

Original Article

Physical, mental, and social functioning in women age 65 and above with and without a falls history: An observational case-control study

Lisbeth Rosenbek Minet^{1,2,3}, Katja Thomsen^{1,4}, Jesper Ryg^{1,4}, Lars Matzen⁴, Tahir Masud^{4,5}, Charlotte Ytterberg^{1,6}

¹Department of Clinical Research, University of Southern Denmark; ²Health Sciences Research Centre, UCL University College; ³Department of Rehabilitation, Odense University Hospital; ⁴Department of Geriatric Medicine, Odense University Hospital; ⁵Nottingham University Hospitals NHS Trust, Nottingham, United Kingdom; ⁶Department of Neurobiology, Care Sciences and Society, Karolinska Institutet, Function Area Occupational Therapy & Physiotherapy, Karolinska University Hospital

Abstract

Objectives: There is a lack of knowledge about how falls are associated with the older person's physical, mental, and social functioning which would help find effective methods for identifying rehabilitation needs in the older population to ensure appropriate follow-up. The aim was to investigate and compare functioning in women with and without a falls history. **Methods:** This was an observational case-control study. Study participants were fallers aged ≥ 65 years recruited consecutively from a hospital; age matched randomly selected community controls (fallers without contact with the healthcare system due to falls and non-fallers). Fallers were classified as once only fallers and recurrent fallers. **Results:** The sample constituted a group of older women with and without a falls history; 117 fallers from the Falls Clinic, and 99 fallers and 106 non-fallers community controls, median age 80 years. Both fallers from the clinic and the community had significantly lower functioning compared to non-fallers in all three domains. Recurrent fallers had poorer functioning compared to once only fallers. **Conclusion:** This study contributes to knowledge about older people's functioning and disability in conjunction with a high fall-risk and highlights the importance of rehabilitation and prevention strategies that focus on early identification of disability in the older population regardless of falls history.

Keywords: Falls, Functioning, Older women, Observational study

Introduction

Falls have important implications for older people through both direct repercussions such as fractures and head injuries, and through long-term consequences such as disability, lower health related quality of life, loss of independence, and decline in social participation¹⁻⁴.

Despite awareness of fall risk factors in the older population, there is a lack of knowledge about how falls are associated with the older person's physical, mental, and social functioning. Knowledge of this population's functioning can help identify adequate methods for assessing their rehabilitation needs; thereby, ensuring proper follow-up^{5,6}. In this context, it is important that further research is performed to identify older people's functioning and disability in conjunction with a high fall-risk⁷. Identification of factors related to functioning and disability may contribute

to the development of preventive interventions reducing the incidence of falls among older people. To the best of our knowledge, no study has compared the functioning and disability status in older people with and without falls history. The aim of this observational case-control study was

The authors have no conflict of interest.

Corresponding author: Lisbeth Rosenbek Minet, Department of Clinical Research, University of Southern Denmark; Health Sciences Research Centre, UCL University College; Department of Rehabilitation, Odense University Hospital, Sdr. Boulevard 29, 5000 Odense C, entrance 108, Denmark

E-mail: Lisbeth.minet@rsyd.dk

Edited by: Yannis Dionyssiotis

Accepted 29 November 2018

to investigate and compare functioning in women with and without a falls history.

Materials and methods

This study was carried out in the context of a longitudinal study on osteoporosis⁸. Study participants were a group of fallers aged ≥ 65 years recruited consecutively from the Falls Clinic at Odense University Hospital in Denmark [FALLCLIN] and age matched randomly selected community controls (fallers without contact with the healthcare system due to falls [FALLCON] and non-fallers [NOFALL]). Of a randomly selected group of 3000 women living in the municipality of Odense 866 women stated they were interested in participating in the study. Controls were consecutively recruited to the study. Individuals not mobile enough to transfer from bed to chair with or without help were excluded from the study. This study complies with the World Medical Association Declaration of Helsinki - Ethical Principles for Medical Research Involving Human Subjects. The regional ethics committee at the Region of Southern Denmark approved the study (S-20110162). All participants provided informed written consent before participating in the study.

All participants were seen in the falls clinic and data were collected by two researchers/health professionals. The World Health Organization's model the International Classification of Functioning, Disability, and Health (ICF) was utilized as a conceptual framework for understanding functioning and disability (i.e., body structure, body function, activity, and participation). The following aspects of functioning were studied: muscle strength assessed by handgrip strength measured with a dynamometer (Smedley, model 281128; Scandidact, Kvistgaard, Denmark) under standardized conditions using the best value of two attempts and the 30 second sit to stand test (STS)⁹, modified if participants had to use their arms to complete the test; basic mobility assessed by the Timed Up and Go test (TUG)¹⁰; gait speed assessed by 4-meter walking test¹¹ with and without a dual task condition of serial three subtractions¹² - the participants walked with their preferred walking speed and used their customary walking aids in all walking tests (for walking tests the best value of three attempts were used); balance assessed by the 14-item Berg Balance Scale¹³; cognition assessed by Mini Mental State Examination (MMSE)¹⁴; symptoms of depression assessed by the Geriatric Depression Scale (GDS)¹⁵; activities of daily living (ADL) assessed by the Avlund Mobility-Tiredness Scale (Avlunds Mob-T)¹⁶. The framework of ICF also includes contextual factors (i.e., environmental and personal factors) which in this study included fear of falling assessed by the Falls Efficacy Scale-International (FES-I)¹⁷ and falls history over one year assessed with a self-reported questionnaire using a standardized definition of a fall¹⁸. Additional contextual factors extracted from medical records were included to describe the sample (age, body mass index (BMI), medication, Charlson Comorbidity Index (CCI)¹⁹, and help with homecare or personal care).

Statistical analysis

Data were analyzed using SPSS version 19.0 for Windows (IBM SPSS Inc., Chicago, IL).

Ratio between controls (FALLCON and NOFALL) and cases (FALLCLIN) was set at 2:1. Sample size was based on an assumption of a significant difference of a 30% decrease in frequency between the case group and control group. For the study to have a power of 80% with a 0.05 significance level the sample had to contain 69 participants in the case group and 138 participants in the control group (69 in each group). When taking a 20% drop-out rate into account, 83 cases and 166 controls would have to be included in the study (83 in each group). Because this population was expected to have an annual mortality rate of 10% we aimed to recruit 100 participants in each of the three groups in the longitudinal study on osteoporosis to allow for attrition and withdrawals.

Significance level was set to 0.05. Descriptive characteristics of the three groups FALLCLIN, FALLCON, and NOFALL were compared using One-way ANOVA analyzes of variance to compare continuous variables and Kruskal-Wallis non-parametric test to compare categorical variables. To explore plausible differences in functioning between the three groups of women the One-way ANOVA of variance was used to compare means and the Kruskal-Wallis non-parametric test to compare medians. For univariate analysis the independent t-test was used to compare means and the Mann-Whitney test was used to compare medians. We also explored differences in functioning between "once only fallers" and "recurrent fallers" in FALLCLIN group and FALLCON group. Women who reported more than one fall within the last 12 months were classified as recurrent fallers. The independent t-test was used to compare means and the Mann-Whitney test was used to compare medians between the two groups.

Results

The total sample constituted 322 women, FALLCLIN (n=117), FALLCON (n=99), and NOFALL (n=106) with an overall median age of 80 years [IQR 75-86]. Non-participants (n=78) from the Falls Clinic (i.e. those who declined participation, withdrew consent, or were excluded according to exclusion criteria), were significantly older than participants (median [IQR]: 83 years [77-89] vs. 81 years [75-86], $p=0.021$). Descriptive characteristics of the FALLCLIN, FALLCON, and NOFALL groups are presented in Table 1. Participants recruited from the falls clinic and controls with falls had increased number of comorbidities and medications and more assistance from home-helpers.

Statistically significant differences were found in all areas of functioning between the three groups (Table 2). Furthermore the use of arms to complete the STS was more prevalent in fallers than non-fallers, 34% (32/95) in the FALLCLIN, 29% (28/97) in the FALLCON group, and 6% (6/104) in the NOFALL group respectively had to use their

Variable	FALLCLIN (n=117)	FALLCON (n=99)	NOFALL (n=106)	p
Age (years), median [IQR]	81 [75-86]	79 [76-85]	80 [75-86]	0.717
BMI (kg/m ²), median [IQR]	26 [23-30]	26 [23-30]	26 [23-29]	0.829
Number of medications (n), median [IQR]	6 [4-8]	5 [3-7]	3 [2-6]	0.024
Charlson Comorbidity Index ¹ , n (%)				
0	44 (37.6)	47 (47.5)	68 (64.2)	<0.001
1-2	53 (45.3)	44 (44.4)	32 (30.2)	
≥3	20 (17.1)	8 (8.1)	6 (5.7)	
Homecare help, n (%)	77 (66%)	42 (42%)	29 (27%)	<0.001
Personal care help, n (%)	37 (32%)	10 (10%)	6 (6%)	<0.001

¹CCI=Charlson Comorbidity Index¹⁹ predicts the one-year mortality for a patient who may have a range of comorbid conditions, such as heart disease, AIDS, or cancer (a total of 21 conditions). Each condition is assigned a score of 1, 2, 3, or 6, depending on the risk of dying associated with each one. The severity of comorbidity was categorized into three grades: mild, with CCI scores of 0; moderate, with CCI scores of 1-2; and severe, with CCI score ≥3.

Table 1. Descriptive characteristics of the three participating groups: Falls Clinic [FALLCLIN], community controls with falls history [FALLCON] and without falls history [NOFALL].

Group	FALLCLIN		FALLCON		NOFALL		p*	p [†]	p [‡]
	n		n		n				
Variables									
Handgrip Strength (kg), mean (SD)	88	17.7 (6.7)	94	18.2 (6.1)	101	21.5 (5.8)	<0.001	0.260	<0.001
Sit to stand test (number), mean (SD)	95	8.3 (3.1)	97	9.8 (4.0)	104	11.7 (3.3)	0.038	0.118	<0.001
Timed Up and Go test (sec), median [IQR]	96	14.0 [10.0-19.0]	97	10.3 [8.2-14.4]	104	8.5 [6.9-11.4]	0.013	0.002	<0.001
Gait speed – 4 meters (m/s), median [IQR]	87	0.78 [0.60-0.97]	94	1.03 [0.78-1.31]	103	1.27 [1.04-1.52]	<0.001	<0.001	<0.001
Gait speed dual task (m/s), median [IQR]	74	0.58 [0.42-0.75]	92	0.76 [0.54-0.97]	102	1.00 [0.72-1.25]	0.004	<0.001	<0.001
Bergs Balance Scale (score), median [IQR]	89	44.5 [38.0-51.0]	96	51.0 [44.0-54.0]	102	53.0 [49.0-56.0]	0.009	0.009	<0.001
Mini Mental State Examination (score), median [IQR]	101	26 [23-28]	98	27 [25-29]	105	28 [26-29]	0.226	0.002	<0.001
Geriatric Depression Scale (score), median [IQR]	100	3 [2-6]	98	2 [1-4]	105	1 [0-3]	0.109	<0.001	<0.001
Avlunds Mobility-Tiredness Scale (score), median [IQR]	117	3 [2-4]	99	4 [3-5]	106	5 [3-6]	0.002	<0.001	<0.001
Falls Efficacy Scale (score), median [IQR]	100	30 [23-37]	97	23 [20-28]	104	20 [18-24]	0.005	<0.001	<0.001

*FALLCON vs. NOFALL. [†]FALLCLIN vs. FALLCON. [‡]FALLCLIN vs. NOFALL.

Table 2. Variables on functioning in the three participating groups: Falls Clinic [FALLCLIN], community controls with falls history [FALLCON] and without falls history [NOFALL].

arm when standing up (p<0.001). Finally, the use of a walking aid in the walking tests was also more prevalent in fallers than non-fallers, 36% (31/87) in the FALLCLIN group, 29% (27/97) in the FALLCON group, and 5% (5/102) in

the NOFALL group respectively (p<0.001).

When comparing functioning between “once only fallers” and “recurrent fallers” no statistically significant differences were found in the FALLCLIN group (Table

Group	FALLCLIN				p	FALLCON				
	Once only fallers		Recurrent fallers			Once only fallers		Recurrent fallers		
Variables	n		N		p	n		n		p
Handgrip strength (kg), mean (SD)	30	18.1 (6.9)	55	16.1 (6.5)	0.201	81	17.9 (5.4)	12	16.9 (7.7)	0.702
Sit to stand test (number), mean (SD)	31	8.9 (3.3)	61	7.8 (3.1)	0.111	84	9.4 (3.7)	12	7.9 (2.8)	0.298
Timed up and go test (sec), median [IQR]	32	11.6 [9.6-19.7]	61	15.0 [10.8-19.0]	0.356	84	11.3 [8.3-14.8]	12	10.6 [8.9-18.9]	0.750
Gait speed – 4 meters (m/s), median [IQR]	29	0.88 [0.70-1.00]	55	0.68 [0.56-0.96]	0.054	81	1.03 [0.79-1.28]	12	1.00 [0.59-1.29]	0.610
Gait speed dual task (m/s), median [IQR]	27	0.67 [0.46-0.80]	44	0.50 [0.39-0.74]	0.268	79	0.76 [0.56-0.98]	11	0.63 [0.40-0.89]	0.235
Bergs Balance (score), median [IQR]	31	44 [38-52]	55	44 [35-51]	0.592	83	50 [42-53]	12	51 [37-53]	0.869
Mini Mental State Examination (score), median [IQR]	35	26 [22-28]	63	26 [23-27]	0.935	86	27 [25-29]	12	27 [25-29]	0.902
Geriatric Depression Scale (score), median [IQR]	34	4 [2-6]	63	3 [2-6]	0.735	86	2 [0-4]	12	5 [2-9]	<0.001
Avlunds Mobility-Tiredness Scale (score), median [IQR]	38	3 [1-4]	76	2 [1-3]	0.127	87	4 [3-5]	12	2 [1-3]	<0.001
Falls Efficacy Scale-1 (score), median [IQR]	34	33 [21-40]	63	29 [24-37]	0.666	85	23 [20-28]	12	32 [22-42]	0.044

Table 3. Functioning in “once only fallers” and “recurrent fallers” in the group of women from the Falls Clinic [FALLCLIN] and women from the community with a falls history [FALLCON].

3) whereas “recurrent fallers” had significantly poorer functioning in regards to symptoms of depression, ADL, and fear of falling in the FALLCON group (Table 3). “Once only fallers” from the FALLCLIN group had significantly poorer functioning in regards to gait speed ($p=0.015$), gait speed dual task ($p=0.049$), cognition (0.027), symptoms of depression ($p<0.001$), ADL ($p=0.037$), and fear of falling ($p=0.006$) compared to “once only fallers” from the FALLCON group. There was no statistically significant difference between any of the outcomes recorded by the two groups of “recurrent fallers”.

Discussion

This observational study explored functioning and contextual factors in women with falls attending a falls

clinic compared to women from the community with and without falls. The study demonstrated that there are significant differences in functioning when comparing older women with or without a falls history. These findings are supported by studies on fall risk factors where low functioning in regards to muscle strength, balance, gait, cognition, depression, ADL, and fear of falling are associated with increased risk of falling²⁰. These results might apply especially for older women. Compared to a younger group of older women (age 60-69 years) the study population would be expected to have lower physical, mental, and social functioning due to the aging process^{21,22}. We were not able to recruit the oldest women from the Falls Clinic. If the oldest group had been included in the study the functioning in women from the

falls clinic was likely to be even lower. Our results showed that there were a number of women in the community who had reduced functioning and a falls history but who were not in contact with the healthcare system in regards to falls. Because women in the community had slightly better mental functioning compared to the women from the falls clinic, they might have had better resilience to cope with their poor physical and social functioning. The reduced functioning level in women in the community highlights the importance of preventive initiatives for women with incipient decreasing functioning. Evidence shows, that a systematic identification and assessment of older people with fall episodes is important for preventing further falls²³. In the group of women with a falls history no difference was found in functioning between “once only fallers” and “recurrent fallers” except in the group of women from the community where “recurrent fallers” had poorer functioning in regards to depressive symptoms, ADL, and fear of falling. The association between depression and poor functioning could be explained by depression-related factors (e.g. fear of falling, cognitive impairment) and the treatment of depression (e.g. impaired balance, movement disorders)²⁴. This interaction is further complicated by common risk factors such as functional decline. Activity limitations and restricted social participation can be a complication of recurrent falls partly explained by increased depressive symptoms in repeated fallers²⁵. Assessment of the physical, mental, and social functioning could be an important part of falls prevention in older women. Our results indicate that older women who fall in general have low functioning and therefore rehabilitation and prevention strategies in the older population should focus on maintaining functioning level regardless of the number of previous falls. This is supported by a prospective study showing that reduced mobility and functional impairment can predict future falls in older people²⁶. However, a multifactorial approach to falls prevention is important to recognise. A recent Cochrane Review suggests that multiple component interventions, usually including exercise, is most effective in reducing the rate of falls and risk of falling among older people²⁷. The strength of this study is the use of functional performance testing in all participants which provides thorough knowledge on performance abilities and functional limitations in older women. Although our study in the control group was limited by the use of self-reported falls questionnaires which might have resulted in lower falls reporting, our case-control design enabled us to obtain general knowledge regarding falls history. The perspective of this study was to increase the knowledge about older people’s functioning and disability in conjunction with a high fall-risk, in order to identify rehabilitation needs in this population. Future research should explore the predictive value of functioning/disability and contextual factors on falls over time to

identify patterns in falls and to inform the design of fall preventive interventions. One way of addressing this would be to perform a longitudinal study in order to get knowledge about variation over time in functioning in older women with and without falls history.

Conclusion

Low physical, mental, and social functioning was distinctive for older women with a falls history. Early identification of disability should be part of community based prevention and rehabilitation strategies in the older population regardless of falls history. Particular emphasis in declining mental function should be considered as this is a strong indicator for clinic attendance.

Funding support

The study was funded by the Odense University Hospital Research Council (6075024).

Acknowledgement

Thank you to Annette Storm, Department of Rehabilitation, Odense University Hospital, for assisting with data collection in the study.

Lisbeth Rosenbek Minet planned and recruited to the study, collected data, drafted and submitted the paper. Katja Thomsen assisted with recruitment and data collection and revisions to the paper. Lars Matzen assisted with planning the study and contributed to the manuscript. Jesper Ryg assisted with planning the study and interpretation of data and contributed to the manuscript. Tahir Masud assisted with planning the study, analysis of the results, and contributed to the manuscript. Charlotte Ytterberg assisted with planning the study, analysis of the results and contributed to the manuscript.

References

1. Sylliaas H, Idland G, Sandvik L, et al. Does mortality of the aged increase with the number of falls? Results from a nine-year follow-up study. *Eur J Epidemiol* 2009;24:351-55.
2. World Health Organization. WHO global report on falls prevention in older age. France: WHO; 2007.
3. Voermans NC, Snijders AH, Schoon Y, Bloem BR. Why old people fall (and how to stop them). *Pract Neurol* 2007;7(3):158-71.
4. Stenhagen M, Ekstrom H, Nordell E, Elmstahl S. Accidental falls, health-related quality of life and life satisfaction: a prospective study of the general elderly population. *Arch Gerontol Geriatr* 2014;58(1):95-100.
5. Conroy SP, Stevens T, Parker SG, et al. A systematic review of comprehensive geriatric assessment to improve outcomes for frail older people being rapidly discharged from acute hospital: ‘interface geriatrics’. *Age Ageing* 2011;40:436-43.
6. Veillette N, Demers L, Dutil E, McCusker J. Development of a functional status assessment of seniors visiting emergency department. *Arch Gerontol Geriatr* 2009;48(2):205-12.
7. Hotchkiss A, Fisher A, Robertson R, Ruttencutter A, Schuffert J, Barker DB. Convergent and predictive validity of three scales related

- to falls in the elderly. *Am J Occup Ther* 2004;58(1):100-3.
8. Thomsen K. Odense Fallers and Osteoporosis Study - Assessment of osteoporosis among older women presenting with falls. University of Southern Denmark University of Southern Denmark; 2014.
 9. Jones CJ, Rikli RE, Beam WC. A 30-s chair-stand test as a measure of lower body strength in community-residing older adults. *Res Q Exerc Sport* 1999;70:113-19.
 10. Podsiadlo D, Richardson S. The timed "Up & Go": a test of basic functional mobility for frail elderly persons. *J Am Geriatr Soc* 1991;39:142-48.
 11. Studenski S, Perera S, Patel K, et al. Gait speed and survival in older adults. *JAMA* 2011;305:50-8.
 12. Granacher U, Wolf I, Wehrle A, et al. Effects of muscle fatigue on gait characteristics under single and dual-task conditions in young and older adults. *J Neuroeng Rehabil* 2010;7:56.
 13. Berg KO, Wood-Dauphinee SL, Williams JL, et al. Measuring balance in the elderly: validation of an instrument. *Can J Public Health* 1992;83:S7-11.
 14. Tombaugh TN, McIntyre NJ. The mini-mental state examination: a comprehensive review. *J Am Geriatr Soc* 1992;40:922-35.
 15. Cheng ST, Yu EC, Lee SY, et al. The geriatric depression scale as a screening tool for depression and suicide ideation: a replication and extension. *Am J Geriatr Psychiatry* 2010;18:256-265.
 16. Schultz-Larsen K and Avlund K. Tiredness in daily activities: a subjective measure for the identification of frailty among non-disabled community-living older adults. *Arch Gerontol Geriatr* 2007;44:83-93.
 17. Kempen GI, Todd CJ, Van Haastregt JC, et al. Cross-cultural validation of the Falls Efficacy Scale International (FES-I) in older people: results from Germany, the Netherlands and the UK were satisfactory. *Disabil Rehabil* 2007;29:155-62.
 18. Lamb SE, Jorstad-Stein EC, Hauer K, et al. Development of a common outcome data set for fall injury prevention trials: the Prevention of Falls Network Europe consensus. *J Am Geriatr Soc* 2005;53:1618-22.
 19. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: Development and validation. *J Chron Dis* 1987;40(5):373-83.
 20. Todd C and Skelton D. What are the main risk factors for falls among older people and what are the most effective interventions to prevent these falls? Copenhagen, WHO Regional Office for Europe (Health Evidence Network report 2004. Available at <http://www.euro.who.int/document/E82552.pdf> (accessed 5 April 2013).
 21. Neyens JCL, van Rossum E, Spreeuwenberg MD, de Witte LP. Predicting ADL disability in community-dwelling elderly people using physical frailty indicators: a systematic review. *BMC Geriatr* 2011;11:33. DOI: 10.1186/1471-2318-11-33.
 22. Milanović Z, Pantelić S, Trajković N, et al. Age-related decrease in physical activity and functional fitness among elderly men and women. *Clin Interv Aging* 2013;8:549-56.
 23. 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.
 24. Iaboni A, Flint AJ. The complex interplay of depression and falls in older adults: a clinical review. *Am J Geriatr Psychiatry* 2013;21(5):484-92.
 25. Miller RR, Ballew SH, Shardell MD, et al. Repeat falls and the recovery of social participation in the year post-hip fracture. *Age Ageing* 2009;38:570-75.
 26. Stenhagen M, Nordell E, and Elmstahl S. Falls in elderly people: a multifactorial analysis of risk markers using data from the Swedish general population study 'Good ageing in Skane'. *Aging Clin Exp Res* 2013;25:59-67.
 27. Hopewell S, Adedire O, Copsey BJ, et al. Multifactorial and multiple component interventions for preventing falls in older people living in the community. *Cochrane Database of Systematic Reviews* 2018;7:CD012221. doi: 10.1002/14651858.CD012221.pub2.