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Key words: long-term care, informal care givers, femoral fracture, stroke.

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Abstract

Background: There has been a shift from nursing home care towards home care, and from formal to informal care to contain long-term care costs in many countries. However, substitution to home care or informal care might be harder to achieve for some conditions than for others. Therefore, insight is needed in differences in long-term care use, and the role of potential informal care givers, across specific conditions. We analyze differences in long-term care use of older patients after a fracture of femur and stroke in general, and examining to what extent having a partner and children affect long-term care use for these conditions in particular.

Methods: Using administrative data on Dutch elderly (55+) with a fracture of femur or stroke in 2013, we investigate their long-term care use in the year after the condition takes place. We use administrative treatment data to select individuals who were treated by a medical specialist for stroke or femoral fracture in 2013. Subsequent long-term care use is measured as using no formal care, home care, institutional care or being deceased at 13 consecutive four-weekly periods after initial treatment. We relate long-term care use to having a partner, having children, other personal characteristics and the living environment.

Results: We find that the probability to use no formal care one year after the initial treatment is equally high for both conditions, but patients with a fracture are more likely to use home care, while patients with a stroke are more likely to use institutional care or have died. Having a spouse has a negative effect on home care and institutional care use, but the timing of the effect, especially for institutional care, differs strongly between the two conditions. Having children also has a negative effect on formal care use, and this effect is consistently larger for patients with a fracture than patients with a stroke.

Conclusion: As the condition and the effect of potential informal care givers matter for subsequent long-term care use, policy makers should take the expected prevalence of specific conditions within the elderly population into account when designing long-term care policies.

Introduction

In many countries, long-term care is under pressure due to ageing populations and limited public budgets. This has led governments to stimulate elderly to live independently as long as possible. As a result, there has been a shift from nursing home care towards home care[1,2], and from formal to informal care[3]. However, substitution to home care or informal care might be harder to achieve for some conditions than for others. Therefore, insight is needed in differences in long-term care use, and the role of potential informal care givers, across specific conditions.

So far, most studies focus on the determinants of long-term care use for the total population of elderly[4-8]. Having a spouse and having a child are positively related to using less formal care[7,9,10]. Also the level of disability, health status, age, gender, household size and the social network are important determinants of the use of care [4,6,7-16].

Others consider the determinants of nursing home use for one single disease[17,18,19]. Van Rensbergen and Nawrot (2010)[20] and Rapp et al. (2015)[21] consider differences in nursing home admissions across several acute conditions, but they do not take home care into account and do not explicitly investigate the effect of confounders other than age and gender. Wong et al. (2010)[7] investigate the effect of different conditions on both home care and nursing home care use among hospitalized patients, but they do not consider condition-specific effects of other confounders such as having a spouse or children.

Femoral fracture and stroke are both severe acute conditions that have a lasting impact on the functioning and wellbeing of elderly patients, and are strong predictors of long-term care use [7,21]. At the same time, stroke seems to be associated more strongly with functional

limitations than femoral fractures[22]. As a result, institutionalization rates for (female) stroke patients seem to be higher than for patients with a femoral fracture[21]. Besides, health benefits of different types of long-term care are different for both conditions[23,24,25].

We investigate whether there are differences in long-term care use of older patients after a fracture of femur and a stroke. We first investigate whether both conditions are associated with different levels of home care and nursing home use[1] at different points in time after initial treatment, controlling for an extensive set of possible confounders. Second, we examine to what extent having a partner and having children affect long-term care use for both conditions.

Methods

Study population

We study the use of long-term care by Dutch elderly who were treated by a medical specialist for stroke or a femoral fracture, during 13 consecutive four-weekly periods after initial treatment. Our source data is administrative data on all Dutch elderly (55 years or older), from which we select individuals who were treated for one of these two conditions in 2013.

The Netherlands has one of the most extensive collective long-term care (LTC) arrangements in the world[26]. In our study period (2013-2014), a social insurance, called the exceptional medical expenses act (AWBZ), covered a broad range of both home care services (social support, personal care, nursing) and institutional care (nursing homes and residential

[1] We use "nursing home care" and "institutional care" interchangeably.

73 care). Eligibility for long-term care was determined by an independent assessment agency,
74 based on health, limitations, and other relevant circumstances, such as the availability of
75 informal care.
76
77 **Data sources**
78 We combine data on an individual level from different administrative sources to construct our
79 dataset. These data have been collected by Statistics Netherlands and can be linked using a
80 personalized identification number. To identify individuals who were treated for a femoral
81 fracture or stroke, we use a dataset containing all declarations for treatments of medical
82 specialists financed by the basic health care insurance in 2013. The data contain *Diagnosis*
83 *Treatment Combination* codes (DTCs, comparable to DRGs) that include the diagnosis. This data
84 contains information on duration, type of care and diagnosis on declarable sub-trajectories
85 within the whole of treatments a patient receives for a particular diagnosis. The basic insurance
86 is compulsory and covers all Dutch inhabitants.
87 To measure care, we use data on LTC use in 2013 and 2014 from the Dutch Central
88 Administrative Office (CAK). The data include information on all publicly financed formal LTC
89 use in the Netherlands. We also include data on mortality records.
90 We include a number of additional datasets that contain relevant information on
91 confounding factors. Gender, age, ethnicity, and household composition are obtained from the
92 Dutch population register. Based on the address on January 1 2013, we include information on
93 the municipality of residence. We also include data on the suitability of the home for individuals
94 with mobility problems. We use data from the tax services to obtain gross income, net financial

wealth, and net housing wealth. To control for health, we include information on eligibility for long-term care 14 days before treatment. We also include total curative health care costs in 2012 (based on administrative data for the basic insurance).

Sample selection

To select individuals who were treated by a medical specialist for stroke or femoral fracture, we use the DTC-subtrajectory codes. The code consists of 12 digits, providing information on the treating specialism, the diagnosis group and sub-group. The last four digits contain information on the disease. Based on this last part, we select individuals with a fracture of femur, or a hemorrhagic or ischemic stroke. We do not include TIAS. As we are interested in long-term care use after initial treatment, we exclude follow-up treatment, inter colleague consults, and DTCs that already started in 2012. We also exclude individuals who already use formal care in the period just before treatment. Our sample contains 26,150 observations for stroke and 7,884 for fractural femur.

Outcomes

We consider four outcomes at 13 consecutive four-weekly periods after the DTC is opened: no long-term care, home care, nursing home care, and death. For each period, we identify whether the individual used any care or died after T periods (T= 1, 2..13). For nursing home care we observe the exact date of use. Home care use is only registered on a monthly basis. As a result, we assume that someone uses home care after T periods if one uses home care in that month. When an individual uses both types of care at the same day, the outcome is set to nursing

117 home care. When an individual dies at a day he uses formal care, the outcome is always set to
118 death.
119
120 **Confounders**
121 Table 1 contains the descriptive statistics for the confounders. Health care costs, income, and
122 wealth are measured in quintiles. Municipality size and urbanity are categorical variables with
123 five groups. Suitability of the home is measured in 4 categories.
124
125 Table 1: Descriptive statistics for both samples

	Fracture of femur (n=7,884)		Stroke (n=26,150)	
	Mean	Standard deviation	Mean	Standard deviation
Partner	0.541	0.498	0.669	0.471
Having children	0.842	0.365	0.872	0.334
Healthcare costs (in euros)	5,917	11,682	5,509	11,375
Eligibility for long-term care t-14	0.090	0.286	0.048	0.214
Man	0.348	0.476	0.568	0.495
Age	76.341	9.832	72.301	9.011
Number of children	2.187	1.589	2.209	1.474
Children living in the household	0.093	0.291	0.114	0.318
First generation immigrant	0.050	0.219	0.089	0.285
Second generation immigrant	0.050	0.217	0.055	0.228
Municipality size	4.867	1.887	4.905	1.854
Urbanity	2.821	1.393	2.850	1.367
Gross income (in euros)	46,313	42,053	50,087	45,055
Home ownership	0.532	0.499	0.556	0.497
Value of the house (in euros)	161,500	195,706	162,677	194,586
Financial wealth (in euros)	224,558	422,025	177,861	391,285
Adaptability home	1.960	1.186	1.917	1.145

126 Descriptive statistics of the two samples.

Statistical analysis

For both diseases, we run 13 separate multinomial logit models; one for each period. These models estimate the log odds of using a particular type of care (or being deceased) in a particular period after treatment compared to using no care in that period. We report two types of outcomes. First, we compare the use of long-term care between elderly with the two different conditions, controlling for differences in confounders between the two populations. Using the estimated parameters, we make predictions for long-term care use in each period for both conditions for a reference person with the same characteristics (woman aged 80, with a spouse, 2 children (not living at home), who has average healthcare costs and average wealth, and who lives in a 2-stars home (which she does not own) in an average sized municipality and city).[2] Second, we focus on the differences in the effect of two confounders (having a spouse and having children) on the use of long-term care between the two conditions. We report relative risk ratios for these confounders for both conditions. We also show the average marginal effects: the effect of a one unit increase in the confounder on the probability of the outcome, averaged over all individuals in the population. The regression coefficients are available on request.

Results

Table 1 presents descriptive statistics for both samples separately. In both samples, the majority of patients have a spouse, with the proportion of patients with a partner being higher in the stroke sample. Moreover, approximately 85% of the patients have children in both

[2] A 2-stars home is a house of which the front door is accessible without taking the stairs. The house consists of multiple levels and a chairlift can be installed.

148 samples. Elderly with a fracture of femur are more often female than male, while the opposite
149 is true for the stroke sample. Besides, elderly with a fracture of femur are on average older than
150 patients with a stroke, but are similar in terms of the living environment.
151
152 *Care use after a fracture of femur and stroke*
153 Figure 1 shows the predicted outcomes for the reference person having one of the two
154 conditions. At all moments in time, the likelihood to use home care after a fracture of femur is
155 higher than after a stroke (Panel B). Shortly after the condition takes place, there is not much
156 difference in the probability to use institutional care (Panel C). For example, three periods after
157 a stroke her probability to receive institutional care is 1.5% while this is 1.9% after a fracture of
158 femur. With time, the probability to use institutional care increases for stroke patients while it
159 stays constant for patients with a fracture of femur. Moreover, mortality is higher in the first
160 year after a stroke than after a femural fracture.
161
162 *The effects of having a partner and children on care use*
163 Table 2 shows relative risk ratios for having a spouse and having children at 12, 24 and 52
164 weeks after a fracture of femur and stroke. For both conditions, having a partner and having
165 children decrease the probability of using home care and institutional care. Having a spouse is
166 also associated with lower mortality for stroke patients, and having children is associated with
167 lower mortality for both conditions.
168 To gain more insight in the timing of the effects, we consider the marginal effects in
169 Figure 2 and 3. Initially, having a spouse has a positive effect on home care use after a fracture

and a negative effect after a stroke. After three months, the effect is negative for both conditions, but larger for fractures. In the longer run, having a spouse has a small negative effect, equal for both conditions. Having a spouse has a negative effect on institutional care use in the first periods after a fracture, but this effect dies out over time. The time pattern for stroke is the reverse.

Having children has a consistently negative effect on both types of formal care use over time. The effect is also consistently stronger for patients with a fracture than for patients with a stroke.

Table 2: Relative risk ratios

		Having a partner			Having children		
		T=12	*T*=24	*T*=52	*T*=12	*T*=24	*T*=52
Fracture of femur	Home care	0.622***	0.679***	0.695***	0.839*	0.732***	0.762**
	Institutional care	0.519***	0.687***	0.778*	0.840	0.605***	0.537***
	Deceased	0.841	0.893	0.878	0.678**	0.626***	0.713**
Stroke	Home care	0.596***	0.575***	0.632***	0.886	0.852**	0.790***
	Institutional care	0.612***	0.531***	0.514***	0.789*	0.743***	0.710***
	Deceased	0.891**	0.845***	0.820***	0.875*	0.844**	0.839**

Relative risk ratios of having a spouse and having children at 12, 24 and 52 weeks after a fracture of femur and stroke. *** p<0.01, ** p<0.05, * p<0.1.

Discussion

We have assessed the impact of fracture of femur and stroke on home care and institutional care use in the first year after diagnosis, using nationwide administrative data and controlling for an extensive set of confounders. We have also analyzed difference in the effects of having a spouse and having children between the conditions. We find that, after one year, the

probability to use no formal care is equally high for both conditions, but patients with a fracture are more likely to use home care, while patients with a stroke are more likely to use institutional care or have died. Having a spouse has a negative effect on home care and institutional care use, but the timing of the effect, especially for institutional care, differs strongly between the two conditions. Having children also has a negative effect on formal care use, and this effect is consistently larger for patients with a fracture than patients with a stroke.

For as far as we can compare our results to other studies, our findings seem to be in line with earlier findings. Both acute conditions have been established as strong predictors of long-term care use[7,21]. Rapp et al. (2015)[21] compare institutional care use six months after different conditions. They also find that the likelihood of the use of institutional care is higher after a stroke than after a fracture of femur, especially for women. The negative effect of having a spouse and children on long-term care use is also well established for the general elderly population [9,10] and after hospitalization [7].

What is novel in our study, is that we condition the effects on having a particular condition, and that we find that these effects indeed differ. The main strength of the study is that we use administrative data on all Dutch patients with a stroke and femoral fracture in 2013, and that we are able to link this data to an extensive set of confounders.

The study also has limitations. First, we have only included two conditions. We do this because these two conditions are acute and can be expected to have a direct impact on care use. Dementia is another important condition, where the timing of care use and the impact of family caregivers could be quite different, but the onset of that condition is much more gradual and much harder to identify in administrative data. Second, our study is in the context of the

Dutch care system of 2013. The Dutch long-term care system is very extensive compared to most countries[25], and eligibility for care, partly, depends on policy rules specific to the Netherlands. This means that caution is needed in generalizing the finding to other countries, or even to the current Dutch system (that was reformed in 2015). A specific issue is that geriatric revalidation care, which one might consider long-term care, is actually part of curative care in the Netherlands, and thus not included. Third, the fact that we sometimes find significant effects of having a spouse or children on mortality, might indicate that these variables are correlated with unobserved health. Caution is thus again needed in interpreting the effects as causal.

Declarations

Ethics approval and consent to participate: Not applicable. Data is retrieved from Statistics Netherlands (CBS). The Statistics Netherlands Act constitutes the legal basis for CBS. In addition, CBS has Regulations of the board. Moreover it has multiple statutory provisions and acts regarding data supply. The General Data Protection Regulation and the GDPR Implementation Act in the Netherlands stipulate what is and what is not permissible with regard to personal data. For more information see https://www.cbs.nl/en-gb/about-us/organisation

Consent for publication: Not applicable

Availability of data and material: The data that support the findings of this study are available from Statistics Netherlands (CBS) but restrictions apply to the availability of these data, which were used under license for the current study, and so are not publicly available. Data are

however available from the authors upon reasonable request and with permission of Statistics Netherlands (CBS).

Competing interests: The authors declare that they have no competing interests.

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Authors' contributions: BW and DvdB came up with the study design, BW and MD acquired the data and drafted the manuscript. All authors analyzed and interpreted the data and read and approved the manuscript.

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