

# Determinants of change in self-rated health among older adults in Europe: a longitudinal perspective based on SHARE data

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**Abstract** The present study aims at detecting factors which may predict a decline or an improvement in self-rated health (SRH) of older adults (persons aged 50 or higher) among socio-demographic characteristics, physical and mental health indicators and risky health behaviours. In the analysis, multinomial logistic regression models are applied to data from waves 1 and 2 of the Survey of Health Ageing and Retirement in Europe (carried out about 3 years apart); persons who report a decline or an improvement in SRH at wave 2 are compared to those who report no change while controlling for SRH at baseline and country of residence. The analysis was carried out for the whole sample and two subgroups, persons aged 50–64 and 65 or higher. The results indicate that female sex and higher educational attainment have a strong protective effect against decline in SRH. Worse health at baseline is an important predictor of subsequent decline but changes occurring between the waves have a more pronounced effect, implying that SRH is influenced more by recent developments. The findings also indicate that improvement in SRH is a more complex concept than decline and is strongly affected by factors other than health. Among behavioural risk factors, low levels of physical activity and a decrease in the levels of activity between the waves are significantly related to decline while frequent drinking seems associated with improvement. Differentiations by

age are modest and probably suggest that advancing age is related to a milder view of one's health.

**Keywords** Self-rated health · SHARE · Longitudinal · Decline · Improvement

## Introduction

Self-rated health (SRH) is a multifaceted measure of health which has long been established as a reliable predictor of morbidity, health utilisation and mortality. Its strong association with objective indicators of physical and mental health, psychosocial factors as well as certain risky health behaviours has been documented in numerous studies (Baron-Epel and Kaplan 2001; Gilmore et al. 2002; Idler and Benyamini 1997; Idler and Kasl 1991; Jang et al. 2009) while its import in estimating mortality risks is maintained even after adjustment for such factors (Appels et al. 1996; Van Doorslaer and Gerdtham 2003). A further strength of the measure is that it may capture illnesses and conditions undetected at the time of a health evaluation (Eriksson et al. 2001; DeSalvo et al. 2005). Nevertheless, extraneous factors such as wording of the question, the language and cultural perceptions may also influence reporting of SRH (Angel and Guarnaccia 1989; Vuorisalmi et al. 2008). In addition, different subgroups of a population may evaluate their health using different thresholds (Lindeboom and Van Doorslaer 2004; Jürges 2007; Zimmer et al. 2000). For instance, older persons seem to have a more lenient view of what constitutes poor health, while higher educated Europeans seem to have a harsher view (D'Uva et al. 2008; Ongaro and Salvini 1995).

Cross-sectional associations of SRH with physical and mental health are consistent across cultures and countries

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and have been researched thoroughly. Most studies agree on the importance of indicators such as chronic diseases, symptoms, functional disabilities, depression and cognitive function (Bardage et al. 2005; Verropoulou 2009). Risky health behaviours such as smoking and drinking, on the other hand, though associated with higher mortality, are not necessarily related to worse SRH (Perlman and Bobak 2008; Verropoulou 2009). Frequent drinkers, for instance, have been found to experience higher mortality than occasional drinkers while reporting better health (Perlman and Bobak 2008). Higher socio-economic status has a favourable effect on SRH while the role of gender and age is ambiguous (Arber and Cooper 1999; Bardage et al. 2005; Kunst et al. 2005; Simon et al. 2005; Zimmer et al. 2000).

Factors related to trajectories of SRH over time, on the other hand, have little been explored since follow-up data are required. In fact, a longitudinal approach is recommended to understand how changes in physical health and increasing age may affect reporting of SRH among the older population (Orfila et al. 2000). There is some evidence showing that deterioration in physical and mental health, functional performance and cognitive function are related to a decline in SRH (Bailis et al. 2003; Jang et al. 2009; Leinonen et al. 2001). In addition, some research indicates strong associations with specific socio-economic factors—e.g. non-employment (Sacker et al. 2007). Nevertheless, studies dealing simultaneously with a multitude of physical, mental health, behavioural risk and cognitive function factors determining changes in SRH are limited while research considering not only a decline but also an improvement, is even scarcer (Hasson et al. 2006; Leinonen et al. 2001). This latter aspect is of interest since there is cross-sectional evidence that whereas worse SRH is related mainly to ill physical health, better SRH is a composite construct linked not only to the absence of illness but also to socio-demographic characteristics (Mackenbach et al. 1994; Smith et al. 1994).

The present study uses data on the SRH of persons aged 50 or higher reported at waves 1 and 2 of the SHARE study (carried out about 2–3 years apart) to consider the following research questions: First, controlling for SRH at wave 1, do socio-demographic characteristics, physical and mental health at baseline and risky health behaviours predict future changes in self-assessment of health? Second, are changes in health indicators, occurring between the waves, stronger predictors than health status at baseline? Third, do factors associated with a decline in SRH differ from those related to an improvement? And finally, do associations differentiate between younger and older old as these groups may have different health expectations? Use of a large multi-national dataset to carry out such an analysis presents certain advantages since it comprises a large sample which ensures robust statistical results while it also allows cross-national comparisons.

## Methods

### Data

The data used in the analysis come from release 2-3-0 (December 2009) of waves 1 and 2 of the Survey of Health, Ageing and Retirement in Europe. SHARE has been modelled on the US Health and Retirement Survey (HRS) and the English Longitudinal Survey of Ageing (ELSA). Wave 1 of the survey was carried out in 2004 in 11 countries representing various regions of Europe, ranging from Scandinavia (Denmark and Sweden) through Central Europe (Austria, France, Germany, Switzerland, Belgium and the Netherlands) to the Mediterranean (Spain, Italy and Greece) (Börsch-Supan et al. 2005a, b). The target population was persons aged 50 or higher and the information collected included, among others, socio-demographic characteristics, SRH, self-reported health indicators and risky health behaviours. Regarding response at wave 1, the average household rate was 61.6 %, ranging from 38.8 % in Switzerland and 39.2 % in Belgium to around 60–63 % in Germany, Denmark, Greece and to 81.0 % in France (SHARE 2011). Individual response rates—i.e. the numbers of interviewed individuals divided by the numbers of eligible persons in the household—ranged from 73.7 % in Spain to 93.3 % in France, the average being 85.3 %. The second wave of the survey was conducted over 2006/2007.

A common problem encountered in panel surveys is sample attrition due to death, moving out of the country or refusal to be re-interviewed. Of the 27,444 interviewees at the first wave of SHARE, 2.3 % had died by wave 2, while another 1.7 % had moved out of their respective country without leaving contact details. Excluding these cases, the average attrition rate between the two waves has been estimated at 27.9 %; it is highest in Germany (41 %) and lowest in Greece (13 %) (Schröder 2008). According to the same source, attrition is not related to gender or employment status but has a U-shaped relationship with age; it is highest among persons below age 58 (at wave 1) and those aged 75 or higher. Moreover, better SRH at wave 1 is related to a higher response rate. The longitudinal sample in the present analysis comprises 18,458 persons who were successfully re-interviewed at wave 2.

### Measures

#### *Self-rated health*

The respondents at the survey were asked to rate their health as excellent, very good, good, fair or poor both at waves 1 and 2. This is ‘the US global version’ of SRH (see Appendix); the so-called European version is of very similar construct but unavailable for wave 2 of the survey.

The dependent variable of the analysis was constructed comparing SRH at baseline to the one reported at wave 2. More specifically, if the respondent's SRH at both waves was identical this was coded as 'unchanged' and was assigned the value of 0 (reference category); if SRH at wave 2 had improved (for instance, had changed from fair to good, very good or excellent) it was coded as 1 ('improvement'), while if it had declined it was coded as 2. Hence, a 3-category variable was constructed.

#### *Socio-demographic variables*

Age is measured in completed years; sex compares females (=1) to males (=0). Socio-economic status is represented by years in education, based on the highest qualification attained and the International Standard Classification of Education ISCED-97 codes (UNESCO 2006). More specifically, the variable included in the models compares persons with 7–12 years in education (secondary educational qualifications) and 13 or more years (post-secondary) to those who have at the most completed primary education (0–6 years). Finally, dummies indicating the country of residence of the respondent were included in the models to allow comparison across countries and to control for differences in the reporting of SRH between countries.

#### *Health indicators*

SHARE includes information on a number of self-reported health indicators. In both waves, the interviewees were asked about chronic diseases diagnosed in their life-time, somatic symptoms lasting for at least 6 months (Nicholas et al. 2003), functional difficulties and, in particular, limitations in activities of daily living (ADLs) (Katz et al. 1963; Katz et al. 1970; Katz 1983), instrumental activities of daily living (IADLs) (Lawton and Brody 1969) and mobility difficulties regarding 10 activities related to stamina, strength, arm and fine motor function (Fonda and Herzog 2004). They also reported separately whether they had experienced a heart attack, stroke or cancer between the waves. The mental health of the respondents was assessed on the basis of 12 symptoms of depression (EURO-D) (Prince et al. 1999) while their cognitive function was evaluated using scores in orientation in time (year, month and day) and numeracy abilities, ranging from 0 (worst) to 4 (best) and from 1 to 5, respectively (Dewey and Prince 2005). The variables used in the analysis represent the number of conditions at baseline; no cut-offs were used. In addition, indicators of whether that number increased or decreased between the waves are included in the models. Decrease in the numbers of chronic diseases is related to treatable conditions such as hip and femoral fractures, cataracts, high blood sugar, high blood pressure

and high blood cholesterol. Variables showing whether the respondent experienced a stroke, a heart attack or cancer in that period are also incorporated as these conditions were reported separately and they constitute the major causes of death in Europe (Eurostat 2011). A list of the items (limitations, symptoms and conditions) comprising the aforementioned health measures is presented in the [Appendix](#).

#### *Behavioural risk factors*

Risky health behaviours comprise, among others, smoking and drinking habits, obesity and physical inactivity. The variable representing smoking habits deals with whether a respondent was a regular smoker at baseline, had stopped smoking, or was a non-smoker (i.e. never smoked daily for at least a year). Drinking behaviour is based on a binary indicator showing whether the respondent had been drinking more than two glasses of alcoholic beverages at least 5 or 6 days a week for the 6 months preceding the survey. Obesity refers to persons whose body mass index (based on the respondents' reported height and weight) is 30 or higher while persons who reported themselves as 'almost never engaging in moderate or vigorous physical activities' (i.e. such as gardening, cleaning the car, etc.) have been classified as physically inactive. Indicators of whether there was any change in these behaviours between the waves were also included in the models but were dropped subsequently due to very small frequencies and collinearity. The only such indicator retained is whether levels of physical activity had increased or declined in that period.

#### *Statistical analysis*

Associations of socio-demographic and health-related factors with improvement or decline in SRH between the waves were estimated applying multinomial logistic regression techniques (Chan 2005). The dependent variable used in the models is a 3-category variable comparing persons whose SRH declined and persons whose SRH improved between the waves to those whose status remained unchanged. The analysis was performed for the pooled sample as well as for two subgroups; those aged 50–64 and those aged 65 or higher at wave 2. To explore possible bias which attrition due to death or to refusal to be re-interviewed may have introduced to the analysis, a multinomial model was also run comparing socio-economic characteristics, health status and health-related behaviour at baseline of these persons to respondents at wave 2 (Orfila et al. 2000). All analyses were carried out using STATA 10.0.

## Results

### Descriptive findings

The percentage distribution and means for the variables included in the analysis, for the whole sample and by broad age group in 2007, are presented in Table 1. Females represent 55 % of the longitudinal sample; their proportion is somewhat higher among persons aged 50–64. Mean age of the respondents is 66.6 years. About half of the sample has completed 7–12 years of education, while about 30 % has post-secondary educational qualifications; the latter proportion is much higher among younger respondents. For the whole sample, 33 % of the respondents reported very good/excellent SRH at baseline, while 41 % reported good health and 26 % fair/poor health. Proportions of persons with fair/poor health are higher among the 65+ age group. Regarding changes in SRH between the waves, proportions are very similar across age groups: about half of the sample did not report any change; 31 % reported a decline while 20 % reported an improvement.

As expected, the mean number of chronic conditions, somatic and depressive symptoms, mobility difficulties, ADLs and IADLs at baseline is somewhat higher among older persons while they also have worse orientation in time and numeracy scores. Proportions of persons reporting deterioration in physical and mental health between the waves are also higher among the older segment of the sample; this, however, holds also for proportions reporting an improvement. Nevertheless, overall, there is a tendency towards deterioration of health between the two waves; the greatest difference is observed in the proportions of persons reporting at least an additional somatic symptom, followed by chronic conditions and mobility difficulties. Regarding depressive symptoms and cognitive function, on the other hand, there seems to be an improvement. Proportions of persons who reported having had a heart attack, a stroke or developed cancer between the two waves are quite low though they are somewhat higher among older respondents. Regarding health-related behaviour, the older age group includes more non-smokers and ex-smokers as well as a higher proportion of persons who report very low levels of physical activity and have experienced a decrease in physical activity levels between the waves.

### Multinomial regression models

#### *Factors related to non-response and death*

Factors associated with non-response and death at wave 2 are presented in Table 2. Non-participants differ regarding specific characteristics compared to respondents although differences are rather small in magnitude. Persons aged

**Table 1** Percentage distribution and means for the variables included in the regression models for the whole sample and broad age groups

Variables in the models	Respondents at wave 2 (Longitudinal sample)		
	Age 50–64	Age 65+	All
<b>Dependent variable (%)</b>			
Decline in SRH between waves	30.9	32.4	31.5
Improvement in SRH between waves	20.6	19.4	20.1
No change	48.5	48.2	48.4
<b>Socio-demographic characteristics</b>			
Age (years)	58.2	74.0	66.59
<b>Sex (%)</b>			
Male	43.8	46.3	45.1
Female	56.2	53.7	54.9
<b>Years in education (wave 1) (%)</b>			
0–6 years	13.4	25.8	19.9
7–12 years	49.0	52.4	50.8
13 years or more	37.6	21.8	29.3
<b>Self-rated health at baseline (%)</b>			
Excellent	15.2	8.0	11.4
Very good	26.3	18.1	21.9
Good	39.2	41.9	40.6
Fair	15.8	25.4	20.8
Poor	3.6	6.7	5.2
<b>Health at baseline (means)</b>			
Self-rated health (1 best–5 worst)	2.66	3.04	2.86
No. of chronic conditions (0–15)	1.19	1.82	1.49
No. of somatic symptoms (0–12)	1.20	1.62	1.43
No. of mobility difficulties (0–10)	0.86	1.63	1.26
No. of ADLs (0–6)	0.05	0.11	0.08
No. of IADLs (0–7)	0.07	0.17	0.13
No. of depressive symptoms (EURO-D; 0–12)	2.12	2.30	2.22
Orientation in time score (0 worst–4 best)	3.89	3.80	3.84
Numeracy score (1 worst–5 best)	3.61	3.22	3.41
<b>Changes in health between waves 1 and 2</b>			
<b>Increase in the no. of conditions/symptoms/difficulties (%)</b>			
Chronic conditions	27.2	31.6	28.6
Somatic symptoms	31.9	39.2	35.8
Mobility difficulties	19.8	32.7	26.6
ADLs	3.0	8.8	6.1
IADLs	5.5	14.5	10.3
Depressive symptoms (EURO-D)	32.3	34.8	33.6
Worse orientation in time score	7.1	11.7	9.5
Worse numeracy score	21.0	25.4	23.3
<b>Decrease in the no. of conditions/symptoms/difficulties (%)</b>			
Chronic conditions	22.9	27.6	25.4
Somatic symptoms	23.8	24.4	24.1
Mobility difficulties	19.3	22.9	21.2
ADLs	3.3	5.8	4.6

**Table 1** continued

Variables in the models	Respondents at wave 2 (Longitudinal sample)		
	Age 50–64	Age 65+	All
IADLs	4.8	8.4	6.7
Depressive symptoms (EURO-D)	37.8	35.8	36.8
Better orientation in time score	7.7	11.0	9.5
Better numeracy score	27.0	26.6	26.8
Health problems between waves 1 and 2 (%)			
Heart attack	1.0	2.2	1.7
Stroke	0.7	2.3	1.5
Cancer	2.1	3.0	2.6
Health-related behaviours (%)			
Smoking			
Non-smoker	46.0	57.0	54.4
Smoker	27.4	13.0	19.4
Ex-smoker	26.6	30.0	26.2
BMI			
BMI < 30	82.3	82.7	82.5
Obese (BMI ≥ 30)	17.7	17.3	17.5
Levels of activity			
Some moderate	95.8	89.9	92.6
Very low	4.2	10.1	7.4
Drinking			
Drinking less	86.0	85.9	86.0
Drinking at least 2 U of alcohol five to six times a week	14.0	14.1	14.0
Changes in health-related behaviour between waves 1 and 2 (%)			
No change	94.7	88.9	91.6
Decrease in levels of physical activity	2.8	7.3	5.2
Increase in levels of physical activity	2.5	3.8	3.2
Country of residence (%)			
Austria	5.2	6.8	5.9
Germany	7.9	9.1	8.6
Sweden	10.9	11.3	11.1
Netherlands	10.4	9.0	9.6
Spain	5.7	7.1	6.5
Italy	9.1	10.4	9.8
France	10.3	10.1	10.2
Denmark	7.3	6.6	6.9
Greece	12.9	11.1	12.0
Switzerland	3.8	3.9	3.9
Belgium	16.5	14.6	15.5
Sample size	7,934	8,922	16,856

70–79 and in particular those over 80 at wave 1 have higher chances of not participating at wave 2. Chances of non-participation also increase significantly among persons with more educational qualifications. Sex is not related to

non-response. SRH below very good at baseline is an important predictor of non-participation; in fact, the worse the SRH the higher the odds of non-response. Regarding various health indicators, it seems that persons reporting a higher number of chronic conditions and of somatic symptoms have lower chances of non-participation; that also holds for those with better numeracy and orientation in time scores. A higher number of IADLs, on the other hand, is related to more non-participation. With respect to risky health behaviours, smokers and persons who tend to be physically inactive have higher chances of not participating at wave 2; the opposite holds for obese persons. Hence, non-participants at wave 2 may have better health at baseline compared to respondents regarding numbers of chronic conditions and somatic symptoms but worse SRH, cognitive scores and more IADL limitations. They are also older and tend to have a more compromising life style (smoking, low levels of physical activity) but higher educational attainment. Hence, the results of the present analysis should be interpreted with caution though under-representation of persons with worse SRH at wave 1 is unlikely to bias the results of the multinomial regression as models control for SRH at baseline.

Persons who died between the waves, on the other hand, differentiate greatly compared to respondents at wave 2. Age is a very important factor; being over 70 substantially increases the odds of death. Male sex also has a very strong association but educational attainment does not seem related. SRH is a very strong and significant predictor; the worse the SRH at baseline the higher the chances of death, especially among persons reporting less than good health. Self-reported health indicators have also some effect; a greater number of IADLs and a poor cognitive function score are related to a higher probability of dying. Regarding health behaviours, low levels of physical activity and smoking significantly increase likelihood of death. Overall, persons who died between the waves form a distinct group compared to respondents at wave 2; on the other hand, their numbers are small (2.2 % of respondents at wave 1) and death is an unavoidable outcome.

#### *Factors related to decline or improvement in SRH*

The full model for the pooled sample is presented in Table 3 where the odds of reporting a decline or an improvement in SRH at wave 2 are compared to having reported no change. Regarding socio-demographic characteristics of the respondent, age seems unimportant. Female sex, on the other hand, either significantly reduces chances of reporting a decline in SRH or increases chances of improvement. Having post-secondary educational qualifications has a significant protective effect against declining SRH.

**Table 2** Relative Risk Ratios and 95 % confidence intervals estimated based on multinomial logistic regression: non-respondents at wave 2 and those dying between the waves compared to respondents

Characteristics at wave 1	Outcome at wave 2			
	Non-response ( <i>N</i> = 7,059)		Dead ( <i>N</i> = 527)	
	RRR	95 % CI	RRR	95 % CI
<b>Socio-demographic characteristics</b>				
Age				
50–59 (ref cat)	1.000		1.000	
60–69	0.953	[0.891, 1.021]	2.541**	[1.806, 3.575]
70–79	1.092*	[1.008, 1.185]	4.496**	[3.202, 6.313]
80+	1.232**	[1.101, 1.382]	9.192**	[6.416, 13.168]
Sex				
Male (ref cat)	1.000		1.000	
Female	0.974	[0.916, 1.035]	0.435**	[0.351, 0.540]
Years in education (wave 1)				
0–6 years (ref cat)	1.000		1.000	
7–12 years	1.135**	[1.055, 1.222]	1.013	[0.813, 1.263]
13 years or more	1.346**	[1.240, 1.462]	1.038	[0.795, 1.356]
<b>Health at baseline (wave 1)</b>				
Self-rated health				
Excellent (ref cat)	1.000		1.000	
Very good	1.113	[0.995, 1.226]	2.214*	[1.075, 4.563]
Good	1.262**	[1.140, 1.399]	2.914**	[1.473, 5.764]
Fair	1.608**	[1.427, 1.811]	5.313**	[2.660, 10.611]
Poor	1.876**	[1.585, 2.219]	6.097**	[2.919, 12.736]
No. of chronic conditions (0–15)	0.924**	[0.900, 0.947]	1.037	[0.969, 1.109]
No. of somatic symptoms (0–12)	0.970*	[0.947, 0.994]	0.937*	[0.879, 0.999]
No. of mobility difficulties (0–10)	1.007	[0.986, 1.028]	1.070*	[1.015, 1.129]
No. of ADLs (0–6)	0.964	[0.912, 1.019]	0.967	[0.874, 1.069]
No. of IADLs (0–7)	1.055*	[1.008, 1.103]	1.159*	[1.066, 1.260]
No. of depressive symptoms (EURO-D; 0–12)	0.987	[0.972, 1.001]	1.017	[0.974, 1.063]
Orientation in time score (0 worst–4 best)	0.934**	[0.886, 0.98]	0.846**	[0.760, 0.943]
Numeracy score (1 worst–5 best)	0.926**	[0.901, 0.955]	0.905*	[0.824, 0.995]
<b>Health-related behaviours</b>				
Smoking				
Non-smoker (ref cat)	1.000		1.000	
Smoker	1.106**	[1.025, 1.193]	1.808**	[1.384, 2.347]
Ex-smoker	0.961	[0.899, 1.031]	1.255*	[1.001, 1.568]
BMI				
BMI < 30 (ref cat)	1.000		1.000	
Obese (BMI ≥ 30)	0.888**	[0.824, 0.958]	0.789	[0.611, 1.017]
Levels of activity				
Some moderate (ref cat)	1.000		1.000	
Very low	1.240**	[1.115, 1.379]	1.849**	[1.446, 2.363]
Drinking				
Drinking less (ref cat)	1.000		1.000	
Drinking at least 2 U of alcohol five to six times a week	0.947	[0.872, 1.028]	0.983	[0.754, 1.281]
Log likelihood	–17,005.9			
Pseudo <i>R</i> <sup>2</sup>	3.38			
<i>N</i>	25,969			

\*\* *p* < 0.01, \* *p* < 0.05

Considering the importance of health indicators at baseline, while at the same time controlling for SRH status at wave 1, some of them are very significant in predicting a decline or an improvement in SRH. More specifically, a higher number of chronic conditions, somatic and depressive symptoms, mobility difficulties and a lower numeracy score are strongly associated with a decline in SRH. These factors, with the exception of cognitive function, are also inversely related to an improvement in SRH.

Deterioration in health between the waves predicts more strongly a decline in SRH, independently of physical and mental health status at baseline. Most measures are very significant, with the exception of numeracy score; the greatest effect can be observed for number of chronic conditions, somatic symptoms and mobility limitations. Considering specific health problems occurring between the waves, all have strong associations with a decline in SRH although cancer seems to have the greatest impact, followed by stroke and heart attack. Improvement in SRH, on the other hand, is not as strongly related to health indicators; the factors that seem important in this instance are a decrease in the numbers of chronic conditions, somatic and depressive symptoms which increase chances of improvement while having had a heart attack or a stroke between waves significantly reduces chances.

With respect to risky health behaviours, smoking does not seem to play a part in determining changes in SRH. Low levels of physical activity and obesity at baseline as well as a decrease in physical activity levels between the waves, on the other hand, are significantly related to a decline in SRH. By contrast, drinking at least 2 U of alcohol five to six times a week has a beneficial effect, increasing chances of improvement in SRH. Running the models with a less skewed version of the activity variable did not provide better defined results.

Regarding the effects of country of residence on a decline in SRH, Sweden, the Netherlands, Italy, France and Belgium do not differ significantly from Austria (reference category); there is a group of three countries (Greece, Denmark and Switzerland) where there is a significantly lower chance of decline while for Spain and Germany odds ratios indicate the opposite. Regarding improvement, country groupings differ; there is a group of seven countries where there is a significantly lower chance of improvement (Germany, the Netherlands, Spain, Italy, France and Greece) compared to the reference category while only in Sweden and Denmark there is a significantly higher chance. Belgium and Switzerland, on the other hand, do not differentiate from Austria.

Overall, it seems that factors related to a decline in SRH differ from those related to improvement. In particular, physical, mental health and cognitive function at baseline as well as changes between the waves have stronger

associations with decline, while educational attainment has a protective effect only against decline. Regarding risky health behaviours, obesity, low levels of physical activity and a decrease in levels of activity between the waves are also related to decline; only drinking at least 2 U of alcohol five to six times a week in the 6 months preceding the survey seems to have a favourable effect on improvement. Associations with country of residence vary.

Table 4 presents relative risk ratios based on the models for respondents aged 50–64 and those aged 65 or higher in 2007. Although the models were run including the same predictors as for the pooled sample, only the variables that exhibited differentiations between these age groups are shown in the table. Socio-demographic indicators and baseline health seem equally important for both groups; changes in health between the waves, however, have differential effects in some instances. Among the younger age group, an increase in ADLs seems more negative while for older persons an increase in IADLs and worse orientation in time have a more pronounced effect. The negative impact of cancer, heart attack and stroke seem more important for the younger age group. Low levels of physical activity at baseline have a significant adverse effect among older respondents but a decrease in the levels of activity between the waves is very negative for both age groups; an increase in the levels of physical activity seems beneficial only among persons aged 65 or higher.

## Discussion

The present study uses data on the SRH of persons aged 50 or higher reported at waves 1 and 2 of the SHARE study (carried out about 3 years apart) and aims at detecting factors which may predict a decline or an improvement in SRH using multinomial logistic regression techniques. Whereas cross-sectional research has reliably identified socio-demographic and health-related factors associated with the reporting of SRH at a specific point in time, exploration of the longitudinal aspect, considering both decline and improvement, is scarce. In the analysis, global SRH has been used; this is the most efficient and robust variant of the question since age trajectories have been found similar across individuals and populations while it is also considered the best predictor of mortality in longitudinal studies as well as a reliable proxy of population health (Vuorisalmi et al. 2005; Andersen et al. 2007; Sargent-Cox et al. 2010). The models control for SRH at baseline and differences in the reporting between countries.

The role of gender in cross-sectional analysis is ambiguous (Bardage et al. 2005; Kunst et al. 2005). There is some longitudinal research showing that whereas adult men report on average better SRH than women, after the

**Table 3** Relative Risk Ratios and 95 % confidence intervals estimated based on multinomial logistic regression; decline and improvement in SRH compared to no change between the waves, all ages

Predictors	All ages (N = 16,856)			
	Decline in SRH		Improvement in SRH	
	RRRs	95 % CI	RRRs	95 % CI
<b>Socio-demographic</b>				
Age	1.004	[0.999, 1.009]	1.000	[0.994, 1.005]
Sex				
Male (ref cat)	1.000		1.000	
Female	0.855**	[0.781, 0.934]	1.265**	[1.144, 1.398]
Years in education (wave 1)				
0–6 years (ref cat)	1.000		1.000	
7–12 years	0.926	[0.819, 1.046]	0.920	[0.804, 1.052]
13 years or more	0.774**	[0.670, 0.894]	1.131	[0.880, 1.208]
<b>Health at baseline (wave 1)</b>				
Self-rated health (1 best–5 worst)	0.263**	[0.247, 0.279]	3.257**	[3.031, 3.500]
No. of chronic conditions (0–15)	1.218**	[1.168, 1.269]	0.773**	[0.738, 0.809]
No. of somatic symptoms (0–12)	1.069**	[1.026, 1.113]	0.865**	[0.827, 0.904]
No. of mobility difficulties (0–10)	1.056**	[1.017, 1.096]	0.926**	[0.891, 0.963]
No. of ADLs (0–6)	0.999	[0.887, 1.128]	1.050	[0.935, 1.179]
No. of IADLs (0–7)	0.864**	[0.786, 0.950]	0.964	[0.876, 1.059]
No. of depressive symptoms (EURO-D; 0–12)	1.087**	[1.059, 1.115]	0.957**	[0.931, 0.983]
Orientation in time score (0 worst–4 best)	0.924	[0.806, 1.060]	0.933	[0.806, 1.078]
Numeracy score (1 worst–5 best)	0.909**	[0.866, 0.954]	1.041	[0.987, 1.098]
<b>Changes in health between waves 1 and 2</b>				
<b>Increase in no. of conditions/symptoms/difficulties</b>				
Chronic conditions	1.756**	[1.597, 1.932]	0.761**	[0.678, 0.854]
Somatic symptoms	1.556**	[1.414, 1.712]	0.703**	[0.628, 0.786]
Mobility difficulties	1.684**	[1.519, 1.867]	0.633**	[0.559, 0.716]
ADLs	1.206*	[1.009, 1.442]	0.866	[0.692, 1.083]
IADLs	1.231**	[1.067, 1.420]	0.877	[0.735, 1.046]
Depressive symptoms (EURO-D)	1.402**	[1.269, 1.550]	0.932	[0.829, 1.047]
Worse orientation in time score	1.234**	[1.078, 1.412]	0.890	[0.760, 1.042]
Worse numeracy score	1.095	[0.989, 1.211]	0.921	[0.821, 1.034]
<b>Decrease in no. of conditions/symptoms/difficulties</b>				
Chronic conditions	0.864*	[0.771, 0.967]	1.578**	[1.048, 1.769]
Somatic symptoms	0.923	[0.821, 1.038]	1.374**	[1.222, 1.546]
Mobility difficulties	1.137*	[1.002, 1.291]	1.011	[0.889, 1.148]
ADLs	1.049	[0.798, 1.378]	1.144	[0.884, 1.481]
IADLs	1.121	[0.905, 1.388]	1.202	[0.982, 1.471]
Depressive symptoms (EURO-D)	0.867*	[0.777, 0.966]	1.208**	[1.077, 1.355]
Better orientation in time score	0.890	[0.726, 1.090]	0.964	[0.778, 1.194]
Better numeracy score	0.896*	[0.809, 0.992]	1.151*	[1.032, 1.284]
<b>Health problems between waves 1 and 2</b>				
Heart attack	1.540**	[1.155, 2.053]	0.515**	[0.333, 0.800]
Stroke	1.813**	[1.335, 2.462]	0.602*	[0.384, 0.942]
Cancer	2.813**	[2.214, 3.575]	0.742	[0.530, 1.038]
<b>Health-related behaviours</b>				
Smoking				
Non-smoker (ref cat)	1.000		1.000	



**Table 3** continued

Predictors	All ages (N = 16,856)			
	Decline in SRH		Improvement in SRH	
	RRRs	95 % CI	RRRs	95 % CI
Smoker	1.091	[0.978, 1.217]	0.928	[0.822, 1.049]
Ex-smoker	0.937	[0.851, 1.033]	1.084	[0.974, 1.208]
<b>BMI</b>				
BMI < 30 (ref cat)	1.000		1.000	
Obese (BMI ≥ 30)	1.124*	[1.010, 1.250]	0.977	[0.871, 1.097]
<b>Levels of activity</b>				
Some moderate (ref cat)	1.000		1.000	
Very low	1.607**	[1.274, 2.026]	0.786	[0.610, 1.013]
<b>Drinking</b>				
Drinking less (ref cat)	1.000		1.000	
Drinking at least 2 units of alcohol five to six times a week	1.041	[0.924, 1.173]	1.231**	[1.082, 1.401]
<b>Changes in health-related behaviour between waves</b>				
No change	1.000		1.000	
Decrease in levels of physical activity	1.717**	[1.433, 2.058]	0.912	[0.734, 1.134]
Increase in levels of physical activity	0.828	[0.607, 1.129]	1.372	[0.997, 1.888]
<b>Country of residence</b>				
Austria (ref cat)	1.000		1.000	
Germany	1.293*	[1.048, 1.595]	0.682**	[0.542, 0.859]
Sweden	0.987	[0.890, 1.202]	1.338*	[1.065, 1.681]
Netherlands	0.998	[0.814, 1.224]	0.715**	[0.570, 0.897]
Spain	1.265*	[1.007, 1.589]	0.710**	[0.550, 0.915]
Italy	1.047	[0.849, 1.291]	0.700**	[0.554, 0.884]
France	0.963	[0.786, 1.181]	0.588**	[0.467, 0.740]
Denmark	0.604**	[0.482, 0.756]	1.343*	[1.046, 1.725]
Greece	0.706**	[0.575, 0.866]	0.778*	[0.619, 0.979]
Switzerland	0.686**	[0.531, 0.887]	1.055	[0.800, 1.391]
Belgium	0.838	[0.693, 1.014]	0.997	[0.808, 1.231]
Log likelihood	−14260.2			
Pseudo R <sup>2</sup>	18.44			

\*\*  $p < 0.01$ , \*  $p < 0.05$

age of 50 the gap narrows as males experience a higher rate of decline and at the age of 80 specific age-curves intersect (McCullough and Laurenceau 2004). The findings of the present study indicate that female sex has a strong protective effect against decline and a beneficial effect on improvement. Hence, the cross-sectional protective effect of female gender on SRH across countries, observed in wave 1 SHARE data, is reconfirmed here in longitudinal context (Verropoulou 2009).

The importance of socio-economic status in health outcomes is a well established fact in the international literature (Huisman et al. 2003; Kunst et al. 2005; Chandola et al. 2007). In the analysis, SES is represented by educational attainment, a variable that has demonstrated its importance as indicator among older persons repeatedly

(D’Uva et al. 2008; Grundy and Holt 2001; Tsimbos 2010). Educational level has the additional advantage of being established early in life; hence, it is not affected by subsequent declines in health and is a fairly robust measure for addressing issues of causality. The findings of the study show that higher educational attainment has a strong protective effect reducing significantly chances of a decline in SRH. These results, however, cannot be compared to other studies, while the importance of educational level has been established in predicting poor health in wave 2 of the SHARE survey; the author is not aware of any research showing how it is related to changes in SRH reporting (Avendano et al. 2009). Nevertheless, studies dealing with effects of other indicators, non-employment for instance, find that poor socio-economic conditions have a negative

**Table 4** Relative risk ratios and 95 % confidence intervals estimated based on multinomial logistic regression; decline and improvement in SRH compared to no change between the waves, ages 50–64 and 65+

Predictors	Age: 50–64 ( <i>N</i> = 7,934)				Age: 65+ ( <i>N</i> = 8,922)			
	Decline in SRH		Improvement in SRH		Decline in SRH		Improvement in SRH	
	RRRs	95 % CI	RRRs	95 % CI	RRRs	95 % CI	RRRs	95 % CI
Changes in health between waves 1 and 2								
Increase in no. of conditions/symptoms/difficulties								
ADLs	1.482*	[1.051, 2.089]	0.716	[0.451, 1.135]	1.142	[0.924, 1.412]	0.909	[0.701, 1.178]
IADLs	0.941	[0.723, 1.225]	0.805	[0.583, 1.113]	1.411**	[1.186, 1.679]	0.912	[0.737, 1.127]
Worse orientation in time score	1.188	[0.948, 1.490]	0.989	[0.772, 1.268]	1.268**	[1.070, 1.502]	0.833	[0.678, 1.025]
Decrease in no. of conditions/symptoms/difficulties								
Chronic conditions	0.855	[0.719, 1.017]	1.717**	[1.447, 2.036]	0.845*	[0.726, 0.984]	1.477**	[1.263, 1.726]
Depressive symptoms (EURO-D)	0.842*	[0.717, 0.989]	1.207*	[1.020, 1.428]	0.892	[0.769, 1.035]	1.219*	[1.035, 1.420]
Better numeracy score	0.829*	[0.713, 0.964]	1.137	[0.969, 1.335]	0.959	[0.835, 1.101]	1.157	[0.994, 1.346]
Health problems between waves 1 and 2								
Heart attack	2.006**	[1.164, 3.454]	0.639	[0.288, 1.416]	1.420*	[1.006, 2.003]	0.471**	[0.276, 0.802]
Stroke	2.307*	[1.196, 4.448]	0.488	[0.185, 1.286]	1.733**	[1.221, 2.458]	0.625	[0.376, 1.038]
Cancer	3.393**	[2.295, 5.018]	0.779	[0.461, 1.317]	2.539**	[1.871, 3.444]	0.730	[0.470, 1.133]
Health-related behaviours								
Levels of activity at baseline								
Some moderate (ref cat)	1.000		1.000		1.000		1.000	
Very low	1.261	[0.769, 2.068]	0.889	[0.541, 1.461]	1.730**	[1.321, 2.265]	0.720*	[0.533, 0.972]
Changes in activity between waves								
No change	1.000		1.000		1.000		1.000	
Decrease in levels of physical activity	2.233**	[1.569, 3.178]	1.222	[0.824, 1.813]	1.614**	[1.301, 2.003]	0.783	[0.601, 1.022]
Increase in levels of physical activity	0.929	[0.507, 1.704]	1.149	[0.632, 2.090]	0.821	[0.564, 1.193]	1.479*	[1.005, 2.175]
Log likelihood	−6683.6				−7516.9			
Pseudo <i>R</i> <sup>2</sup>	18.96				18.60			

The models are adjusted for socio-demographic characteristics of the respondent, country of residence, baseline health and changes between the waves

\*\*  $p < 0.01$ , \*  $p < 0.05$

impact on SRH trajectories in the US and the British populations (Sacker et al. 2007).

The present findings imply that physical and mental health statuses at baseline predict future changes in SRH. Changes in health indicators occurring between the waves, however, exhibit even stronger associations with decline than initial status while specific health problems occurring between the waves also show strong relationships with decline in SRH; cancer seems to have the greatest impact, followed by stroke and heart attack. Other research shows that health status at baseline, and in particular number of chronic diseases, functional performance and cognitive capacity were not significant in predicting a decline; a worsening in cognitive function, however, was predictive of a worsening (Leinonen et al. 2001). Initial health (functional difficulties, chronic conditions and pain), on the other hand, was found a significant predictor of subsequent SRH reporting in other analysis which did not consider whether there was a decline or an improvement in the reporting; health changes between the waves were more important in this instance, too (Shields and Shooshtari 2001). These analyses, hence, indicate that recent changes

in health influence more strongly the perception of one's health status than a pre-existing condition that one has become accustomed to.

Regarding the role of behavioural risk factors in the present study, low levels of physical activity at baseline as well as a decline in the levels between the waves are strongly related to a decline in SRH. Similar results were found by Leinonen et al. (2001). Obesity exhibits also a negative association, significant at the 5 % level. By contrast, drinking at least 2 U of alcohol four to five times a week significantly increases chances of improvement in SRH as does an increase in the levels of physical activity but only among persons aged 65 or higher. Unhealthy behaviours were found in other research significant in predicting later on fair and poor SRH; improvement in life style, however, was not important (Shields and Shooshtari 2001). The lack of any association with smoking and the improvement in SRH among persons who are frequent drinkers has been observed before in cross-sectional context, in spite of the strong relationship between smoking and mortality, observed in this study too (Perlman and Bobak 2008). This probably highlights the subjective and

complex nature of SRH; although unhealthy lifestyle practices are related to disease and death, they do not necessarily have an impact on this measure.

Performing the analysis by age of the respondent, the results show that socio-demographic predictors, health at baseline and most indicators of health changes between the waves are equally important for both the 50–64 and the 65+ age groups. However, occurrence of cancer, heart attack and stroke between the waves has a more pronounced negative effect among younger respondents. This finding seems to support the results of another study where, researching health appraisals of older adults, it was found that the older the respondents were the less likely it was that they focused on physical aspects of their health when reporting on their health status (Borawski et al. 1996).

Finally, factors related to decline in SRH are not as strongly related to improvement; more specifically, while deterioration in health between the waves substantially increases chances of decline, a reduction in the numbers of conditions and health problems is not as important in determining improvement. In fact, there is some research suggesting that whereas worse health is mainly related to ill physical health, better health is a complex concept, related not only to lack of illness but also to socio-demographic characteristics and self-image (Smith et al. 1994).

A few limitations of the study should be mentioned. First, due to the longitudinal nature of the data, there is the issue of sample attrition between SHARE waves. Attrition in general has the potential to introduce severe bias in any analysis. In this case, attrition due to non-response is age-specific while it is also related to worse SRH at wave 1 (Schröder 2008). This was also confirmed in multinomial regression analysis comparing baseline characteristics of these persons and of those who died between the waves to respondents at wave 2. Non-respondents additionally present mixed characteristics regarding their health at baseline while they combine higher educational attainment with unhealthier lifestyle. Hence, persons with better SRH at wave 1 are overrepresented in the longitudinal sample but that is not likely to affect estimates of relative risk ratios based on multinomial regression models since these control for SRH at baseline. Non-response is also country specific but the models have been adjusted for country of residence. Nevertheless, as non-respondents differ compared to respondents in some aspects, results should be interpreted with caution. Persons who had died by wave 2 form a distinct group; however, attrition due to death is unavoidable and the relevant proportion is quite small.

Another limitation of the study is that the results concern only the non-institutionalised population aged 50 or higher. Prevalence of institutionalisation is higher among the older old while it also differentiates substantially across European countries. In fact, there is a south to north gradient with the

rates being lowest in southern Europe (Delbès et al. 2006). However, it is unclear how omission of these persons from the analysis may affect the results. On the one hand, old adults living in institutions tend to have worse health compared to the general population; hence, persons with good health are likely to be overrepresented in the sample, particularly in north-western European countries. On the other hand, the present analysis deals with changes between waves and these persons have been omitted from both waves; in addition, the models control for baseline health and country of residence. It would seem, thus, that any bias introduced in the analysis would be limited.

Another point to bear in mind is that the interval between the waves is only 3 years long or less; this is a rather short period to observe changes in SRH, in particular among younger respondents (i.e. below age 65). Finally, further research is needed to explain the differences observed between countries in the present study, particularly as these may have been affected by differential non-response.

There are also some important points emerging from the analysis. First, among socio-demographic characteristics female sex, whose role in cross-sectional analysis is inconsistent, emerges as a strong predictor of improvement which at the same time has a substantial protective effect against decline; educational attainment also has a protective effect. Health at baseline and, in particular, a higher number of chronic conditions, somatic and depressive symptoms and worse cognitive function significantly increase chances of a subsequent decline while they also reduce chances of improvement. Second, recent changes occurring between the waves have stronger associations compared to baseline health but this holds only regarding a decline in SRH. Among risky health behaviours, low levels of physical activity and a decrease in the levels between the waves have a significant association with decline. Third, factors strongly related to decline in SRH are not as important in determining improvement. Finally, segmentation of the sample in broad age groups indicates that factors affecting SRH are similar across age groups with the exception of deterioration in health occurring between the waves which has a greater impact among younger respondents. In future research, it would be of interest to further the analysis exploring changes and trajectories in connection to data from a subsequent wave, once they get collected. This would lengthen the period of observation and help to reinforce conclusions.

## Appendix: Questions and items comprising the health indicators included in the analysis

### Self-Rated Health US version

Would you say your health is....

Excellent

Very good  
 Good  
 Fair  
 Poor

### Self-Rated Health European version

Would you say your health is...  
 Very good  
 Good  
 Fair  
 Bad  
 Very bad

### Mobility Difficulties

Because of a physical or health problem, do you have difficulty doing any of the activities on this card? Exclude any difficulties you expect to last less than three months.

Walking 100 meters  
 Sitting for about two hours  
 Getting up from a chair after sitting for long periods  
 Climbing several flights of stairs without resting  
 Climbing one flight of stairs without resting  
 Stooping, kneeling, or crouching  
 Reaching or extending your arms above shoulder level (either arm)  
 Pulling or pushing large objects like a living room chair  
 Lifting or carrying weights over 10 pounds, like a heavy bag of groceries  
 Picking up a 5p coin from a table

### ADL (Activities of Daily Living)

Here are a few more everyday activities. Please tell me if you have any difficulty with these because of a physical, mental, emotional or memory problem. Again exclude any difficulties you expect to last less than three months.

Dressing, including putting on shoes and socks  
 Walking across a room  
 Bathing or showering  
 Eating, including cutting up your food  
 Getting in or out of bed  
 Using the toilet, including getting up or down

### IADL (Instrumental Activities of Daily Living)

Using a map to figure out how to get around in a strange place  
 Preparing a hot meal  
 Shopping for groceries  
 Making telephone calls  
 Taking medications  
 Doing work around the house or garden  
 Managing money, such as paying bills and keeping track of expenses

### Chronic Conditions

Has a doctor ever told you that you had any of the following conditions?

Heart attack including myocardial infarction or coronary thrombosis or any other heart problem including congestive heart failure  
 High blood pressure or hypertension  
 High blood cholesterol  
 A stroke or cerebral vascular disease  
 Diabetes or high blood sugar  
 Chronic lung disease such as chronic bronchitis or emphysema  
 Asthma  
 Arthritis, including osteoarthritis, or rheumatism  
 Osteoporosis  
 Cancer or malignant tumour, including leukaemia or lymphoma, excluding minor skin cancers  
 Stomach or duodenal ulcer, peptic ulcer  
 Parkinson disease  
 Cataracts  
 Hip fracture or femoral fracture  
 Other conditions, not yet mentioned

### Somatic Symptoms

For the past six months at least, have you been bothered by any of the following health conditions?

Pain in your back, knees, hips or any other joint  
 Heart trouble or angina, chest pain during exercise  
 Breathlessness, difficulty breathing  
 Persistent cough  
 Swollen legs  
 Sleeping problems  
 Falling down  
 Fear of falling down  
 Dizziness, faints or blackouts  
 Stomach or intestine problems, including constipation, air, diarrhoea  
 Incontinence or involuntary loss of urine  
 Other symptoms, not yet mentioned

### Depressive Symptoms comprising the EURO-D scale

Sadness—Depression  
 Pessimism  
 Suicidal tendency  
 Guilt  
 Trouble sleeping  
 Lack of Interest  
 Irritability  
 Loss of appetite  
 Fatigue  
 Lack of enjoyment  
 Tearfulness  
 Lack of concentration

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