Changes in morbidity by proximity to death over time: Evidence from Europe *

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October 29, 2015

*This paper uses data from SHARE Wave 5 release 1.0.0, as of March 31st 2015 (DOI: 10.6103/SHARE.w5.100) or SHARE Wave 4 release 1.1.1, as of March 28th 2013 (DOI: 10.6103/SHARE.w4.111) or SHARE Waves 1 and 2 release 2.6.0, as of November 29th 2013 (DOI: 10.6103/SHARE.w1.260 and 10.6103/SHARE.w2.260) or SHARELIFE release 1.0.0, as of November 24th 2010 (DOI: 10.6103/SHARE.w3.100). The SHARE data collection has been primarily funded by the European Commission through the 5th Framework Programme (project QLK6-CT-2001-00360 in the thematic programme Quality of Life), through the 6th Framework Programme (projects SHARE-I3, RII-CT-2006-062193, COMPARE, CIT5- CT-2005-028857, and SHARELIFE, CIT4-CT-2006-028812) and through the 7th Framework Programme (SHARE-PREP, N° 211909, SHARE-LEAP, N° 227822 and SHARE M4, N° 261982). Additional funding from the U.S. National Institute on Aging (U01 AG09740-13S2, P01 AG005842, P01 AG08291, P30 AG12815, R21 AG025169, Y1-AG-4553-01, IAG BSR06-11 and OGHA 04-064) and the German Ministry of Education and Research as well as from various national sources is gratefully acknowledged (see www.share-project.org for a full list of funding institutions).

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Abstract

Over the years, life expectancy has increased significantly in the EU. Whether the additional life time is spent in good or in poor health will drastically influence the development of health care costs as morbidity status rather than age per se determines an individual's need for health services. However, empirical evidence on whether the prolonged lifespan is associated with a compression or an extension of morbidity is still sparse and inconclusive. In this paper, we analyse the prevalence of disability in the population 50+ in Europe by age and by proximity to death over time using longitudinal data from the Survey of Health, Ageing, and Retirement in Europe (SHARE). Despite an ageing population, we find average disability levels to remain constant over time. However, disability levels close to death increases.

JEL classification: I10, J11, J14

Keywords: ageing, demographic trends, decomposition methods

1 Introduction

Life expectancy in Europe is increasing. In times of tight government budgets, the pressing question is how much these developments will lead to an increase in health care costs. While the answer to this question heavily depends on whether the increase in life expectancy comes with a delayed onset of diseases, evidence to this end is scarce and remains inconclusive (Cutler et al., 2013; Karlsson et al., 2008). According to Fries (1980), a compression of morbidity leads to a longer time in good health, while Gruenberg (1977) argues that it is unhealthy years which are added to life when the life expectancy increases.

To shed more light on this issue, we analyse recent developments in disability levels in the elderly population in Europe and relate these changes both to age and proximity to death. After showing the pattern of morbidity of the elderly over time, we decompose drivers of the change in morbidity into underlying demographic, clinical and behavioural factors as well as in changes of the impact of these factors on disability status to identify possible drivers of changes in morbidity. While average disability did not change over time, our results show that this findings is the result of two opposing trends: while changes in the population composition by itself would have led to an increase in the average disability level, unobserved changes counteracted this effect.

The remainder of the paper is organized as follows. Section 2 describes the data, Section 3 provides an overview of morbidity patterns over time by age and proximity of death, Section 4 introduces the estimation strategy for the multivariate analysis, and Section 5 presents the results. Section 6 concludes.

2 The SHARE data

Data on disability, demographics, and socioeconomic status is drawn from the Survey of Health, Ageing, and Retirement in Europe (SHARE) waves 1, 2, and 4 collected in 2004/05, 2006/07, and 2010/11, respectively. This data is supplemented by exit inter-

views, during which a proxy, usually a close relative, answered questions about a former SHARE respondent's last year of life. We use exit interviews from waves 2 to 5 of SHARE; data collection for wave 3 and 5 took place in 2008 and 2012/13, respectively. The exit interviews contain information on time and cause of death as well as health problems in the year before death, which we link to the respondents' data from previous waves. To assure a better comparison, we only include individuals from countries that participated in all waves.[1]

The disability status of an individual is used to measure morbidity. We define disability as a composite measure that summarizes the number of limitations with activities of daily living (ADL) and limitations with instrumental activities of daily living (IADL) an individual experiences. ADL limitations include having problems concerning dressing, walking across a room, bathing or showering, eating, getting out of bed, and using the toilet, while IADL limitations include having problems concerning orientation using a map, preparing a hot meal, shopping for groceries, making telephone calls, taking medications, doing work around the house or garden, managing money. Spector and Fleishman (1998) show that adding both measures represents a meaningful measure of disability. Moreover, limitations with ADL and IADL are often used to assess the need for long-term care (LTC) services and thus the eligibility for LTC payments (see, for example, (Colombo et al., 2011)). The measure is therefore also relevant from a policy perspective.

3 Disability status, age, and time to death

To better understand the average morbidity level in our population, we look at the prevalence of health conditions and disability status by age and by proximity to death. While morbidity levels by age are informative about whether the healthy life span is extended in absolute terms, morbidity levels by proximity of death are relevant in answering

[1]These include Austria, Germany, Sweden, the Netherlands, Spain, Italy, France, Denmark, Switzerland and Belgium.

the question of whether sickness is compressed into a shorter time span before death. As we are interested in how morbidity patterns change over time, we compare respondents from the first wave of SHARE with respondents from the fourth wave. Hence, we can observe a time span of approximately seven years. Restricting our sample in this way allows us to analyse morbidity status between individuals who have died within two years of the interview and individuals who are still alive after two years.[2]

Table 1: Descriptives

	TTD:2				AW:2			
	Wave 1		Wave 4		Wave 1		Wave 4	
	mean	sd	mean	sd	mean	sd	mean	sd
Dependent Variable								
Activity Limitations	3.09	4.03	3.94	4.65	0.51	1.57	0.54	1.66
Demographics								
Age 50-59	0.10	0.30	0.06	0.24	0.38	0.49	0.35	0.48
Age 60-69	0.18	0.38	0.15	0.36	0.31	0.46	0.32	0.46
Age 70-79	0.31	0.46	0.26	0.44	0.22	0.41	0.23	0.42
Age 80+	0.42	0.49	0.53	0.50	0.09	0.29	0.11	0.32
Male	0.53	0.50	0.44	0.50	0.45	0.50	0.46	0.50
Married	0.43	0.50	0.48	0.50	0.65	0.48	0.66	0.47
Lower Education	0.58	0.49	0.56	0.50	0.36	0.48	0.26	0.44
Medium Education	0.32	0.47	0.35	0.48	0.45	0.50	0.50	0.50
Higher Education	0.10	0.30	0.08	0.27	0.19	0.39	0.24	0.43
Living in a City	0.09	0.29	0.07	0.26	0.12	0.32	0.09	0.29
Area missing	0.02	0.14	0.34	0.47	0.01	0.10	0.32	0.47
Net Worth (in 10k)	15.13	41.53	13.66	35.60	21.74	59.88	17.04	26.00
Conditions								
Cancer	0.17	0.38	0.17	0.37	0.05	0.22	0.06	0.23
Chronic Lung Disease	0.12	0.33	0.15	0.36	0.06	0.23	0.07	0.25
Parkinson's Disease	0.03	0.18	0.04	0.20	0.01	0.08	0.01	0.07
Heart Attack	0.27	0.44	0.25	0.43	0.11	0.32	0.11	0.31
Stroke	0.10	0.30	0.11	0.31	0.04	0.18	0.04	0.19
Hip or Femoral Fracture	0.03	0.17	0.06	0.23	0.02	0.14	0.02	0.15
High Blood Pressure	0.41	0.49	0.42	0.49	0.33	0.47	0.38	0.49
High Blood Cholesterol	0.17	0.38	0.20	0.40	0.21	0.41	0.24	0.43
Diabetes	0.19	0.39	0.23	0.42	0.11	0.31	0.13	0.33
Asthma	0.08	0.27	0.00	0.07	0.04	0.20	0.00	0.06
Arthritis	0.30	0.46	0.32	0.47	0.24	0.42	0.25	0.43
Osteoporosis	0.08	0.27	0.01	0.11	0.08	0.28	0.01	0.09

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[2]The information on morbidity status and the main covariates comes from the respondents' interviews in waves 1, 2, 4 and 5 while the information on time of death comes from interviews conducted in all waves with a proxy respondent, i.e someone close to the deceased SHARE participant.

continued from previous page

	TTD:2				AW:2			
	Wave 1		Wave 4		Wave 1		Wave 4	
	Mean	SD	Mean	SD	Mean	SD	Mean	SH
Ulcer	0.07	0.26	0.06	0.24	0.06	0.23	0.04	0.19
Cataracts	0.14	0.35	0.15	0.36	0.08	0.27	0.09	0.29
Behaviour								
Smokes	0.15	0.36	0.13	0.33	0.18	0.38	0.18	0.38
Physically inactive	0.83	0.38	0.84	0.37	0.44	0.50	0.45	0.50
Heavy drinker	0.26	0.44	0.17	0.38	0.31	0.46	0.27	0.45
Underweight	0.05	0.22	0.01	0.09	0.01	0.11	0.00	0.06
Normalweight	0.41	0.49	0.13	0.34	0.38	0.48	0.15	0.35
Overweight	0.35	0.48	0.17	0.37	0.41	0.49	0.15	0.36
Obese	0.13	0.34	0.13	0.34	0.18	0.38	0.07	0.26
BMI missing	0.05	0.22	0.56	0.50	0.02	0.13	0.62	0.48
Countries								
Austria	0.03	0.16	0.03	0.16	0.02	0.16	0.03	0.17
Germany	0.22	0.42	0.16	0.36	0.23	0.42	0.27	0.44
Sweden	0.04	0.20	0.03	0.18	0.04	0.19	0.03	0.18
Netherlands	0.05	0.21	0.03	0.18	0.05	0.22	0.06	0.24
Spain	0.20	0.40	0.30	0.46	0.14	0.34	0.15	0.36
Italy	0.22	0.42	0.25	0.43	0.22	0.41	0.17	0.37
France	0.19	0.39	0.13	0.34	0.22	0.41	0.20	0.40
Denmark	0.02	0.15	0.02	0.14	0.02	0.14	0.02	0.15
Switzerland	0.01	0.11	0.02	0.14	0.02	0.15	0.03	0.16
Belgium	0.02	0.13	0.03	0.17	0.04	0.19	0.04	0.19
Observations	696		834		17594		25689	

Note: Summary measures using calibrated weights.

Table 1 shows descriptive statistics separately for individuals who are within the last 2 years of life (TTD:2) and those that we know are alive within 2 years of the interview (AW:2).[3] Throughout the analysis, observations are weighted using calibrated weights based on the procedure by Deville and Särndal (1992) to make results representative for the population 50 and older in the respective countries at the time of the interview. Individuals who died within two years of the interview are on average older, more likely to be male, less likely to be married, and suffer from more health conditions. Moreover, the average age increased between waves 1 and 4, independent of whether the individuals is alive or dead two years following the interview. The number of activity limitation remains constant over time for individuals who are still alive within two years but increases over time for individuals who die within this time by almost one additional activity limitation.

[3]Individuals who participated in wave 1 and 4 of SHARE may be included twice.

Next, Table 2 shows the prevalence rates of our aggregated meassure activity limitations (ALs), ADL, and IADL limitations across all waves, as well as clinical conditions for all individuals in our sample (50+) differentiated by age groups. While few individuals aged 50 to 59 suffer from any limitations with ADL, an individual aged 80 or above suffers from about one limitation with ADL. Limitations with IADL are somewhat more frequent already at younger ages but also increase steeply with age. Except for asthma, which stays constant, and high blood cholesterol, which first increases but then decreases with age, the prevalence of all other health condition increases with age.

Table 2: Prevalence Rates of Clinical Conditions by Age Groups

	Ages..			
	50-59	60-69	70-79	80+
Activity Limitations	0.21	0.31	0.76	2.58
ADL Limitations	0.09	0.13	0.29	0.97
IADL Limitations	0.12	0.18	0.47	1.62
Cancer	0.04	0.06	0.07	0.07
Chronic Lung Disease	0.04	0.06	0.09	0.09
Parkinson's Disease	0.00	0.00	0.01	0.02
Heart Attack	0.05	0.10	0.18	0.25
Stroke	0.02	0.03	0.05	0.09
Hip or Femoral Fracture	0.01	0.02	0.02	0.07
High Blood Pressure	0.25	0.37	0.46	0.43
High Blood Cholesterol	0.19	0.25	0.25	0.21
Diabetes	0.07	0.13	0.15	0.17
Asthma	0.03	0.03	0.03	0.03
Arthritis	0.17	0.24	0.31	0.39
Osteoporosis	0.03	0.05	0.08	0.10
Ulcer	0.04	0.04	0.05	0.06
Cataracts	0.02	0.06	0.15	0.24
Observations	20563	20987	14405	6429

Note: SHARE sample 2004-2011 using sampling weights (calibrated weights). The Main Sample includes all individuals aged 50 and over.

To see whether there are differences by gender, education or net wealth, the prevalence rates of the health conditions are shown for these subgroups in Table 3. Women suffer from more limitations with ADL and IADL. While men more often suffer from

a heart attack of high blood pressure, women suffer more frequently from arthritis or cataracts. The subgroup analysis also shows clear evidence for socioeconomic gradients for limitations with ADL and IADL as well as for almost all health conditions.

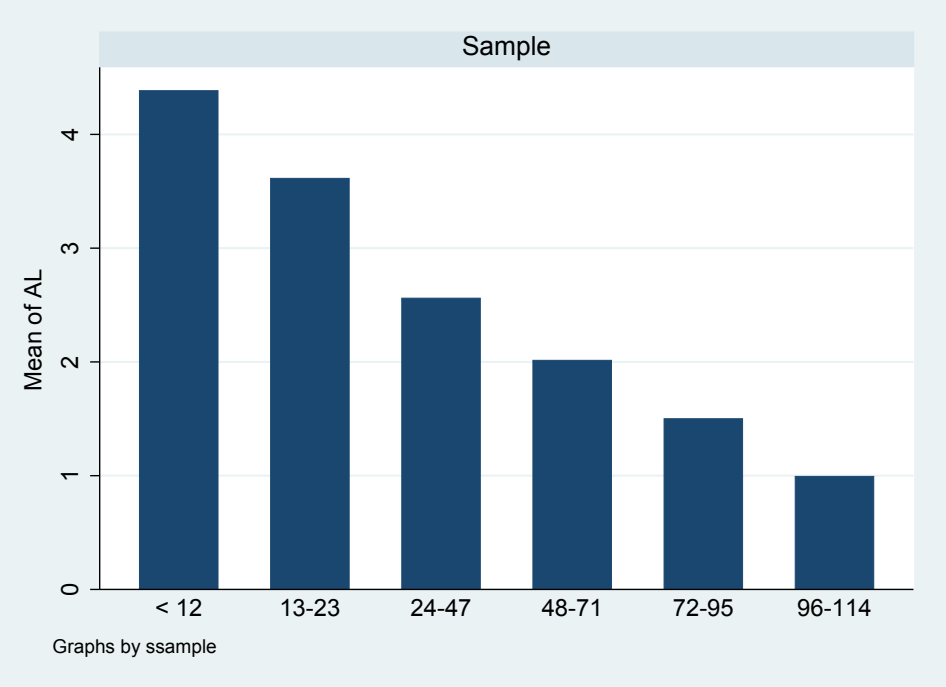
Figure 1 shows the average number of activity limitations by time to death. The exit interviews are available for a varying number of years after the interview i.e. the maximum number of months until death that are observed are 108-114 in 2004, 96-107 in 2005, 84-95 in 2006, 72-83 in 2007 and 24-35 in 2011. Individuals who die within a year suffer from more than four limitations on average. As time to death increases, the average number of limitation decreases monotonously. This pattern is true for both genders, though women suffer from more limitations, independent of the time to death (Figure 2). Lastly, Figure 3 shows how the average number of limitations changes across waves. Average disability levels increased over time for individuals close to death. While individuals within 12 months of dying suffer from less than 4 limitations on average in wave 1, this number increased to almost 4.5 in wave 4. For individuals farther away from death, the increase is even more pronounced. The average number of limitations increased from slightly under 3 in wave 1 by approximately one additional limitation in wave 4.

This pattern would suggest an extension of morbidity, i.e. people live longer with disability (assuming that the prevalence of limitations with ADL and IADL remained constant within each age group). However, the finding that average disability levels remained constant while the population grew older would rather suggest that morbidity levels decline over time. To control for possible confounding factors, such as changes in the age and sex composition, a multivariate analysis is necessary, which we turn to now.

4 Estimation strategy

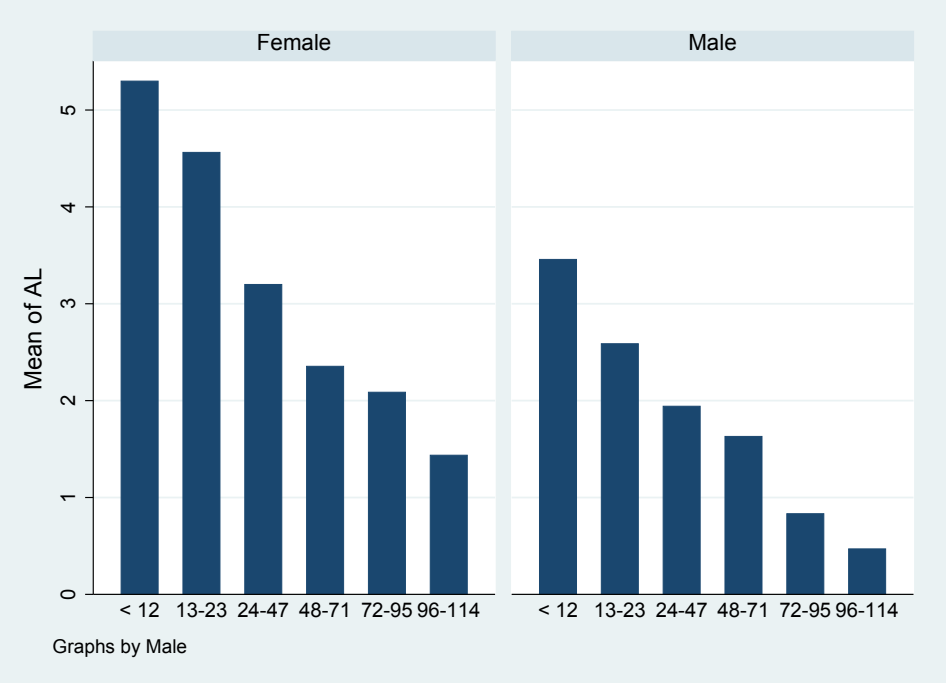
We consider a linear model of health, where health is explained by demographic, clinical and behavioural factors and control for the country of origin:

Figure 1: Disability by Time (in Months) until Death



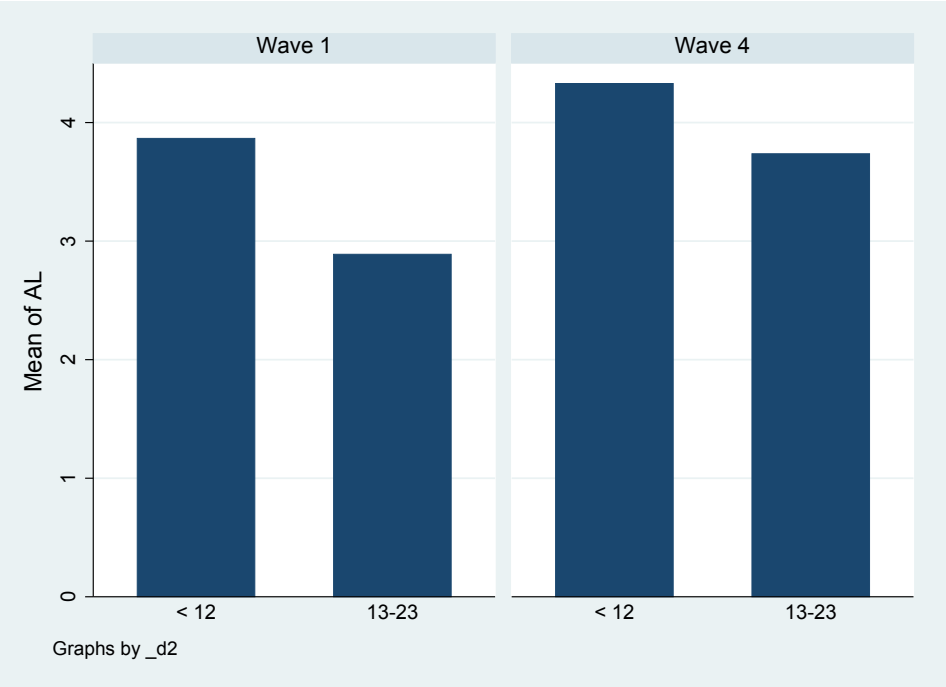
Note: SHARE sample 2004-2011 using sampling weights (calibrated weights).

Figure 2: Disability by Time (in Months) until Death by Gender



Note: SHARE sample 2004-2011 using sampling weights (calibrated weights).

Figure 3: Disability by Time (in Months) until Death by Wave – Last Two Years of Life



Note: SHARE sample 2004-2011 using sampling weights (calibrated weights).

Table 3: Prevalence Rates of Clinical Conditions by Time to Death and by Subgroups

	(1) Sample	(2) TTD:2	(3) AW:2	(4) Male	(5) Female	(6) L.Ed.	(7) M.Ed.	(8) H.Ed.	(9) W.Q1	(10) W.Q2	(11) W.Q3	(12) W.Q4
Activity Limitations	0.64	3.68	0.51	0.48	0.78	1.17	0.45	0.24	1.09	0.67	0.48	0.37
Cancer	0.05	0.16	0.05	0.05	0.06	0.05	0.06	0.06	0.05	0.06	0.05	0.05
Chronic Lung Disease	0.07	0.15	0.06	0.07	0.06	0.09	0.06	0.04	0.09	0.08	0.06	0.04
Parkinson's Disease	0.01	0.04	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Heart Attack	0.12	0.26	0.11	0.14	0.10	0.16	0.10	0.09	0.14	0.13	0.11	0.09
Stroke	0.04	0.10	0.03	0.04	0.03	0.05	0.03	0.03	0.05	0.04	0.03	0.02
Hip or Femoral Fracture	0.02	0.05	0.02	0.02	0.03	0.03	0.02	0.01	0.03	0.02	0.02	0.01
High Blood Pressure	0.36	0.38	0.36	0.34	0.37	0.40	0.35	0.30	0.40	0.38	0.34	0.31
High Blood Cholesterol	0.22	0.17	0.22	0.22	0.22	0.25	0.21	0.19	0.22	0.23	0.22	0.21
Diabetes	0.12	0.21	0.11	0.13	0.11	0.16	0.11	0.07	0.17	0.13	0.10	0.08
Asthma	0.03	0.06	0.03	0.03	0.03	0.04	0.03	0.02	0.04	0.03	0.03	0.02
Arthritis	0.25	0.30	0.24	0.17	0.31	0.37	0.20	0.15	0.29	0.26	0.24	0.20
Osteoporosis	0.06	0.06	0.06	0.02	0.09	0.08	0.05	0.04	0.07	0.06	0.05	0.05
Ulcer	0.04	0.06	0.04	0.05	0.04	0.06	0.04	0.03	0.06	0.04	0.04	0.03
Cataracts	0.08	0.15	0.08	0.06	0.10	0.11	0.07	0.07	0.11	0.09	0.08	0.06

Note: SHARE sample 2004-2011 using sampling weights (calibrated weights). Country specific wealth quartiles as in wave 1 (2004-2005) in ten thousands ppp-adjusted Euros.

AL=$\beta_0 + \beta_{dem} * DEMOG + \beta_{clin} * CLINICAL + \beta_{beh} * BEHAVIOUR + \beta_{coun} * COUNTRY$.

To analyse changes over time, we follow the strategy of (Cutler et al., 2013) and decompose drivers of the change in morbidity into the change in demographic, clinical and behavioural factors and the change of their impact on morbidity status (Cutler et al. (2013), Oaxaca (1973), Blinder (1973), Jann (2008)):

$$\begin{aligned}\Delta AL = \quad & \Delta\beta_0 + (\Delta dem * \beta D_{t_0} + \Delta clin * \beta C_{t_0} + \Delta beh * \beta B_{t_0}) \\ & + (\mathrm{dem}_{t_0} * \Delta\beta_D + clin_{t_0} * \Delta\beta_C + beh_{t_0} * \Delta\beta_B)\end{aligned}$$

where t_0 describes the initial time period and Δ indicates changes over time. Hence, ΔAL denotes the difference in morbidity between the individuals in 2004/5 and 2011. In this equation, the middle part of the right hand side are the characteristic effects, i.e. the explained variation, which indicates the impact of a change in demographic, clinical and behavioural factors. The last part of the right hand side are the coefficient effects, i.e. the unexplained variation, which indicates the change of an impact of these factors on disability.

5 Results

The regression results explaining the drivers of disability by time to death are shown in Table 4. Individuals during the last two years of their lives suffer from approximately two additional activity limitations. Not surprisingly, health conditions such as Parkinsons's disease, hip fracture, stroke, or lung disease also increase the number of activity limitations. After controlling for health conditions, old age (age 80+) is still positively and related to the number of activity limitations, but the effect is more pronounced for women. In addition, low socioeconomic status and being single are associated with more activity limitations.

Table 4: Regression Explaining Disability (AL) 2004-2011 – Sample

Demographics		
Dead in 2 years	1.974***	(0.134)
Age 60-69	-0.073***	(0.023)
Age 70-79	0.141***	(0.037)
Age 80+	1.402***	(0.086)
Male 60-69	-0.030	(0.034)
Male 70-79	-0.234***	(0.050)
Male 80+	-0.612***	(0.135)
Male	0.068***	(0.023)
Married	-0.092***	(0.024)
Lower Education	0.265***	(0.028)
Higher Education	-0.028	(0.021)
Living in a City	-0.061*	(0.034)
areaMV	0.115***	(0.030)
Net Worth (in 10k EURO)	-0.000**	(0.000)
Conditions		
Cancer	0.083	(0.057)
Chronic Lung Disease	0.331***	(0.055)
Parkinson's Disease	2.775***	(0.309)
Heart Attack	0.280***	(0.045)
Stroke	1.802***	(0.131)
Hip or Femoral Fracture	0.943***	(0.128)
High Blood Pressure	-0.044*	(0.023)
High Blood Cholesterol	-0.081***	(0.026)
Diabetes	0.171***	(0.042)
Asthma	0.112	(0.080)
Arthritis	0.227***	(0.029)
Osteoporosis	0.283***	(0.062)
Ulcer	0.164**	(0.064)
Cataracts	0.101*	(0.056)
Behaviour		
Smokes	-0.073***	(0.022)
Physically inactive	0.423***	(0.020)
Drinks min. 5-6 Days/week	-0.137***	(0.021)

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Underweight	0.571**	(0.249)
Overweight	-0.034	(0.031)
Obese	0.070*	(0.041)
bmiMV	0.044	(0.029)
Countries		
Austria	0.129***	(0.031)
Germany	0.164***	(0.031)
Sweden	-0.027	(0.030)
Netherlands	0.065**	(0.028)
Spain	0.191***	(0.039)
Italy	0.085**	(0.035)
France	0.036	(0.028)
Switzerland	-0.034	(0.026)
Belgium	0.114***	(0.027)
Constant	-0.139***	(0.038)
Observations	61915	
R^2	0.309	

Note: Regression for the sum of reported ADL and IADL impairments in 2004 and 2011 respectively. Standard errors in parenthesis. Reference groups: Female aged 50 to 55, Medium education, Living in a suburban Area. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 5: Regressions Explaining Disability (AL) – Changes over Time, 2004/5 vs. 2011

	overall		explained		unexplained	
Wave 1	0.622***	(0.021)				
Wave 4	0.615***	(0.024)				
difference	0.007	(0.032)				
explained	-0.063*	(0.036)				
unexplained	0.070	(0.043)				
Demographics			-0.019	(0.017)	-0.358**	(0.172)
Conditions			0.018	(0.012)	-0.057	(0.036)
Behaviour			-0.055**	(0.026)	-0.189**	(0.094)
Countries			-0.006**	(0.003)	-0.009	(0.015)
Constant					0.683***	(0.195)
Observations	44,473		44,473		44,473	

Note: Wave 1 (group 1) consists of observations from 2004-2005, Wave 4 (Group 2) consists of observations from 2011. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6: Regressions Explaining Disability (AL) – Changes over Time, 2004/5 vs. 2011

	overall	explained		unexplained	
Dead in 2 years		0.016**	(0.006)	-0.015	(0.013)
Age 50-59		-0.011***	(0.003)	-0.038*	(0.022)
Age 60-69		0.002	(0.003)	-0.002	(0.018)
Age 70-79		0.002	(0.002)	-0.008	(0.018)
Age 80+		-0.020***	(0.007)	0.017	(0.017)
Male 50-59		0.003	(0.002)	0.033	(0.021)
Male 60-69		-0.001	(0.001)	0.005	(0.018)
Male 70-79		0.000	(0.000)	0.005	(0.012)
Male 80+		0.003*	(0.002)	0.002	(0.008)
Male		0.001	(0.001)	-0.189*	(0.114)
Married		0.001	(0.001)	0.005	(0.037)
Lower Education		0.020***	(0.003)	0.008	(0.014)
Medium Education		0.004***	(0.001)	0.001	(0.014)
Higher Education		0.007***	(0.001)	-0.007	(0.007)

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	overall	explained		unexplained	
Living in a City		-0.001	(0.001)	-0.004	(0.009)
areaMV		-0.041***	(0.011)	-0.003	(0.006)
Net Worth (in 10k EURO)		-0.002**	(0.001)	0.020*	(0.011)
Cancer		-0.000	(0.000)	-0.006	(0.008)
Chronic Lung Disease		-0.004**	(0.002)	0.017**	(0.008)
Parkinson's Disease		0.003	(0.004)	-0.005	(0.006)
Heart Attack		0.001	(0.002)	-0.017	(0.013)
Stroke		-0.000	(0.006)	0.013	(0.012)
Hip or Femoral Fracture		-0.004*	(0.002)	-0.004	(0.006)
High Blood Pressure		0.002	(0.001)	-0.007	(0.020)
High Blood Cholesterol		0.001	(0.001)	-0.007	(0.014)
Diabetes		-0.004***	(0.002)	-0.012	(0.012)
Asthma		0.003	(0.003)	-0.001	(0.002)
Arthritis		-0.003*	(0.002)	-0.008	(0.017)
Osteoporosis		0.021***	(0.006)	0.004	(0.003)
Ulcer		0.003*	(0.001)	-0.009	(0.008)
Cataracts		-0.000	(0.001)	-0.015	(0.011)
Smokes		0.000	(0.000)	-0.014	(0.009)
Physically inactive		-0.001	(0.004)	0.002	(0.022)
Drinks min. 5-6 Days/week		-0.005***	(0.001)	0.016	(0.015)
Underweight		0.003	(0.002)	-0.000	(0.002)
normalweight		-0.026*	(0.014)	-0.066**	(0.028)
Overweight		-0.037**	(0.015)	-0.079***	(0.030)
Obese		-0.004	(0.006)	-0.030**	(0.015)
bmiMV		0.015	(0.036)	-0.019	(0.042)
Austria		-0.000	(0.000)	-0.001	(0.001)
Germany		-0.003**	(0.001)	0.009	(0.015)
Sweden		-0.000*	(0.000)	0.002	(0.002)
Netherlands		0.000	(0.000)	0.001	(0.003)
Spain		-0.002**	(0.001)	-0.035***	(0.011)
Italy		0.000	(0.002)	-0.001	(0.013)
France		-0.001**	(0.001)	0.014*	(0.008)
Denmark		0.000	(0.000)	0.004***	(0.001)
Switzerland		0.000***	(0.000)	-0.000	(0.001)
Belgium		0.000	(0.000)	-0.002	(0.002)

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	overall		explained	unexplained	
Wave 1	0.622***	(0.021)			
Wave 4	0.615***	(0.024)			
difference	0.007	(0.032)			
explained	-0.063*	(0.036)			
unexplained	0.070	(0.043)			
Constant				0.683***	(0.195)
Observations	44,473		44,473	44,473	

Note: Wave 1 (group 1) consists of observations from 2004-2005, Wave 4 (Group 2) consists of observations from 2011. Standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

To analyse changes over time, we run separate regressions for the years 2004-2005 (wave 1) and 2011-2012 (wave 4) and divide the difference into explained differences (driven by changes in the population composition) and unexplained differences (changes in the impact of the explanatory variables). The decomposition results are shown in Table 5.

Average disability levels decreased slightly between wave 1 and wave 4 by 0.007. However, this difference is insignificant and negligible in size. The slight deviation from the earlier descriptive results is due to a slightly smaller sample since observations with missing values in any of the variables are dropped. However, had the population composition remained unchanged, the difference in the number of activity limitations between wave 1 and wave 4 would be smaller by 0.063 limitations, in which case the morbidity level would have increased between wave 1 and 4. The finding that the average number of limitations stayed constant was thus caused by changes in the impact of explanatory factors.

Table 6 shows the detailed composition results. The pooled model serves as reference. The hypothetical increase in disability levels had the population composition remained constant is partly driven by the fact that the population in wave 4 is older than in wave 1 and thus would, ceteris paribus, suffer from more limitations. Changes in the education

level (the average education level increased over time (compare Table 1), however, helped to increase the difference in disability levels between wave 1 and wave 4.

With respect to our research question, the unexplained changes are also of interest. With the exception of chronic lung disease, the unexplained changes for the health conditions are statistically insignificant. Thus, the impact of health conditions did not change over time, which seems reasonable as a major change in the impact of conditions could arguably only happen if new treatment options became available or if it were somehow possibly to reduce the burden of a disease in a new way. Likewise the impact of most of the socioeconomic variables, with the exception of household income, remained unchanged. Somewhat surprisingly, belonging to the fairly young age group (ages 50 to 59) has a significant negative unobserved effect. Hence the change in the impact had a negative influence on the difference in activity limitations between wave 1 and 4. The size of the effect, however is relatively small and the coefficients of the other age groups are insignificant.

6 Conclusion

This paper examines how disability changes with age and proximity to death. We analyse disability status for different age groups and differentiate between different socioeconomic groups. Our research contributes to the analysis of population health in an ageing population and is a first step to analyse whether, for Europe, changed in morbidity over time are best described by a compression or an extension or morbidity.

[To be completed]

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