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ORIGINAL ARTICLE

Specific versus general self-reported health indicators predicting mortality among older adults in Europe: disparities by gender employing SHARE longitudinal data

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Abstract
Objectives The study aims at assessing the relative importance of specific versus general self-reported indicators of health and disability in predicting mortality among older adults and at exploring the potential value of the global activity limitation indicator (GALI), a recently validated general measure of activity restrictions, as predictor of death.
Methods Longitudinal data from two waves (2004 and 2006–2007) of the Survey of Health, Ageing and Retirement in Europe were employed. The sample comprises 17,941 persons aged 50+ at baseline, representing 11 countries. Associations were estimated by sex using Cox's proportional hazards regression models.
Results Most specific and general indicators of health and disability are strong and independent predictors. There are disparities by sex; among general measures, controlling for all indicators under consideration, self-rated health (SRH) only remains significantly associated with mortality among males and GALI among females.
Conclusions A combination of specific and general measures is more efficient in predicting mortality than either of these alone. SRH and GALI seem to share some traits, adding health and disability dimensions over specific measures, representing though different aspects by gender.

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Introduction

Mortality is a complex phenomenon, associated directly with the status of one's health and indirectly, among others, with socio-demographic characteristics, risky health behaviours, availability and access to health care, pollution, etc. Mortality rates are a function of age and differentiate by sex; marriage has a protective effect, especially among males (Blomgren et al. 2012). The effect of socio-economic status (SES) is usually mediated by various factors, including risky health behaviours, which are more widespread among persons of low SES (Fukuda et al. 2005). Whereas the detrimental impact of smoking and physical inactivity is unequivocal (Reynolds and Silverstein 2003; Simons et al. 2005; Simoes et al. 2012), the effect of body mass index (BMI) is less clear cut. Obesity (BMI > 30) significantly contributes to premature mortality (Flegal et al. 2005) but among older persons being underweight (BMI < 18.5) or losing weight seem to be very important, too (Dey et al. 2001; Orpana et al. 2008).

Ill health is in many instances a precursor to death; certain diseases, chronic conditions, disability, poor cognitive function, etc. are strongly associated with a higher risk of mortality (Korten et al. 1999; Simons et al. 2005; Rolland et al. 2006). Associations, however, are not straightforward as several conditions are interrelated. Certain chronic diseases such as stroke and heart attack (Cho et al. 1998; Gilmour and Park 2006), Parkinson's disease and fractures (Woo et al. 1998) predispose to disability. Depression has a strong link with physical ill health among persons aged 70 or higher, leading to the

underestimation of its importance as predictor of death (Korten et al. 1999).

In many population surveys, health status is represented by self-reported 'specific' measures and indices since biomarkers and performance tests are complex and expensive to implement. Several such measures, for instance EURO-D (depression), limitations in activities of daily living (ADLs) and in instrumental activities of daily living (IADLs) (activity restrictions), though self-reported have been validated (Prince et al. 1999; Katz 1983). In addition, in such surveys respondents often report their own view of their health, providing a basis for constructing 'general' health indicators such as self-rated health (SRH) and the global activity limitation indicator (GALI) (Robine and Jagger 2003). GALI is associated with morbidity and disability (Jagger et al. 2010); this holds also for SRH that, further, predicts mortality (Idler and Kasl 1991; Idler and Benyamini 1997). GALI, on the other hand, has been developed and validated fairly recently and, though used extensively in estimating healthy life years, its potential usefulness in predicting mortality has not been explored, yet (Van Oyen et al. 2006).

Such general measures, based on a single question each, have two possible advantages: first, they may capture conditions undetected at the time of a health evaluation; second, they may substitute in short surveys a whole range of questions on 'specific' health indicators (DeSalvo et al. 2005). On the other hand, they encompass a subjective element and may be affected by differential reporting across population sub-groups. For instance, cultural and linguistic borders may affect reporting of SRH (Vuorisalmi et al. 2008; O'Reilly and Rosato 2010). Moreover, SRH exhibits inconsistencies in its ability to predict mortality according to both age and gender, a matter deserving further exploration (Deeg and Bath 2003).

The present study uses data on the survival status of the respondents of the Survey of Health, Ageing and Retirement in Europe (SHARE) wave 1 at the second wave (carried out about 2–3 years apart) to consider three main research questions: First, controlling for socio-demographic characteristics and risky health behaviours at baseline, which is the relative importance of self-reported specific and general health indicators in predicting mortality? Second, is GALI significant in predicting mortality risks? Finally, how do associations differentiate between men and women?

Methods

Data

The data used in the analysis come from release 2-5-0 (May 2011) of waves 1 and 2 of the SHARE study. Wave 1 was carried out in 2004 in 11 countries ranging from Northern (Sweden, Denmark) to Central (the Netherlands, Germany, Austria, Switzerland, Belgium and France) to Southern Europe (Spain, Italy, Greece) (Börsch-Supan et al. 2005). The second wave was conducted over 2006/2007. The survey collected, among others, information on socio-demographic characteristics, self-reported specific and general health indicators and risky health behaviours of persons aged 50 or higher. The average household response rate at wave 1 was 61.6 %, ranging from 38.8 % in Switzerland to 81.0 % in France (SHARE documentation online 2013). 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 %. Interviews by proxy (i.e. a selected household member) were allowed for specific questions regarding housing conditions, finances, etc. in order to avoid getting multiple responses by all eligible members of a household (SHARE 2011).

Of the respondents at the first wave 2.3 % had died by wave 2 while another 1.7 % had moved out of their country of residence without leaving contact details. Excluding these cases, the average attrition rate between the two waves was estimated at 27.9 %; it was highest in Germany (41 %) and lowest in Greece (13 %) (Schröder 2008). Persons whose status at the second interview was unknown comprise a higher proportion of younger (below 58) and older (above 75) respondents while their physical and mental health is, on average, worse than of the individuals who were successfully re-interviewed (Schröder 2008; Schulz and Doblhammer 2011). A discussion of how non-respondents compare to respondents and to persons who had died by the second wave and how their omission from the analysis might affect the estimates is included in the "Results" and "Discussion" sections. The final longitudinal sample used in the present study (excluding 44 persons whose date of death was unknown and a few cases where covariates of interest were missing, representing <2 % of the sample) comprises 17,941 persons, out of which 17,458 were successfully re-interviewed at wave 2 while 483 (270 males and 213 females) had died.

Measures

Socio-demographic variables

All variables represent baseline characteristics. Age has been included in the models in categorical rather than in continuous form as the risk of dying does not increase in a linear fashion among older adults; in addition, in this way possible effects of misreporting due to memory errors are reduced. Three age groups are considered: 50–64

(reference category) including mostly persons before retirement age, persons aged 65–74 who have retired recently and those aged 75 or higher who are more likely to be frail. Regarding marital status, partnered persons (married and in registered partnerships) are contrasted to unpartnered individuals (single, divorced, widowed and separated). Socio-economic status is represented by educational attainment in binary form, comparing persons with 0–6 years of schooling (=1) to those with at least 7 years (=0).

Behavioural risk factors

Three relevant variables are included in the study; smoking, BMI and physical inactivity. Smoking deals with whether a respondent was a regular smoker (smoked daily for at least a year) at baseline (=0), an ex-smoker (had stopped smoking), or a non-smoker. Regarding BMI, a detailed five-category variable was constructed initially but, following preliminary analysis, a binary construct was finally used, comparing underweight individuals (BMI < 18.5) to all others. Finally, persons who reported themselves as "almost never engaging in moderate or vigorous physical activities" (vigorous: sports, heavy housework or a job involving physical labour; moderate: gardening, cleaning the car, doing a walk, etc.) were classified as physically inactive and were compared to all others.

Self-reported 'specific' health indicators

SHARE includes information on a number of self-reported health indicators: limitations in activities of daily living (ADLs) (Katz et al. 1970), instrumental activities of daily living (IADLs) (Lawton and Brody 1969) and mobility difficulties (Fonda and Herzog 2004). Respondents also reported on 14 chronic conditions (heart attack, stroke, cancer, asthma, diabetes, etc.). Mental health was evaluated on the basis of 12 symptoms of depression (EURO-D) (Prince et al. 1999). The variables used in the analysis are indicators showing whether the respondent suffered from specific conditions at baseline, at least one IADL limitation, three mobility difficulties, or four symptoms of depression. Certain chronic conditions and ADLs were not significant in preliminary analysis and were not included in the final models. ADLs were strongly and significantly correlated with IADLs and mobility difficulties; the respective tertrachoric correlation coefficients are 0.745 and 0.770. Cognitive function is represented by orientation in time and ranges from 0 (bad) to 4 (good).

Self-reported 'general' health indicators

The "US global version" of SRH was included in the questionnaire; respondents rated their health as excellent, very good, good, fair or poor. Good SRH served as the reference category. GALI was constructed from a question on whether the respondent considered himself as 'strongly limited in activities people usually do', 'limited but not strongly', or 'not limited', for at least the 6 months preceding the survey due to a health problem (Robine and Jagger 2003). In the analysis limited and strongly/severely limited persons are compared to those not limited.

Statistical methods

Associations between covariates and mortality were estimated using Cox's proportional hazards regression models; survival time is represented by number of months between the first interview and death or between the first and the second interviews (censored cases). The information required on the month and year of death was derived by proxy interview (SHARE 2011). Three main types of models have been estimated, all of which are adjusted for country of residence of the respondent (Schulz and Doblhammer 2011). The first model is the 'basic model' and considers only socio-demographic characteristics and behavioural risk factors at baseline. Two variants of that model were also run: 1a apart from the 'basic model' includes SRH as well, while 1b includes GALI instead; in this way, the predictive power of each of these 'general' indicators is tested separately. Model 2 is the 'basic model' with the addition of specific health indicators; Model 2a further includes SRH while Model 2b includes GALI, to test the predictive power of each of these indicators in conjunction with the specific ones. Finally, Model 3 is a comprehensive model including all predictors to evaluate the relative contribution of each of them. The analysis has been carried out for males and females separately using STATA 10.1. The assumption of proportionality has been tested based on Schoenfeld residuals and was satisfied for all models. The analysis was also run considering a binary outcome variable (alive/dead–logistic regression) to evaluate the effect of 44 fewer cases in Cox's analysis due to missing dates of death; the results were reassuringly similar. Finally, to assess the possible bias introduced in the analysis due to attrition, multinomial regression models comparing the characteristics of non-respondents and respondents at wave 2 to those who died as well as a logistic regression model comparing non-respondents to respondents were also run (Schulz and Doblhammer 2011; Verropoulou 2012).

Table 1 Percentage distribution and means (standard deviations in parenthesis) of variables used in the analysis by sex and status of the respondent at wave 2 (2006/2007) of SHARE (Survey of Health Ageing and Retirement in Europe)

Variables (baseline)	Males ($N = 8,217$)		Females ($N = 9,724$)		Both sexes ($N = 17,941$)	
	Dead ($N = 270$)	Alive ($N = 7,947$)	Dead ($N = 213$)	Alive ($N = 9,511$)	Dead ($N = 483$)	Alive ($N = 17,458$)
Socio-demographic characteristics						
Age						
50–64	21.0	54.6	9.8	54.7	16.0	54.6
65–74	28.0	29.3	18.4	26.5	23.6	27.8
75 or higher	51.0	16.0	71.8	18.9	60.4	17.6
Partnership status						
Single/sep/div/widowed	31.3	18.4	68.8	36.8	48.3	28.4
Partnered	68.7	81.6	31.2	63.2	51.7	71.6
Educational attainment						
0–6 years	42.4	25.2	55.7	32.5	48.4	29.2
7 years or more	57.6	74.8	44.4	67.5	51.6	70.8
Behavioural risk factors						
Smoking						
Smoker	21.3	23.2	11.5	15.3	16.9	18.9
Non-smoker	26.6	34.9	75.6	67.3	48.6	52.6
Ex-smoker	52.1	41.9	12.8	17.4	34.4	28.5
BMI						
Under weight (BMI < 18.5)	1.8	0.34	6.6	1.7	3.9	1.1
All others	98.2	99.6	93.4	98.3	96.1	98.9
Physical activity						
Some	68.5	93.6	44.0	89.7	57.5	91.5
Nearly none	31.4	6.4	56.0	10.3	42.5	8.5
"Specific" health indicators						
Specific chronic conditions						
High blood pressure/hypertension	39.9	29.3	44.9	34.1	42.2	31.9
High blood cholesterol	16.8	21.3	16.2	21.1	16.5	21.2
Asthma	10.1	4.0	6.4	4.8	8.5	4.4
Cancer	17.1	4.2	15.8	5.7	16.5	5.0
Depression symptoms (EUROD)						
At least 4	38.1	15.5	44.8	31.7	45.5	24.4
Less than 4	61.9	84.5	55.2	68.3	54.5	75.6
Mobility difficulties						
At least 3	48.6	12.9	70.9	27.4	58.7	20.9
No limitations	51.4	87.1	29.1	72.6	41.3	79.1
IADL limitations						
At least 1	40.9	9.6	66.5	18.5	47.6	14.5
No limitations	59.1	90.4	33.5	81.5	52.4	85.5
Orientation in time (0 bad–4 excellent)	3.21 (1.35)	3.78 (0.60)	2.77 (1.53)	3.80 (0.61)	3.01 (1.45)	3.79 (0.60)
"General" health indicators						
Self-rated health						
Excellent	0.3	12.5	2.1	9.4	1.1	10.8
Very good	8.4	22.8	7.7	19.9	8.1	21.2
Good	28.0	40.7	21.8	40.1	25.2	40.4
Fair	42.0	18.9	36.8	24.0	39.6	21.7
Poor	21.3	5.1	31.6	6.6	26.0	5.9

Table 1 continued

Variables (baseline)	Males ($N = 8,217$)		Females ($N = 9,724$)		Both sexes ($N = 17,941$)	
	Dead ($N = 270$)	Alive ($N = 7,947$)	Dead ($N = 213$)	Alive ($N = 9,511$)	Dead ($N = 483$)	Alive ($N = 17,458$)
GALI						
Severely/strongly limited	34.3	10.8	44.5	13.1	38.8	12.0
Mildly limited	36.7	25.4	39.7	31.1	38.1	28.5
Not limited	29.0	63.8	15.8	55.8	23.1	59.5

Results

Descriptive findings

The percentage distribution and means (standard deviations in parentheses) for the variables included in the models are presented in Table 1 by sex and survival status at wave 2. Comparing the characteristics of those who died to those who remained alive between the waves, striking differences can be observed. As expected, persons who had died by wave 2 are older, tend to have lower educational attainment, while they comprise higher proportions of men and of unpartnered persons. They also include a higher percentage of ex-smokers, of underweight persons and markedly fewer of them report doing some physical activity. Their health at baseline is, as expected, worse; more of them suffer from chronic conditions, mobility limitations, IADLs and they have lower orientation in time scores. This also holds for their 'general' health status; a higher proportion rated their health as 'poor' or 'fair' and reported being mildly or severely limited in activities 'people usually do'. These contrasting patterns between persons alive and dead at wave 2 are broadly similar across genders. However, specific characteristics differentiate somewhat by sex. For example, women, independently of survival status, tend to be unpartnered and non-smokers in higher proportions compared to men, less educated, they have a lower BMI and report more activity restrictions/limitations (Table 1 around here).

Non-respondents compared to respondents

Table 2 shows odds ratios (ORs) based on logistic regression, comparing among respondents at wave 1 the baseline characteristics of those who were not re-interviewed at wave 2 (non-response) to those who were (response); the ORs are adjusted for country of residence. Overall, it seems that non-respondents do not differentiate significantly compared to respondents regarding several characteristics. However, there are a few statistically significant differences: non-respondents include higher proportions of unpartnered, of physically inactive and of persons with at least one IADL difficulty but fewer of them report GALI activity restrictions. Female non-respondents are also less likely to have reported depression at baseline but they have worse orientation in time scores and include more smokers; male non-respondents are more likely to report fair rather than good SRH. Nevertheless, the magnitude of these differences is rather small. Additional multinomial regression models comparing the baseline characteristics of non-respondents and of respondents to those who had died by wave 2 (results not shown here) indicate that both groups differentiate very substantially compared to those dead with respect to the same characteristics (age, suffering from cancer, orientation in time, etc.)

Cox's proportional hazards regression models

Table 3 shows hazard ratios for mortality, adjusted for country of residence, for males. Model 1 shows associations with socio-demographic characteristics and risky health behaviours at baseline (basic model). Increasing age of the respondent, being unpartnered, low educational attainment, being a smoker and lack of physical activity significantly increase the odds of dying; these associations remain significant throughout the analysis with the exception of educational attainment. Model 1a further includes SRH, which proves a significant predictor of mortality. Poor SRH more than triples the odds of dying [95 % CI (2.155, 4.714)] compared to having good SRH while having excellent SRH substantially minimises chances of death [HR 0.05, 95 % CI (0.008, 0.397)]. In Model 1b, GALI is also a significant predictor; having reported mild activity restrictions doubles the odds of death [CI (1.569, 2.885)] while severe restrictions triple them [CI (2.207, 4.416)]. Model 2, which includes specific health indicators, shows that having cancer at baseline more than triples the odds of dying [HR 3.62, CI (2.601, 5.050)] while asthma is also quite important [HR 1.67, CI (1.083, 2.566)]. Depression, mobility difficulties, IADL limitations and worse orientation in time are also significantly linked to higher chances of mortality. Adding SRH to Model 2

Table 2 Odds ratios (ORs) and 95 % confidence intervals based on binary logistic regression: respondents at wave 1 who were not re-interviewed at wave 2 of the Survey of Health Ageing and Retirement in Europe (2004–2006/2007) compared to those who were: males and females

Characteristics at wave 1 (baseline)	Non-response at wave 2 vs response			
	Males		Females	
	OR	95 % CI	OR	95 % CI
Socio-demographic characteristics				
Age				
50–59 (ref cat)	1.000		1.000	
60–74	0.960	(0.869–1.060)	1.086	(0.988–1.193)
75+	1.067	(0.941–1.211)	1.123	(0.997–1.265)
Partnership status				
Single/sep/div/widowed (ref cat)	1.000		1.000	
Partnered	0.780**	(0.702–0.867)	0.854**	(0.784–0.931)
Years in education (wave 1)				
0–6 years (ref cat)	1.000		1.000	
7 years or more	0.924	(0.824–1.037)	1.059	(0.956–1.174)
Behavioural risk factors				
Smoking				
Smoker (ref cat)	1.000		1.000	
Non-smoker	0.905	(0.809–1.013)	0.852**	(0. 761–0.953)
Ex-smoker	0.849**	(0.760–0.948)	0.843*	(0.736–0.965)
BMI				
Under weight (BMI < 18.5)	1.406	(0.756–2.614)	1.288	(0.975–1.701)
All others (ref cat)	1.000		1.000	
Physical activity				
Some (ref cat)	1.000		1.000	
Nearly none	1.353**	(1.137–1.610)	1.223**	(1.071–1.397)
"Specific" health indicators				
Specific chronic conditions				
Asthma	1.080	(0874–1.445)	n.a.	
Cancer	1.157	(0.949–1.410)	0.963	(0.816–1.136)
No (ref cat)				
Depression symptoms (EUROD)				
At least 4	0.957	(0.845–1.085)	0.867**	(0.791–0.950)
Less than 4 (ref cat)	1.000		1.000	
Mobility difficulties				
At least 3	0.974	(0.837–1.133)	1.026	(0.917–1.147)
No limitations (ref cat)	1.000		1.000	
IADL limitations				
At least 1	1.185*	(1.011–1.390)	1.175**	(1.046–1.320)
No limitations (ref cat)	1.000		1.000	
Orientation in time (0 bad–4 excellent)	0.941	(0.870–1.017)	0.903**	(0.842–0.968)
"General" health indicators				
Self-rated health				
Excellent	1.018	(0.879–1.178)	0.885	(0.760–1.030)
Very good	1.041	(0.928–1.168)	0.979	(0.877–1.093)
Good (ref cat)	1.000		1.000	
Fair	1.287**	(1.137–1.457)	1.058	(0.948–1.180)
Poor	1.230	(0.981–1.541)	1.154	(0.960–1.389)

Table 2 continued

Characteristics at wave 1 (baseline)	Non-response at wave 2 vs response			
	Males		Females	
	OR	95 % CI	OR	95 % CI
GALI				
Not limited (ref cat)	1.000		1.000	
Mildly limited	0.914	(0.788–0.985)	0.873**	(0.790–0.965)
Severely limited	0.881*	(0.771–1.086)	0.890	(0.766–1.034)
Log likelihood	−7781.7		−8694.7	
Pseudo R^2	0.053		0.052	
N	11,788		13,883	

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

(Model 2a) turns mobility difficulties and IADLs non-significant while depression becomes less important. SRH is again a significant predictor of death though the magnitude of the effect is more modest now. This more or less holds when GALI is included instead of SRH in that model (Model 2b). When all covariates are included (Model 3) several of the specific health indicators lose significance (depression, IADLs and mobility difficulties) as does GALI. In fact, SRH and GALI are highly correlated (correlation coefficient 0.506) and the same holds for SRH and EUROD (0.388). Nevertheless, SRH remains a significant predictor of mortality increasing odds by at least 1.5 times among men reporting poor and fair health [CI (1.324–2.631) and (1.032–2.780), respectively] and decreasing them among men having excellent health [CI (0.009–0.477)]. Performing a likelihood ratio test between nested models shows that addition of SRH and GALI (Model 3) to specific health indicators (Model 2) results in a statistically significant improvement in model fit (LR. χ^2, 6 *df*, 47.7).

For females the respective models are presented in Table 4. Age is a very strong predictor but partnership status is less significant compared to men. Higher educational attainment has a protective effect which, contrary to what was observed for men, remains significant in all models. Regarding risky health behaviours, non-smoking is significant only in some models. Being underweight is a significant predictor, roughly doubling chances of dying [i.e. Model 1, CI (1.245–3.874)] as is physical inactivity [i.e. Model 2, CI (1.811–3.705)]. Regarding the associations of SRH and GALI with mortality (Models 1a and 1b) both are strong predictors. Addition of specific health indicators in model 1 (Model 2) shows that cancer [HR 2.26, CI (1.516, 3.381)] is very significant, as are orientation in time scores [HR 0.74, CI (0.644, 0.842)] and IADLs [HR 1.58, CI (1.072, 2.341)]. Addition of SRH in Model 2 (Model 2a) alters only slightly the associations, since SRH is non-significant. GALI (Model 2b), on the other hand, remains an important predictor, significantly increasing chances of death for the severely limited by 2.5 times [CI (1.503, 4.146)] and for the mildly limited by 2 times [CI (1.283, 3.118)]; in that model IADLs become non-significant. In the full Model (Model 3), all the above-mentioned associations of Model 2b remain significant. The likelihood ratio test indicates that addition of SRH and GALI to specific health indicators results in a statistically significant improvement in model fit (LR. χ^2, 6 *df*, 15.3).

Discussion

The findings of the study show that general indicators of health and disability are significant predictors of mortality for both sexes when included separately in a model controlling for socio-demographic confounders and risky health behaviours. In that sense, GALI proves to be as important a predictor as SRH. When specific health indicators are added in these models, GALI (for both males and females) and SRH (only for males) retain their significance though the magnitude of the corresponding associations diminishes, as general and specific indicators are interrelated up to point. Several specific health measures also remain significant (cancer, asthma among males, cognitive function, etc.) while other lose significance and/or become less important (depression, mobility and IADLs). This is not surprising given that several of these indicators, including mobility difficulties, depression and limitations in activities (ADLs and IADLs), are strong predictors of SRH and GALI (Kivinen et al. 1998; Dunlop et al. 2002; Verropoulou 2009; Jagger et al. 2010).

In the comprehensive models, including both general measures simultaneously, GALI loses significance among males, implying an overlap; in fact, men who report activity restrictions tend also to report worse SRH

Table 3 Adjusted hazard ratios of death (and 95 % CI) between waves 1 and 2 of the Survey of Health, Ageing and Retirement in Europe (2004–2006/2007): males

Variables (baseline)	Model 1 (socio-demographics: basic model)	Model 1a Model 1 plus SRH	Model 1b Model 1 plus GALI	Model 2 (basic plus specific health indicators)	Model 2a (Model 2 plus SRH)	Model 2b (Model 2 plus GALI)	Model 3 (full model)
Socio-demographic characteristics							
Age							
50–59 (ref cat)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
60–74	2.247** (1.583–3.190)	2.041** (1.436–2.900)	2.186** (1.539–3.105)	2.092** (1.456–3.004)	1.952** (1.358–2.806)	2.073** (1.443–2.978)	1.948** (1.355–2.801)
75+	5.176** (3.698–7.245)	4.236** (3.023–5.934)	4.481** (3.193–6.287)	3.954** (2.764–5.658)	3.629** (2.537–5.191)	3.795** (2.651–5.433)	3.598** (2.514–5.149)
Partnership status							
Single/sep/div/widowed (ref cat)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Partnered	0.625** (0.479–0.815)	0.609** (0.467–0.794)	0.616** (0.472–0.803)	0.681** (0.514–0.903)	0.654** (0.493–0.867)	0.671** (0.506–0.889)	0.654** (0.493–0.867)
Educational attainment							
0–6 years (ref cat)	1.492* (1.083–2.055)	1.230 (0.891–1.697)	1.311 (0.948–1.813)	1.208 (0.860–1.697)	1.111 (0.793–1.557)	1.166 (0.829–1.639)	1.108 (0.790–1.553)
7 years or more	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Behavioural risk factors							
Smoking							
Smoker (ref cat)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Non-smoker	0.626* (0.438–0.897)	0.639* (0.445–0.919)	0.611** (0.426–0.876)	0.609** (0.420–0.883)	0.615* (0.423–0.894)	0.605** (0.417–0.878)	0.616* (0.424–0.895)
Ex-smoker	1.009 (0.733–1.389)	0.930 (0.674–1.283)	0.938 (0.681–1.292)	0.862 (0.619–1.201)	0.830 (0.595–1.157)	0.849 (0.610–1.183)	0.830 (0.595–1.577)
BMI							
Under weight (BMI < 18.5)	1.666 (0.678–4.095)	1.591 (0.648–3.907)	1.632 (0.664–4.013)	0.784 (0.246–2.499)	0.770 (0.242–2.451)	0.806 (0.253–2.571)	0.784 (0.246–2.502)
All others (ref cat)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Physical activity							
Some (ref cat)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Nearly none	3.623** (2.724–4.818)	2.278** (1.676–3.098)	2.468** (1.807–3.372)	1.920** (1.358–2.716)	1.843** (1.300–2.612)	1.865** (1.311–2.654)	1.859** (1.307–2.644)
"Specific" health indicators							
Specific chronic conditions							
Asthma				1.667* (1.083–2.566)	1.613* (1.049–2.483)	1.611* (1.047–2.48)0	1.601* (1.040–2.464)
Cancer				3.625** (2.601–5.050)	3.258** (2.332–4.550)	3.445** (2.467–4.810)	3.243** (2.320–4.534)

Table 3 continued

Variables (baseline)	Model 1 (socio-demographics: basic model)	Model 1a Model 1 plus SRH	Model 1b Model 1 plus GALI	Model 2 (basic plus specific health indicators)	Model 2a (Model 2 plus SRH)	Model 2b (Model 2 plus GALI)	Model 3 (full model)
No (ref cat)				1.000	1.000	1.000	1.000
Depression symptoms (EUROD)							
At least 4				1.544** (1.147–2.078)	1.349* (1.001–1.818)	1.455* (1.079–1.962)	1.345 (0.997–1.815)
Less than 4 (ref cat)				1.000	1.000	1.000	1.000
Mobility difficulties							
At least 3				1.791** (1.277–2.512)	1.365 (0.971–1.918)	1.580** (1.117–2.233)	1.352 (0.959–1.908)
No limitations (ref cat)				1.000	1.000	1.000	1.000
IADL limitations							
At least 1				1.453* (1.028–2.054)	1.318 (0.936–1.856)	1.372 (0.968–1.945)	1.319 (0.935–1.861)
No limitations (ref cat)				1.000	1.000	1.000	1.000
Orientation in time (0 bad–4 excellent)				0.810** (0.705–0.933)	0.812** (0.705–0.935)	0.812** (0.706–0.935)	0.813** (0.706–0.937)
"General" health indicators							
Self-rated health							
Poor		3.187** (2.155–4.714)			1.914** (1.378–2.661)		1.866** (1.324–2.631)
Fair		2.557** (1.884–3.470)			1.712* (1.079–2.715)		1.694* (1.032–2.780)
Good (ref cat)		1.000			1.000		1.000
Very good		0.701 (0.437–1.125)			0.675 (0.409–1.112)		0.689 (0.416–1.141)
Excellent		0.055** (0.008–0.397)			0.064** (0.009–0.461)		0.066** (0.009–0.477)
GALI							
Severely limited			3.122** (2.207–4.416)			1.587* (1.045–2.410)	1.137 (0.809–1.599)
Mildly limited			2.127** (1.569–2.885)			1.580** (1.139–2.192)	1.053 (0.677–1.638)
Not limited (ref cat)			1.000			1.000	1.000
Log Likelihood	−2218.0	−2167.8	−2195.1	−1990.3	−1966.8	−1986.3	−1966.5

All models are adjusted for country of residence; the 11 countries included at wave 1 of the survey are considered in this instance (Sweden, Denmark, the Netherlands, Germany, Austria, Switzerland, Belgium, France, Spain, Italy and Greece)

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

Table 4 Adjusted hazard ratios of death (and 95 % CI) between waves 1 and 2 of the Survey of Health, Ageing and Retirement in Europe (2004–2006/2007): Females

Variables (baseline)	Model 1 (socio-demographics: basic model)	Model 1a Model 1 plus SRH	Model 1b Model 1 plus GALI	Model 2 (basic plus specific health indicators)	Model 2a (Model 2 plus SRH)	Model 2b (Model 2 plus GALI)	Model 3 (full Model)
Socio-demographic characteristics							
Age							
50–59 (ref cat)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
60–74	3.158** (1.866–5.345)	3.083** (1.818–5.227)	2.951** (1.742–4.998)	2.979** (1.722–5.152)	2.982** (1.722–5.152)	2.917** (1.687–5.042)	2.974** (1.717–5.151)
75+	8.876** (5.354–14.717)	8.302** (4.998–13.790)	7.522** (4.530–12.490)	7.122** (4.162–12.185)	7.169** (4.162–12.185)	6.811** (3.990–11.630)	6.982** (4.078–11.953)
Partnership status							
Single/sep/div/widowed (ref cat)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Partnered	0.686* (0.499–0.941)	0.682* (0.498–0.935)	0.682* (0.497–0.936)	0.786 (0.557–1.109)	0.777 (0.551–1.069)	0.770 (0.556–1.087)	0.769 (0.545–1.085)
Educational attainment							
0–6 years (ref cat)	2.041**(1.362–3.057)	1.889**(1.254–2.847)	1.959**(1.304–2.944)	1.630* (1.057–2.515)	1.586* (1.026–2.453)	1.628* (1.055–2.513)	1.620* (1.047–2.509)
7 years or more	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Behavioural risk factors							
Smoking							
Smoker (ref cat)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Non-smoker	0.708 (0.444–1.128)	0.702 (0.439–1.122)	0.689 (0.429–1.106)	0.603* (0.372–0.980)	0.605* (0.372–0.980)	0.602* (0.370–0.980)	0.600* (0.368–0.977)
Ex-smoker	0.827 (0.470–1.457)	0.834 (0.473–1.467)	0.797 (0.451–1.406)	0.807 (0.450–1.450)	0.812 (0.453–1.458)	0.793 (0.442–1.425)	0.791 (0.441–1.421)
BMI							
Under weight (BMI < 18.5)	2.196** (1.245–3.874)	2.157** (1.227–3.789)	2.102* (1.186–3.727)	1.934* (1.075–3.478)	1.947* (1.083–3.498)	1.982* (1.099–3.576)	2.024* (1.122–3.650)
All others (ref cat)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Physical activity							
Some (ref cat)	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Nearly none	4.594** (3.418–6.173)	3.538** (2.582–4.849)	3.373** (2.461–4.621)	2.591** (1.811–3.705)	2.478** (1.726–3.557)	2.376** (1.655–3.410)	2.345** (1.630–3.374)
"Specific" health indicators							
Specific chronic conditions							
Cancer				2.264** (1.516–3.381)	2.146** (1.429–3.223)	2.097** (1.400–3.140)	2.057** (1.368–3.095)
No (ref cat)				1.000	1.000	1.000	1.000

Table 4 continued

Variables (baseline)	Model 1 (socio-demographics: basic model)	Model 1a Model 1 plus SRH	Model 1b Model 1 plus GALI	Model 2 (basic plus specific health indicators)	Model 2a (Model 2 plus SRH)	Model 2b (Model 2 plus GALI)	Model 3 (full Model)
Depression symptoms (EUROD)							
At least 4				1.079 (0.777–1.498)	1.018 (0.726–1.427)	1.008 (0.725–1.403)	1.003 (0.715–1.407)
Less than 4 (ref cat)				1.000	1.000	1.000	1.000
Mobility difficulties							
At least 3				1.250 (0.844–1.845)	1.142 (0.758–1.719)	0.985 (0.660–1.472)	0.978 (0.648–1.475)
No limitations (ref cat)				1.000	1.000	1.000	1.000
IADL limitations							
At least 1				1.584* (1.072–2.341)	1.515* (1.021–2.248)	1.408 (0.952–2.082)	1.401 (0.944–2.078)
No limitations (ref cat)				1.000	1.000	1.000	1.000
Orientation in time (0 bad–4 excellent)				0.736** (0.644–0.842)	0.742** (0.648–0.849)	0.749** (0.655–0.857)	0.753** (0.657–0.862)
"General" health indicators							
Self-rated health							
Poor		2.593** (1.727,–3.894)			1.577 (0.966–2.576)		1.240 (0.747–2.058)
Fair		1.468* (1.011–2.127)			1.327 (0.886–1.988)		1.123 (0.745–1.692)
Good (ref cat)		1.000			1.000		1.000
Very good		1.050 (0.599–1.840)			1.133 (0.629–2.040)		1.304 (0.719–2.366)
Excellent		0.840 (0.329–2.143)			0.973 (0.377–2.510)		1.294 (0.492–3.402)
GALI							
Severely limited			3.224** (2.103–4.943)			2.496** (1.503–4.146)	2.470** (1.424–4.284)
Mildly limited			2.351** (1.571–3.520)			2.000** (1.283–3.118)	2.038** (1.273–3.263)
Not limited (ref cat)			1.000			1.000	1.000
Log Likelihood	−1679.4	−1667.6	−1662.8	−1428.4	−1426.6	−1421.4	−1420.8

All models are adjusted for country of residence; the 11 countries included at wave 1 of the survey are considered in this instance (Sweden, Denmark, the Netherlands, Germany, Austria, Switzerland, Belgium, France, Spain, Italy and Greece)

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

(correlation coefficient 0.541). Indeed, both measures seem to express similar aspects of health. Among women GALI is the only significant indicator; further research, however, is needed to determine whether its predictive power differentiates consistently between genders. Overall, regarding the relative importance of specific versus general indicators of health, the findings of the study imply that most of them are strong and, to a great extent, independent predictors of mortality. Both SRH and GALI add information on top of the specific measures while, at the same time, they improve significantly the fit of the models. Hence, a combination of specific and general indicators seems more efficient in predicting mortality than either of these alone.

Between genders, some similarities and some differences can be observed. Cancer and orientation in time, the latter here represents cognitive function, are strong predictors of mortality for both sexes and this is in accord with past studies (Mehta et al. 2003). Asthma here, on the other hand, significantly predicts death only for males; this also holds regarding depression and mobility difficulties. What differentiate sexes markedly in the present analysis, however, are general health indicators; in the comprehensive models, SRH is a significant predictor only among men whereas GALI is significant only among women. The results may imply that these two general measures represent different aspects of health by gender but they may also show that there are different thresholds in the reporting of men and women.

The analysis also indicates some differences by gender in the importance of risky health behaviours. For instance, smoking significantly increases chances of mortality but is of greater import among men while low BMI is significant only among women. These results are probably related to these behaviours being more widespread within a specific gender; the importance of smoking and low BMI in increasing chances of mortality have been noted before (Dey et al. 2001; Simons et al. 2005; Orpana et al. 2008). Physical inactivity, on the other hand, remains a strong predictor of death in all models and for both sexes. Finally, the results confirm the importance of educational attainment, albeit only for women, and the protective effect of being partnered for men.

Some methodological aspects and limitations of the study should be noted. An important issue arises because of the quite substantial attrition between the waves of the survey which, if systematic, has the potential of severely biasing the estimates. According to Schulz and Doblhammer (2011) as well as the results of the present and past analyses of the author (Verropoulou 2012), SHARE panel respondents are positively selected in terms of physical, mental health and other socio-demographic characteristics. Regarding mortality between waves 1 and 2 of SHARE, Schulz and Doblhammer (2011) suggest that it is underestimated, mainly due to the exclusion of the institutionalised population from the sample design; however, the data can be used to study mortality for all countries combined though a certain bias may remain.

Undoubtedly, non-reported deaths at wave 2 are included in non-response but they seem to constitute only a small fraction of that group, since a comparison of the characteristics of respondents and non-respondents to those dead indicates that the first two groups differ markedly compared to the third while they resemble each other. Though underreporting of deaths within SHARE itself may be limited, the fact remains that, due to the omission of the institutionalised population and of the positive selection of panel respondents, the persons considered in the present analysis are those having better health at baseline and a higher socio-economic profile. This may lead to the underestimation of the importance and significance of such factors in predicting mortality. Hence, the estimates of the study may be considered as a lower bound of the significance and importance of these predictors.

Other limitations of the study include: First, the small number of deaths by sex may have lead to further underestimation of the significance of some associations. Second, the analysis is based on self-reported measures and the precision of the estimates relies upon accurate reporting. For instance, misreporting of the respondents' weight and height may have led to misclassification of underweight and incorrect assessment of the respective associations. Third, the analysis is based on the available information; hence, there is residual confounding since several mortality risk factors, such as consumption of excessive amounts of alcohol on a regular basis, unhealthy diet, unhealthy environmental conditions, etc., are not included in the study. Fourth, the interval between waves in this instance is rather short, only 2–3 years, and causality is difficult to establish. A longer interval of observation would help to strengthen current results. Fifth, partnership includes only formalised cohabitation and may not reflect accurately partnership status in countries where non-formalised cohabitation is a common practice. Hence, the importance of partnership may have been underestimated. Finally, general measures such as SRH are known to be affected by differential reporting across population subgroups (Vuorisalmi et al. 2008) and this should be kept in mind when interpreting the results. Since, however, this is a multinational sample bias introduced by cultural perceptions should be fairly small.

Conclusion

The analysis shows that specific and general self-reported health indicators work best in conjunction to predict death;

general indicators add health information beyond specific measures. SRH and GALI seem to share some traits and are not simultaneously significant. In fact, their importance seems to differentiate between the sexes. The main novelty of the study lies in the emergence of GALI as a strong predictor of mortality. The implications are important; GALI, already widely used in estimating healthy life years, being simpler than other similar measures of activity restrictions, could perhaps substitute them in brief surveys. This matter deserves further exploration and attention in context where additional specific and biometric indicators of health may be included in the analysis. Observation over longer periods of time would also serve to clarify associations and reinforce conclusions.

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