1), longer TUG time (11 vs 8.7 s) and slower UGS (0.82 vs. 0.98 m/s), higher number of chronic drugs (6 vs. 5). Female sex (80.4% vs 57.8%), falls (51.1% vs. 27.0%), , probable sarcopenia (15.3% vs. 8.6%), long TUG time (47.2% vs. 3.5%), slow UGS (28.1% vs. 22.8%), undernutrition (45.7% vs. 22.8%), frailty (prefrail+frail phenotype) (74.7% vs. 50.5%), positive SARC-F sarcopenia screening (30.1% vs. 10.1%), depression screening (18.5% vs. 5.8%), anxiety screening (22.1% vs. 6.0%), self-reported sleep problems (50.1% vs. 40.1%), urinary incontinence (52.9% vs. 33.6%), fecal incontinence (5.9% vs. 2.7%), suffer from chronic pain (63.4% vs. 49.6%) were also more prevalent in FOF positive patients compared to FOF negative patients.

Table 1
General characteristics of the study population with comprehensive geriatric assessment data (n=1021)

Age (years)*	74.9±6.9
Sex (female/male)	693 (67.9%)/ 328 (32.1%)
Falls (last year)	385 (37.7%)
Fear of falling	455 (44.6%)
Hand grip strength (kg) (n=981)	25.5±8.6 (Median: 24)
Low muscle mass (height²) (n=979)	29 (2.8%)
Probable sarcopenia (27/16) (n=981)	114 (11.6%)
Confirmed sarcopenia (25/16) (n=996)	10 (1%)
Confirmed sarcopenia (25/16) (n=996)	20 (2%)
Timed up and go test (s)	9.4 (5-65)
Long TUG (n=966)	61 (6.3%)
Slow UGS (n=967)	324 (33.5%)
Usual gait speed (m/s)	0.93 (0-1.65)
Frail score (n=958)	1 (0-5)
Frailty (prefrail or frail) (n=958)	587 (61.3%)
Frailty (robust/prefrail/frail) (n=958)	371 (38.7%)/ 404 (42.1%)/ 184 (19.2%)
SARC-F score >=4 (n=450)	84 (18.7%)
SARC-F score (n=450)	1 (0-10)
Generalized anxiety measure score>=10 (n=305)	38 (12.5%)
Generalized anxiety measure score (n=305)	2 (0-21)
*BMI (kg/m²)**	26.1+5.2
Number of medications† (n=728)	6 (0-20)
Number of diseases† (n=728)	4 (0-11)
Undernutrition (MNA-SF)	244 (23.9%)
MNA-SF	13 (1-18)
ADL†	6 (0-6)
IADL†	8 (0-8)
Daily physical activity (n=656) (none/ sometimes/ 1-2 times per week/ daily)	136 (20.7%)/ 4 (0.6%)/ 202 (30.8%)/ 314 (47.9%)
Chronic pain	568 (55.6%)
Education(illiterate/elementary/high school/university+)	133 (18.4%)/ 352 (48.6%)/ 138 (19%)/ 101 (13.9%)
Subjective sleep problem	454 (44.5%)
Dementia screening (n=660)	37 (5.6%)
Urinary incontinence	430 (42.1%)
Fecal incontinence	42 (4.1%)

*: mean±standard deviation, †: median (interquartile range), BMI: body mass index, ADL: activities of daily living, IADL: instrumental activities of daily living, Malnutrition is screened by MNA-SF

Multivariate analyses

We ran regression analyses with the parameters that were found significantly associated with FOF in the univariate analyses. We ran two different models. In Model 1, the dependent variable was fear of falling; independent variables were age, sex, falls within last year, probable sarcopenia, SARC-F sarcopenia screening, Frail frailty screening, long TUG-time, slow UGS, undernutrition, GAS anxiety screening, urinary incontinence, sleep problems, at least one limitation in ADL, chronic pain, educational level, number of drugs and chronic diseases. This model revealed that female sex (OR=4.1, 95%CI= 2.0-8.4, p<0.001), anxiety (OR=2.7, 95%CI= 1.1-6.5, p=0.03) and ADL limitation (OR=2.5, 95%CI= 1.03-6.3, p=0.04) were independent associates of FOF. We outlined the results of the regression analysis in Table 3.

In Model 2, we excluded SARC-F sarcopenia screening from the regression analysis due to a potential risk of multicollinearity with the probable sarcopenia and frailty. Here, the independent associates of FOF remained unchanged, as sex (OR=4.2, 95%CI= 2.0-8.5, p<0.001), presence of anxiety (OR=2.8, 95%CI= 1.2-6.8, p=0.02), and ADL limitation (OR=2.6, 95%CI= 1.06-6.4, p=0.04) (results not shown).

Discussion

We found more than 1/3 falls within the last year and a FOF prevalence of (44.6%) representing almost half of the study population. The prevalence of FOF has been studied in a variety of reports from different regions of the world (12, 31-34). Falls represent one of the leading causes of death in the older aged (35). Thus, falls have been considered a public health problem in recent decades. While this is an important step to move forward to improve the well-being of the older adult, it owns a possible effect that promotes an increase in the incidence of FOF (36). As also reported in this study, the prevalence FOF exceeds that of falls (35, 37, 38). Even while falls were associated with FOF in the univariate analysis, it became non-significant in the regression analyses revealing that falls itself may not be an independent associate of FOF. FOF may cause limiting physical activities. With a vicious cycle, limitations in physical activities are expected to cause loss of muscle strength and mass beyond the expected by aging and constitute a well-identified risk factor for future falls (39). Furthermore, thereby, FOF has the potential to decrease quality of life, which may be due to decreases social contacts or leisure time activities (35, 37, 38). FOF has also been identified as a major driver for anxiety. Hence, FOF necessitates being screened, and preventive and treatment measures should be considered universally (36).

This study represents one of the few studies that examine the relationship between FOF and frailty, sarcopenia, malnutrition, physical performance and functional measures, anxiety, urinary incontinence, sleep problems, and chronic pain. Noteworthy that while depression, balance or gait problems, polypharmacy, previous falls have been studied for their relationship with FOF, the relationship of FOF with anxiety, functional measures, sarcopenia, frailty has been studied in few (16, 40). Associations of FOF with other geriatric syndromes such as sleep problems, urinary incontinence have not been studied (41). Urinary incontinence may cause FOF as it pushes older

Table 2
Univariate associations of fear of falling with study parameters

	FOF negative (n=566)	FOF positive (n=455)	p
Age	73.8±6.7	76.3±6.9	<0.001*
Sex (female)	57.8%	80.4%	<0.001*
Falls	27.0%	51.1%	<0.001*
LMM (height^2)	3.4%	2.3%	0.3
Probable sarcopenia	8.6%	15.3%	0.001*
Confirmed sarcopenia	0.9%	1.1%	0.7
Long TUG time	3.5%	47.2%	<0.001*
Slow UGS	22.8%	28.1%	<0.001*
Undernutrition	20.9%	45.7%	0.007*
Frailty (prefrail+frail)	50.5%	74.7%	<0.001*
Frail-1	23.6%	45.7%	<0.001*
Frail-2	18.6%	38.8%	<0.001*
Frail-3	15.4%	37.2%	<0.001*
Frail-4	1.6%	4.4%	0.02*
Frail-5	14.1%	22.1%	0.004*
Sarcopenia screening	10.1%	30.1%	<0.001*
Anxiety screening	6.0%	22.1%	<0.001*
Sleep problem	40.1%	50.1%	0.002*
Urinary incontinence	33.6%	52.9%	<0.001*
Chronic pain	49.6%	63.4%	<0.001*
Education (illiterate vs university+)	12.1% vs 18.4%	26% vs 8.5%	<0.001*
Handgrip strength	27.9±8.9	22.4±7.2	<0.001*
TUG	8.7 (5-65)	11 (6-54.5)	<0.001*
UGS	0.98 (0-1.6)	0.82 (0-1.65)	<0.001*
ADL	6 (0-6)	6 (0-6)	<0.001*
IADL	8 (0-8)	8 (0-8)	<0.001*
MNA-SF	13 (2-14)	13 (1-18)	<0.001*
Frail score	1 (0-5)	2 (0-5)	<0.001*
GDS-SF score	2 (0-14)	5 (0-15)	<0.001*
EQ-5D score	6.5 (0-12)	8 (3-14)	<0.001*
SARC-F score	1 (0-9)	2 (0-10)	<0.001*
GAS score	1 (0-21)	3 (0-21)	0.005*
Regular drug number (per day)	5 (0-17)	6 (0-20)	0.005*
Chronic disease number	4 (0-10)	4 (0-11)	0.004*

*significant association **most significant association; † (only one patient with low muscle mass (height2) and obesity), BMI: body mass index, GAS: generalized anxiety scale; Questions of the FRAIL questionnaire: Frail-1: How much of the time during the past four weeks did you feel tired?; Frail-2: By yourself and not using aids, do you have any difficulty walking up 10 steps without resting?; Frail-3: By yourself and not using aids, do you have any difficulty walking several hundred yards?; Frail-4: : For 11 illnesses, participants are asked, "Did a doctor ever tell you that you have [illness]?" 1 = Yes, 0 = No. The total illnesses (0–11) are recorded as 0–4 = 0 and 5–11 = 1. The illnesses include hypertension, diabetes, cancer (other than minor skin cancer), chronic lung disease, heart attack, congestive heart failure, angina, asthma, arthritis, stroke, and kidney disease.; Frail-5: Loss of weight: How much weight with your clothes on but without shoes? (current weight). One year ago in, how much did you weigh with your clothes on but without shoes? Percent weight change is computed as [(weight one year ago-current weight)/weight one year ago)]*100.

Table 3
Multivariate Cox Regression analyses for significant independent associates of fear of falling (Model 1)

	Hazzard Ratio	95% Confidence Interval	p
Age	1.04	0.99-1.09	0.1
Sex	4.1	2.0-8.4	<0.001*
Falls	1.2	0.7-2.1	0.5
Probable sarcopenia	1.07	0.4-3.0	0.9
SARC-F sarcopenia screening	1.2	0.5-3.1	0.7
Frailty	0.8	0.4-1.5	0.4
Long TUG time	0.8	0.2-3.6	0.8
Slow UGS	1.6	0.7-3.5	0.3
Undernutrition	1.06	0.5-2.1	0.9
GAS anxiety-screening	2.7	1.1-6.5	0.03*
Urinary incontinence	0.4	0.2-1.01	0.055
Sleep problems	1.06	0.6-1.9	0.8
ADL limitation (at least one)	2.5	1.03-6.3	0.04*
Chronic pain	1.3	0.7-2.4	0.5
Education	0.5	0.2-1.3	0.2
Number of regular medications	1.06	0.95-1.2	0.3
Number of chronic diseases	1.02	0.8-1.2	0.9

*: significant predictors of death; ADL: activities of daily living, IADL: instrumental activities of daily living, the dependent variable was fear of falling; independent variables were age, sex, falls within last year, probable sarcopenia, SARC-F sarcopenia screening, Frail frailty screening, long TUG-time, slow UGS, undernutrition, GAS anxiety screening, urinary incontinence, fecal incontinence, sleep problems, at least one limitation in ADL, chronic pain, educational level, number of drugs and chronic diseases

adults to walk in a hurry and thereby could cause FOF (42), and sleep problems may end with unrested older adults who may be prone to falls and thereby to FOF (18).

Prevalence of FOF in sarcopenia screening positive participants was 30.1%; in probable sarcopenic participants, 15.3%; in those with undernutrition, 45.7%; in fallers, 51.1%; in females, 80.4%; and in prefrail/frail was 74.7%. Accompanying FOF has been reported at a similar rate, 76.6%, in a very recent study reported from China (16). On the other hand, that study reported FOF accompanying positive sarcopenia screening much higher, 93.3%. Another Asian study reported from Japan looked for the association of low muscle mass with FOF and reported it as 67.7%. In those with low muscle mass (43). Sarcopenia may be related to FOF bidirectionally. It may cause risk for falls due to causing gait and balance problems (43-45) and/or it may be a direct consequence of FOF when it causes limitations in physical activities and, thus, deconditioning (46).

We found that apart from sex, the most significant associate was the presence of anxiety. The older participants who had anxiety were about 3 times more likely to have FOF than those that do not have FOF (Table 3). This association has been found in a variety of studies (11, 47, 48). Fear, itself, is a major driver for developing anxiety. Again, a bi-directional relationship is present between the anxiety and FOF. FOF itself may be a driver of anxiety, and/or the presence of anxiety can be a driver for FOF.

This study found that FOF was present in a higher percentage (44.6%) of the study population when compared to the prevalence of falls within one year (37.7%). About 50% of patients that were suffering from FOF had not experienced any fall last year. This is in line with the other studies. In the recent study reported by Merchant et al., the results were similar, reporting that three-quarters of those with FOF had not experienced a fall (16). A very similar figure has been reported by Reelick et al. report that 50% of older persons with FOF had not fallen before (34). As noted above, FOF itself can be a major cause of future falls by deconditioning and by the distraction of focus on gait and balance due to overwhelming anxiety.

Chronic pain was more prevalent in those that reported FOF to compare to those without FOF in univariate analysis (63.4% vs. 49.6%). The association of chronic pain with FOF has not been studied so far extensively (16, 49). In the recent study on FOF, the presence of at least moderate pain was higher in the FOF group as 7.6% vs. 3.9% (50). This figure is lower than ours, as the authors were specified the presence of at least moderate intensity pain. Chronic pain can cause increased pain in motion and can distract the focus from gait/balance to the pain.

Another significant finding of our study was the independent association of limitations in ADL with the presence of FOF (13).

Functionality becomes impaired due to decreased physical activity due to a fear of falls. The FOF, together with impaired functionality, in a way, paralyzes the older adults restricting their overall movements.

As the aging society, we have the possibility to fight against FOF and its associates. As most of the relationship between FOF and its associates are bidirectional, we can take advantage of the vicious cycle that nourishes FOF in order to decrease both FOF incidence and its associates. Apart from the female sex, all other associates of FOF are subject to modifications, especially at their earlier phases.

This study has limitations and strengths. At first, we have screened FOF by a single question instead of a detailed test, the FES-I48 (36). However, the single question is much more applicable to be used in everyday practice and also has been shown to have a moderate agreement with FES-I (16). It has been integrated successfully in multiple studies (8, 13, 20). Another point is that we have not assessed the relationship many other potential associates of FOF, such as vision, hearing problems, depression, cognition…etc. We had to exclude participants with significant cognitive impairment; thus, it was not possible to look for association with meaningful cognitive impairment. However, this approach increased the reliability of our results, albeit it is prone to under- or over-reporting. Lastly, as an example of a cross-sectional study design, we cannot suggest a causal-effect relationship between FOF and its associates found here. Our strengths include a high number of participants representing one of the largest studies in this era. Missing variables were not very prevalent for sarcopenia, performance, and functional measures, frailty.

We conclude that this study outlines the high prevalence of FOF in aged people. Observational and interventional longitudinal studies are needed worldwide to take advantage of knowing the associates of FOF in order to develop preventive and treatment plans.

Financial Disclosure: none.

Conflict of Interest: The authors declare no conflict of interest.

Author Contributions: Study concept and design: Bahat and Karan.

Acquisition of data: Kilic, Bozkurt.

Data analysis: Bahat.

Data interpretation: All authors.

Preparation and content of manuscript: All authors.

Sponsor's Role: None.

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