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15 Transitions between frailty states – a European comparison

- Frailty trajectory is not a linear process but a dynamic one with room for improvement
- Men and women experience different patterns of frailty transitions
- Physical activity prevents the decline of frailty states and facilitates frailty states improvement
- A North-South gradient was observed in the probability to decline toward a worse frailty state

The unprecedented increase in life expectancy means that the number of young-old and old-old citizens will dramatically increase. However, individuals aged 50+ are much more vulnerable. They are more likely to experience negative events such as hospitalisation, institutionalisation, disability, or even death. The increase in the number of seniors impacts the sustainability of health and social security systems. Therefore, the development of effective interventions based on active ageing and inter-individual solidarity to prevent, delay, and reduce the collateral consequences of ageing is a challenge for any ageing society.

This chapter examines the evolution of physical vulnerability among older individuals from a frailty perspective. The concept of frailty appeared in the geriatric literature 20 years ago to define physical decline due to ageing (Spini et al. 2007: 572). It refers to a complex phenomenon recognised as geriatric syndrome, which is distinct from disability and comorbidity, resulting from a gradual and inevitable decline in reserve capacity, affecting different physiologic systems as people age (Fried & Walston 2003: 1489–1490, Spini et al. 2007: 573–575). In other words, physiological systems are wearing out as people age. The fact that many systems become disturbed reduces and weakens resilience capacities. This leads to a loss of homeostasis, which means that the body is not anymore able to react properly to environmental changes in order to maintain itself in the condition so that all organs can function properly.

Although frailty is a gradual dynamic process, few studies have adopted a longitudinal perspective (Guilley et al. 2008: 301, Etman et al. 2012: 1116–1117, Sirven 2012: 9–12). Recent longitudinal studies established that several sociodemographic determinants such as age, gender, and social inequalities affect the frailty process. Older individuals are more likely to become frail. Women are more affected than men by physical decline, and their trajectories in older age often take a more dramatic turn compared to men. And finally, the evolution of frailty is related to financial condition; poorer individuals are more likely to become frail when they get older (Sirven 2012: 23).

One of the most common recommendations to prevent and delay the onset of frailty is physical exercise, which is considered one of the most effective prevention tools against frailty (Fried 2011:1–2). Designing new ways to keep people active and socially engaged would be a major political measure to prepare against what the American National Institute of Ageing characterised as a "silver tsunami" (Fox et al. 2001 in Fried & Hall 2008: 1791).

Based on the theoretical background presented above, this research aims to offer more insights into the way people's frailty state evolves over time. Using the SHARE data from Wave 2 and Wave 4, we examine first to what extent sociodemographic determinants and more specifically living arrangements and gender are related to different evolution patterns, and second to what extent engagement in regular physical exercise prevents the transition toward worse frailty states. These findings will contribute to the broader literature on the relation between socio-determinants and frailty transitions patterns in older age among European countries.

15.1 Sample, measures and methods

15.1.1 Sample

The study population consists of the 15,776 participants who took part in the second and fourth waves of the SHARE survey. We selected individuals aged 50+ for whom complete information on frailty state at both waves and on all variables considered in the analyses was available.

15.1.2 Measurement of frailty state and frailty transitions

Our dependent variable is the evolution of frailty states between Wave 2 and Wave 4. There are different operational definitions of frailty in the literature (Levers et al. 2006: 284–287). For the current paper, we followed the definition proposed by Fried and Walston (2003: 1489–1490) and adapted for the SHARE survey by Santos-Eggimann et al. (2009: 676). Frailty is defined on the basis of the five following dimensions: 1) shrinking, 2) exhaustion, 3) low physical activity, 4) muscle weakness, and 5) slow walking speed. *Shrinking* refers to the self-report of appetite loss. *Exhaustion* refers to the self-report of poor endurance and lack of energy during the month preceding the interview. *Low physical activity* refers to individuals who rarely or never engaged in activities that required a low or moderate level of energy such as gardening, cleaning the car, or going for a walk. *Muscle weakness* is based on grip strength measures. This dimension was fulfilled when

a respondent's score was in the lowest 20 per cent, applying cut-offs based on gender and body mass index. *Slow walking speed* is operationalised by a question that asks participants whether they experienced difficulty (expected to last more than 3 months) walking 100 meters and/or climbing one flight of stairs because of a health problem. Based on the number of fulfilled dimensions, respondents were considered non-frail (zero dimensions), pre-frail (one or two dimensions), or frail (three or more dimensions).

Then, based on this categorisation – non-frail, pre-frail, frail – two dummy variables were computed to capture the transitions of frailty states between Waves 2 and 4. The first dummy variable identifies people who experienced a transition toward a worse frailty state or died (0= no change and 1=got worse or died) and the second dummy variable identifies individuals whose frailty state improved over time (0= no change and 1 = improved).

Of the 15,776 participants, 6,713 (42.5 %) showed a transition toward another frailty state. Transitions toward a worse frailty state (N=4,325; 27.4 %) were more likely than transitions toward a better frailty state (N=2,388; 15.1 %). Table 15.1 details the transition patterns observed between Wave 2 and Wave 4.

Table 15.1: Frequency of the different frailty transition patterns between Waves 2 and 4

Frailty state at: Wave 2	Wave 4	Layer %	Total %	N
Non-frail to…				
	Non-frail	63.4	34.6	5,461
	Pre-frail	31.7	17.3	2,733
	Frail	2.6	1.4	224
	Deceased	2.2	1.2	191
	SUBTOTAL	100.0	54.6	8,609
Pre-frail to…				
	Non-frail	32.4	12.8	2,012
	Pre-frail	51.3	20.2	3,282
	Frail	11.6	4.6	719
	Deceased	4.6	1.8	288
	SUBTOTAL	100.0	39.3	6,201
Frail to…				
	Non-frail	7.0	0.4	68
	Pre-frail	31.9	2.0	308
	Frail	43.5	2.7	420
	Deceased	17.6	1.1	170
	SUBTOTAL	100.0	6.1	966

Notes: Excluding individuals younger than 50 years old
Source: SHARE Wave 2 release 2.5.0; Wave 4 release 1

At Wave 2, 8,609 participants were non-frail. Most of them remained non-frail at Wave 4 (63.4 %). In case of health decline, transition toward pre-frailty (31.7 %) was much more likely than transition toward frailty (2.6 %) or death (2.2 %).

At Wave 2, 6,201 participants were pre-frail. The majority of them remained pre-frail at Wave 4 (51.3 %). The health state of a non-negligible number of participants improved over time, moving from pre-frailty to non-frailty (32.4 %), whereas a minority of them declined, moving from pre-frailty to frailty (11.6 %) or death (4.6 %).

Finally, 966 individuals were frail at Wave 2. The majority of them remained frail at Wave 4 (43.5 %). Again, a non-negligible number of frail individuals improved over time, moving from frailty to pre-frailty (31.9 %) or non-frailty (7.0 %), whereas about one fifth died (17.6 %).

Our descriptive results show that individuals are more likely to experience a transition toward a worse frailty state than toward a better frailty state. This is not surprising given the fact that panel participants are getting older and more exposed to physiological degenerative processes (see Andersen-Ranberg et al. in this volume). The descriptive results also show that a non-negligible number of individuals improve over time. This is in line with the literature and confirms that the frailty process is not a linear one but a dynamic one with space for improvement. Individuals who get pre-frail might still have enough resources to recover from their health decline. However, the literature shows that individuals who were already once pre-frail are more likely to get pre-frail again and to further decline toward frailty (Spini et al. 2007: 576–577).

15.1.3 Individual characteristics considered in the analyses

The individual characteristics of interest were (1) gender (male=1), (2) living arrangement, and (3) regular physical exercise at baseline. *Living arrangement* refers to whether people live alone, coded 1, or with a spouse or partner, coded 0. *Regular physical exercise* refers to individuals who engage in vigorous physical activity, such as sports, heavy housework, or a job that involves physical labour at least once a month, coded 1.

Analyses were controlled for age, years of education, chronic diseases, income, frailty state at baseline, and country. Chronic diseases were measured by a dichotomous variable where 0 refers to individuals who had no chronic diseases and 1 to individuals who indicated one or more chronic diseases. Income information is based on the total annual household income adjusted for household size by dividing the value of income following the OECD (1982) equivalent-scale and categorised into country-specific tertiles. Twelve countries were part of the

analyses: Sweden, Denmark, Germany, Netherlands, Belgium, France, Switzerland, Austria, Spain, Italy, Poland, Czech Republic. Each country was compared to the mean of the overall sample.

15.1.4 The statistical analyses

We used logistic regressions to model four-year changes in frailty state as a function of (1) gender, (2) living arrangement, and (3) regular physical exercise and controlled for age, years of education, chronic diseases, income, frailty state at baseline and country. We used "no change" in frailty state as a reference category. Interaction terms between frailty state at baseline and each of the variables of interest were introduced one by one. No weights were used.

15.2 Results

15.2.1 The relationship between gender and frailty transitions

Figure 15.1 (left-hand panel) shows that men who were non-frail at baseline were less likely to move toward a worse frailty state compared to non-frail females at baseline (Odds Ratio (OR) = 0.81; 95 per cent confidence interval (CI) 0.73 to 0.88). However, this advantage among men disappears for pre-frail and frail individuals at baseline. Indeed, men who were pre-frail at baseline were more likely to pass to a worse frailty state compared to pre-frail women at baseline (OR=1.26; 95 per cent CI 1.08 to 1.46), and men who were frail at baseline were more likely to die compared to frail women at baseline (OR= 2.51; 95 per cent CI 1.70 to 3.70).

However, even though pre-frail and frail men were more likely to move toward a worse frailty state, they were also more likely to move toward a better frailty state (right-hand panel of Figure 15.1, OR= 1.35; 95 per cent CI 1.21 to 1.51).

These results show that the frailty process differs for men and women. In line with the literature, they suggest that women experience a smoother decline, living longer in a sort of intermediary health state, whereas men live longer in a good health, recovering more often from slight health declines, but declining rapidly once reaching a certain point.

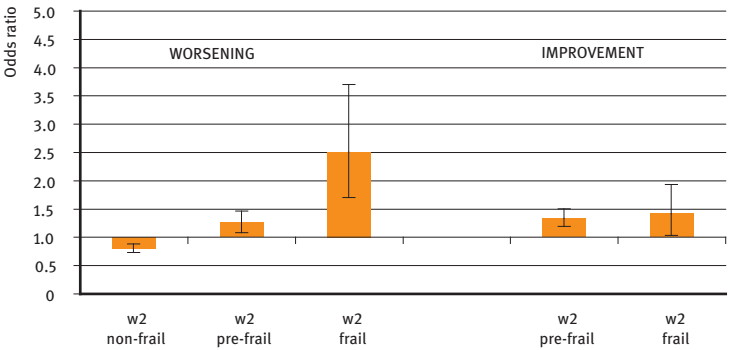


Figure 15.1: Odds ratio comparing men and women (ref.) with respect to their probability to move toward a worse versus better frailty state according to their baseline frailty state
Notes: Logistic regressions were controlled for age, years of education, chronic diseases, income, frailty state at baseline, and country (Sweden, Denmark, Germany, Netherlands, Belgium, France, Switzerland, Austria, Spain, Italy, Poland, and Czech Republic). Worsening: N=13,388; Improvement: N=5,990.
Source: SHARE Wave 2 release 2.5.0; Wave 4 release 1

15.2.2 The relationship between living arrangement and frailty transitions

Figure 15.2 shows that non-frail individuals who live alone were more likely to move toward a worse frailty state compared to non-frail individuals who live with a partner or a spouse (OR=1.15; 95 per cent CI 1.02 to 1.29). This difference turned out to be non-significant for pre-frail and frail individuals regardless of whether they experienced a transition toward a worse or a better frailty state.

This result is consistent with the literature showing that social networks are positively linked to self-rated health (see Deindl et al. in this volume) and physical health. An explanation might be that social contacts facilitate healthier behaviours such as exercise or eating healthy. They might also promote adherence to medical regimes and thus maximises adaptation and recovery from illness. Finally, social network availability influences psychological processes like mood, depression, and self-esteem, which in turn might influence people's general physical health state. However according to our results this protective effect seems to be significant only at the early stage of the frailty process.

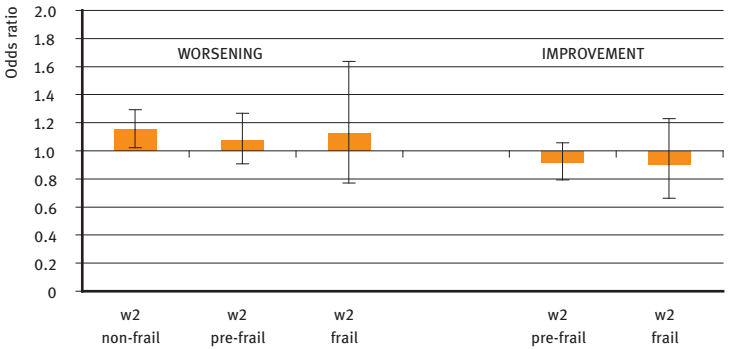


Figure 15.2: Odds ratio comparing individuals living alone and individuals living with a partner (ref.) with respect to their probability to move toward a worse versus better frailty state according to their baseline frailty state
Notes: Logistic regressions were controlled for age, years of education, chronic diseases, income, frailty state at baseline, and country (Sweden, Denmark, Germany, Netherlands, Belgium, France, Switzerland, Austria, Spain, Italy, Poland, and Czech Republic). Worsening: N=13,388; Improvement: N=5,990.
Source: SHARE Wave 2 release 2.5.0; Wave 4 release 1

15.2.3 Regular physical exercise lowers the risk of becoming frail

Figure 15.3 (left-hand panel) shows that individuals who engage in regular physical exercise at baseline were less likely to move toward a worse frailty state four years later (OR=0.75; 95 per cent CI 0.81 to 0.69). However the impact of regular physical exercise was stronger for individuals who were pre-frail at baseline (OR= 0.55; 95 per cent CI 0.48 to 0.65) than for individuals who were non-frail (OR=0.85; 95 per cent CI 0.77 to 0.94) or frail (OR=0.68; 95 per cent CI 0.32 to 1.41) at baseline.

Similarly, Figure 15.3 (right-hand panel) shows that individuals who engage regularly in physical exercise at baseline were more likely to move toward a better frailty state four years later (OR=1.23; 95 per cent CI 1.10 to 1.38). However, the impact of regular physical exercise was stronger for individuals who were frail at baseline (OR=1.81; 95 per cent CI 1.20 to 2.75) than for individuals who were pre-frail at baseline (OR= 1.19; 95 per cent CI 1.06 to 1.34).

These results are consistent with Fried's assertion (2011) that regular physical exercise might be one of the most promising preventive interventions against frailty. Indeed, our results show that regular physical exercise was associated with a lower probability to pass to a worse frailty state and with a higher probability to pass to a better frailty state.

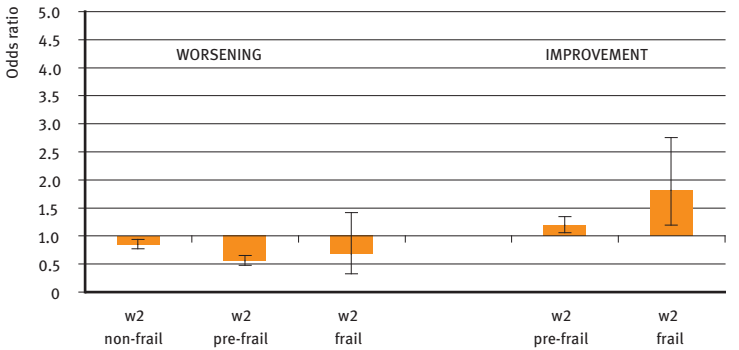


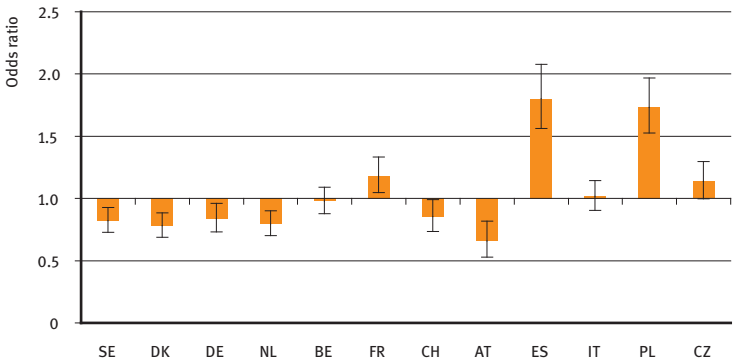
Figure 15.3: Odds ratio comparing individuals' engagement in regular physical exercise or inactive individuals (ref.) with respect to their probability to move toward a worse versus better frailty state according to their baseline frailty state
Notes: Logistic regressions were controlled for age, years of education, chronic diseases, income, frailty state at baseline, and country (Sweden, Denmark, Germany, Netherlands, Belgium, France, Switzerland, Austria, Spain, Italy, Poland, and Czech Republic). Worsening: N=13,388; Improvement: N=5,990.
Source: SHARE Wave 2 release 2.5.0; Wave 4 release 1

15.2.4 Variations of frailty transitions across European countries

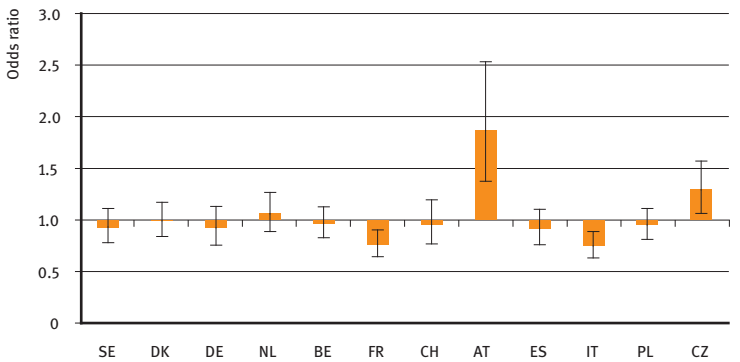
Country level probabilities of transitions toward worse versus better frailty states were compared to the average probability of the overall sample. Figure 15.4a shows that the probability to experience a transition toward a worse frailty state after four years varies from one country to another. Individuals living in the Northern countries (Sweden, Denmark, Germany, and Netherlands) were less likely to experience a transition toward a worse frailty state. This was also the case for individuals living in Switzerland and Austria. In contrast, individuals living in France, Italy and Poland were more likely to move toward a worse frailty state.

The differences between countries were attenuated when looking at the probability to move toward a better frailty state as shown by the Figure 15.4b. Only the Czech Republic, Italy and France significantly differed from the average. Italians and French were less likely and Czechs were more likely to move toward a better frailty state than the average.

We hypothesised that people's health state would decline more rapidly in some countries because sport was less widespread in these countries, as shown by the Eurobarometer Survey on Sport and Physical Activity (2010: 10–18) and because, as demonstrated by our analyses, regular physical exercise was signifi-



(a) Odds ratio comparing the country level probability to move toward a worse frailty state to the probability of the overall sample (N=13,388)



(b) Odds ratio comparing the country level probability to move toward a better frailty state to the probability of the overall sample (N=5,990)

Figure 15.4: Country specific transitions patterns
Notes: Logistic regressions were controlled for age, years of education, chronic diseases, income and frailty state at baseline.
Source: SHARE Wave 2 release 2.5.0; Wave 4 release 1

cantly related to the evolution of frailty. However, sport did not mediate differences between countries in our analyses. Other authors explained this North-South gradient in frailty state by differences in rates of institutionalisation around Europe (Santos-Eggiman et al. 2009: 680). As far as frailty is associated with disability, the higher prevalence of frailty in the Southern Europe might be due to a lower rate of institutionalisation compared to Central and Northern Europe.

15.3 Principal results and general discussion

Individuals aged 50+ experience a lot of new life course transitions (e. g. transition to retirement, to grandparenthood, to frailty, disease and disability). SHARE is a unique longitudinal data source which gives researchers the opportunity to better understand the processes underlying these important life course transitions and provide scientific based information to develop targeted prevention and intervention campaigns.

In this regard, this contribution examined the evolution of frailty among individuals who participated to the second and the fourth wave of SHARE. We first reported the different frailty transition patterns that were observed in this sample. The descriptive results suggest that frailty trajectories are not a linear process but a dynamic one with room for improvement. Indeed, a substantial percentage of participants who were already pre-frail or frail at baseline experienced an improvement of their physical health state. Future studies should examine more closely this process by considering for instance more than two measurement points.

In a second step, we used logistic regressions to test to what extent sociodemographic variables and regular physical exercise were related to different frailty transition patterns. First of all, our results showed gender-specific frailty transition patterns. The results suggest that women might experience a smoother decline, living longer in an intermediary health state, compared to men who live longer in a good health condition, recovering more often from slight health declines, but declining rapidly once reaching a certain threshold. The next step would be to further investigate the reasons underlying these differences and to model terminal drop or terminal health decline by gender.

Living arrangement was also related to frailty transition patterns, but only among individuals who were non-frail at baseline. Non-frail people at baseline who live alone were more likely to decline than non-frail individuals living with a spouse or a partner. One explanation might be that people living with someone have more social resources, which help them maintain a stable and good health state and motivates them to remain active or to adopt health-promoting behaviors. Future studies need to investigate further why living arrangement matters only for the specific group of non-frail individuals.

With respect to regular physical exercise, the results showed that individuals engaging in vigorous physical exercise at least once a month were less likely to move toward a worse frailty state and more likely to move toward a better frailty state. These results consolidate the claim that the promotion of physical exercise is an efficient prevention measure to delay and reduce the onset and progression of frailty among young-old and old-old individuals.

Finally, we observed, once again, a North-South gradient in the probability to decline toward a worse frailty state that could not be explained by cross-country differences in physical activity levels. Further research should investigate country-specific characteristics more thoroughly to better understand the cross-country differences in frailty transition patterns.

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