Factors associated with increased hospitalisation risk among nursing home residents in Sweden: a prospective study with a three-year follow-up

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Background. Hospitalisation of nursing home residents might lead to deteriorating health.

Aim. To evaluate physical and psychological factors associated with hospitalisation risk among nursing home residents.

Design. Prospective study with three years of follow-up.

Methods. Four hundred and twenty-nine Swedish nursing home residents, ages 65–101 years, from 11 nursing homes in three municipalities were followed during three years. The participants’ physical and psychological status was assessed at baseline. A Cox proportional hazards model was used to evaluate factors associated with hospitalisation risk using STATA.

Results. Of the 429 participants, 196 (45.7%) were hospitalised at least once during the three-year follow-up period, and 109 (25.4%) during the first six months of the study. The most common causes of hospitalisation were cardiovascular diseases or complications due to falls. A Cox regression model showed that residents who have
had previous falls ($P < 0.001$), are malnourished ($P < 0.001$), use a greater number of drugs ($P < 0.001$) and have more diseases ($P < 0.001$), are at an increased risk of hospitalisation.

**Conclusion.** Nursing home residents are frequently hospitalised, often due to falls or cardiovascular diseases. Study results underscore the relationships between malnutrition, previous falls, greater numbers of drugs and diseases and higher risk of hospitalisation.

**Implications for practice.** Preventive interventions aimed at malnutrition and falls at the nursing home could potentially reduce the number of hospitalisations. With improved education and support to nurses concerning risk assessment at the nursing homes, it may be possible to reduce the numbers of avoidable hospitalisation among nursing home residents and in the long run improve quality of life and reduce suffering.

**Key words:** hospitalization, nursing home residents, preventive care, prospective design

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**Introduction**

Nursing home residents are often hospitalised. In general, more than 15% of long-stay nursing home residents are hospitalised within a six-month period (Intrator et al., 2004, 2007). Many hospitalisations are believed to be avoidable and better treated outside the hospital, not least for nursing home residents that often are frail. It has been shown that hospitalisation among nursing home residents can cause iatrogenic disorders, confusion, falls and nosocomial infections leading to serious consequences (Creditor, 1993; Charette, 2003; Grabowski et al., 2008). Nursing home residents are often more physically and cognitively impaired when they return to the nursing home than they were before the hospital admission (Ouslander et al., 2000; Gill et al., 2009; Boltz et al., 2010). From this perspective, prevention of nursing home residents’ hospitalisation is important to reduce unnecessary suffering.

Previous studies suggest that increasing age, reduced physical function (Carter, 2003a; Grabowski et al., 2008), as well as polypharmacy (Flaherty et al., 2000; Albert et al., 2010) are associated with an increased risk of hospitalisation. Specific clinical conditions as congestive heart failure (CHF), circulatory problems, respiratory problems and genitourinary problems have also been related to an increased risk of hospitalisation in nursing home residents (Carter, 2003b; Carter & Porell, 2005).

Currently, the predictive values of risk assessment tools that are increasingly used in nursing homes, such as the Mini Nutritional Assessment (MNA) or the Mini-Mental State Examination (MMSE), are not well researched in relation to hospitalisation risk. Further, current knowledge is mainly based on cross-sectional studies including few risk factors, limiting the possibility of identifying factors that may be addressed by long-term preventive actions. Last but not least,
the current literature is mainly based on findings from the United States. As it is likely that hospitalisations are influenced by health policies and economic concerns (Walsh et al., 2012), it is important to study hospitalisation risk factors within other healthcare systems. Several European countries such as Sweden have high levels of public funded health care (Gelormino et al., 2011) and is an interesting and contrasting example to countries with lower levels of public funded health care. In Sweden, access to nursing homes is based on need assessment, and residents are prioritised based on their greater need of care, that is those with the most severe functional impairments and multimorbidity receive priority access. In nursing homes, Registered Nurses and nurse assistants provide health care under specific instruction from primary care physicians who serves as consultants, as nursing homes in Sweden do not have physicians stationed (National Board of Health and Welfare, 2012). Normally primary care physicians visit the nursing homes once a week and when need arises. The Registered Nurse stationed at the nursing home make the decision to transfer to a hospital, after consulting the physician. Hence, nurses have an important role in this decision as their judgments are based on recognising and understanding changes in the resident’s physical and/or mental health. Decreasing numbers of avoidable hospitalisation, especially from nursing homes, has been prioritised in the last decades (Swedish Association of Local Authorities and Regions, 2012). Still a recent study reveal that approximately 16% of Swedish nursing home residents’ emergency departments transfer are possibly avoidable (Kirsebom et al., 2014).

As nursing home residents are typically frail and often suffering from multimorbidity, it is important to learn to reduce or avoid unnecessary suffering due to hospitalisations. Therefore, the current study aimed to analyse potential risk factors related to increased risk of hospitalisation among nursing home residents. Specifically, physiological and psychological risk factors were evaluated using risk assessment tools and tests commonly used in nursing home settings.

Aim

The aim of this study was to evaluate physical and psychological factors associated with hospitalisation risk over time among nursing home residents.

Method

Subjects

The current study is based on data from the Study of Health and Drugs in Elderly living in institutions (SHADES) (Ernsth Bravell et al., 2011). SHADES is a longitudinal, open cohort, multipurpose study including older people in 11 nursing homes in three different municipalities in Sweden.

The nursing homes included 30 general departments and 10 departments focused on dementia care. All residents (N = 443) living in the selected nursing homes were invited to participate. Among those invited, 175 were excluded for various reasons (refusal 58, relatives refusal 31, severe illness 49, communication difficulties 11, no reason given 5, death before study entry 18, <65 years of age 3). At the first assessment, 268 nursing home residents participated, giving a participation rate of 61%. Written informed consent from the participant or next of kin was obtained. The participants were examined every six months over three years (2008–2010), which was considered appropriate intervals to study an older population as changes in health condition occur rapidly in high ages. Those who ended their participation during the study period [due to death (n = 193), migration (n = 7) or refusal (n = 4)] were replaced by a new resident entering the site in order to maintain a larger sample (Fig. 1). In total, 429 persons participated in at least one assessment. The study was approved by the Regional Research Ethics Board in Linköping, Sweden.

Outcome variable

The dates of and reasons for hospitalisation during the study period were extracted from the nurses’ documentation at the nursing homes, based on diagnosing codes from the hospital medical records. The outcome variable was a resident’s hospitalisation, and the time to event was the time from when a resident first enters the study to the first hospitalisation. For individuals not subjected to hospital care, the follow-up time was to the last assessment in the study, or to the time of death.
Independent variables

Health indicators

Information about the participants’ number of medical diagnoses and number of drugs was collected from the medical records and from the nurses’ documentation. The research nurses measured weight and blood pressure. Need of care was evaluated by five items assessing dependency in performing Instrumental Activities of Daily Living (IADL) (range 0–20) and five items assessing dependency in performing Personal Activities of Daily Living (PADL) (range 0–20) (Katz et al., 1963), where higher values indicate higher dependency. The responsible healthcare assistant or nurse reported physical activity, included how many hours per week a resident conducted physical activity such as walking, balance training or exercises led by a physiotherapist.

Risk assessment tools

A wide set of risk assessment tools that are commonly used in nursing home settings were included. Given the skewed distribution of the scores on these tools, the scores were dichotomised at well-established cut-off points as follows. Downton Fall Risk Index (DFRI) was used to estimate the risk of falling (Downton, 1993). The maximum score is 11, with scores higher than 3 indicating a high risk of falling (Olsson Möller et al., 2012). Nutritional status was assessed with the Mini Nutritional Assessment (MNA) (Vellas et al., 1999). The maximum score of the Mini Nutritional Assessment-SF (short form) is 14; a score of less than 11 points indicates risk for malnutrition and a score of less than 7 points indicates malnutrition (Rubenstein et al., 2001). The Modified Norton Scale (MNS) assesses the risk of developing pressure ulcers. The maximum score is 30 and a score of 20 or less indicates an elevated risk of developing pressure ulcers (Ek et al., 1989). The Cornell Scale for Depression in Dementia (CSDD) is designed to be used on people with cognitive dysfunction (Alexopoulos et al., 1988), but has been shown to be equally valid for older persons with or without dementia (Kørner et al., 2006). The maximum score is 38, and a score above 8 indicates depression. The Mini-Mental Status Examination Test is a screening of cognitive ability, with a maximum score of 30 (Folstein et al., 1975), and was dichotomised at 24, which is usually considered to be an indication of cognitive impairments (Grut et al., 1993).

Nursing home organisational factors

The number of Registered Nurses and of nurse assistants were summed and divided by number of residents to derive a crude staff ratio. The staff ratios were dichotomised at the mean.

Statistical analyses

We used either a t-test or a chi-square test (using SPSS 19.0) to analyse differences in the baseline characteristics of participants who had been hospitalised during the follow-up period and those who had not. Both bivariate and multivariate Cox proportional hazard regression analyses were performed to evaluate factors associated with hospitalisation risk. Variables that were associated with hospitalisation risk from the bivariate analyses were included in the multivariate analyses. The Cox proportional hazard regression analyses were performed with STATA with robust standard errors to control for potential dependency within sites, as well as within nursing homes. Continuous variables were standardised using z-transformation before analysis, to allow for easier comparisons.

Figure 1 Flow diagram describing the in- and outflow from the SHADES-study and number of participants in each of the in person testing (IPT), and how many IPT each resident participated in.
Results

Descriptive statistics

The mean age of the sample was 85 (range 65–101) years and 70.9% of the participants were female. Of the 429 participants, 196 (45.7%) had at least one, 73 (17.0%) had two and 8 (0.02%) had even five or six hospitalisations during the three-year follow-up period. The most common reasons for admission, according to the medical records, were cardiovascular disease (26%) and complications due to falls (25%). Among cardiovascular diseases, CHF (9.7%) was the most common diagnosis, followed by stroke (8.7%). The remaining reasons for hospitalisation were infections such as pneumonia, urinary tract infection or sepsis (16%), dementia (12%), disorders of the gastrointestinal tract (11%) and 10% were due to other disorders such as diabetes, anaemia or pain related conditions.

Table 1 describes the baseline characteristics and differences between those who were hospitalised during the study period and those who were not. Participants that were hospitalised during the study period had a higher risk of falls and of malnutrition, used more drugs and had more diseases. There was no difference in age, gender, signs of depression or risk for pressure ulcers at baseline between those who became hospitalised and those who did not. Participants who were enrolled during the study did not differ from the participants who were involved from the study start. Staff ratios did not affect hospitalisation risk, but the variance in staff ratios was

Table 1 Baseline characteristics and comparisons and Cox proportional hazards regression bivariate model of time to hospitalisation

<table>
<thead>
<tr>
<th>Risk assessment</th>
<th>Baseline</th>
<th>Cox Proportional Hazards Regression Bivariate Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age, N (SD)</td>
<td>84.4 (6.9)</td>
<td>85.6 (6.9)</td>
</tr>
<tr>
<td>Male, n (%)</td>
<td>125 (29.1)</td>
<td>66 (28.3)</td>
</tr>
<tr>
<td>Health indicators</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>66.8 (15.1)</td>
<td>66.5 (15.8)</td>
</tr>
<tr>
<td>Systolic blood pressure (mm/Hg)</td>
<td>137.1 (25.3)</td>
<td>134.2 (23.7)</td>
</tr>
<tr>
<td>Diastolic blood pressure (mm/Hg)</td>
<td>74.1 (12.0)</td>
<td>72.5 (12.5)</td>
</tr>
<tr>
<td>Pulse pressure</td>
<td>62.0 (20.4)</td>
<td>60.8 (19.5)</td>
</tr>
<tr>
<td>Number of diseases*</td>
<td>3.1 (1.3)</td>
<td>2.8 (1.4)</td>
</tr>
<tr>
<td>Number of drugs</td>
<td>7.3 (3.2)</td>
<td>6.4 (3.0)</td>
</tr>
<tr>
<td>No physical activity, n (%)</td>
<td>233 (54.3)</td>
<td>121 (51.3)</td>
</tr>
<tr>
<td>Previous falls</td>
<td>0.7 (0.5)</td>
<td>0.6 (0.5)</td>
</tr>
<tr>
<td>Need of care IADL</td>
<td>20.0 (0.0)</td>
<td>20.0 (0.3)</td>
</tr>
<tr>
<td>Need of care PADL</td>
<td>12.1 (5.9)</td>
<td>12.2 (6.0)</td>
</tr>
<tr>
<td>Risk assessment</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Risk of falling, DFRI</td>
<td>4.8 (1.6)</td>
<td>4.6 (1.6)</td>
</tr>
<tr>
<td>Risk of malnutrition</td>
<td>189 (44.1)</td>
<td>108 (55.1)</td>
</tr>
<tr>
<td>MNA-SF, n (%)</td>
<td>81 (41.3)</td>
<td>55 (28.2)</td>
</tr>
<tr>
<td>MNA-SF, n (%)</td>
<td>10 (50.0)</td>
<td>15 (69.2)</td>
</tr>
<tr>
<td>MMSE, n (%)</td>
<td>14 (71.4)</td>
<td>150 (64.4)</td>
</tr>
<tr>
<td>Cornell Depression Scale, n (%)</td>
<td>23 (5.4)</td>
<td>9 (3.9)</td>
</tr>
</tbody>
</table>

*Dementia (63.2%), hypertension (43.6%), stroke (22.1%), atrial fibrillation (21.2%), diabetes mellitus (19.1%), congestive heart failure (17.7%). Cut-off scores: DFRI ≥ 3, risk of malnutrition MNA-SF 8–11, malnourished MNA-SF ≤ 7, risk of pressure ulcers MNS ≤ 20, Cornell Depression Scale CSDD > 8. In the Cox proportional hazards regression bivariate model, each variable is controlled for age, gender and sites. Age and gender are controlled for each other. Continuous variables were standardised using z-transformation to allow for easier comparisons.
small both for Registered Nurses (M = 0.03, SD=0.01) and for nurse assistants (M = 0.74, SD=0.09).

Table 1 also presents the results from the bivariate Cox’s proportional hazards model for survival. Each variable was analysed separately, controlling for age, sex and dependency within sites. A positive regression coefficient implies an increased risk of hospitalisation. Nursing home residents with previous falls (P < 0.001) and with malnourishment (P < 0.001) were at greater risk of hospitalisation. Further, hospitalisation risk was significantly greater for those residents with a higher number of prescribed drugs (P < 0.001) and more diseases (P < 0.001).

Variables that were significantly associated with increased risk of hospitalisation in the bivariate models were entered into a multivariate Cox proportional hazard regression model (Table 2). The results suggests that nursing home residents with previous falls, malnourishment and a greater number of diseases and prescribed drugs have increased hospitalisation risks, as presented in Fig. 2. The Mini-Mental Status Examination Test was, however, not significantly associated with increased risk of hospitalisation. The Cornell Depression Scale was not a significant factor in the multivariate Cox proportional hazard regression model. Post hoc analyses showed that Cornell Depression Scale is correlated with the Mini Nutritional Assessment-short form (r = 0.257, P < 0.001). The result also suggests that an increased number of risk factors increase hospitalisation risk, as shown in Fig. 2e.

**Discussion**

This study shows that nursing home residents are frequently hospitalised; almost one of two were hospitalised during this rather short time period of three years. The main findings suggest that nursing home residents with malnourishment, previous falls, more drugs prescribed and multimorbidity are at greater risk of hospitalisation over a three-year period. Addressing these risk factors could potentially reduce the number of hospitalisations. Nurses are important actors in this work as they are responsible of assessing risk of severe outcomes among nursing home residents.

As mentioned in the introduction, one of the strengths of studying factors associated with hospitalisation in Sweden is that the financial incentives to hospitalise nursing home residents are low. The high congruency between the current findings and studies performed on nursing home residents in United States indicates that there are some risk factors that are consistent despite very different healthcare systems, especially polypharmacy, malnutrition and falls (Flaherty et al., 2000; Jensen et al., 2001; Carroll et al., 2008).

One of the main reasons for hospitalisation was the prevalence of and complications from cardiovascular diseases. The single most common reason was CHF. This finding confirms previous findings from different contexts (Condelius et al., 2008; Ouslander et al., 2011; Jingping Xing et al., 2013; Swedish Association of Local Authorities and Regions, 2013) and is not very surprising given that cardiovascular diseases often demand acute hospital care. However, hospitalisations due to CHF is considered to be an avoidable hospitalisation (Agency for Healthcare Research and Quality); thus, these results indicates that knowledge and treatment strategies of heart failure in nursing homes need to be improved.

Another main reason for hospitalisation was falls. Despite the fact that the majority of falls in nursing homes are considered to be injury-free, about one in four falls are thought to result in hospital admission (Vu et al., 2006). Although falls might have multifactorial causes, findings in this study highlight the importance of fall prevention and better use of fall risk assessment tools.

The nursing home residents’ nutritional status was poor. About 16% of the residents were malnourished and 44% were at risk of malnutrition. Previous international research has shown that malnutrition and eating disorders in older community residents increase the risk of hospitalisation (Jensen et al., 2001), and longer hospital stays (Van Nes et al., 2001). The current study extends these findings and shows that this is also true for nursing home residents. It has been suggested that lower staff level at the nursing homes is associated with weight loss among the residents (Tamura et al., 2013). Greater risk of hospitalisations should likely be added to the list of negative consequences of malnutrition.
Risk for hospitalisation was also associated with the use of a large number of drugs, confirming findings among older people with home care (Flaherty et al., 2000). Polypharmacy is also related to a longer hospital stay and several other outcomes such as mortality, fractures and institutionalisation (Frazier, 2005). The nursing home residents in this study were taking 6.8 drugs on average, confirming the average use of drugs (7.2 drugs) by institutionalised older persons in Sweden, to be compared to community-dwelling individuals taking 4.3 drugs on average (Johnell & Fastbom, 2012).
may of course be an indication that nursing home residents have many health problems, but may also indicate that nursing home residents consume too many and sometimes inappropriate drugs.

Despite access to health care around the clock, our study showed that many of the nursing home residents were malnourished (or at risk of malnutrition), had a high number of drugs and had experienced fall, etc. This is potentially modifiable risk factors and needs to have a high priority in nurses’ daily work and in research. One way to make nurses aware of these factors and changes in them might be to implement systematic assessment tools. According to previous research, nurses find it useful to use systematic assessment tools in the areas of malnutrition, pressure ulcers and falls in their daily work in nursing homes as it makes patients caring needs visible (Rosengren et al., 2012).

According to the medical records, dementia was the fourth most common reason for hospitalisation. This support previous studies revealing that 15–16% of nursing home residents with advanced dementia were hospitalised during a period of three months and six months, respectively (Givens et al., 2012, 2013). In Sweden, it is common for nursing home residents to have a diagnosis of dementia (Sund-Levander et al., 2003), as dementia is associated with greater care needs. However, it was not possible in this study to find out from the medical records whether hospitalisations due to dementia were actually caused by worsened behavioural symptoms of dementia or symptoms of something else. The majority (60%) of those who were hospitalised due to dementia were not living in a dementia department with specialised staff. This suggests that more beds in dementia departments and/or staff better qualified to care for persons with dementia, or preferably both, could possibly reduce the number of hospitalisations. Future studies should evaluate whether education programmes could reduce the number of hospitalisations among nursing home patients with a dementia diagnoses.

It is noteworthy that 40% of those hospitalised due to dementia lived in a dementia department. The overall quality of life should guide the decision to hospitalise a nursing home resident with dementia as unfamiliar hospital environment can be stressful for this population (Givens et al., 2012). As the current study shows that a dementia diagnose is not protective to hospitalisation, periodic advance care planning including discussions of when a hospital event should be considered in nursing homes.

Depression was not associated with an increased risk of hospitalisation in the multivariate Cox proportional hazard regression models. Post hoc analyses showed that depression was correlated with the MNA-SF. This association is probably due to overlapping questions relating to weight loss and loss of appetite. It may therefore be possible, or even likely, that depression is also a risk factor of hospitalisation. Prior research have found that the residents’ preferences regarding hospitalisation, that is where they prefer acute conditions to be treated, as well as the overall quality of life are the most important factors to hospitalise nursing home residents, even more important than clinical factors such as likelihood of death, discomfort and disability (Buchanan et al., 2006).

Strengths of this current study are its prospective design in a setting where economic incentives are low. The study also includes nursing home residents, a group that has received relatively little attention in research. Few prior studies have used validated risk assessment tools commonly used in nursing homes to study hospitalisation risk factors. Furthermore, the use of survival analyses as the Cox proportional hazard regression model makes it possible to study the importance of each health indicator over a long period of time. The study has limitations; as in all studies involving older people, the selection of the participating nursing homes was based on convenience sampling and on nursing homes positive to improvement work and therefore more likely to participate. However, the nursing homes included were typical for Sweden and did not differ from other nursing homes in terms of participants mean age and staffing (Ernsth Bravell et al., 2011). However, the placement of nursing homes in three different parts of Sweden increases the chance that they are representative and likely increases the generalisability of the results. Unfortunately, there was a rather low participating rate of 61%, mainly due to the excluded participants or their relatives refused participation. We have no knowledge of the reasons for their refusal; however, studies conducted on older persons tend to have lower participating rates as dropouts are correlated with health and functional ability (Chatfeld et al., 2005). There is also a selection bias, where the healthier nursing homes residents were more likely to participate. On the other hand, this potential bias might be less relevant as the study shows that nursing home residents in general are old and frail. Unfortunately, we lack information about length and outcome of the hospitalisations, and whether some of the hospitalisations among the nursing home residents could have been avoided.

Conclusion and Implications for practice

In conclusion, despite access to healthcare nursing home residents are frequently hospitalised, often due to falls or cardiovascular diseases. Malnutrition, previous falls, a greater number of drugs and diseases are also associated
with greater risk of hospitalisation. The clinical implications from our findings suggest that preventive interventions for malnutrition and falls at nursing homes could likely reduce the number of hospitalisations. With improved education and support to nurses concerning risk assessment at the nursing homes, it may be possible to reduce the numbers of avoidable hospitalisation among nursing home residents and in the long run improve quality of life and reduce suffering. How knowledge of risk factors and early signs could guide nurses in their hospital decision-making in nursing homes need to be further studied.

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Contributions
Drafting the manuscript and analysed the data: JH, AKDA; planning and collecting the data: MEB, SM, CJÖ, PM; all authors are responsible for the intellectual content of the manuscript.

Conflict of interest
None declared.

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