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RESEARCH BRIEFS

The Patterns of Health Care Utilization by Elderly Europeans: Frailty and Its Implications for Health Systems

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Objective. To examine the patterns of health care utilization by the elderly and test the influence of functional decline.

Data Source and Study Design. We used the three regular waves of the SHARE survey to estimate the influence of frailty on health care utilization in 10 European countries. We controlled for the main correlates of frailty and unobserved individual effects.

Results. The frail elderly increase their primary and hospital care utilization before the onset of disability. Multimorbidity moderates the effect of frailty on care utilization.

Conclusions. The prevalence of frailty is high in most countries and is expected to increase. This renders frailty prevention and remediation efforts imperative for two complementary reasons: to promote healthier aging and to reduce the burden on health systems.

Key Words. Frailty, health care utilization, aging, Europe, prevention

Population aging is challenging the sustainability of health systems in developed countries (Knickman and Snell 2002; World Health Organization 2008; European Commission 2012). Growing consensus regards the necessity to redesign care processes to better respond to the care needs of the elderly (Giannakouris 2008), especially for complex patients, like the frail subjects.

Frailty is a biological syndrome defined as a state of vulnerability resulting from progressive, cumulative physiological declines in reserve capacity and fitness across multiple body systems (Fried et al. 2001). It cannot be strictly separated from the natural process of aging and is a precursor of disability (Fried et al. 2004; Buchman et al. 2009). Frail individuals can hardly cope with common acute stressors (e.g., hospitalization); thus, they are prone to poor/adverse health outcomes (Morley 2006; Bortz 2010; Rochat et al. 2010; Xue 2011).

The literature on the specific patterns of health care utilization for frail patients is scarce (Hoeck et al. 2011). However, the topic is important because health systems are striving to contain expenditures and accurate information on care utilization by this cluster of patients might help to prioritize interventions. Therefore, we attempt to fill this gap and use data from the Survey of Health, Ageing and Retirement in Europe (SHARE) to estimate how care utilization changes with functional decline, controlling for the main correlates of frailty: disability and multimorbidity (Buchman et al. 2009; Heuberger 2011). In addition, it is important to control for the effect of psychological factors (Espinoza and Fried 2007), gender (Woods et al. 2005; Heuberger 2011), socio-economic status, and behavioral risks (Woods et al. 2005; Espinoza and Fried 2007).

Study Objectives, Data, and Methods

This study addresses the question: "Is frailty significantly associated with increased levels of health care utilization among the elderly, even after accounting for all of its main correlates such as disability and multimorbidity?" To answer this question, we independently estimate the influence of frailty on primary and hospital care utilization.

We employ data from the three regular panel waves of SHARE, as published in releases 2.5.0 and 1.1.1 (Börsch-Supan and Jürges 2005). Data collection ran in the periods 2004–2005, 2006–2007, and 2011–2012, respectively. Two characteristics of the data led us to select the econometric approach: (1) the dataset is longitudinal and thus the observations are not distributed independently in time; and (2) the selected response variables are all limited variables.

Exploiting the panel structure of the data allows us to relax the homogeneity assumption and control for unobserved individual heterogeneity, as well as for potential differences between waves. The longitudinal approach of the study led us to retain only the 10 countries that participated in all three waves: Denmark, Sweden, the Netherlands, Germany, France, Belgium, Switzerland, Austria, Spain, and Italy. Our sample consists of 83,019 observations from 50,967 individuals. The resulting panel is unbalanced: 10,159 and 11,734

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individuals have been observed in all the three waves and in two waves, respectively.

To ensure attrition does not affect our estimates, we ran variable addition tests (Verbeek and Nijman 1996). Results reject the hypothesis of significant correlation between the pattern of missing values and our health utilization variables. We also ran the estimation on pooled data and on individual waves, and verified the robustness of our results. Finally, we decided against using the balanced longitudinal subsample because death and incapacity are likely to be important sources of nonresponse in the SHARE data. Therefore, such a restriction would introduce bias by eliminating the more frail individuals from the analysis (Jones et al. 2007).

The three dependent variables used are as follows: the number of doctor visits, the number of general practitioner (GP) visits, and whether the individual has been admitted to a hospital in the 12 months prior to the study. We used Poisson regression models for the count dependent variables and logistic regression models for the binary response variable.

We adopted the phenotype definition of frailty (Fried et al. 2001), which consists of assessing five dimensions: grip strength, energy, walking speed, physical activity, and unintentional weight loss. An individual is frail if three or more of the above dimensions are compromised, whereas s/he is robust when none of these deficits are present. Intermediate situations are defined as prefrailty. Santos-Eggimann et al. (2009) adapted this operationalization to the SHARE dataset and Romero-Ortuno et al. (2010) validated it.

In addition to frailty and its two main correlates, multimorbidity and disability—the latter measured as the number of activities of daily living (ADL) limitations accumulated in the six dimensions of the ADL index (Katz et al. 1970)—our models include three categories of control variables: health status, socio-economic status, and behavioral risks (see Table 1). Whenever possible, we control for country and time fixed effects and their interactions.

For each dependent variable, we first estimate a pooled model with an unstructured correlation matrix (Rabe-Hesketh and Skrondal 2008). We further enrich the estimation by including individual unobserved effects. Two alternative estimations are possible: the random effects and the fixed effects estimator. The former is efficient under the assumptions of strict exogeneity of the regressors, conditional on the unobserved effects and the mean independence of the unobserved effects from the regressors. However, the fixed effects estimator allows for causal inference if only the strict exogeneity assumption is satisfied (Wooldridge 2010).

Table 1: Descriptive Statistics of the Sample by Frailty Category

Frailty Category	*Robust*		*Prefrail*		*Frail*		
Variable	*Obs.*	*Mean (SD)/ Proportion*	*Obs.*	*Mean (SD)/Proportion*	*Obs.*	*Mean (SD)/ Proportion*	*Variable Range*
No. of doctor visits	40,222	4.4 (6.1)	33,414	7.71 (10.3)	8,397	13.8 (15.8)	0–98
No. of GP visits	33,932	3.6 (4.4)	30,372	5.8 (7.8)	8,060	10.4 (12.9)	0–98
Hospital admission	40,296	0.1 (0.3)	33,597	0.2 (0.4)	8,516	0.3 (0.5)	0/1
Multimorbidity	40,378	0.3 (0.5)	34,103	0.5 (0.5)	8,538	0.7 (0.4)	0/1
ADL limitations (disability)	40,367	0.03 (0.2)	33,664	0.2 (0.8)	8,535	1.2 (1.7)	0–6
Health status							
Self-perceived health	40,370	2.6 (0.9)	33,682	3.2 (1.0)	8,536	4.2 (0.8)	1–5
Long-term illness	40,365	0.3 (0.5)	33,701	0.6 (0.5)	8,535	0.8 (0.4)	0/1
Two or more symptoms	40,363	0.2 (0.4)	33,668	0.5 (0.5)	8,535	0.8 (0.4)	0/1
Depression symptoms*	39,752	1.2 (1.3)	32,688	3.0 (2.1)	8,235	5.1 (2.5)	0–12
Socio-economic status							
Age (years)							
50–59	15,121	37.5	9,964	29.2	1,010	11.8	0/1
60–69	15,717	38.9	10,622	31.2	1,666	19.5	0/1
70–79	7,862	19.5	8,716	25.6	2,704	31.7	0/1
80+	1,673	4.1	4,787	14.0	3,158	37.0	0/1
Male	40,378	0.5 (0.5)	34,103	0.4 (0.5)	8,538	0.3 (0.5)	0/1
Living with partner	40,375	0.8 (0.4)	34,090	0.7 (0.5)	8,537	0.5 (0.5)	0/1
Children	40,378	0.9 (0.3)	34,103	0.9 (0.3)	8,538	0.9 (0.3)	0/1
Education							
Primary	8,459	21.0	22,717	56.5	9,047	22.5	0/1
Secondary	10,431	30.8	17,945	52.9	5,521	16.3	0/1
Tertiary or higher	3,999	47.1	3,753	44.2	738	8.7	0/1

Continued

Table 1. *Continued*

Frailty Category	*Robust*		*Prefrail*		*Frail*		
Variable	*Obs.*	*Mean (SD)/ Proportion*	*Obs.*	*Mean (SD)/Proportion*	*Obs.*	*Mean (SD)/ Proportion*	*Variable Range*
Household wealth quartile							
1st quartile	7,553	18.7	9,532	28.0	3,691	43.2	0/1
2nd quartile	9,866	24,4	8,684	25.5	2,192	25.7	0/1
3rd quartile	10,883	27.0	8,253	24.2	1,621	19.0	0/1
4th quartile	12,076	29.9	7,634	22.4	1,034	12.1	0/1
Financial distress†							
Great difficulty	1,848	4.6	3,068	9.0	1,483	17.4	0/1
Some difficulty	7,339	18.2	8,494	24.9	2,719	31.8	0/1
Relative ease	15,089	37.4	12,573	36.9	2,684	31.4	0/1
Ease	16,102	39.9	9,968	29.2	1,652	19.4	0/1
Behavioral risks							
Is socially active	40,081	0.5 (0.5)	33,044	0.4 (0.5)	8,161	0.2 (0.4)	0/1
Is physically active	40,367	0.6 (0.5)	33,394	0.4 (0.5)	8,161	0.2 (0.4)	0/1
Has ever smoked	32,777	0.6 (0.5)	26,911	0.6 (0.5)	6,585	0.6 (0.5)	0/1
Is a frequent drinker	40,370	0.3 (0.5)	33,400	0.3 (0.4)	8,258	0.2 (0.4)	0/1

Note. Standard deviations in parentheses.
*Euro-D scale (Prince et al. 1999).
†The levels reported are answers to the question "Household makes ends meet with. . .".

The Durbin–Wu–Hausman test (Hausman 1978) and the joint Wald test of significance, used to analyze the coefficients of the time-averaged regressors included in the Mundlak random effects specifications (Wooldridge 2010), indicated that the fixed effects estimator is the most appropriate (Tables 2 and 3). Therefore, we discuss only these estimates in the following section, but the results of the pooled estimation and of the random effects specification are presented for comparison.

We used robust standard errors for the pooled estimates and bootstrap estimation (with 300 iterations) for the random and fixed effects models. We also reran the estimation using subsamples excluding extreme cases: comparisons confirm that our results are not driven by outliers.

We addressed the potential issue of overdispersion by verifying that the coefficients and the levels of significance do not change considerably when a negative binomial model is used (Long 1997). Finally, we confirm the stability of the results obtained with the Gauss–Hermite adaptive quadrature with 8, 12, and 16 integration points (Stata Corp 2009).

RESULTS

The average prevalence of frailty was 10.3 percent in our sample, with a constant increase across the waves. Approximately half of the individuals were robust, and 40 percent of the observed individuals were classified as prefrail. Frail subjects used approximately three times more health care services (among the ones considered) as compared with robust individuals (Table 1). Not surprisingly, the prevalence of multimorbidity and disability increased with frailty.

Table 2 shows that frailty has a strong, positive impact on the number of doctor visits: prefrail and frail individuals are expected to see a doctor 17 and 45 percent more times, respectively, than robust individuals. Multimorbidity and disability are positively associated with the number of doctor visits. Everything else equal, a multimorbid subject sees a doctor 23 percent more times than a patient who does not suffer from the condition. In addition, every additional ADL limitation increases the expected number of visits per year by 3.7 percent.

We also found evidence of the interplay between the two conditions: the interaction term for multimorbidity and the frailty indicator is statistically significant; hence, the effect of frailty on the response variable is moderated by the presence of multimorbidity. This finding is important because

Table 2: Estimates for the Number of Visits (Incidence Rate Ratios)

	Number of Doctor Visits			*Number of GP Visits*		
	Pooled	*Fixed Effects*	*Random Eff. Mundlak*	*Pooled*	*Fixed Effects*	*Random Eff. Mundlak*
Frailty (ref. Robust)						
Prefrail	1.206***	1.168***	1.170***	1.156***	1.092**	1.089***
Frail	1.488***	1.452***	1.441***	1.418***	1.368***	1.317***
Multimorbidity	1.386***	1.228***	1.229***	1.251***	1.143***	1.125***
Prefrail × Multimorbidity	0.935**	0.947	0.938**	0.969	0.969	0.974
Frail × Multimorbidity	0.787***	0.727***	0.746***	0.853***	0.733***	0.800***
ADL limitations	1.034***	1.037*	1.041**	1.050***	1.029	1.040*
Self-perceived health	1.252***	1.185***	1.187***	1.182***	1.109***	1.110***
Long-term illness	1.324***	1.172***	1.180***	1.199***	1.112***	1.122***
Two or more symptoms	1.163***	1.117***	1.139***	1.121***	1.054*	1.090***
Depression symptoms	1.027***	1.018**	1.017**	1.019***	1.019**	1.018**
Age category (ref. 50–59)						
60–69	1.034*	0.972	1.041	1.058***	0.942	1.015
70–79	1.050**	0.936	1.050	1.112***	0.872*	1.008
80+	0.991	0.916	1.036	1.109***	0.843*	0.994
Male	0.991		0.961**	1.029*		1.015
Living with partner	1.014	1.034	1.010	0.977	1.012	1.000
Children	1.023	1.173	1.187	1.024	1.215	1.184
Education (ref. Primary)						
Secondary	0.971*	0.949	0.951	0.913***	0.943	0.971
Tertiary or higher	1.018	0.930	0.946	0.867***	0.962	0.972
Hh. wealth (ref. 1st quartile)						
2nd quartile	0.967*	1.009	1.000	0.931***	1.009	0.988
3rd quartile	0.951**	0.983	0.988	0.901***	0.963	0.975
4th quartile	0.943***	1.011	1.005	0.841***	0.967	0.958

Continued

Table 2. *Continued*

	Number of Doctor Visits			Number of GP Visits		
	Pooled	*Fixed Effects*	*Random Eff. Mundlak*	*Pooled*	*Fixed Effects*	*Random Eff. Mundlak*
Fin. distress (ref. Great difficulty)						
Some difficulty	0.959*	0.976	0.971	0.924***	0.969	0.957
Relative ease	0.935**	0.933	0.937	0.890***	0.921	0.930
Ease	0.978	0.953	0.962	0.904***	0.938	0.946
Is socially active	1.016	0.971	0.976	0.963***	0.964	0.975
Is physically active	0.937***	0.971	0.969	0.938***	0.949*	0.947**
Has ever smoked	0.995	0.941*	0.990	0.969**	0.932	0.981
Is a frequent drinker	0.930***	0.943	0.937*	0.949***	1.006	0.999
Country dummies	Yes	No	Yes	Yes	No	Yes
Wave dummies	Yes	Yes	Yes	Yes	Yes	Yes
Country × Wave dummies	Yes	Yes	Yes	Yes	Yes	Yes
Time-averages of regressors	No	No	Yes	No	No	Yes
Durbin–Wu–Hausman test						
χ^2 (42)		1,185.95			959.86	
p-value		.000			.000	
Wald joint test (Ho: $\gamma = 0$)						
χ^2 (15)			207.86			181.79
p-value			.000			.000
LR test (H0: $\sigma(\sigma_i = 0)$)						
$\bar{\chi}^2$ (02)			1.8×10^5			9.8×10^4
p-value			.000			.000
Observations	64,003	29,067	64,003	56,433	24,099	56,433
No. of individuals	48,871	14,459	48,871	44,170	11,990	44,170

Note. All results are based on bootstrapped standard errors. Coefficients for country and wave dummies and their interactions can be provided upon request.
$*p < .05$, $**p < .01$, $***p < .001$.

Table 3: Estimates for the Probability of Being Admitted to Hospital (Odds Ratios)

	Pooled	*Conditional Logit*	*Random Effects-Mundlak*
Frailty (ref. Robust)			
Prefrail	1.373***	1.234**	1.291***
Frail	1.964***	1.895***	1.770***
Multimorbidity	1.508***	1.434***	1.390***
Prefrail × Multimorbidity	0.949	1.027	0.959
Frail × Multimorbidity	0.840*	0.737*	0.844*
ADL limitations	1.062***	1.087**	1.116**
Self-perceived health	1.431***	1.393***	1.415***
Long-term illness	1.330***	1.172**	1.247***
Two or more symptoms	1.203***	1.220***	1.206***
Depression symptoms	1.039***	1.059***	1.054***
Age category (ref. 50–59)			
60–69	1.132***	1.059	1.153*
70–79	1.307***	1.220	1.365**
80+	1.230***	1.296	1.302
Male	1.282***		1.298***
Living with partner	0.988	1.240	1.248
Children	1.150***	0.861	1.008
Education (ref. Primary)			
Secondary	1.041	1.015	0.972
Tertiary	1.024	0.986	0.885
Hh. wealth (ref. 1st quartile)			
2nd quartile	0.994	1.053	0.990
3rd quartile	0.934	0.971	0.923
4th quartile	1.124**	1.153	1.114
Fin. distress (ref. Great difficulty)			
Some difficulty	1.025	1.197	0.998
Relative ease	1.020	1.083	0.961
Ease	1.073	1.097	0.984
Is socially active	1.040	0.882**	0.910
Is physically active	0.949	0.910	0.913
Has ever smoked	1.109***		1.126***
Is a frequent drinker	0.943*	0.847*	0.896
Country dummies	Yes	No	Yes
Wave dummies	Yes	Yes	Yes
Country × Wave dummies	Yes	Yes	Yes
Durbin–Wu–Hausman test			
χ^2 (42)		79.38	
p-value		.000	
Wald joint test (Ho: $\gamma = 0$)			
χ^2 (15)			34.97
p-value			.002

Continued

Table 3. *Continued*

	Pooled	*Conditional Logit*	*Random Effects-Mundlak*
LR test (H0: $\rho = 0$)			
$\bar{\chi}^2(02)$			29.85
p-value			.000
Observations	64,196	14,118	64,196
No. of individuals	48,995	5,521	48,995

Note. All results are based on bootstrapped standard errors. Coefficients for country and wave dummies and their interactions can be provided upon request.
$^*p < .05$, $^{**}p < .01$, $^{***}p < .001$.

approximately 65 percent of multimorbid patients also suffer from functional decline (47 percent are prefrail, and almost 18 percent are frail). The negative coefficient means that the combined effect of frailty and multimorbidity on doctor visits is lower than the sum of the impact associated with the two conditions when they are observed separately.

The presence of long-term illness is also positively associated with the number of doctor visits.

All health status variables considered are positively and significantly associated with the number of doctor visits, while none of our socio-economic or behavioral risk controls is significant after we controlled for individual unobserved heterogeneity.

The estimates for the number of GP visits during the previous 12 months produce results that are strikingly similar to those of the general analysis presented above (see Table 2).

Table 3 shows that, all else being equal, individuals who suffer from two or more chronic conditions have 1.43 times greater odds of being admitted to a hospital in a given year than do nonmultimorbid subjects. A worsening disability status also leads to higher probabilities of being hospitalized: for every increase in the number of ADL limitations the odds ratio goes up by a factor of 1.09.

The effect of frailty on hospital care utilization is considerably larger: everything else equal, prefrailty is associated with 1.24 times greater odds of hospital admission than with the robust reference category, and frailty nearly doubles the same odds. The 89 percent increase in the odds associated with frailty illustrates a relationship that is more than twice as strong as the association between the probability of being hospitalized and self-assessed health status (OR = 1.393) and four times as strong as the association between hospitalization and the presence of two or more symptoms (OR = 1.221) or depression symptoms (OR = 1.059).

Finally, none of the socio-economic control variables had a statistically significant influence on the probability of hospitalization.

Discussion

To the best of our knowledge, this is the largest, multinational study investigating the influence of frailty on access to health care. We show that functional decline, together with chronic conditions and disability, explain health care utilization in different care settings, after controlling for socio-economic and health status, and behavioral risks.

We did not assess costs in our analysis. However, it is safe to assume that the increasing prevalence of frailty, documented also in our dataset, would generate a relevant burden for European health systems. In fact, Robinson et al. (2011) conducted a study on a cohort of older adults with similar preoperative comorbidities and intraoperative variables. Compared to robust subjects, frail patients had significantly higher hospital acute costs (about 2.75 times, on average) and from discharge to 6-month health costs (about 3.31 times, on average). Khandelwal et al. (2012), studying a cohort of 250 hospitalized elderly, found that frail subjects had a higher median hospital stay (about 1.75 times) compared to robust patients. In this respect, it would be interesting to conduct further, large studies that could help predict accurately the influence of frailty on health care costs. Based on such information, policy makers might envision potential cost savings associated with initiatives targeting frail patients, as such interventions seem to be cost-effective (Melis et al. 2008).

The similarity of the results for GP and doctor visits likely stems from the centrality of GPs in European health systems and their coordination role in the care processes. Even in countries where GPs are not gatekeepers, they are likely to treat and follow up with patients for longer periods than other health providers. This suggests that GPs might be key partners to implement successful initiatives aimed to target frail patients. For instance, GPs could lead screening initiatives to detect early frailty in the elderly, thus enabling the health system to target these individuals more effectively and avoid inappropriate frequent access to more expensive care settings and adverse outcomes. In addition, GPs could represent a pillar of the coordination and adherence necessary for the success of initiatives aimed to contrast frailty. The feasibility of such an approach depends on GPs' workload and technological equipment (e.g., electronic health records) and varies by country. However, the alternative of a (comprehensive) geriatric assessment calls for multidisciplinary resources, while less demanding methods should be tested in terms of discriminative power. In this respect, primary care might have a role in fostering the development of generally agreed-upon, sound methods. The current lack of consensus on how frailty should be diagnosed and assessed (Espinoza and Walston 2005) hinders appropriate care for frail individuals.

The moderating role of multimorbidity in the relationship between frailty and care utilization is an interesting finding. Perhaps, the attention usually received by multimorbid patients from their primary care providers helps address their functional decline, thus contrasting the increase in doctor visits. As a consequence, for the 55 percent of the elderly population who are not diagnosed with multimorbidity, the transition from robustness to frailty is expected to lead to a large, unmitigated increase in care utilization.

Long-term diseases positively influenced doctor visits but less so than functional decline or multimorbidity. We suggest that this is the case because such illnesses are generally treated in specialized care settings. Therefore, they are likely to have a greater impact on the level of home and long-term care utilization, which we do not consider in this study.

Finally, our results confirm that frail patients are hospitalized more frequently compared to robust individuals. This raises the question of the appropriateness of their care in the acute setting and the necessary coordination of hospital professionals with the doctors who know the history and conditions of such patients.

Conclusion

The pressure on health systems from functional decline in the older age groups begins further upstream than is generally believed. In fact, regardless of their disability and morbidity status, frail and prefrail subjects are frequent users of primary and hospital care.

Although caution must be used when generalizing results, the accuracy and robustness of our estimates, which are based on data from different institutional settings and population characteristics (Santos-Eggimann et al. 2009), give us the confidence to express general conclusions.

Frailty is a dynamic process characterized by frequent transitions between states over time, a third of which are associated with functional improvement (Fallah et al. 2011; Etman et al. 2012). Therefore, functional decline is not irreversible and our findings will hopefully draw attention to frailty as an important target for prevention.

Interventions can attempt to identify the population at risk and/or remediation among the frail group, which would help offset a probable decline into worse health states (Lang, Michel, and Zekry 2009). The literature highlights the importance of timely intervention and identifies the dimensions of frailty that are most responsive to treatment (Knickman and Snell 2002; Fairhall et al. 2011; Cameron et al. 2013; Smit et al. 2013). Aspects of paramount importance are embedding assessment and intervention initiatives, the multidisciplinary and coordinated care approach (the frail elderly frequently move between settings and receive multiple services in a single year), and the experience of health professionals in the care of older people. Flexible delivery and focus on increasing adherence are also important because of the fluctuating care needs of this cluster of patients (Fairhall et al. 2011).

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Supporting Information

Additional supporting information may be found in the online version of this article:

Appendix SA1: Author Matrix.