Do behavioral disturbances predict falls among nursing home residents?

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ABSTRACT. ***Background and aims:*** *The purpose of our study was to examine whether severity of dementia, behavioral and psychological symptoms and depression can predict falls among nursing home residents, such as demographic variables, activities of daily living, and use of psychotropic drugs, when potential confounders are controlled for.* ***Methods:*** *1147 nursing home residents were examined in this one-year follow-up study. All residents were examined with the Physical Self-Maintenance scale (Activities of Daily Living - ADL), Clinical Dementia Rating Scale (CDR), Neuropsychiatric Inventory (NPI) and Cornell Scale for Depression in Dementia. Demographic data, gender, education, physical health and use of medication were collected from medical records.* ***Results:*** *40% of participants had at least one fall during the one-year follow-up period. Bivariate survival analysis revealed that low level of education, severe dementia, severe behavioral and psychological symptoms, severe depression, greater functional impairment, age, worsening in physical health, and use of sedatives, significantly predict one or more falls. Multivariate Cox regression analyses showed that age, higher scores on NPI and CDR, use of sedatives and dependency in ADL were all, independently of each other, predictors of an increased risk of falling.* ***Conclusions:*** *Having a high NPI score was identified as a significant and independent predictor of falls. Since falling is a common event which causes considerable morbidity and mortality in older people, these findings are important for healthcare and for the individuals concerned. To prevent falling in nursing homes, special attention must be paid to residents with severe dementia, to behavioral symptoms and use of sedatives.*

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INTRODUCTION

Falls are common among nursing-home residents. They are not a non-specific accompaniment of aging, but mostly the result of clinically identifiable causes (1). Studies conducted in institutions on the incidence of falls have reported that the frequency of falling is considerably higher among residents of institutions than among those living in their own homes (1). Prospective studies conducted in nursing homes have found an annual rate of falls ranging from 30% to 56% (1, 2). Many falls among nursing-home residents lead to injuries, with various consequences. Falls are responsible for fractures, immobility, considerable morbidity, and mortality (1).

The causes of falls among nursing-home residents are complex and multi-factorial, and a high number of risk factors seems to contribute to a high incidence of falls among nursing-home residents (1). The multifactorial causes of falls and the prediction of a future event are complicating factors in fall risk assessments, and the criteria for high accuracy in fall risk assessment tools are not well established (3). A positive fall history, advanced age, frailty, mental status, use of medicaments, low level of vitamin D, bladder incontinence, lack of mobility, poor balance, muscle weakness, visual problems, and transfer supports and the use of walking aids are all predictors of falls for residents in nursing homes (1, 3, 4).

Previous research has found that anxiety, cognitive impairment and depression are also associated with falls among nursing-home residents (5, 6). In a study among Norwegian nursing-home residents, it was found that mental impairment and restricted mobility were independently associated with an increased risk of falling (7). People with dementia have a two- or threefold risk of falls (8, 9). Dementia is associated with gait and balance disturbances, behavioral and psychological symptoms, and lack of judgment – all of which increase the risk of a fall (10).

Key words: Behavioral symptoms, falls, nursing home, sedatives.

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In a systematic review, Härlein et al. (11) concluded that there are few studies examining risk factors for falls in cognitively impaired older adults in general. Their review asks for prospective studies to check whether behavioral disturbances contribute to the risk of falling. The purpose of our study is to examine whether the severity of dementia, behavioral and psychological symptoms, and depression can predict falls among nursing-home residents, when potential confounders, such as demographic variables, ability to perform ADL, and the use of psychotropic drugs are controlled for.

METHODS

Design

This study is a part of a cohort study in Norway, describing the prevalence and course of behavioral and psychological symptoms in nursing-home patients with dementia (12). The main project is based on the epidemiological data of this sample, exploring the prevalence and course of behavioral and psychological symptoms over the one-year follow-up period. The use of psychotropic medication and its association with the course of the disease is also investigated. The present study focuses on falls recorded during a one-year follow-up period, as well as the variables recorded in the project of Selbæk (12).

Participants

All eligible residents, staying a minimum of 14 days because of the observation time needed for measurements (n=1165), in 26 nursing homes in 18 municipalities in four of Norway's nineteen counties, were invited to participate. Two were not willing to participate, and four were not included because their level of dementia was not recorded, which left 1159 patients in the main study. Residents 60 years or older were included in the fall study, during the one-year follow-up period, which excluded 10 residents (range 29-59 years). The fall registers for two residents were not completed, which left 1147 available for analysis. Of the patients assessed at baseline, 933 had dementia, with a score of one or more on the Clinical Dementia Rating scale (CDR) (13). During the follow-up period, 336 residents died.

Data collection

Sixteen research nurses, using a standardized interview collected baseline data from November 2004 to January 2005. They interviewed patients' primary carers, who were all registered nurses. The same procedure was applied to all assessments. The same registered nurse filled in a questionnaire regarding functional impairment and the use of medication. Data concerning the use of medication and diagnostics were also collected from medical records. All research nurses had experience of clinical work with psycho-geriatric patients. Prior to the first data collection, they attended a two-day course on how to conduct the interview. They also participated in a one-day course on the same topic before the second data collection.

Fall - dependent variable

In this study, the definition of Lord et al. (2) is used: a fall is "an unexpected event in which the participant comes to rest on the ground, floor or at a lower level". Falls were recorded on the date during the one-year follow-up period. The fall variable was coded in two categories; 0 fall -0-, one or more falls -1-. The time to the first fall was recorded and was measured as the number of days between the inclusion date and the date of the first fall.

Demographic data

Demographic data, gender, education, and use of medication were collected from medical records, together with information on walking (whether participants were able to walk without support, and their physical health. Physical health was rated on a four-item scale with the following categories: good=0, fairly good=1, poor=2 and very poor=3. A similar scale had proved to be valid in previous studies (14).

Activity of daily living

The Physical Self-Maintenance Scale (15) was used to assess patients' ability to perform the basic activities of daily living (ADL). This scale assesses personal Activities of Daily Living (PADL) in six domains; Toilet, Feeding, Dressing, Grooming, Physical ambulation, Bathing. Each domain has five levels: 1-independent; 2-need some help; 3-need reasonable help; 4-needs considerable help; 5-resists help. The scores for the domains are added to produce a sum score -30-, higher scores indicating greater functional impairment (15). Cronbach's alpha for this sum score is 0.68 in the present study.

Dementia

The severity of dementia was evaluated by the Clinical Dementia Rating Scale (CDR) which is a five-point scale used to characterize six domains of cognitive and functional performance applicable to Alzheimer's disease and related dementias (14, 16, 17). Two Norwegian studies have shown that CDR staging is a valid substitute for a dementia assessment among nursing-home patients (16) for rating dementia and its severity. Nurses were instructed to base their scoring solely on mental function, and not to include physical frailty. Cronbach's alpha for this sum score is 0.71 in the present study.

Behavioral and Psychological Symptoms in Dementia (BPSD)

The Neuropsychiatric Inventory (NPI) (18) was used to collect information on Behavioral and Psychological Symptoms in Dementia (BPSD). In this study, the Norwegian version of the 12-item NPI nursing-home version

was applied. The psychotropic properties of the scale have recently been investigated (19). This scale assesses behavioral and psychological symptoms in patients with Alzheimer's disease or other neuro-degenerative disorders (18). The products of the intensity (1-3) and frequency (1-4) of individual NPI items are added into a sum score, ranging from 0 to144 (no distress-severe distress). The sum score was used. Cronbach's alpha for this sum score is 0.76 in the present study.

Depression

To rate symptoms of depression, the Cornell Scale for Depression in Dementia (CSDD) was used, a 19-item clinician-administered instrument which uses information from interviews with both patients and a nursing-home staff member (20). It has also been used in patients without dementia (20). Each item is rated on a three-point scale (0-absent, 1-mild or intermittent, 2-severe). When the scoring of an item is inappropriate, a 'not applicable' designation may be used. In this study, we did not perform interviews with patients, but relied on information from the nursing-home staff member most familiar with them (16). The sum score was used. Cronbach's alpha for this sum score is 0.70 in the present study.

Statistics

Statistical analyses were carried out with SPSS, version 17.0. A 5% significance level was used. The results of the Kolmogorov-Smirnov statistic showed that the assumption of normality was violated. In our case, the p-value was below 0.001 for all continuous variables. The Cox proportional hazard model (21) was used to examine the association between independent variables (exposure variable related to severity of dementia, behavioral symptoms, depression symptoms, demographic variables, ADL, use of psychotropic drugs, and the risk of falling. The time in the present study was the number of days between the inclusion date and the event (fall) or censoring (death or end of follow-up). The study had no other censoring. After the predictors had been examined individually, all significant predictors were examined in a multivariate model, in order to assess which of the significant variables, independent of each other, predict falls. Multivariate analyses were used to control for confounders related to the variables which proved to predict falls in bivariate Cox regression analyses. The proportional hazard assumption was checked and found to be adequately fulfilled. The final multivariate model included only independent variables significant at the 5% level. Cronbach's alpha was used as an indicator of the internal consistency of the measurement consisting of several item (see *methods*).

Ethical and legal considerations

Information about the study was given to patients and their relatives. Explicit consent was not required for enrollment, but patients or their next-of-kin were informed that they could refuse to participate at any stage in the study. The Regional Ethics Committee for Medical Research, Data Inspectorate and Directorate for Health and Social Affairs approved this procedure.

RESULTS

In total, 1147 residents were included in the study. Their mean age was 85 years (range 60-107). Of these, 73.1% were women and a total of 18.7% were still married.

Demographic variables are listed in Table 1. In total, 40% of the participants had at least one fall and 33% had two or more falls during the one-year follow-up. The mean time to the first fall was 115 days (95% CI 106-124). There was no significant relationship between falls and gender, marital status, vision or use of medicaments.

Table 1 - *Demographics (n=1147).*

Variables	n (%)	Mean (SD)	Median	Range
Age mean		84.79 (6.86)		60-107
Women, n (%)	839 (73.1)			
Marital status, n (%)	214 (18.7)			
Education <9 years, n (%)	838 (75.0)			
Education ≥9 years, n (%)	280 (25.0)			
Able to walk (without personal support), n (%)	888 (77.4)			
Physical health (0-3p)		1.46 (0.94)		0-3
Number of psychotropic drugs		1.35 (1.15)		0-6
PADL sum (0-30p)		18.02 (5.4)	19.00	4-30
NPI 12 sum*		18.71 (19.4)	12.00	0-102
Cornell sum (0-38p)		5.35 (5.1)	4.00	0-31
CDR sum (0-18p), n (%)	933 (81.0)	11.27 (5.3)	12.00	0-18

PADL: Personal Activity of Daily Living; CDR: Clinical Dementia Rating Scale; NPI: Neuropsychiatric Inventory. *Scored according to (18).

Table 2 - *Cox Regression of factors predicting falls (n=1147).*

	Unadjusted			Adjusted		
Variables	**RR**	**95% CI of RR**	***p*-value**	**RR**	**95% CI of RR**	***p*-value**
Age (years)	1.02	1.01, 1.03	0.008	1.03	1.01, 1.04	0.002
Gender (1=male, 2=female)	1.08	0.88, 1.33	0.450			
Marital status (1=married, 2=unmarried)	1.05	0.98, 1.12	0.224			
Physical health	0.74	0.60, 0.91	0.004	0.89	0.78, 1.01	0.062
Education (high/low)	1.13	1.03, 1.60	0.027	1.12	0.96, 1.30	0.153
Vision (1=normal vision, 2=reduced vision)	0.92	0.70, 1.21	0.559			
Able to walk (1=without personal support, 2=with personal support)	0.75	0.61, 0.91	0.003	1.14	0.88, 1.50	0.327
CDR sum	1.40	1.14, 1.65	0.001	1.06	1.03, 1.08	0.000
PADL sum	0.75	0.61, 0.88	0.001	0.95	0.92, 0.97	0.000
NPI 12 sum	1.63	1.35, 1.97	0.000	1.15	1.08, 1.19	0.000
Cornell sum	1.37	1.13, 1.65	0.001	0.99	0.96, 1.02	0.545
Number of medicaments	1.02	0.99, 1.05	0.193			
Use of antidepressants	1.12	0.98, 1.42	0.079			
Use of sedatives	1.31	1.08, 1.59	0.006	1.08	1.04, 1.23	0.003
Use of neuroleptics	1.09	0.88, 1.35	0.409			

CDR: Clinical Dementia Rating Scale; PADL: Personal Activity of Daily Living; NPI: Neuropsychiatric Inventory; *p*: level of significance; CI: Confidence Interval; RR: relative risk.

Table 2 lists the results from bi- and multivariate analyses. Bivariate Cox regression analysis revealed that low level of education, severe dementia (higher scores on CDR), severe psychological and behavioral symptoms (higher scores on NPI), severe depression (higher scores on Cornell scale), greater functional impairment (higher scores on PADL scale), age and a worsening in physical health, use of sedatives, and not being able to walk without personal support significantly predicted one or more falls (Table 2). The four strongest predictors were severe psychological and behavioral symptoms (higher NPI score), severe dementia (higher CDR scores), severe depression (higher Cornell scores), use of sedatives, RR 1.63 (95% CI 1.35, 1.97), RR 1.40 (95% CI 1.14, 1.65), RR 1.37 (95% CI 1.13, 1.65), RR 1.31 (95% CI 1.08, 1.59), respectively.

When excluding non-significant results from analysis, multivariate Cox regression analysis showed that age, higher scores on NPI, CDR and PADL and use of sedatives were all independent of the other predictors of increased risk of falling. The strongest predictor of a fall was severe psychological and behavioral symptoms (higher NPI score) and the second strongest predictor was use of sedatives, RR 1.15 (95% CI 1.08, 1.19) and RR 1.08 (95% CI 1.04, 1.23), respectively. In addition, severe dementia, dependency in PADL and high age were strong predictors of falls.

DISCUSSION

In or study, high NPI scores remained as significant predictors of one or more falls, even after possible confounding variables had been controlled for (Table 2). This is in contrast to the study by Camicioli and Licis (22), as their results showed that NPI was not a statistically significant predictor of falls in a Cox model which included age, gender, mental status and NPI; however, their study had only 42 participants and its results must thus be interpreted with caution. Other studies using bivariate analysis with participants 70 years or older have reported psychological and behavioral symptoms to be strong predictors of falls, and our results correspond with the findings of Kallin et al. (10). In their Swedish study of over 2000 cognitively impaired residents, these authors found that behavioral symptoms, such as wandering and restless behavior (as well as verbally disruptive/attention-seeking behavior and escape behavior), together with scores for hyperactive, paranoid depressive, hallucinatory and total psychiatric symptoms, were significantly associated with falls.

In our study, the CDR score showed that 81% of the nursing-home residents had dementia, and the results of the analysis indicated that severe dementia is a predictor of falls, which is in line with the results of other studies (6, 10, 23). Nygaard (7) found that, among persons with advanced dementia, lack of mobility and mental impairment were both significantly associated with an increased risk of falling. Only the CDR multivariate results by Camicioli and Licis (22), mentioned above, do not match our results, and showed that CDR not was useful in predicting falls.

The association between falls and PADL scores remained significant even in multivariate analysis. Dependency in PADL is an expression of frailty, and this result

may indicate that dependence in eating and dressing, need for help with personal hygiene, and dependency in functional activities all predict falls (15).

Psychotropic drugs are frequently used to reduce or treat psychiatric and behavioral symptoms in nursing homes, although their effects are reported to be modest and the risk of adverse effects is quite high (12). Psychotropic medication, multiple medication for cognitive disturbances, and behavioral manifestations increase the risk of falls in the geriatric psychiatric population (8). Psychotropic medications can also cause restlessness, wandering, and urinary incontinence, all contributors to high fall-risk behavior (24). These medicaments are thought to contribute to falls in patients suffering from impaired reaction times, impaired balance and insomnia (22). In the present study, use of sedatives remained as a significant factor. In their meta-analyses, Leipzig et al. (25, 26) found significant association between falls and the use of neuroleptics, sedative/hypnotics and any antidepressant. However, the evidence to date, is based solely on observational data, with little adjustment for potential confounders, dosage or duration of therapy. The evidence here is difficult to interpret, partly because of the problems of separating the side-effects of the drugs from the effects of the disease for which they are prescribed (25, 26), and moreover because of a lack of knowledge about whether the medication reported as taken at baseline was still being taken at the time of the fall (27). The main mechanism by means of which medications may increase the risk of falling probably lie in the commonly encountered side-effects of sedatives, i.e., reduced alertness, dizziness, dyskinesia, sedation, and blurred vision.

Higher age was a significant predictor of falls in our study. As falls are generally considered to be associated with physical frailty and therefore cognitive impairment and dementia, it is not surprising that advancing age predicts falls (9). Our results fit those of Tinetti et al. (28) in whose study high age was a predictor of falls. In studies by Camicioli and Licis (22), Eriksson et al. (23) and Kallin et al. (10) age was not a significant predictor of falls.

Physical health, depression (Cornell scores), gait and level of education were all significant predictors of falls in bivariate analysis, although not significantly independent of each other after multivariate regression analysis. This finding is important, considering that the first three of these confounding variables, although not education, are known to be strong predictors of falls (6, 8, 9). One explanation is that other variables, such as age, PADL scores and dementia, are confounders for physical health and gait. NPI scores may be confounders for depression which is an item in the NPI scoring system.

One strength of our study was the large study population. Another strength was the prospective fall recording. However, during the course of the year there were changes among the staff, and this may be a limitation to our results, if falls were recorded differently by new staff members. Regarding falls, recording of previous falls and examination of the fear of falling would have strengthened the study. Another limitation of the study was the lack of performance-based tests, especially to assess patients' function and motor impairment. Other limitations are the lack of recording information regarding medical risk factors, such as vision, cerebrovascular diseases, orthostatic hypertension, osteoarthritis, peripheral vascular diseases and foot problems (2). In this study, 458 (40%) residents had at least one fall during the follow-up period, which is in line with other studies (1). All baseline registrations were done during the winter (November-January) which may imply seasonal variations in the different variables, especially depression, which is often described to have seasonal variations. Dam et al. (29) pointed out that depression among older people is less sensitive to seasonal variations. This study's population seems to be representative of nursing-home residents, as regards age and gender (30). General conclusions must be drawn with caution and no conclusions about risk factors should be drawn beyond populations in a nursing-home setting.

CONCLUSION

Falls are common among nursing-home residents, and about 40% of the participants in our study experienced at least one fall during the one-year follow-up. According to this study, more severe behavioral and psychological symptoms, more severe dementia, use of sedatives, dependency in PADL, and being very old, increased the risk of falling, independently of each other. Since falling is a common event which causes considerable morbidity and mortality in older people, these findings are important for healthcare and for individuals. To prevent falling in nursing homes, special attention must be paid to residents with severe dementia, to behavioral symptoms and use of sedatives.

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