A cohort study on hospitalization before and after nursing home admission in Germany: Age and sex matter, but depending on period

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ABSTRACT

Objectives: We aimed to examine hospitalizations of nursing home residents before and after institutionalization, stratified by sex and age.

Study design: A cohort study using data of a large health insurance fund was conducted. 127,227 residents aged 65 years and older newly admitted to a nursing home between January 1, 2010, and December 31, 2014 were analyzed.

Main outcome measurements We assessed hospitalization rates and proportions being hospitalized in 6-month intervals one year before nursing home placement up to 5 years thereafter. Multiple Poisson regression models were fitted to calculate relative risks (RR).

Results: Mean age was 84.0 years and 74.6% were females. Hospitalization rates were 194.4 per 100 person-years (PY) in the 12 months before institutionalization and 120.0 per 100 PY thereafter. Rates are highest immediately before entry in both sexes. The influence of age was most pronounced in the 12–7 months before entry (RR: 2.37 for 65–74 vs. 95+ years) and declined thereafter (1.29–1.38 up to month 24 after entry). In contrast, the influence of sex was higher after entry (RR: 1.13 for males vs. females in the 12–7 months before and 1.23–1.31 up to month 24 after entry).

Conclusions: Hospitalization rates of nursing home residents are much higher in Germany than in other Western countries. We provided insight in the influence of age and sex on hospitalization, which depends on the period analyzed. We urgently recommend that future studies on hospitalizations of residents should stratify their analyses by sex, age and period.

1. Introduction

Demographic changes are affecting health worldwide and lead to an increase in the number of older care-dependent persons especially in Western countries [1,2]. In Germany, about 0.8 million persons are living in nursing homes (30% of older care-dependent persons) [3].

Hospitalizations of nursing home residents might have negative clinical consequences [4,5], are often considered to be avoidable [6–8] and are costly [4], but transfers to hospitals occur frequently [9,10]. The proportion of residents being hospitalized at least once during 12 months varies widely between 12 and 35% across different studies [11]. Hospitalization rates are highest shortly before being newly admitted to nursing homes and decline with length of stay [9,12–14]. There is a large body of literature on facility, market or policy characteristics influencing hospitalizations of residents [9,15], but sociodemographic factors have not gained that attention. In a recent systematic review, we only found 21 studies that reported age- or sex-specific analyses for overall hospitalizations [11]. These studies clearly showed that hospi-

talizations occur more frequently in male residents with odds ratios ranging between 1.22 and 1.67 for males compared to females, but reasons for these impressive differences are unclear. The results concerning the influence of age are more conflicting with some studies showing increasing admissions with increasing age, but several studies also reported decreasing hospitalizations above the age of about 80–85 years. We only found one study that reported analyses stratified by age and sex [16] and two studies investigating causes of hospitalization stratified by sex [13,16]. No study assessed hospitalizations by age and sex during the course of care starting before nursing home entry.

Against this background, we aimed to investigate differences in hospitalization rates between age groups and sexes in a large sample of newly admitted nursing home residents, and analyzed changes before and after entry to the home.

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2. Methods

2.1. Design and study population

We used data of the DAK-Gesundheit, a large health insurance fund with about 6 million members (corresponding to 7.5% of the German population). Our study included all people aged 65 years and older newly admitted to a nursing home between January 1, 2010, and December 31, 2014, subsequent to a continuous insurance period of at least 365 days without nursing home placement. Data on nursing home placement were obtained from the German Long-Term Care Insurance ("Gesetzliche Pflegeversicherung"). Information are also available on levels of care dependency, ranging from care level I (considerable need of care) to care level III (most heavily care dependent), and dates of changes in care levels. Further information on the German health care and long-term care system are available in Busse and Blümel [17]. In principle, all residents are assigned to a care level on the day of admission. Levels of care dependency were used as indicators of physical disabilities.

Data on reimbursed medication were also available. The number of prescribed medications were used as a measure of health status like in recent studies [18]. This performed well as a predictor for health services utilization and mortality in older persons [19]. For that, we categorized the number of different Anatomical Therapeutic Chemical (ATC) codes reimbursed during the 90 days preceding nursing home admission into quartiles.

We further used data on hospitalizations spanning the time period 1 year before nursing home placement up to 5 years thereafter. Dates on admission and discharge as well as main hospital discharge diagnoses (with corresponding ICD-10-GM codes) were available.

2.2. Statistical analysis

All analyses were stratified by sex and age. The observation period was divided into 6-month intervals, two prior to nursing home admission and up to ten thereafter. We calculated hospitalization rates excluding times of hospitalization from the denominator. The nominator was the number of hospitalizations during follow-up. A "new" hospitalization was counted after at least one day at risk, meaning that hospitalizations where the date of discharge equals the day of (another) admission were counted once. Cohort exit was defined as the end of the insurance period, death or end of follow-up (December 31, 2014), whichever came first. Hospitalization rates per 100 person-years (PY) were calculated by dividing the number of hospitalizations by the accumulated time under risk. We estimated 95% confidence intervals (95% CIs) using the Wilson method.

We then fitted multiple Poisson regression models to calculate relative risks (RR) with 95% CI for each 6-month interval. We included sex (2 categories), age groups (65–74, 75–84, 85–94 and 95+ years), level of care dependency at admission (3 categories) and quartiles of the numbers of medications during the 90 days preceding admission (4 categories) in these multiple adjusted models.

We also estimated the proportion of residents being hospitalized at least once during these 6-month intervals with exact (Clopper–Pearson) 95% CI and used log-binomial regression analysis to calculate adjusted prevalence ratios (PR) with 95% CI [20] including the variables and categories as mentioned above.

Furthermore, we calculated the proportion of residents being hospitalized during weekly observation periods 52 weeks before and up to 260 weeks thereafter. Only residents that were alive on the first days of the corresponding week were included. Main discharge diagnoses were further assessed and classified according to Ramroth et al. in 12 distinct groups [13].

The level of significance was 0.05. We performed all statistical analyses with SAS for Windows version 9.4 (SAS Institute Inc, Cary, North Carolina).

3. Results

3.1. Baseline characteristics

A total of 127,227 people were newly admitted to a nursing home between 2010 and 2014 and about three quarters were female (74.6%). They were on average 84.0 (SD: 7.2) years old, and males were younger than females (82.5 vs. 84.5 years). More than half (58.0%) of the residents had care levels 0/I at the time of institutionalization (50.0% in males and 60.7% in females). The average number of distinct medications was 7.5 per resident with no differences between sexes (Supplementary Table 1).

The mean follow-up after admission was 1.4 years (SD: 1.2), 1.2 years for males and 1.5 years for females.

3.2. Overall hospitalization

There were 227,285 hospitalizations during 116,896 PY in the 12 months before institutionalization (194.4 per 100 PY) and 206,436 hospitalizations during 172,043 PY over 5 years after institutionalization (120.0 per 100 PY).

Hospitalization rates were highest during the 6 months prior to nursing home entry (310.4 per 100 PY), fell immediately thereafter to 170.6 and decreased further in the following 6-month intervals to 97.2 per 100 PY during months 19–24 after institutionalization (Table 1). In the following 6-month intervals, rates changed only slightly ranging between 86 and 93 per 100 PY during months 25–60 after institutionalization (Supplementary Table 2).

A total of 107,141 of the 127,227 residents were hospitalized at least once during the 12 months before institutionalization (84.2%) and 65.3% were hospitalized over the 5 years after nursing home entry (52.8% and 44.7% in the first and second year). With 79.4%, this proportion was also highest during the 6 months prior to admission (Table 2). It fell thereafter to 42.0% in the following 6 months and remained at about one third (33.4–29.4%) during months 7–24. After that, the proportion of residents being hospitalized decreased steadily to 16.2% during months 55–60 after institutionalization (Supplementary Table 3).

3.3. Influence of sex on hospitalization

The distribution of residents that are hospitalized per week is shown in Fig. 1 and patterns are comparable between both sexes. This proportion is up to 5% between weeks 51 to 34 before admission and increased thereafter until the date of nursing home entry. It was highest in week 3 before admission with 42.2% in males and 40.8% in females. This weekly proportion of residents being in hospitals decreased immediately after nursing home entry with proportions between 8 and 12% up to week 9. After that, there was a slight decrease up to about week 40 in both sexes. These weekly proportions then remained about 5–6% in males and 4% in females up to week 104. Differences between sexes with higher proportions in males are visible especially after nursing home entry. They were smallest directly before entry (males vs. females: 40.5% vs. 39.3% (+3.1%) in week 4 and 42.2% vs. 40.8% (+3.5%) in week 3 before institutionalization). These differences between sexes increased immediately after nursing home admission with 10.7% in males vs. 8.5% in females (+26.4%) in week 2 and then remained constantly higher in males that are between 21.2% and 46.0% more often hospitalized than females up to week 104. The weekly proportions of residents that were being cared for in a hospital decreased slightly after that up to the 5 years of follow-up and differences between sexes persisted (data not shown).

When assessing the proportion of residents hospitalized at least once during the 6-month intervals (Table 2), differences between sexes with higher prevalences in males were also predominantly found after nursing home entry with virtually no difference in the 6 months before