Journal of Clinical Gerontology & Geriatrics 3 (2012) 73–76

Contents lists available at SciVerse ScienceDirect

Journal of Clinical Gerontology & Geriatrics

journal homepage: www.e-jcgg.com

Original article

Predicting falls among Egyptian nursing home residents: A 1-year longitudinal study

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ARTICLE INFO

Article history:
Received 18 July 2011
Received in revised form
12 November 2011
Accepted 6 March 2012

Keywords:
Falls
Frailty
Nursing homes
Timed up-and-go test

ABSTRACT

Background/Purpose: Falls and their related complications are serious health problems among the institutionalized older population. This study aimed to evaluate the incidence of falls and the risk factors among nursing home residents in Cairo, Egypt.

Methods: A one-year prospective cohort study was done in three nursing homes in Cairo. Overall, 84 residents aged over 60 years participated in this study. Baseline demographic characteristics and results of comprehensive geriatric assessments, e.g. cognition, depression, functional and nutritional status, previous falls, fear of falling, assistive device use, and assessment by the timed up-and-go test (TUG) test were collected. All falling accidents were recorded by the nursing home staff during the study period.

Results: During the study period, 163 incident falls (1940 falls/ 1000 resident-years) were identified in 53 fallers (631 fallers/1000 resident-years) were recorded. On average, fallers may fall twice a year (mean ± SD 2.0 ± 2.1 episodes, range 1–6). Compared to nonfallers, fallers were older, more likely to have hadprevious falls, fear of falling, frailty, impaired instrumental activities of daily living, poor cognitive status, malnutrition or its risk, assistive device use, and slower TUG. The most sensitive (86.8%) and specific (90.3%) predictor for falls in this study was TUG >14 seconds.

Conclusion: Sixty-three percent of Egyptian nursing home residents may fall during one year follow-up with the incidence of 1019 falls/1000 resident-years. The most important predictive factor for falls in this study was the TUG >14 seconds.

1. Introduction

Falls are a major health care problem for older adults due to their association with fractures, head injuries, disability, fear of falling, and loss of independence.[1] Moreover, falls are also a common and important adverse event in residential care settings and hence are considered a marker of frailty rather than vitality of old people and aged care services.[2] Several previous studies have shown that institutionalized older people were three times more likely to fall than community-dwelling older people,[3,4] and falls may occur more commonly in mobile[5,6] and physically active institutionalized residents.[7] The etiology of falls among senior citizens was multifactorial,[8] including previous falls, muscle weakness, gait and balance deficit, use of assistive devices, visual deficit, arthritis, impaired activities of daily living, depression, cognitive impairment, use of psychotropic medications, and age over 80 years.[9] Assessment of physical mobility has been an important screening instrument for falls,[10] but ultimately, risk of falls may differ between different cultures and races. Although falls and their risk factors in nursing facilities have been reported extensively, there has been little published regarding falls and predictive factors in Egyptian nursing homes. Therefore, the main purpose of this study was to evaluate the incidence of falls in a year and predictive factors of falls among Egyptian nursing home residents.

2. Methods

2.1. Study design

This was a prospective cohort study that invited residents of three nursing homes in Cairo, Egypt for participation from June 2009 to May 2010. All fall events were recorded during the study period. A fall was defined as any event in which a person inadvertently or unintentionally came to rest on the ground or a lower

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2210-8335
doi:10.1016/j.jcgg.2012.04.005

level such as a chair, toilet, or bed.[11] A 'previous faller' was defined as a person who fell at least once in the preceding year.

The study sample size was estimated using sample size calculation formula ($n = p(1-p)z^2/d^2$), where d is the degree of precision (assumed to be 10.0%), z is the value of α error (assumed to be 90.0%) according to Salkeld et al,[12] who found a prevalence of falls of (p) 50.0%. The calculated sample size was 79 and by adding 20% for the excepted loss, it would be at least 95.

Inclusion criteria of this study were as follows: age of 60 years or more, being mobile, cognitively competent to understand the purpose of the study and to follow simple instructions. We included those aged 60 and above in our study, because this is the age for qualification for admission into nursing homes in Egypt. Furthermore, several other studies carried out in Egyptian nursing homes also considered those aged 60 and above as elderly.[13,14]

Exclusion criteria were individuals with medical or neurological conditions that significantly impaired their abilities to perform a timed up-and-go (TUG) test. In addition, subjects with the mini-mental state examination (MMSE) score ≤24 were excluded as well because they would not be able to give reliable falls history and also because of difficulties in obtaining informed consent. All participants were enrolled when they were fully consented.

2.2. Comprehensive geriatric assessment

Comprehensive geriatric assessment (CGA) was performed for all participants at enrollment as the baseline assessment. CGA in this study included medical history, physical examination, the Arabic translation of MMSE, [15] the Arabic translation of Geriatric Depression Scale (GDS)-15,[16] activities of daily living,[17] instrumental activities of daily living (IADL),[18] and mini-nutritional assessment.[19] Additionally, the TUG was performed to evaluate functional mobility for all participants,[20] which was generally recommended to screen risk of falling.[21] Participants had one practice trial, and the second trial was timed. Those who used an assistive device when walking were requested to use their devices.[20]

Frailty was assessed by the study of osteoporotic fractures frailty index, which defines frailty as the presence of 2 or more of the followings: 1) unintentional weight loss of 5% or more in the last year; 2) inability to rise from a chair five times without using the arms; and 3) exhaustion identified by an answer of "no" to the question "Do you feel full of energy?" on the GDS-15. Participants who had none of these components were considered robust, those who had one component were considered prefrail, and participants who had two or more components were considered frail.[22]

2.3. Data analysis

Statistical analyses were performed using SPSS 17.0 (SPSS, Chicago, IL, USA). The Kolmogorov–Smirnov test was used to confirm the normality of the distributions (all data were normally distributed except for 4 variables). Inferential analyses were done for quantitative variables using independent t test in cases of two independent groups with parametric data and Mann–Whitney U in cases of two independent groups with nonparametric data. Inferential analyses were done for qualitative data using Chi-square test for independent variables and Fisher's exact test for independent variables with small expected numbers. For all tests, a two-tailed p-value <0.05 was considered statistically significant. Relevant variables with statistical significance in univariate analysis were selected for multivariate logistic regression to identify independent risk factors of falls. Moreover, a receiver–operator curve was used to determine an optimal cut-off point in TUG to predict falls (Fig. 1).

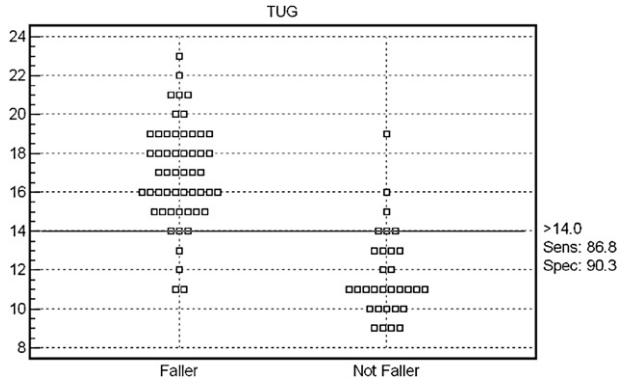

Fig. 1. The receiver operator curve (ROC) analysis of TUG times between fallers and non fallers.

3. Results

In total, 112 nursing home residents were enrolled, but 28 failed to complete the study (26 left the nursing homes and 2 died). Therefore, the actual number completing the study was 84 (mean ± SD age: 71.9 ± 7.2 years, 42.9% males). Table 1 summarizes the baseline demographic characteristics of all participants. During the study period, 163 incident falls occurred among 53 fallers, equivalent to 1940 falls/1000 resident-years (5.3 events/1000 resident-days), and 631 fallers/1000 resident-years. On average, every faller experienced two falls (2.0 ± 2.1 episodes, range: 1–6) during the study period. Compared to nonfallers, fallers were significantly older (74.8 ± 6.6 vs. 67.0 ± 5.1 years, $p < 0.001$), poorer

Table 1
Clinical characteristics.

Item	Results		
	n (%)	Mean ± SD	Range
Demographic characteristics			
Age		71.93 ± 7.15	60.0–90.0
Gender (male)	36 (42.9%)		
Years of residence		5.0 ± 4.06	1.0–16.0
Comprehensive geriatric assessment			
Activities of daily living			
Independent	80 (95.2%)		
Assisted	4 (4.8%)		
Instrumental activities of daily living			
Independent	58 (69%)		
Assisted	26 (31%)		
GDS score		4.61 ± 2.55	1.0–10.0
MMSE score		28.56 ± 1.62	24.0–30.0
MNA			
• No risk of malnutrition	38 (45.2%)		
• At risk of malnutrition	36 (42.9%)		
• Malnourished	10 (11.9%)		
Frailty status			
• Well	39 (46.4%)		
• Prefrail	29 (34.5%)		
• Frail	16 (19.0%)		
No. of prescribed drugs		3.58 ± 2.50	0.0–10.0
TUG (seconds)		15.04 ± 3.5	9.0–23.0
Assistive device use	11 (13.1%)		
Fear of falling	53 (63.1%)		
Previous falling	50 (59.5%)		
Fallers in one year follow up	53 (63.1%)		
No. of falls in one year per resident		2.02 ± 2.08	0.0–6.0
Diabetes mellitus	32 (38.1%)		
Hypertension	45 (53.6%)		
Ischemic heart disease	20 (23.8%)		
Osteoarthritis	24 (28.6%)		
Depression	39 (46.4%)		

GDS = geriatric depression scale; MMSE = mini-mental status examination; MNA = mini-nutrition assessment; SD = standard deviation; TUG = timed up-and-go test.

in cognition (MMSE score 28.1 ± 1.6 vs. 29.4 ± 1.3, $p < 0.001$) and poorer ambulation (TUG 17.0 ± 2.6 vs. 11.7 ± 2.3 seconds, $p < 0.001$ than nonfallers).

Table 2 showed that years of residence, the number of prescribed drugs, body mass index, and depression did not differ significantly between fallers and nonfallers. However, fallers were more likely to have osteoarthritis (37.7% vs. 12.9%, $p = 0.015$), IADL dependence (39.6% vs. 16.1%, $p = 0.025$), malnutrition or at risk of malnutrition (67.9% vs. 32.3%, $p = 0.006$), prefrailty or frailty (71.7% vs. 22.6%, $p < 0.001$), previous falls (73.6% vs. 35.5%, $p < 0.001$), fear of falling (84.9% vs. 25.8%, $p < 0.001$), and assistive device use (13.1% vs. 0.0%, $p = 0.006$). Multiple logistic regression showed that frailty (odds ratio 2.340, 95% confidence interval 1.542–16.746, $p = 0.012$) and poorer results of TUG tests (odds ratio 3.271, 95% confidence interval 1.287–19.539, $p < 0.001$) were independent risk factors for falls (Table 3). A cut-off of 14 seconds in TUG tests may significantly predict falls in this study (sensitivity: 86.5%, specificity: 90.3%).

4. Discussion

In this study, the incidence of falls among Egyptian nursing home residents was 5.3 events/1000 resident-days, and 63.1% of the study participants fell during the study period. Results of this study were similar to a previous German study (2558 falls/1,000 resident-years, and 645 fallers/1000 resident-years).[23] Another study in Finland found that incidence of falls among institutionalized elderly was 2021 falls/1000 resident-years in men and 1423 falls/1000 residents-years in women.[4] Although the study recruited a relatively small study sample, results were comparable with that from western countries. However, the study subjects were about 10 to 15 years younger than the previous reports (mean age of 84 years in the German study and >80 years in the Finnish study), which deserves further investigation. Nevertheless, results of this study are of great importance because it was the first prospective cohort study evaluating incidence rate of falls and related risk factors among Egyptian nursing home residents, to the best of our knowledge.

During the study period, 63.1% of study subjects fell at least once (mean: 2.0 ± 2.1 episodes). Previous studies showed that approximately 50% of older people in residential care facilities may fall at least once a year,[12] and 40% of residents may fall more than once in a year.[24] The high prevalence of falls in this study may result from the active reporting of every fall incident, while most noninjurious falls (75–80%) were never reported to health professionals in previous studies.[25] It may also be explained by environmental hazards and participants' comorbidities. However, the fall prevention programs and quality of care in Egyptian nursing homes also deserve a careful review for further comparisons.

In this study, advancing age, poorer cognition, poorer ambulation, presence of osteoarthritis, IADL dependence, malnutrition or its risk, prefrailty or frailty, history of previous falls, fear of falling, and assistive device use were all significantly associated with falls. Various risk factors for falls have been identified in previous studies, including history of falls in the past year, advanced age, poor cognitive function, arthritis, IADL score, use of walking aid, hand grip strength, transfer assistance, urinary incontinence, and use of trunk restraints.[22,26–28] However, in this study, frailty and poorer results of TUG tests were the only independent risk factors for falls. The association between frailty and falls has been reported before,[29] and frailty may increase the risk of falls, fractures, and mortality.[30]

Another important predictor for falls in this study was the results of TUG tests. The TUG test was originally developed as a mobility performance task in older adults with multiple comorbidities,[11] and has been used to assess fall risk.[31] The results of TUG test were related to difficulties in performing activities of daily living.[11] A previous study found that a TUG test longer than 13.5 seconds significantly predict falls (both sensitivity and specificity were 87%).[32] Our study demonstrated similar results with the optimal cut-off of TUG tests being 14 seconds (sensitivity 86.8% and specificity 90.3%) in predicting falls. A further intervention program is needed for all subjects with risk of falls.

There are several limitations in this study. First, the study sample is relatively small although the sample size is statistically sound. While the small sample size may limit the identification of

Table 2
Comparison between non fallers and fallers.

Variable	Nonfallers	Faller	p
Age, mean ± SD [a]	67.0 ± 5.1	74.8 ± 6.6	<0.001
Gender, *n* (%) [b]			
• Male	16 (51.6%)	20 (37.7%)	0.215
• Female	15 (48.4%)	33 (62.3%)	
Education, *n* (%) [c]			
• Illiterate	2 (6.5%)	11 (20.75%)	0.299
• Can read and write	9 (29.0%)	11 (20.75%)	
• Primary education	9 (29.0%)	17 (32.1%)	
• High education	11 (35.5%)	14 (24.4%)	
Smoking, *n* (%) [c]			
• Nonsmoker	18 (58.0%)	39 (73.6%)	0.078
• Smoker	6 (19.4%)	2 (3.8%)	
• Ex-smoker	7 (22.6%)	12 (22.6%)	
Years of residence, mean ± SD [d]	3.9 ± 3.3	5.7 ± 4.3	0.078
Activities of daily living, *n* (%) [c]			
• Independent	30 (96.7%)	50 (94.3%)	1.000
• Assisted	1(3.2%)	3 (5.6%)	
Instrumental activities of daily living, *n* (%) [b]			
• Independent	26 (83.9%)	32 (60.4%)	0.025
• Assisted	5 (16.1%)	21 (39.6%)	
GDS, mean ± SD [d]	4.4 ± 2.7	4.8 ± 2.5	0.510
MMSE, mean ± SD [d]	29.4 ± 1.3	28.1 ± 1.6	<0.001
MNA, *n* (%) [c]			
• No risk of malnutrition	21 (67.7%)	17 (32.1%)	0.006
• At risk of malnutrition	8 (25.8%)	28 (52.8%)	
• Malnourished	2 (6.5%)	8 (15.1%)	
BMI, mean ± SD [a]	31.9 ± 4.8	30.6 ± 6.3	0.304
Frailty status, *n* (%) [b]			
• Well	24 (77.4%)	15 (28.3%)	<0.001
• Prefrail	4 (12.9%)	25 (47.2%)	
• Frail	3 (9.7%)	13 (24.5%)	
No. of prescribed medications [d]	3.0 ± 2.2	3.9 ± 2.6	0.104
TUG, mean ± SD [a]	11.7 ± 2.3	17.0 ± 2.6	<0.001
Assistive device use, *n* (%) [c]	0 0.0%	11 (20.8%)	0.006
Fear of falling, *n* (%) [b]	8 (25.8%)	45 (84.9%)	<0.001
Previous falling, *n* (%) [b]	11 (35.5%)	39 (73.6%)	<0.001
Diabetes Mellitus, *n* (%) [b]	15 (48.4%)	17 (32.1%)	0.137
Hypertension, *n* (%) [b]	17 (54.8%)	28 (52.8%)	0.859
Ischemic heart disease, *n* (%) [b]	6 (19.4%)	14 (26.4%)	0.463
Osteoarthritis, *n* (%) [b]	4 (12.9%)	20 (37.7%)	0.015

BMI = body mass index; GDS = geriatric depression scale; MMSE = mini-mental status examination; MNA = mini-nutrition assessment; TUG = timed up-and-go test.

[a] Student's *t* test.
[b] Chi-square test.
[c] Fisher's exact test.
[d] Mann–Whitney *U* test.

Table 3
Multiple logistic regression analysis evaluating the association between falls and predictors of falls.

Variables	Odds ratio	95% confidence interval	p
Age	1.24	0.843–9.451	0.090
TUG (seconds)	3.271	1.287–19.539	<0.001
Assistive device use	0.420	0.041–4.142	0.175
Frailty	2.340	1.542–16.746	0.012
MMSE score	1.060	0.845–5.351	0.074
MNA	1.410	0.539–0.4972	0.180

MMSE = mini-mental status examination; MNA = mini-nutrition assessment; TUG = timed up-and-go test.

certain rare risk factors, results of this study are still of great importance since it is the first prospective cohort study in Egypt. Second, this study excluded demented residents in the nursing homes. The prevalence of dementia in long-term care facilities was high and the exclusion of such individuals may overlook some hidden risk factors for falls. Third, the locations of fall incidents were not recorded, which limited the possibility to explore the factors of nursing home environments.

In conclusion, the prevalence and incidence of falls among nursing home residents in Egypt were high. Several risk factors have been identified, and the most important predictor of falls was TUG test longer than 14 seconds. Further intervention study is needed to reduce falls in nursing homes, and thereby improve quality of long-term care in Egypt.

Acknowledgments

The authors would like to thank the staff members and residents of the elderly homes in which the study was conducted for their gracious help.

The authors have indicated that they have no conflict of interest with regard to the content of this article.

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