Mobility , balance and frailty in community-dwelling older adults: what is the best 1-year predictor of falls?

DOI:10.1111/ggi.12893

Mobility , balance and frailty in community-dwelling older adults: what is the best 1-year predictor of falls?

Journal:	*Geriatrics & Gerontology International*
Manuscript ID	GGI-0162-2016.R2
Manuscript Type:	Original Article
Date Submitted by the Author:	n/a

Complete List of Authors:	Mulasso, Anna; University of Torino, Department of Psychology Roppolo, Mattia; University of Torino, Department of Psychology Gobbens, Robbert; Inholland University of Applied Sciences, Faculty of Health, Sports and Social Work; Zonnehuisgroep Amstelland Rabaglietti, Emanuela; University of Torino, Department of Psychology

Keywords:	Geriatric Medicine < Clinical Medicine, Nursing care < Geriatric Medicine < Clinical Medicine, Health Science < Clinical Medicine, Preventive Medicine < Socio-Medical Science
Optional Keywords:	Falls, Frail older adults, Gait, Longitudinal studies, Postural balance

Mobility, balance and frailty in community-dwelling older adults: what is the best 1-year predictor of falls?

Mulasso, A., PhD, [1], Roppolo, M., PhD, [1], Gobbens, R.J., RN, MScN, PhD, [2-3], Rabaglietti, E., PhD [1]

[1]- Department of Psychology, University of Torino, Via Verdi 10, 10124, Torino, Italy

[2]- Faculty of Health, Sports and Social Work, Inholland University of Applied Sciences, De Boelelaan 1109, 1081 HV, Amsterdam, the Netherlands

[3]- Zonnehuisgroep Amstelland, Groenelaan 7, 1186 AA, Amstelveen, the Netherlands

Running title.

Mobility, balance, frailty and fall risk

Corresponding author:

Mattia Roppolo
Department of Psychology, University of Torino
Via Verdi, 10, 10124 – Torino (IT)
e-mail: mattia.roppolo@unito.it
phone: 0039 011 6702788
fax: 0039 011 6702790

Abstract

Aim. This study aimed, firstly, to compare the ability to predict falls over 12-months for three measures – mobility, balance, and frailty. Secondly, among the three domains of frailty – physical, psychological, and social - we investigated what is the strongest predictor of falls. Methods. One hundred ninety-two community-dwelling older adults (age 73.0±6.2; 62% women) were involved in this longitudinal study. Timed Up and Go test (TUG), One Leg Standing (OLS) test, and the Tilburg Frailty Indicator (TFI) were respectively used to measure mobility, balance and frailty. The TFI is a questionnaire based on a multidimensional conceptualization of frailty consisting of 15 items in three domains (physical, psychological, and social). Falls were self-reported during the 12-month follow-up. Logistic regression models, adjusted for interesting variables, were conducted to predict the risk of falls. Results. History of falls and chronic conditions were the indicators more strongly related with falls over 12 months. The TFI resulted as a stronger predictor of falls when compared to the TUG and the OLS tests. The explained variance of the three models was 31.2%, 22.4% and 22.2%, respectively. The TFI was significantly associated with falls ($p<.001$), while the TUG and the OLS were not ($p>.05$). Among the three frailty domains, physical ($p<.001$) and psychological ($p=.041$) domains were significant predictors of falls. Conclusion. Findings showed that the TFI may be an effective tool for predicting falls at 12-months in aged populations, probably because it is able to capture the multifactorial facets that can lead to falls.

Key-words: falls, frail older adults, gait, longitudinal studies, postural balance.

Introduction

Falls are among the major public health problems in the world. Approximately 30-40% of people aged 65 years and older fall at least once a year [1,2]. Consequences of falls are often devastating: some of which include fractures, serious injuries, need of healthcare services, hospitalization, early admission in residential care facilities and premature death [1,3,4]. Therefore, prevention of falls can be done through the implementation of physical exercise, environmental inspection and modification, psychological therapy, education and knowledge training, or multiple interventions consisting of a combination of two or more of previous intervention categories [1,5]. One important need is the early identification of individuals at risk of falls who can benefit from these interventions.

In the past, gait and balance abnormalities in association to a previous history of falls have been judged as the best predictors of risk of falling in older adults [6]. Therefore, many screenings for risk of falling have consisted of an evaluation of gait and mobility performances. Among these screening tools, the Timed Up and Go (TUG) test and the One Leg Standing (OLS) test were the most commonly used due to their simplicity and rapidity of administration [7,8,9]. Recently, different studies [10,11] reported a limited ability of these instruments, used in isolation, to predict falls in older adults. In fact, nowadays more authors [10,12] argue that the multifactorial nature of falls requires the development of a comprehensive tool able to accurately detect older adults at risk of falling.

Consistent with this vision, the construct of frailty has been associated with increased risk of adverse events, like falls, in older adults [13,14,15]. Frailty is a dynamic and multidimensional condition, defined as a loss of reserve in one or more domains (physical, psychological, and social) of individual functioning [15]. Furthermore many frailty components such as poor vision, low handgrip strength, walking speed decline, use of walking-aids, drugs use and depression, are also recognized as risk factors for falls [16,17,18] The prevalence of frailty increases with age, reaching about one third of the aged population [19,20]. Several studies [14,18,21,22,23] examined the relationship between frailty and falls, typically considering frailty in a one-dimensional and biomedical perspective. Studies investigating this relationship using a comprehensive operationalization of frailty are still few. A first study [13] demonstrated that a frailty operationalization including physical, psychological and cognitive variables is associated with falls in community-dwelling people aged 55-85 years. A second study [24] showed that physical, psychological, and social frailty predicted falls in older adults living in residential care facilities. These previous studies used the LASA frailty instrument and the Tilburg Frailty Indicator (TFI), respectively.

To the best of our knowledge, currently there are no studies of comparison between physical tests and more comprehensive frailty measures in terms of falls prediction conducted in community-dwelling older adults. Our hypothesis is that a multidimensional assessment of frailty might be a better predictor of falls in a 12-month period than a physical measure of gait or balance impairment. To test this hypothesis we conducted a longitudinal study in community-dwelling older adults. In addition, we investigated which frailty domains (physical, psychological, social) were associated with falls. Therefore, the present paper aimed to: i) compare the ability to predict falls for three measures - mobility, balance, and frailty, ii) determine, among the physical, psychological, and social frailty domains, the strongest predictor of falls, in a sample of Italian community-dwelling older adults. Results will provide insights about the best tool to be utilized for the prediction of risk of falling in aged populations.

Methods

Study population and procedures

In total, 498 people aged 65 and over were contacted, of whom 23 (5%) did not meet the study's inclusion criteria (e.g., severe physical restrictions) and 190 (38%) did not wish to participate. Two hundred eighty-five (57%) people were enrolled in this longitudinal study, and one hundred ninety-two completed it: 18 (6%) and 75 (26%) of individuals did not complete the first and second wave of the study respectively. Drop-outs were not statistically different for socio-demographic variables from the whole project's sample (N=285). Participants who met the following criteria were included: i) they were aged ≥ 65, ii) they were able to understand and speak Italian, iii) they could walk independently (the use of assistive devices was admitted), and iv) there were no severe health problems contraindicating the administration of physical tests (e.g., recent fractures or surgical operation). Institutionalized people were excluded from the study. Participant recruitment was done through direct contact between the project coordinator and the available senior associations (14 in total) located in the Piedmont Region. In order to explain the aims of the project and answer any questions, a preliminary meeting was organized in each association. Participation was voluntary. No rewards or incentives for participating were provided. The Ethical Committee of the University of Torino approved the study protocol. In accordance with Italian law and the ethical code of the American Psychological Association [25], written informed consent for the collection and use of data was obtained from all participants.

Data were collected in two waves (T1 and T2), one year apart from each other. The first data collection was done in the period of January/March 2014 and the second over the same period in 2015. In the initial data collection, physical and cognitive tests in association to questionnaires were administered. While, in the second data collection, only questionnaires were filled out. The physical and cognitive tests were administered in the same order and individually for each participant by qualified and trained staff (an expert in physical exercise and a psychologist). Questionnaires were self-reported and filled out in the presence of a psychologist in order to clarify any doubts.

Measures

Frailty. The Italian version of the Tilburg Frailty Indicator (TFI) [26,27] was used to evaluate frailty according to a multidimensional approach. The TFI is constituted of two parts. Part A contains 10 questions on determinants of frailty such as gender, age, marital status, level of education, chronic diseases, and Part B consists of 15 items on components of frailty, subdivided in three domains: physical (8 items, range 0-8 points), psychological (4 items, range 0-4 points), and social (3 items, range 0-3 points) domains. The score of the TFI ranges from 0 to 15 points. Higher scores correspond to a more serious frailty status.

Gait. The Timed Up and Go test (TUG) [28] was used to measure gait. The test requires a person to rise from a chair, walk three meters, turn around a cone, walk back and sit down. Timing started upon the instructor's "Go" and stopped when the person returned to the initial position. The TUG was executed once, in addition to an untimed trial.

Balance. The One Leg Standing test (OLS) [29] was administered to evaluate the balance skill of a person. The OLS measures the time a person is able to stand on one leg without support. For each lower limb, the test was performed once. The time stopped when 60 seconds were elapsed or when the stance foot shifted or the lifted foot was placed on the ground. The best value between right and left lower limbs was considered in the analysis.

Adverse outcome. The number of falls was investigated at baseline and during the follow-up using this question: *"How many times have you fallen in the last 12 months?"* (categories of answer: *"Never", "1 time", "2 times", "3 times", and ">3 times"*). The outcome was self-reported.

Statistical analysis

Statistical analyses were conducted using Statistical Package for Social Sciences (SPSS), version 22.0 (SPSS Inc, Chicago, IL, USA). Statistical significance level was fixed at alpha <.05 for all tests.

Descriptive and frequencies analyses were executed for all the study's variables. Participants who fell at least once during the 12-month follow-up period were classified as fallers. Participants who did not experience a fall were classified as non-fallers. To identify any differences between fallers and non-fallers for socio-demographic, clinical and health variables T-tests for unpaired samples and chi-square test were carried out. To compare the predictive ability of mobility (TUG time), balance (OLS time), and frailty (TFI score) for falls (dichotomous outcome) during the 12-month follow-up, three logistic regression models, adjusted for age, gender, presence of chronic diseases, and baseline falls, were performed. Lastly, to explore the relationships among the single domains of frailty (physical, psychological, and social) and falls during the 12-month follow-up, three other logistic regression models, adjusted for the same previous variables, were executed. Odds ratio (OR) with 95% confidence intervals and variance using the Nagelkerke R^2 index were calculated for each model.

Results

Baseline participants characteristics

Table 1 shows baseline characteristics of the study's participants and compares fallers and non-fallers. Of the 192 participants, 119 (62%) were women. The mean age was 73.0 years old (range 65-90, SD=6.2). Most of the participants (45%) had a level of education corresponding to secondary school. A high number of people referred to having one or more chronic disorders (68%). The level of cognitive functioning was high, with a mean value of MMSE corresponding to 27.7 points. With respect to frailty, the TFI reported a mean value of 4.28 points. Considering the physical variables, the TUG and the OLS tests showed mean times of 9.8 and 28.1 seconds, respectively. 16% of the participants reported to experiencing at least one fall in the previous 12-months.

Fallers and non-fallers differed on seven of ten variables. Analysis did not report statistical differences between fallers and non-fallers for the level of education (p=.06), cognitive functioning (p=.77), and comorbidities (p=.72). All the other variables resulted in statistically significant differences between the two categories (see Table 1). In this regard, it is important to note that fallers were older and had a higher rate of chronic diseases than non-fallers, specifically for arthritis and cardiovascular diseases. However, the number of concurrent diseases was not statistically different between fallers and non-fallers. The fallers included in a higher percentage of women when compared to the non-fallers.

[Insert Table 1 about here]

Relationship between mobility, balance, frailty and falls

Controlling for age, gender, presence of chronic diseases, and previous falls, three logistic regression models were conducted to predict the single effect of mobility, balance and frailty on the likelihood that participants experience a fall within 12 months (see Table 2).

The first model (mobility) was statistically significant, $\chi^2(5)=29.48$, $p<.001$, indicating that the predictors as a set reliably distinguish between fallers and non-fallers during the next 12-months. The model explained 22.4% of the variance and correctly classified 82.8% of the participants. Women were 3.182 times more likely to fall than men, and fallers in the previous 12-months were 3.409 times more than non-fallers. Individuals affected by one or more chronic diseases were 3.489 times more likely to fall than those without chronic diseases. Age and TUG time were not significant predictors of falls. The second model (balance) was statistically significant, $\chi^2(5)=29.16$, $p<.001$. The variance was 22.2% and the prediction success overall was 81.8%. Women were 3.129 times more likely to fall than men, fallers in the previous 12-months were 3.462 times more than non-fallers, and those with one or more chronic diseases were 3.523 times more than those without chronic diseases. Age and balance time were not statistical predictors of falls. The third model (frailty) was also statistically significant, $\chi^2(5)=42.38$, $p<.001$. The model explained 31.2% of the variance, and correctly classified 78.6% of the individuals. Fallers in the previous 12-months were 2.789 times more likely to fall again than non-fallers, and individuals affected by chronic diseases were 3.404 times more likely than those without chronic diseases. Increasing frailty was associated significantly with an increased likelihood of falls ($p<.001$). Age and gender were not significant predictors of falls.

[Insert Table 2 about here]

Relationship between physical, psychological, social frailty and falls

Logistic regression analyses were performed to compare the single effect of physical, psychological and social frailty on the likelihood that participants incur a fall within 12-months (see Table 3). All three models were adjusted for age, gender, presence of chronic diseases, and previous falls.

All models were all statistically significant (Model 1: $\chi^2(5)=41.95$, $p<.001$; model 2: $\chi^2(5)=31.55$, $p<.001$; model 3: $\chi^2(5)=30.37$, $p<.001$). Model 1, 2, and 3 explained 30.9%, 24.5%, and 23.0% of the variance, and correctly classified 81.8%, 80.7%, and 80.2% of people, respectively. In all models, gender, presence of one or more chronic diseases, and falls in the previous year were significant predictors of falls, while age was not. In the first model, increasing physical frailty was associated significantly with an increased likelihood of falls (p<.001). Similarly, in the second model, psychological frailty was a significant predictor of falls (p=.041). On the contrary, in the third model, social frailty was not significantly associated with falls in the next 12-months.

[Insert Table 3 about here]

Discussion

This longitudinal study compared the ability to predict falls for three measures that are known to be associated with falls in older adults. Two of these are physical tests (the TUG and the OLS) that investigated mobility and balance, the third (the TFI) is a comprehensive measure of frailty based on a multidimensional definition. Findings of this study showed that, in general, history of falls and chronic conditions are the indicators more strongly related with falls over 12-months. Moreover, the TFI is a better 1-year predictor of falls than the TUG and the OLS tests in a sample of community-dwelling older adults. It is important to focus on the relevance to include frailty measures in the prediction of future falling. Indeed we found that, excluding the TFI indicators from the models tested here, the amount of variance accounted by each model decreased (Table 2 – Model 3: from 31.2% to 21.5%; Table 3 – Model 1, 2, 3: from 30.9%, 24.5%, and 23% for the physical, psychological and social frailty domains to 21.5%).

Our results are consistent with those obtained by Barry et al. (2014) and Lin et al. (2004) [10,11] who showed limited predictive ability of the TUG and the OLS for risk of falls in older adults, and Gobbens et al. (2015) [24] who reported the significant contribution of the TFI on risk of falls. These are expected findings, since the TUG and the OLS are single measures of mobility and balance impairment that are unable to capture all the complex intrinsic and extrinsic factors leading older adults to fall. As demonstrated in this study, a more comprehensive measure such as the TFI should be preferred for the identification of older adults at risk of falling in comparison to single physical measures. In line with our results, Okochi et al. (2006) [18] found that history of falls and the four frailty-related items (walking speed, use of walking-aids, back deformation, and medication use) had a strong relationship with risk of falls. The TFI is based on an integral conceptual definition of frailty consisting of three domains of frailty – physical, psychological, and social. Each of these can be potentially related to and can contribute to the prediction of falls. In fact, the close relationship between the different components of human functioning and falls [30], as well the interrelated nature and the mutual influences among the three components [26] are well known. Specifically, this study reported high predictive value of the physical and the psychological domains of frailty for falls, while the social domain of frailty did not result a significant predictor. In this regard, it is important to notice that the physical TFI does not only measure mobility and balance, but also other components referring to physical functioning such as poor vision and physical tiredness. It is possible to hypothesize that the physical TFI is a good predictor of falls because it is comprehensive of the whole spectrum of physical functions, on the contrary of the TUG and the OLS. With respect to the social domain, similarly to our results, Gobbens et al. (2015) [24] in their study did not find an association between the social frailty domain and falls. On the contrary, other studies [24,31] demonstrated the ability of social frailty to predict adverse events such as disability and quality of life. Probably, the limited number of items that constitutes this frailty domain (three items in total) can affect its predictive ability for certain outcomes. Further studies to better understand the predictive role of social frailty on different outcomes will certainly be needed.

The main strength of this study is that it was conducted longitudinally. A 12-month follow-up period was a sufficiently wider time for detecting falls in older adults. Furthermore, the adoption of a multidimensional and validated frailty tool that includes physical, psychological, and social components of frailty should be seen as a strength of this study. However, our results should be interpreted in the context of some limitations. Firstly, participants were older adults living in a small area of Italy, and the recruitment was not based on randomization or stratification strategies. Consequently, our findings may not be generalized to the entire aged population. Secondly, there is a quite high drop-out rate between the baseline and the follow-up period leading to a sample size reduction. However, it is noteworthy to observe that the drop-outs were not statistically different for socio-demographic variables from the study participants. Finally, the outcome of this study - the number of falls occurred in the previous 12-months – was measured self-reported. This could have resulted in some loss of information.

In conclusion, this study showed that a multidimensional assessment of frailty such as the TFI could be effective for predicting falls in older adults at 12-months. In this study, the TFI provided better results in terms of falls prediction than single measures of mobility and balance. Among the three domains of frailty, the physical and the psychological domains showed satisfying results in terms of fall prediction. Therefore, our findings suggested that the TFI could be a suitable tool for detecting individuals at risk of falling, probably because it is able to capture the multifactorial facets that can lead to falls. It is worth noting that the TFI is a user-friendly, self-report, and cost-saving instrument less stressful than physical measures. As a consequence, if further studies conducted on a larger and different population will confirm these results, the TFI could be used in clinical settings to identify older adults at increased risk of falls.

Acknowledgments

The authors would like to gratefully acknowledge all the persons who collaborated in the recruitment of participants and in the data collection. A special thanks is for older adults who took part in the study.

Disclosure statement

The authors declare no conflict of interest.

References

1. Rubenstein LZ. Falls in older people: epidemiology, risk factors and strategies for prevention. *Age Ageing* 2006; 35 Suppl 2: ii37-ii41.

2. Tinetti ME, Williams CS. The effect of falls and fall injuries on functioning in community-dwelling older persons. *J Gerontol A Biol Sci Med Sci* 1998; 53: M112-119.

3. Tinetti ME, Speechley M, Ginter SF. Risk factors for falls among elderly persons living in the community. *N Engl J Med* 1988; 319: 1701-1707.

4. Masud T, Morris RO. Epidemiology of falls. *Age Ageing* 2001; 30 Suppl 4: 3-7.

5. Gillespie LD, Robertson MC, Gillespie WJ*, et al.* Interventions for preventing falls in older people living in the community. *Cochrane Database Syst Rev* 2012; 9: CD007146.

6. Ganz DA, Bao Y, Shekelle PG, Rubenstein LZ. Will my patient fall? *JAMA* 2007; 297: 77-86.

7. Vellas BJ, Rubenstein LZ, Ousset PJ*, et al.* One-leg standing balance and functional status in a population of 512 community-living elderly persons. *Aging (Milano)* 1997; 9: 95-98.

8. Okumiya K, Matsubayashi K, Nakamura T*, et al.* The timed "up & go" test is a useful predictor of falls in community-dwelling older people. *J Am Geriatr Soc* 1998; 46: 928-930.

9. Shumway-Cook A, Brauer S, Woollacott M. Predicting the probability for falls in community-dwelling older adults using the Timed Up & Go Test. *Phys Ther* 2000; 80: 896-903.

10. Barry E, Galvin R, Keogh C, Horgan F, Fahey T. Is the Timed Up and Go test a useful predictor of risk of falls in community dwelling older adults: a systematic review and meta-analysis. *BMC Geriatr* 2014; 14: 14.

11. Lin MR, Hwang HF, Hu MH, Wu HD, Wang YW, Huang FC. Psychometric comparisons of the timed up and go, one-leg stand, functional reach, and Tinetti balance measures in community-dwelling older people. *J Am Geriatr Soc* 2004; 52: 1343-1348.

12. Kojima G, Masud T, Kendrick D*, et al.* Does the timed up and go test predict future falls among British community-dwelling older people? Prospective cohort study nested within a randomised controlled trial. *BMC Geriatr* 2015; 15: 38.

13. de Vries OJ, Peeters GM, Lips P, Deeg DJ. Does frailty predict increased risk of falls and fractures? A prospective population-based study. *Osteoporos Int* 2013; 24: 2397-2403.

14. Li G, Ioannidis G, Pickard L, *et al.* Frailty index of deficit accumulation and falls: data from the Global Longitudinal Study of Osteoporosis in Women (GLOW) Hamilton cohort. *BMC Musculoskelet Disord* 2014; 15: 185.

15. Gobbens RJ, Luijkx KG, Wijnen-Sponselee MT, Schols JM. In search of an integral conceptual definition of frailty: opinions of experts. *J Am Med Dir Assoc* 2010; 11: 338-343.

16. Stalenhoef PA, Diederiks JP, Knottnerus JA, Kester AD, Crebolder HF. A risk model for the prediction of recurrent falls in community-dwelling elderly: a prospective cohort study. *J Clin Epidemiol* 2002; 55: 1088-1094.

17. Koski K, Luukinen H, Laippala P, Kivela SL. Risk factors for major injurious falls among the home-dwelling elderly by functional abilities. A prospective population-based study. *Gerontology* 1998; 44: 232-238.

18. Okochi J, Toba K, Takahashi T, *et al.* Simple screening test for risk of falls in the elderly. *Geriatr Gerontol Int* 2006; 6: 223-227.

19. Collard RM, Boter H, Schoevers RA, Oude Voshaar RC. Prevalence of frailty in community-dwelling older persons: a systematic review. *J Am Geriatr Soc* 2012; 60: 1487-1492.

20. Roppolo M, Mulasso A, Gobbens RJ, Mosso CO, Rabaglietti E. A comparison between uni- and multidimensional frailty measures: prevalence, functional status, and relationships with disability. *Clin Interv Aging* 2015; 10: 1669-1678.

21. Ensrud KE, Ewing SK, Taylor BC, *et al.* Comparison of 2 frailty indexes for prediction of falls, disability, fractures, and death in older women. *Arch Intern Med* 2008; 168: 382-389.

22. Ensrud KE, Ewing SK, Taylor BC, *et al.* Frailty and risk of falls, fracture, and mortality in older women: the study of osteoporotic fractures. *J Gerontol A Biol Sci Med Sci* 2007; 62: 744-751.

23. Fried LP, Tangen CM, Walston J*, et al*. Frailty in older adults: evidence for a phenotype. *J Gerontol A Biol Sci Med Sci* 2001; 56: M146-156.

24. Gobbens RJ, Krans A, van Assen MA. Validation of an integral conceptual model of frailty in older residents of assisted living facilities. *Arch Gerontol Geriatr* 2015; 61: 400-410.

25. Ethical principles of psychologists and code of conduct. *Am Psychol* 2002; 57: 1060-1073.

26. Gobbens RJ, van Assen MA, Luijkx KG, Wijnen-Sponselee MT, Schols JM. The Tilburg Frailty Indicator: psychometric properties. *J Am Med Dir Assoc* 2010; 11: 344-355.

27. Mulasso A, Roppolo M, Gobbens RJ, Rabaglietti E. The Italian Version of the Tilburg Frailty Indicator: Analysis of Psychometric Properties. *Res Aging* 2015.

28. Podsiadlo D, Richardson S. The timed "Up & Go": a test of basic functional mobility for frail elderly persons. *J Am Geriatr Soc* 1991; 39: 142-148.

29. Bohannon RW. Single Limb Stance Times: A Descriptive Meta-Analysis of Data From Individuals at Least 60 Years of Age. *Topics in Geriatric Rehabilitation* 2006; 22: 70-77.

30. Skelton D, Todd C. What are the main risk factors for falls amongst older people and what are the most effective interventions to prevent these falls? In: Network H-HE, editor. WHO - World Health Organization2004.

31. Gobbens RJ, Luijkx KG, van Assen MA. Explaining quality of life of older people in the Netherlands using a multidimensional assessment of frailty. *Qual Life Res* 2012.

Table 1. Baseline characteristics for the whole sample, fallers and non-fallers

Variable	Whole sample N=192	Fallers n=39	Non-fallers n=153	*P* value †
Age, years, mean (SD)	73.0 (6.2)	74.7 (7.4)	72.5 (5.8)	.05
Gender, n (%) of female	119 (62)	32 (82)	87 (57)	.004
Level of education, n (%)				
Primary school, 5 years	53 (28)	17 (44)	36 (24)	
Secondary school, 8 years	87 (45)	13 (33)	74 (48)	.06
High school diploma, 13 years	36 (19)	5 (13)	31 (20)	
University degree, 18 years	16 (8)	4 (10)	12 (8)	
Chronic diseases, n (%) of Yes	130 (68)	34 (87)	96 (63)	.004
Hypertension	85 (44)	21 (54)	64 (42)	.208
Diabetes	17 (9)	6 (15)	11 (7)	.119
Osteoporosis	16 (8)	4 (10)	12 (8)	.745
Arthritis	23 (12)	10 (26)	13 (9)	.010
Cardiovascular disease	24 (13)	10 (26)	14 (9)	.012
Comorbidities, mean (SD) of chronic diseases	1.6 (.9)	1.7 (.9)	1.6 (.9)	.72
MMSE, mean (SD)	27.7 (2.6)	27.6 (2.7)	27.7 (2.6)	.77
TFI, mean (SD)	4.28 (2.6)	6.3 (2.5)	3.8 (2.4)	<.001
Physical TFI, mean (SD)	1.8 (1.7)	2.6 (2.1)	1.7 (1.6)	.028
Psychological TFI, mean (SD)	1.4 (1.0)	1.9 (.9)	1.3 (1.0)	.004
Social TFI, mean (SD)	1.0 (.9)	1.1 (.9)	1.0 (.9)	.465
TUG, seconds, mean (SD)	9.8 (3.0)	11.2 (4.2)	9.5 (2.5)	.001
OLS, seconds, mean (SD)	28.1 (22.6)	19.6 (20.8)	30.3 (22.6)	.008
Any falls (previous 12 months),	30 (16)	13 (33)	17 (11)	.001

n (%) of Yes

† Based on independent t-test for continuous variables and on chi-squared test for categorical variables

MMSE, Mini Mental State Examination. TFI, Tilburg Frailty Indicator.TUG, Timed Up and Go test. OLS, One Leg Standing test.

Table 2. Ability of mobility, balance, and frailty for predicting falls during the 12-month follow-up

Variable	**Model 1 - mobility**		**Model 2 - balance**		**Model 3-frailty**	
	OR (95% CI)	***P* value**	**OR (95% CI)**	***P* value**	**OR (95% CI)**	***P* value**
Age	1.020 (0.956-1.087)	.551	1.025 (0.964-1,090)	.428	1.031 (0.970-1.096)	.319
Female gender	3.182 (1.254-8.077)	.015	3.129 (1.227-7.982)	.017	2.437 (0.927-6.409)	.071
Chronic diseases	3.489 (1.207 – 10.084)	.021	3.523 (1.229 – 10.100)	.019	3.404 (1.145 – 10.121)	.028
Falls in the previous year	3.409 (1.409-8.248)	.007	3.462 (1.421-8.434)	.006	2.789 (1.089-7.139)	.032
TUG	1.076 (0.949-1.219)	.256	-	-	-	-
OLS	-	-	0.990 (0.971-1.010)	.328	-	-
TFI	-	-	-	-	1.341 (1.142-1.573)	<.001

Notes. OR, odds ratio; CI, confidence intervals

Model 1 used the TUG time, Model 2 used the OLS time, Model 3 used the TFI total score. All the models were adjusted for age, gender, chronic diseases, and falls in the previous year.

TFI, Tilburg Frailty Indicator. TUG, Timed Up and Go test. OLS, One Leg Standing test.

Table 3. Ability of single domains of frailty for predicting falls during the 12-month follow-up

Variable	**Model 1 – physical frailty**		**Model 2 – psychological frailty**		**Model 3 – social frailty**	
	OR (95% CI)	***P* value**	**OR (95% CI)**	***P* value**	**OR (95% CI)**	***P* value**
Age	1.031 (0.971-1.096)	.315	1.045 (0.985-1.109)	.144	1.028 (0.969-1.090)	.365
Female gender	2.681 (1.023-7.028)	.045	3.277 (1.289-8.333)	.013	2.949 (1.153-7.541)	.024
Chronic diseases	3.325 (1.124 – 9.830)	.030	3.786 (1.315 – 10.895)	.014	4.024 (1.402 – 11.550)	.010
Falls in the previous year	2.909 (1.131-7.481)	.027	2.891 (1.168-7.153)	.022	3.573 (1.462-8.730)	.005
TFI phys	1.531 (1.210-1.936)	<.001	-	-	-	-
TFI psych	-	-	1.553 (1.018-2.369)	.041	-	-
TFI social	-	-	-	-	1.389 (0.897-2.152)	.141

Notes. Model 1 used the physical frailty score, Model 2 used the psychological frailty score, Model 3 used the social frailty score. All the models were adjusted for age, gender, chronic diseases, and falls in the previous year.

TFI, Tilburg Frailty Indicator