

Prevalence of Frailty in Middle-Aged and Older Community-Dwelling Europeans Living in 10 Countries

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Background. Frailty is an indicator of health status in old age. Its frequency has been described mainly for North America; comparable data from other countries are lacking. Here we report on the prevalence of frailty in 10 European countries included in a population-based survey.

Methods. Cross-sectional analysis of 18,227 randomly selected community-dwelling individuals 50 years of age and older, enrolled in the Survey of Health, Aging and Retirement in Europe (SHARE) in 2004. Complete data for assessing a frailty phenotype (exhaustion, shrinking, weakness, slowness, and low physical activity) were available for 16,584 participants. Prevalences of frailty and prefrailty were estimated for individuals 50–64 years and 65 years of age and older from each country. The latter group was analyzed further after excluding disabled individuals. We estimated country effects in this subset using multivariate logistic regression models, controlling first for age, gender, and then demographics and education.

Results. The proportion of frailty (three to five criteria) or prefrailty (one to two criteria) was higher in southern than in northern Europe. International differences in the prevalences of frailty and prefrailty for 65 years and older group persisted after excluding the disabled. Demographic characteristics did not account for international differences; however, education was associated with frailty. Controlling for education, age and gender diminished the effects of residing in Italy and Spain.

Conclusions. A higher prevalence of frailty in southern countries is consistent with previous findings of a north–south gradient for other health indicators in SHARE. Our data suggest that socioeconomic factors like education contribute to these differences in frailty and prefrailty.

Key Words: Frailty—Aged—Middle-aged—Frail elderly—Epidemiology—Prevalence.

MOST industrialized countries will need to adapt their health care systems to meet the challenges arising from population aging. This will require meaningful estimates of population health from epidemiological surveys. Functional impairments in the oldest age group have been discussed with regard to current and projected long-term care needs; however, this limits the view of the future needs of aging populations. In Europe, the large cohort of post–World War II baby boomers will reach retirement age over the next two decades. And although preventing an unfavorable evolution toward loss of autonomy in this generation is a public health priority, little is known regarding the proportion at risk for functional decline in middle age and beyond. Health indicators based on selected chronic conditions or unhealthy behaviors are difficult to interpret because multiple combinations of degenerative diseases result in considerable heterogeneity in the risk for functional loss and health care needs.

Thus, the geriatric concept of frailty (1–3) is of particular interest because frailty is likely to be a precursor of disability (4–6) and may be reversible in its early stages (7). The prevalence of frailty might summarize health and the needs for prevention in middle-aged and older populations (8,9). A major impediment to measuring frailty in population-based surveys is the lack of an operational definition.

However, Fried and colleagues (4,10) identified a frailty phenotype that was predictive of adverse outcomes such as falls and fractures (11,12), mobility and functional declines (4,5,12), hospitalizations (4), nursing home admissions (5), and death (4–6,11–13). The prevalence of this phenotype has mainly been estimated for Northern America and scant data are available for Europe (14,15). The population of European countries could experience different levels of frailty due to cultural, regional, or political distinctions.

The purposes of this study were to quantify the prevalence of frailty in community-dwelling middle-aged and older Europeans participating in the Survey of Health, Aging and Retirement in Europe (SHARE) in 2004, compare this prevalence among the 10 countries included in this survey, and evaluate selected population characteristics as potential explanations for international differences observed in the 65 years and older (65+) subgroup.

METHODS

Data Source and Participants

SHARE is a multidisciplinary European Union research project (16) covering 10 countries in its 2004 first wave: Austria, Denmark, France, Germany, Greece, Italy, the

Table 1. Overall Response Rate in SHARE Wave 1 (2004), Working Sample Size and Age Distribution

	Overall Response Rate (%)	Working Sample Size (N)	Weighted* Proportion 50–64 y of Age (%)	Weighted* Mean (SD) Age in 65+ Category (y)
Sweden	50.2	2,050	51.5	75.2 (7.6)
Denmark	63.2	1,572	58.7	74.7 (6.9)
The Netherlands	61.3	2,221	59.3	73.9 (6.4)
Germany	63.4	2,278	50.6	73.8 (6.9)
Austria	58.1	1,829	53.2	74.2 (6.7)
Switzerland	37.6	938	55.2	74.5 (7.2)
France	73.6	1,651	51.5	74.8 (6.9)
Italy	55.1	1,971	48.7	74.2 (6.8)
Spain	53.3	1,762	47.3	75.0 (7.1)
Greece	61.4	1,955	50.4	73.8 (6.9)
All 10 countries	61.8	18,227	50.7	74.3 (6.9)

Notes: SHARE = Survey of Health, Aging and Retirement in Europe.

*Accounting for the primary sampling unit, the strata, and the calibrated individual weight.

Netherlands, Spain, Sweden, and Switzerland. Probability samples were selected in each country, using sampling techniques adapted to the local conditions (17). Baseline data were collected from 24,690 individuals living in households that included at least one member who was 50 years of age or older. All household members in this age category and their spouses of whatever age were eligible; some countries also included institutionalized individuals. The overall response rate was 61.8% (Table 1), varying across countries from 50.2% to 73.6%, except in Switzerland, which had a particularly low response rate (37.6%) (18).

After excluding 5,431 individuals from additional samples drawn in some countries for a supplementary survey, 674 spouses younger than 50 years, 295 individuals living in institutions, 61 with insufficient information on sampling characteristics, and 2 nonevaluable individuals, 18,227 community-dwelling individuals were eligible for analysis.

Data Collection and Measurements

The survey was based on standardized computer-assisted face-to-face personal interviews conducted by trained (19) and supervised interviewers using a common questionnaire translated from a generic English version (available online at <http://www.share-project.org/>) (20). Interviews were supplemented by measurements of handgrip strength in all participants and a 2.5-m walking test in participants 75 years of age and older.

Variables Definition

Frailty and prefrailty were defined on the basis of the five dimensions in a phenotype described by Fried and associates (4). However, operationalization of these dimensions required adaptation to our survey contents. Exhaustion was identified as a positive response to the question, “In the last month, have you had too little energy to do things you wanted to do? (yes/no).” The shrinking criterion was fulfilled by reporting a “diminution in desire for food” in response to the question, “What has your appetite been like”

or, in the case of an uncodable response to this question, by responding “less” to the following question: “So have you been eating more or less than usual?” Weakness was derived from the highest of four consecutive dynamometer measurements of handgrip strength (two from each hand), applying gender and body mass index cutoffs set by Fried and associates. Because SHARE measured walking speed only in individuals 75 years of age and older, slowness was defined using mobility questions, after previous analysis showed a strong relationship between low speed and positive answers to either of the following two items: “Because of a health problem, do you have difficulty [expected to last more than 3 months] walking 100 meters” or “... climbing one flight of stairs without resting” (21). The low activity criterion was fulfilled in participants responding “one to three times a month” or “hardly ever or never” to the question, “How often do you engage in activities that require a low or moderate level of energy such as gardening, cleaning the car, or going for a walk?.” One point was allocated for each fulfilled criterion; individuals with zero points were classified as nonfrail, with one or two points as prefrail and with three to five points as frail. Participants with health-related difficulties in one or more of the five Katz basic activities of daily living (eating, bathing or showering, dressing, transferring, using the toilet) for at least 3 months were considered disabled.

Statistical Analysis

A cross-sectional analysis of SHARE wave 1 (baseline) was performed with Stata 9.0 version 2.0.1, which includes design weights for multistage sampling design and calibration to population totals within countries to reflect national populations (17). Population characteristics in middle (50–64 years) and old (65+ years) ages were first described overall and in each country by computing the prevalence estimates with 95% confidence intervals (CIs). International differences in the prevalences of frailty and prefrailty were then explored in the subset of older individuals (65+ years) without disability using multivariate logistic regression

models, adjusting first only for gender and age (in years) and then for both demographics and education (number of years) as an indicator of socioeconomic status; the outcome was frailty in Model 1, and either prefrailty or frailty in Model 2. Germany was chosen as the reference country, based on both statistical (large sample size) and geographical (central location in Europe) considerations. Adjusted odds ratios and 95% CIs were calculated for country effects. The significance level was set at $p < .01$ to account for multiple comparisons during interpretation. Results are presented for countries sorted from north to south based on their mean latitude.

RESULTS

Of 18,227 participants 50 years of age and older, 9.0% had missing information on one or two dimensions of frailty, leaving 16,584 participants for analysis. In the middle-aged population, 4.1% (95% CI 3.4–4.7) were frail and 37.4% (35.8–39.1) were prefrail. A sensitivity analysis conducted on 18,227 observations with imputation of zero for up to two missing values on frailty criteria produced slightly higher estimates of the prevalence of frailty and prefrailty, with differences never exceeding 1.7% in both age categories (data not shown, results available upon request). Women were more frequently frail and prefrail (5.2% [4.3–6.1] and 42.0% [40.0–44.0], respectively) than men (2.9% [2.0–3.8] and 32.7% [30.5–34.9], respectively; $p < .001$). In the 65+ group, 17.0% (15.3–18.7) were frail and 42.3% (40.5–44.1) prefrail, with frailty and prefrailty noted in 21.0% (18.6–23.3) and 42.7% (40.2–45.1), respectively, of women, and in 11.9% (10.3–13.6) and 41.9% (39.5–44.2), respectively, of men ($p < .001$).

Table 2 shows significant country differences in the prevalences of frailty criteria and frailty status. In both age categories, frailty and prefrailty were particularly frequent in Spain and, to a lesser extent, in Italy. All frailty criteria except low physical activity had a higher prevalence in Spain. Weakness, slowness, and low physical activity were frequent in Italy in the 65+ group. In contrast, Sweden and Switzerland were characterized by a low prevalence of frailty. Their profiles were particularly favorable in the dimensions of slowness and physical activity.

Table 2 also shows differences in the prevalence of disability for those in the 65+ group, ranging from 8.4% in Austria to more than 16.2% in Italy. Figure 1 indicates a high prevalence of frailty in southern countries (Spain, Italy, France, and Greece). A high frequency of disability was also recorded for Spain, Italy, and France (Table 2). However, in the nondisabled population, frailty was again found to be more common in southern Europe (21.0% in Spain, 14.3% in Italy, 11.3% in Greece, 9.3% in France), whereas its prevalence was lower than 9.0% in all other countries (Figure 2). Prefrailty was also most frequent in Spain, Italy, and Greece.

Table 3 (upper) shows unadjusted country effects. In adjusted multivariate analysis controlling for demographics only, these effects did not change substantially (data not shown, available upon request): Frailty remained more frequent in Spain and Italy and less frequent in Switzerland as compared with Germany (Model 1). In contrast, the four southernmost European countries included in SHARE had a higher age- and gender-adjusted proportion with signs of prefrailty or frailty (Model 2). However, the estimates of country effects changed markedly after simultaneously adjusting for gender, age, and education (Table 3, lower panel). In both models, women were more likely to be frail than men and increasing age positively influenced the probability of frailty, whereas additional years of education had a negative effect on this probability. After adjusting for demographics and education, only Sweden and Switzerland still had a significantly different prevalence of frailty than the reference country at $p < .01$ (Model 1). The combined prevalence of prefrailty and frailty (Model 2) was not lower in Sweden and Switzerland but was significantly higher in Spain and Italy.

DISCUSSION

Data from SHARE showed that signs of frailty were not rare in the middle-aged and were frequent in the older-aged community-dwelling population in Europe. The data also showed between-country differences in the distribution of a frailty phenotype. This survey was based on a large probability sample that included 50- to 64-year-old individuals, a group for which few studies provide estimates of frailty, and it relied on a standardized instrument, thus permitting international comparisons.

The prevalence of frailty in SHARE was higher than expected from reports of the landmark Cardiovascular Health Study (65+ years: men 4.9%, women 7.3% frail) (4), the *Invecchiare in Chianti* study (65+ years: 8.8% frail) (14), the Osteoporotic Fractures in Men study (65+ years: 4% frail) (13), the Women's Health and Aging Studies (70–79 years: 11.3% frail) (5), the Women's Health Initiative study (65–79 years: 16.3% frail) (6), or the Study of Osteoporotic Fractures (69+ years: 16.3% frail) (11,12). However, other studies found higher estimates, such as the Hispanic Established Populations for the Epidemiologic Studies of the Elderly study (70+ years: 20%) (22) and the Massachusetts Male Aging Study (70–79 years: 11.0%; 80–86 years: 36.5%) (23). Variations across studies may be due to methodological differences that preclude direct comparison of the results. One variation is the protocol for excluding individuals with health conditions potentially related to frailty. SHARE did not exclude individuals on the basis of selected diseases, which could have resulted in higher proportions of frailty. A different operationalization of the dimensions of the frailty phenotype identified by Fried and associates could be another reason for variations in the estimated prevalence of

Table 2. Prevalence of Frailty and Disability in Community-Dwelling Population, by Country and Age Category (weighted proportion and 95% confidence interval)

	10 Countries	Sweden	Denmark	The Netherlands	Germany	Austria	Switzerland	France	Italy	Spain	Greece
Age 50–64 y (n)	9,074	1,038	877	1,261	1,146	849	470	803	958	733	939
Frailty criteria											
Exhaustion	27.3 (25.8–29.9)	31.6 (28.5–34.6)	30.8 (27.6–34.1)	23.6 (20.7–26.5)	20.4 (17.3–23.6)	20.5 (17.6–23.5)	25.4 (21.3–29.4)	30.0 (26.0–33.9)	29.8 (25.7–34.0)	38.4 (34.3–42.4)	22.0 (19.2–24.8)
Shrinking	5.2 (4.6–5.9)	5.2 (3.7–6.7)	5.9 (4.1–7.7)	4.1 (2.3–6.0)	3.4 (2.2–4.7)	5.9 (4.2–7.6)	5.2 (3.1–7.3)	6.7 (5.0–8.4)	4.4 (2.9–5.9)	8.9 (6.7–11.0)	4.2 (2.8–5.5)
Weakness	6.1 (5.3–6.8)	4.5 (3.1–5.9)	3.1 (1.9–4.4)	4.7 (3.6–5.8)	3.9 (2.6–5.2)	3.5 (2.2–4.7)	2.5 (1.1–4.0)	4.6 (3.0–6.3)	7.2 (5.2–9.3)	13.9 (11.1–16.6)	5.7 (4.2–7.2)
Slowness	6.7 (5.8–7.6)	2.9 (1.8–4.0)	5.5 (3.9–7.1)	7.3 (5.5–9.1)	5.9 (3.6–8.2)	6.5 (4.5–8.5)	3.9 (2.0–5.8)	4.3 (2.7–5.9)	8.8 (6.7–10.9)	9.5 (7.0–11.9)	8.6 (6.7–10.4)
Low activity	13.8 (12.3–15.3)	4.5 (3.1–5.8)	6.3 (4.6–8.1)	8.8 (6.7–10.8)	9.6 (7.0–12.3)	13.6 (10.7–16.5)	11.2 (8.1–14.3)	14.8 (12.1–17.5)	24.7 (19.6–29.7)	11.8 (8.8–14.7)	10.9 (8.9–13.0)
Frailty status											
Prefrailty	37.4 (35.8–39.1)	35.9 (32.8–39.1)	34.9 (31.5–38.3)	30.8 (27.1–34.5)	30.9 (27.3–34.5)	30.4 (26.7–34.2)	36.1 (31.4–40.7)	40.3 (36.6–44.0)	43.5 (39.4–47.7)	44.9 (40.7–49.0)	33.5 (30.3–36.8)
Frailty	4.1 (3.4–4.7)	1.9 (1.1–2.8)	3.0 (1.8–4.2)	3.5 (2.4–4.7)	2.6 (1.5–3.8)	3.9 (2.6–5.2)	1.3 (0.3–2.2)	3.2 (1.9–4.5)	5.9 (4.1–7.7)	7.5 (5.5–9.5)	2.8 (1.7–3.9)
Disability											
BADL* difficulty	4.5 (3.9–5.2)	4.7 (3.3–6.1)	5.8 (4.2–7.4)	3.7 (2.4–5.0)	4.3 (2.8–5.8)	4.4 (2.8–6.1)	3.4 (1.6–5.2)	5.2 (3.5–6.9)	3.9 (2.4–5.4)	6.0 (4.1–8.0)	2.6 (1.5–3.6)
Age 65+ y (n)	7,510	873	635	830	933	707	412	687	833	816	784
Frailty criteria											
Exhaustion	36.7 (34.7–38.7)	39.1 (35.5–42.7)	32.9 (29.0–36.8)	28.9 (24.5–33.3)	30.0 (25.5–34.4)	27.6 (23.3–31.9)	28.0 (23.6–32.5)	36.4 (32.6–40.3)	38.4 (33.3–43.6)	54.5 (50.1–59.0)	29.8 (26.5–33.1)
Shrinking	11.1 (9.8–12.4)	8.8 (6.7–10.9)	8.4 (6.1–10.6)	6.8 (5.2–8.4)	8.0 (5.2–10.9)	6.9 (4.7–9.1)	5.0 (2.9–7.1)	9.5 (7.1–11.9)	13.4 (10.0–16.8)	19.2 (15.9–22.5)	10.8 (8.7–13.0)
Weakness	26.3 (24.4–28.3)	17.9 (15.0–20.7)	16.9 (13.7–20.0)	17.8 (14.2–21.4)	15.1 (12.0–18.2)	13.6 (10.4–16.8)	16.7 (13.0–20.5)	22.7 (19.2–26.2)	38.1 (32.0–44.1)	44.0 (39.8–48.2)	27.3 (24.1–30.6)
Slowness	22.7 (20.9–24.6)	12.7 (10.2–15.2)	19.5 (16.2–22.8)	19.9 (16.7–23.0)	18.7 (15.0–22.4)	18.9 (14.7–23.1)	10.3 (7.2–13.4)	20.7 (17.1–24.3)	28.1 (23.1–33.2)	29.3 (25.2–33.4)	27.6 (24.4–30.8)
Low activity	21.3 (19.2–23.4)	10.3 (8.0–12.5)	14.1 (11.2–17.1)	16.9 (13.5–20.3)	15.7 (12.4–19.0)	24.8 (19.1–30.5)	15.5 (11.7–19.3)	22.6 (19.0–26.2)	30.1 (23.2–37.0)	22.9 (19.1–26.7)	17.3 (14.6–20.0)
Frailty status											
Prefrailty	42.3 (40.5–44.1)	45.3 (41.8–48.9)	38.4 (34.5–42.3)	38.5 (34.4–42.7)	34.6 (31.1–38.1)	40.7 (36.5–45.0)	46.5 (41.5–51.4)	43.6 (39.6–47.6)	45.6 (40.7–50.5)	50.9 (46.8–55.1)	44.9 (41.4–48.4)
Frailty	17.0 (15.3–18.7)	8.6 (6.5–10.8)	12.4 (9.6–15.1)	11.3 (9.0–13.5)	12.1 (8.8–15.3)	10.8 (8.0–13.5)	5.8 (3.5–8.1)	15.0 (12.2–17.8)	23.0 (18.0–28.0)	27.3 (23.5–31.0)	14.7 (12.2–17.3)
Disability											
BADL* difficulty	13.5 (12.2–14.7)	11.1 (8.7–13.5)	11.8 (9.1–14.5)	9.0 (7.1–10.9)	11.4 (8.6–14.1)	8.4 (6.1–10.7)	9.9 (7.0–12.7)	16.1 (13.1–19.2)	16.2 (13.0–19.3)	14.1 (11.0–17.2)	9.5 (7.4–11.6)

Note: * Basic activities of daily living: bathing or showering, dressing, eating, getting in and out of bed, using the toilet.

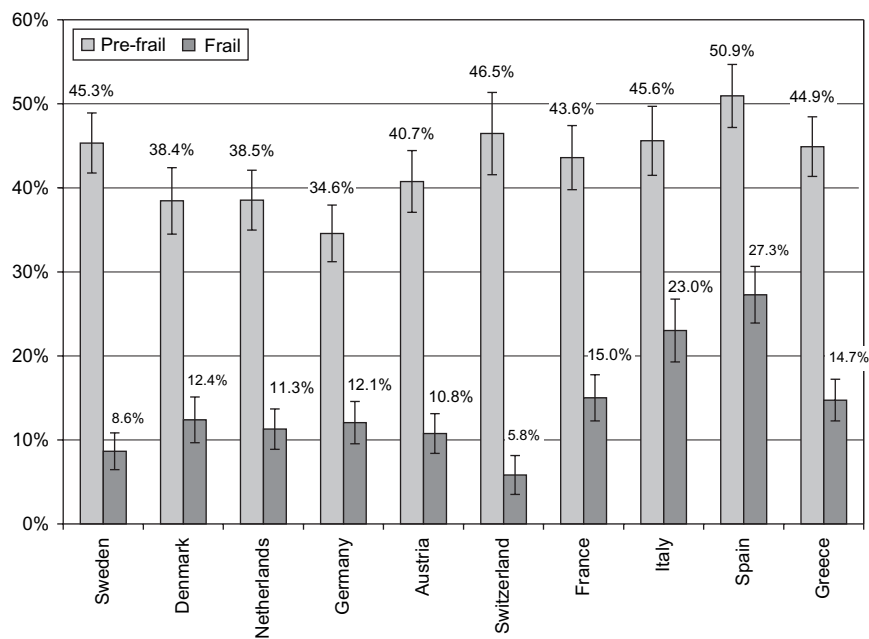


Figure 1. Percentage of the 65 years and older community-dwelling population classified as prefrail and frail by country (weighted results).

prefrailty and frailty. Criteria in SHARE were not identical to those defined in the Cardiovascular Health Study, except for weakness (4), and may be less specific, leading to higher prevalence estimates particularly for exhaustion, which was common in the SHARE population. The longitudinal design of SHARE will permit verification of the predictive validity of frailty criteria assessed in this survey. A third methodological difference is the treatment of missing information. In the Cardiovascular Health Study, participants with missing information for less than two frailty components were

considered evaluable, whereas SHARE data were analyzed only for participants with complete data for all components. The sensitivity analysis conducted on SHARE data showed that imputation tends to decrease the estimated proportion of nonfrail slightly; however, this effect was negligible.

Variations between European countries in the frequency of frailty are consistent with previous findings of a north-south gradient characterizing other health indicators in SHARE (16). Lower rates of institutionalization of older disabled persons in southern countries may be one explanation

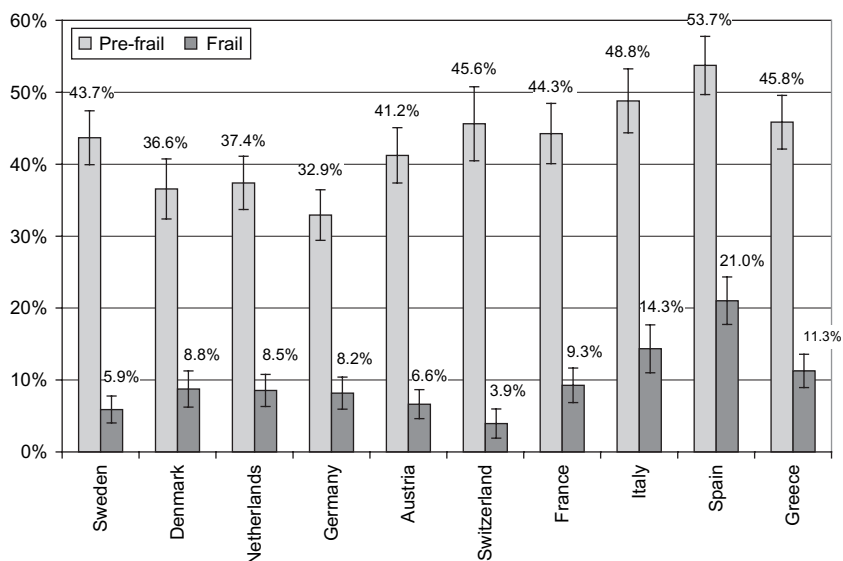


Figure 2. Percentage of the 65 years and older community-dwelling population without disability classified as prefrail and frail by country (weighted results).

Table 3. Country Effects on Frailty in the 65 Years and Older Community-Dwelling Population Without Disability (weighted results)

	Model 1 Outcome: Frail		Model 2 Outcome: Prefrail or Frail	
	OR (95% CI)	p Value	OR (95% CI)	p Value
Unadjusted				
Sweden	0.70 (0.45–1.10)	.126	1.41 (1.14–1.74)	.002
Denmark	1.08 (0.70–1.66)	.738	1.19 (0.94–1.49)	.144
The Netherlands	1.05 (0.69–1.58)	.822	1.22 (0.98–1.51)	.073
Austria	0.80 (0.52–1.24)	.316	1.32 (1.06–1.64)	.014
Switzerland	0.46 (0.25–0.85)	.013	1.41 (1.09–1.82)	.009
France	1.14 (0.76–1.73)	.521	1.65 (1.31–2.07)	.000
Italy	1.88 (1.26–2.81)	.002	2.46 (1.94–3.12)	.000
Spain	2.99 (2.09–4.27)	.000	4.24 (3.34–5.39)	.000
Greece	1.42 (0.98–2.08)	.066	1.91 (1.54–2.36)	.000
Adjusted for				
Gender (women)	1.58 (1.23–2.04)	.000	1.25 (1.07–1.45)	.005
Age, y	1.08 (1.06–1.10)	.000	1.08 (1.07–1.10)	.000
Education, y	0.91 (0.88–0.94)	.000	0.93 (0.91–0.95)	.000
Sweden	0.44 (0.27–0.70)	.001	0.97 (0.77–1.23)	.830
Denmark	0.80 (0.51–1.25)	.329	0.97 (0.76–1.23)	.791
The Netherlands	0.76 (0.49–1.17)	.212	0.95 (0.75–1.20)	.661
Austria	0.64 (0.41–1.01)	.055	1.11 (0.88–1.40)	.367
Switzerland	0.31 (0.16–0.60)	.000	1.16 (0.88–1.53)	.297
France	0.58 (0.35–0.96)	.033	1.06 (0.82–1.38)	.654
Italy	0.99 (0.59–1.65)	.961	1.59 (1.19–2.13)	.002
Spain	1.28 (0.78–2.10)	.333	2.32 (1.72–3.13)	.000
Greece	0.72 (0.44–1.17)	.187	1.22 (0.94–1.58)	.134

Note: CI = confidence interval; OR = odds ratio. Germany is the reference country.

for a higher prevalence of frailty in their communities because frailty is strongly associated with disability. Organization for Economic Co-operation and Development's statistics (24) indicated that there were 14.8 long-term care beds per 1,000 inhabitants 65 years of age and older in Italy and 77.9 in Sweden in 2003; however, we found that France ranked high in both long-term care bed density and frailty prevalence. Moreover, higher levels of frailty were also observed in the older nondisabled population and in the middle-aged population of southern countries. In contrast, a lower frequency of frailty was noted in Switzerland and Sweden. Low participation may explain the favorable health indicators found for Switzerland, based on the assumption that the fittest are more likely to participate in surveys. However, similar participation rates in Sweden, Spain, and Italy make this explanation less likely to account for the differences in frailty prevalence among these three countries. Like most other studies, we found a higher prevalence of frailty in women and in older-aged people. However, in between countries differences persisted after controlling for age and gender. Differences could also result from cultural characteristics influencing the perception of health or from misunderstandings due to language differences despite considerable efforts invested in translation. However, although this explanation cannot be completely discarded, we found that objectively measured low grip strength contributed to the higher prevalence of frailty in Spain and Italy.

Although demographic characteristics did not explain international differences in frailty, we found a strong relation-

ship between education and frailty, and an attenuation of country effects after adjusting for this factor. This illustrates the need to integrate nonmedical factors when studying the epidemiology of frailty. Although caution should be exercised when interpreting our results due to the cross-sectional study design, our data also suggest that education may protect from frailty at an individual level. This converges with recent reports of a negative relationship between the level of education and the frequency of cognitive disorders in later life. Future studies should examine the extent to which differences in frailty between European countries mirror differences in the prevalence of cognitive impairments.

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