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ORIGINAL PAPER

Poor eudaimonic subjective wellbeing as a mortality risk factor

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Abstract
We investigate the nexus between poverty of sense of life (a dimension of eudaimonic subjective wellbeing) and mortality in a large sample of individuals from several European countries. We find that poverty of sense of life is significantly and positively correlated with mortality, net of the impact of socio-demographic factors, life styles, symptoms and even life and health satisfaction controls. We as well test whether the observed correlation is mainly explained by physiological factors or, as well, by behavioural factors such as unhealthy life styles and/or insufficient physical activity.

Keywords Mortality · Eudaimonic wellbeing · Sense of life

JEL Classification I10 Health general · I12 Health Behavior · I31 General welfare · Wellbeing

1 Introduction

The present paper contributes with original research to the investigation of the nexus between eudaimonic wellbeing (sense of life) and mortality, extending the analysis to a cross-country sample of 12 European countries and investigating aspects so far unexplored in this field.

Identifying factors associated with longevity has been a longstanding research effort in the last decades. Most of the existing literature has been primarily concerned with the effects of income and education on mortality. The extensive review of Cutler et al. (2006) reports a strong correlation between income per capita and mortality rates, with richer and better-educated individuals (over history, over countries, and across groups within countries) living longer. Studies on

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mortality have however recently started being more focused on the less explored intangible aspects of life such as subjective wellbeing (SWB) and self-assessed health. These immaterial factors can actually help to capture health dimensions not covered by objective indicators and can contribute to predict longevity, especially in high-income countries where high living standards have already been achieved. More specifically on this point, recent scientific works in medicine and psychology have highlighted the important role of eudaimonic wellbeing—and specifically purpose in life—in predicting mortality risk. These studies document that having a sense and/or purpose in life is a particularly relevant component of human flourishing. The construct of eudaimonic wellbeing finds its philosophical origins in the *Nichomachean Ethics* of Aristotle (1962). More recently, Ryff and Keyes (1995) regarded purpose in life as one of the six key dimensions of psychological well-being. In the well-being perspective, purpose in life refers to the sense that life has in terms of meaning and direction and relates to the fact that individual goals and living potential are being achieved or are achievable. This notion focuses on self-realization and goes beyond the evaluation of life as a whole (as in the life satisfaction cognitive wellbeing indicator) or experienced emotions (as in the positive/negative affect affective wellbeing indicators). While eudaimonic wellbeing is the least well-researched SWB dimension, it is definitely the one where more progress can and needs to be done in the next future (OECD 2013).

As is well-known the relevance of subjective indicators in social sciences depends as well on their capacity of predicting objective outcomes. In this respect purpose in life has long been hypothesized to be an important determinant of physical health and vitality, even though prospective data regarding the association of purpose in life with mortality are lacking. Rigorous empirical studies on this topic have been published only recently and are limited to US or Japanese samples. While the US studies evaluated a sense of purpose or meaning in life, or “usefulness to others”, generally using three or more questions from the scale of psychological well-being (Ryff and Keyes 1995), the Japanese studies focused on the concept of *ikigai*, which can be translated as “a life worth living.”

Results from the above mentioned literature suggest that finding a purpose in life may add years to it. Studies have found that purposeful older adults experience a diminished mortality risk in American samples (Krause 2009), even after controlling for known predictors of longevity (Boyle et al. 2009). Prior research has demonstrated that similar effects have been produced by the sense of *ikigai* in a Japanese sample (Koizumi et al. 2008, Sone et al. 2008). Hill and Turiano (2014) extend previous findings by examining whether purpose in life promotes longevity across the adult years, using data from the longitudinal Midlife in the United States (MIDUS) sample. By pooling observations from the available US and Japanese studies, Cohen et al. (2016) find that mortality was about one-fifth lower for participants reporting a strong sense of purpose, or *ikigai*.

Our paper aims to extend and enrich the above described literature by testing the predictive power of an eudaimonic indicator—i.e. purpose in life—on mortality on a large sample of individuals from 12 European countries.

Our research is innovative in several respects.

First, with the present study we want to verify whether the recent findings on American and Japanese samples can be extended to European countries. Using data from waves 4 and 5 of the SHARE survey we test the hypothesis that greater purpose in life is associated with a reduced risk of mortality among European citizens aged above 50. Second, the findings illustrated in the paper document that a higher level of purpose in life is associated with a substantially reduced risk of mortality even after controlling for health and life satisfaction in addition to the traditional predictors of longevity used in the literature. In this respect the novelty of our paper is that the sense of life-mortality nexus is tested net of the impact of a richer and more severe set of concurring factors including self-assessed-health which works as a proxy of the unmeasured (and often unobservable) severity of objective health conditions.

Third, in formulating our null hypothesis we discriminate between a *behavioural* and a *physiological* channel accounting for the correlation between poor sense of life and mortality. According to the former, the effect on health and mortality is produced by reduced self-care and medical checks. According to the latter, the effect arises even after controlling for self-care and depends on the existence of a direct physiological channel between poor sense of life and body reactions (see Sect. 2 for additional details on this point).

Fourth, in our robustness check we wonder whether the sense of life-mortality nexus is affected by measurement error on mortality, has a gender specific dimension and/or varies according to the level of respondents' education.

Last but not least, given its findings our paper contributes to the literature debate on the importance and role of subjective indicators that are generally considered less valid and relevant in terms of policy consequences (Frey and Stutzer 2002; Clark et al. 2006; Becchetti and Pelloni 2013). The best way to test whether subjective indicators matter is to check whether they are significantly correlated with future changes in objective outcomes (on this point see among others Judge 1992; Judge et al. 2001).

In our specific case, if the sense of life dimension of eudaimonic wellbeing is correlated with future mortality rates and is therefore a leading health indicator, collection of information about this variable has obvious importance for demographers and for policies in health and active ageing.

2 The outline of our hypothesis and the physiological and behavioural channels

In this section we try to go deeper into the rationales for the rejection of our null hypothesis (tested in the econometric estimates that follow) of absence of correlation between sense of life and mortality after controlling for all the relevant concurring factors.

The two main channels through which the nexus may operate are *physiological* and *behavioral*. From the first point of view (the physiological channel), given the strict physiological connections between our body functioning and the psychological dimension, rich sense of life is postulated to strengthen per se (even without any intended voluntary action of the individual) our physical health producing physiological effects that reduce the probability of mortality or increase the physical capacity to react to life shocks.

More specifically on this point, Krause (2007) argues that traumatic life events produce relatively less depressive symptoms (and therefore lower physical effects) on the elders who have a richer sense of life. Salovey et al. (2000) find that positive emotions are positively correlated with sense of life since they produce significant effects on immune functioning measures including secretory immunoglobulin A, lymphocyte proliferation, and natural killer cell activity. Ryff et al. (2004) find significant correlation between purpose of life and better regulation of physiological systems (e.g., reduced inflammatory markers and cardiovascular risk factors), together with brain-based mechanisms (e.g., insular cortex volume, reduced amygdala activation, sustained ventral striatum activation). Fredrickson et al. (2013) find that eudaimonic wellbeing is associated with enhanced expression of antiviral response genes and reduced expression of proinflammatory genes by examining gene transcriptional profiles. All these studies find support for the first—physiological—channel since they document that high (low) eudaimonic wellbeing triggers biological mechanisms that determine positive (negative) health outcomes.

From the second point of view (the behavioral channel) the effect on our body and health is indirect and passes through individual action via the relaxation of life styles. In this specific case individuals who experience poor sense of life (or who feel that life is not worth living, consistently with the Japanese definition of *ikigai*) change their behavior, become careless and such change produces an increase in the probability of chronic diseases and mortality (Park 2007). In this respect Kim et al. (2014) find on a large sample of American adults aged above 50 (consistently with what mentioned above but in the opposite direction), that higher eudaimonic wellbeing is correlated with more sustained choice to pursue preventive health care services (e.g., flu shots, cholesterol tests, colonoscopies, mammograms, pap smears, and prostate examinations).

An interesting characteristic of our database is that, in case of rejection of the null, we can disentangle between the two different (physiological and behavioral) rationales. To this purpose we propose specifications where the impact of poor sense of life is tested including/not including life style controls (alcohol consumption, physical activity, smoking, number of doctor visits). Among them alcohol consumption and physical activity may be significantly regarded as proxies of the desire of self-care. A rejection of the null when life styles are included indicates that the direct physiological channel works since the impact is significant also net of the concurring effect of life styles. A sense of life coefficient significant and relatively higher in the specification without life styles vis-à-vis that including life styles tells as well that the behavioral channel is also at work accounting for the differential between the two coefficients.

More specifically, the estimated model is

$$\Delta Mort_{i,t} = \alpha_0 + \alpha_1 PoorSenseOfLife_{i,t-1} + \sum_k \gamma_k LifeStyles_{i,t-1} + \sum_m \lambda_m Controls_{i,t-1} + \varepsilon_{i,t-1} \quad (1)$$

compared to

$$\Delta Mort_{i,t} = \beta_0 + \beta_1 PoorSenseOfLife_{i,t-1} + \sum_m \lambda_m Controls_{i,t-1} + \varepsilon_{i,t-1} \qquad (1')$$

The behavioural channel matters [and (1′) suffers from omitted variable bias] if $\beta_1 > \alpha_1$ with $\beta_1, \alpha_1 > 0$, while the behavioural channel does not matter if $\beta_1 = \alpha_1$ and no relevant life style factors are absent in the augmented specification (1).

3 Data

Information for our empirical analysis comes from the "Survey of Health, Ageing and Retirement in Europe (SHARE)",[1] a cross-national panel dataset on health, socio-economic status, and the social and family networks of more than 59,599 Europeans aged 50 and over. The database provides information about a wide range of objective and subjective variables related to physical health status and subjective wellbeing of the respondents and their family members with observations coming from 12 countries: Austria, Germany, Sweden, The Netherlands, Spain, Italy, France, Denmark, Czech Republic, Estonia, Slovenia and Poland. A legend of the SHARE variables used in the analysis is provided in Table 1.

The focus of our analysis is on a specific dimension of eudaimonic wellbeing represented by sense/meaning of life. The variable is measured in the SHARE survey with the following question: "*How often do you feel that your life has meaning?*".[2] The four possible answers to this question are "*often, sometimes, rarely, never*" producing a 1–4 scale discrete qualitative variable. An advantage of this specific construction with respect to standard cognitive subjective wellbeing measures such as 0–10 life satisfaction scales is its reduced abstraction since, for any number, we find a corresponding adjective in the indicator. A potential disadvantage is the relative imbalance toward negative judgement that concentrates good visions of life in only one response ("often"). This choice however reflects the particular age interval of the SHARE database. Being well-known that meaning of life falls with age (Ryff and Keyes 1995; Keyes 2011) the researchers who created the survey thought that it would be more important to have more item variability on the negative than on the positive side. Another original feature is that the variable is measured in terms of

[1] SHARE was created following a Communication by the European Commission calling to "examine the possibility of establishing, in co-operation with Member States, a European Longitudinal Ageing Survey". The database became a major pillar of the European Research Area and was selected as one of the projects to be implemented in the European Strategy Forum on Research Infrastructures (ESFRI) in 2008. The project has been given the status of the first ever European Research Infrastructure Consortium. The research is harmonized with the US Health and Retirement Study (HRS) and the English Longitudinal Study of Ageing (ELSA) and adopts rigorous methodologies that ensure and ex-ante harmonized cross-national design.

[2] Note that the maintained hypothesis in this literature for a nexus between this commonly used variable and the wider concept of eudaimonic wellbeing is that getting closer to one's own self-fulfillment progressively increases one's own sense of life. Hence the two variables are expected to be strictly positively correlated.

Table 1 Variable legend

Variables	Description
Socio-demographic variables	
Ageclass	(0/1 dummies for the following age groups) Age 55–59; age 60–64; age 65–69; age 70–74; age 75–79, age 80–84; age 85–89; age 90–95; age 95 +
EduYears	Years of education
Male	Dummy variable = 1 if the respondent's gender is male and 0 otherwise
LogPerCapitaIncome	Ln of household total gross income. Its value is equal to the sum over all household members of the individual-level values of: annual net income from employment and self-employment (in the previous year); Annual public old age/early or pre-retirement/disability pension (or sickness benefits); Annual public unemployment benefit or insurance, public survivor pension from partner; Annual war pension, private (occupational) old age/early retirement/disability pension, private (occupational) survivor pension from partner's job, public old age supplementary pension/public old age/public disability second pension, secondary public survivor pension from spouse or partner, occupational old age pension from a second and third job; Annual public and private long-term insurance payments; Annual life insurance payment, private annuity or private personal pension, private health insurance payment, alimony, payments from charities received; Income from rent. Values of the following household level variables are added: Annual other HHD members' net income; Annual other HHD members' net income from other sources; Household bank accounts, government and corporate bonds, stocks/shares; mutual funds
Married	Dummy variable = 1 if the respondent is married, 0 otherwise
Divorced	Dummy variable = 1 if the respondent is divorced, 0 otherwise
Widowed	Dummy variable = 1 if the respondent is widowed, 0 otherwise
Employed	Dummy variable = 1 if the respondent is employed, 0 otherwise
Retired	Dummy variable = 1 if the respondent is retired, 0 otherwise
Single/never married	Dummy variable = 1 if the respondent is single/never married, 0 otherwise
UnderWeight	Dummy variable = 1 if the respondent is underweight (BMI < 18.49), 0 otherwise
OverWeight	Dummy variable = 1 if the respondent is overweight (29.9 < BMI < 34.9), 0 otherwise
Obese	Dummy variable = 1 if the respondent is obese (BMI > 34.9), 0 otherwise
Health related variables	
Arthritis	Dummy variable = 1 if the doctor told you had: arthritis, 0 otherwise
Asthma	Dummy variable = 1 if the doctor told you had: asthma, 0 otherwise
Cancer	Dummy variable = 1 if the doctor told you had: cancer, 0 otherwise
Cataracts	Dummy variable = 1 if the doctor told you had: cataracts, 0 otherwise
Chroniclungdisease	Dummy variable = 1 if the doctor told you had: chronic lung disease, 0 otherwise
Diabetes	Dummy variable = 1 if the doctor told you had: diabetes or high blood sugar, 0 otherwise
Health_Satisfaction	Self-perceived health status: 1 = excellent, 2 = very good; 3 = good; 4 = fair; 5 = poor

Table 1 (continued)

Variables	Description
Heartattack	Dummy variable = 1 if the doctor told you had: heart attack, 0 otherwise
Cholesterol	Dummy variable = 1 if the doctor told you had: high blood cholesterol, 0 otherwise
Hypertension	Dummy variable = 1 if the doctor told you had: high blood pressure or hypertension, 0 otherwise
Hipfractureorfemoralfracture	Dummy variable = 1 if the doctor told you had: hip fracture or femoral fracture, 0 otherwise
Osteoporosis	Dummy variable = 1 if the doctor told you had: osteoporosis, 0 otherwise
Stroke	Dummy variable = 1 if the doctor told you had: stroke, 0 otherwise
Stomach ulcer	Dummy variable = 1 if the doctor told you had: stomach or duodenal ulcer, peptic ulcer, 0 otherwise
N_DoctorVisits	Number of doctor visits in the last 12 months
Health styles	
Drinking	Dummy variables: Drink 5 or 6 days a week; Drink 3 or 4 days a week; Drink 1 or 2 a week; Drink once or twice a month; Drink < once a month; Not Drinking for 3 months (not drinking at all is the omitted benchmark)
Smoking	Dummy variable = 1 if the respondent smokes at the present time
Inactivity	Dummy variable = 1 if the respondent does not practice sports or vigorous activities, 0 otherwise

frequency of evaluations across time and not of an overall evaluation given at just one point in time. An advantage in adopting this approach may be that of making the respondent aware that her/his evaluation at a single point in time may be influenced by momentary circumstances that can be averaged out by the frequency-mode question. The other substantial advantage of our sample is given by the opportunity of controlling for an extremely detailed set of socio-demographic factors, diagnosed illnesses and reported symptoms. This is unique of the SHARE survey and makes it richer than traditionally used administrative data that usually do not allow such a wide cross-country comparability with a wide set of controls homogeneously reported in each country. More specifically on this point, another important advantage is the possibility of accounting for other subjective variables such as cognitive life satisfaction and self-assessed health.

4 Descriptive findings

Information from the SHARE survey tells us that between the fourth and the fifth wave 2129 of 59,599 persons (3.6%) died. In the overall sample average education years are around 10 and a half (below completion of a high school degree), retired individuals account for 56% of the sample, while widowed for around 15%. 19% of respondents are smokers and around 21.5% are classified above the obese BMI threshold (Table 2).

We start by examining the crude associations of characteristics of individuals (at wave 4) who died in the following period (wave 5) compared to those of survivors (Table 3). Descriptive findings of the two samples document differences in several respects. Those who died were older and more likely to be male than survivors. They reported on average lower per capita income and a lower number of education years (around 9.2 against 10.7). In addition, those who died reported lower life satisfaction, eudaimonic wellbeing and health satisfaction in the previous wave. The difference in terms of physical activity is also striking: around 40% of those who died were physically inactive in the previous wave, while the share falls to around 10% among those who survived. This descriptive finding can be interpreted in two ways: absence of physical activity raises the probability of mortality and/or absence of physical activity in the previous wave is a sign that the health condition of respondents is already compromised. This is why the econometric analysis in the next section (where we control for all possible factors proxying for health conditions) is crucial to identify the determinants of mortality. Among marital status variables the share of widowed and retired is much higher in the deceased sample (30% against 15% for widowed and 81% against 56% for retired).

Obviously the previous wave comparison of characteristics between the survived and deceased sample give only first indications and does not allow to evaluate the impact of a given variable net of all the other concurring effects. Given the complex pattern of correlations among them (income and education are correlated, individuals in the would-be deceased sample are as expected older and this affects marital status and retirement) we can disentangle net effects only with the econometric analysis that follows.

Before proceeding with the econometric analysis we examine more in depth the nexus between sense of life and mortality in our descriptive evidence. We find that individuals who stated in wave 4 that their life has "never" a meaning (lowest self-reported level of life sense) register in the following wave an average change in the dummy variable 'deceased' (dead = 1, alive = 0 in wave 5) of about 0.09. We may grossly interpret this evidence as documenting that the lowest self-reported level of purpose in life is correlated with a 9% probability of dying in the following period. Compared to them, those who choose "rarely" register a change of 0.07, those who choose "sometimes" of 0.04, up to those answering that their life has "often" a meaning who register an average change of just 0.02. Figure 1 documents that these averages are significantly different from each other even when we consider two close and consecutive rungs of the life-sense ladder (95% confidence intervals do not overlap except for the couple "never"–"rarely"). These descriptive findings suggest that the probability of not surviving in the following period is about four times larger for those reporting the lowest than for those reporting the highest level of purpose in life.

Table 2 Summary descriptive findings

Variables	Obs.	Mean	Std.	Min.	Max.
Deceased (t + 1)	39,674	0.036	0.188	0	1
Poor sense of life	56,552	0.338	0.473	0	1
Age class					
55–60	58,462	0.121	0.326	0	1
60–65	58,462	0.170	0.376	0	1
65–70	58,462	0.180	0.385	0	1
70–75	58,462	0.156	0.362	0	1
75–80	58,462	0.133	0.339	0	1
80–85	58,462	0.101	0.301	0	1
85–90	58,462	0.071	0.256	0	1
90–95	58,462	0.036	0.186	0	1
95 +	58,462	0.012	0.109	0	1
Male	59,599	0.436	0.496	0	1
Log per capita income	58,167	9.031	1.437	− 19.274	14.222
Education years	55,598	10.441	4.444	0	25
Married	39,009	0.678	0.467	0	1
Divorced	39,009	0.109	0.312	0	1
Widowed	39,009	0.153	0.360	0	1
Single/never married	39,009	0.059	0.236	0	1
Retired	57,684	0.564	0.496	0	1
Employed	57,684	0.273	0.446	0	1
Drink alcohol					
Less than once a month	57,726	0.110	0.313	0	1
Once a month	57,726	0.119	0.324	0	1
Once a week	57,726	0.170	0.375	0	1
Three times a week	57,726	0.065	0.247	0	1
Five times a week	57,726	0.028	0.165	0	1
Almost every day	57,726	0.182	0.385	0	1
Smoking	57,909	0.188	0.391	0	1
Under weight	37,210	0.013	0.113	0	1
Over weight	37,210	0.408	0.492	0	1
Obese	37,210	0.215	0.410	0	1
Inactivity	57,713	0.125	0.330	0	1
N.DoctorVisits	57,669	6.698	9.741	0	98
Life satisfaction	56,864	7.560	1.864	0	10
Self assessed health	58,142	3.248	1.082	1	5
Heart attack	58,126	0.138	0.345	0	1
Hypertension	58,126	0.393	0.488	0	1
Cholesterol	58,126	0.230	0.421	0	1
Stroke	58,126	0.044	0.205	0	1
Diabetes	58,126	0.125	0.331	0	1
Lung disease	58,126	0.066	0.248	0	1

Table 2 (continued)

Variables	Obs.	Mean	Std.	Min.	Max.
Asthma	58,126	0.007	0.085	0	1
Arthritis	58,216	0.241	0.435	0	1
Osteoporosis	58,216	0.011	0.130	0	1
Cancer	58,126	0.053	0.224	0	1
Stomach ulcer	58,126	0.058	0.233	0	1
Parkinson	58,126	0.007	0.085	0	1
Cataracts	58,126	0.085	0.279	0	1
Hip fracture	58,126	0.024	0.154	0	1

5 The econometric specification

In order to test whether the correlation shown above is robust when controlling for concurring factors we adopt the following fully augmented logistic specification

$$\begin{aligned}(1)\, Deceased_t &= \alpha_0 + \alpha_1 NeverRarely_{t-1} + \alpha_2 Sometimes_{t-1} \\ &+ \sum_k \gamma_k DAgeClass_{t-1} + \alpha_3 Male_{t-1} + \alpha_4 LogPerCapitaIncome_{t-1} \\ &+ \alpha_5 EduYears_{t-1} + \sum_j \delta_j DMaritalStatus_{t-1} + \sum_l \theta_l DJobStatus_{t-1} \\ &+ \sum_n \varphi_n DAlcoholCons_{t-1} + \alpha_6 UnderWeight_{t-1} + \alpha_7 OverWeight_{t-1} \\ &+ \alpha_8 Obese_{t-1} + \alpha_9 Smoking_{t-1} + \alpha_{10} Inactivity_{t-1} + \alpha_{11} N.DoctorVisits_{t-1} \\ &+ \alpha_{12} HealthSat_{t-1} + \alpha_{13} LifeSat_{t-1} + \sum_m \chi_m DIllnesses_{t-1} + \sum_s \lambda_s DCountry_{t-1} + \varepsilon_{t-1}\end{aligned}$$

where the dependent variable is a unit dummy taking value one if the individual was alive and participated to the survey at time t − 1 (wave 4) while was registered as deceased at time t (wave 5). Our main regressors of interest, are the dummy variable "NeverRarely", which takes unit value if the respondent reported in t_0 that her/his life has never or rarely sense and zero otherwise, and "Sometimes" which takes unit value if the respondent in t_0 reported that her/his life has sometimes sense and zero otherwise ("often" is therefore the omitted benchmark).

We decide to aggregate the first two items of our eudaimonic wellbeing measure given that "never" and "rarely" are judgements having a quite close common negative evaluation of sense of life. The response "sometimes" is considered separately for its difference in meaning with respect to the other two, as it is the only positive answer available "often". The null hypothesis of absence of effects of poor sense of life on mortality is therefore H_0: $\alpha_1 = 0$.

Since we deal with binary response variable, any factor that affects the probability of realization π that y = 1 will modify not just the mean but also the variance of the observations. This suggests that a linear model that allows the regressors to affect the mean while assuming that the variance is constant is not appropriate for the purpose of our

Table 3 Descriptive statistics at wave 4 for survived/non survived individuals at wave 5

Variables (wave 4)	Survived (at wave 5)			Non survived (at wave 5)		
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
Age class:	38,203			1462		
55–60		0.118	0.322		0.000	
60–65		0.168	0.374		0.050	0.218
65–70		0.183	0.386		0.086	0.281
70–75		0.162	0.369		0.083	0.276
75–80		0.141	0.348		0.122	0.327
80–85		0.104	0.306		0.176	0.381
85–90		0.068	0.251		0.190	0.393
90–95		0.030	0.172		0.176	0.381
95 +		0.009	0.092		0.096	0.295
Male	38,212	0.427	0.495	1462	0.535	0.499
LogPerCapitaIncome	38,055	9.204	1.334	1455	8.766	1.530
EducationYears	36,409	10.725	4.476	1384	9.164	4.313
Married	24,269	0.666	0.472	895	0.562	0.496
Divorced	24,269	0.120	0.325	895	0.076	0.265
Widowed	24,269	0.152	0.359	895	0.298	0.458
Retired	37,931	0.556	0.497	1387	0.811	0.392
Employed	37,931	0.283	0.451	1387	0.043	0.202
Drink alcohol	37,941			1389		
Less than once a month		0.112	0.315		0.093	0.290
Once a month		0.125	0.331		0.085	0.279
Once a week		0.185	0.389		0.100	0.300
Three times a week		0.072	0.258		0.035	0.185
Five times a week		0.030	0.170		0.012	0.110
Almost every day		0.187	0.390		0.165	0.371
Smoking	38,020	0.186	0.389	1421	0.170	0.375
Non normal weight	28,934			2145		
UnderWeight		0.011	0.120		0.047	0.210
OverWeight		0.414	0.492		0.371	0.483
Obese		0.201	0.401		0.189	0.391
Life satisfaction	37,952			1277		
1		0.003	0.050		0.011	0.104
2		0.004	0.067		0.030	0.170
3		0.012	0.109		0.027	0.163
4		0.017	0.129		0.048	0.213
5		0.094	0.291		0.146	0.353
6		0.074	0.261		0.099	0.298
7		0.163	0.369		0.138	0.345
8		0.309	0.462		0.240	0.427
9		0.158	0.365		0.111	0.315
10		0.161	0.368		0.139	0.346

Table 3 (continued)

Variables (wave 4)	Survived (at wave 5)			Non survived (at wave 5)		
	Obs.	Mean	Std. Dev.	Obs.	Mean	Std. Dev.
Self assessed health	38,136			1452		
Very good (1)		0.178	0.382		0.048	0.213
Good (2)		0.363	0.481		0.191	0.393
Fair (3)		0.282	0.450		0.348	0.476
Poor (4)		0.101	0.302		0.397	0.490
Life sense	37,348			1261		
Rarely (2)		0.064	0.244		0.153	0.360
Sometimes (3)		0.220	0.414		0.305	0.461
Often (4)		0.689	0.463		0.463	0.499
Inactivity	56,110	0.096	0.295	2196	0.396	0.489

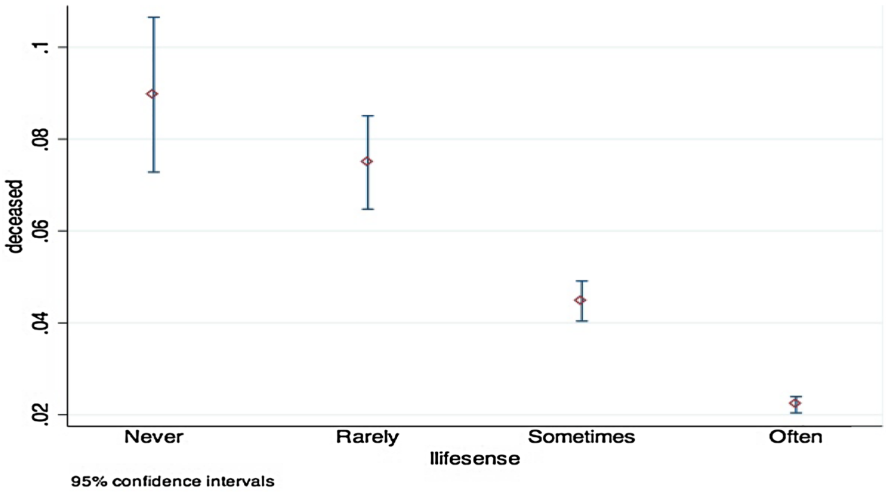

Fig. 1 Sense of life in wave 4 and probability of death in wave 5. Horizontal axis: answer to the question: *How often do you feel that your life has meaning?*" at wave 4. Vertical axis: share of deceased at wave 5 (0.2 = 2%)

analysis. As previously mentioned, our dependent variable is equal to 0 if the individual is still alive in wave 5 and equal to 1 if the individual deceased between wave 4 and wave 5. We therefore apply the logistic transformation to remove the range restrictions, and then model the transformation as a linear function of the covariates.

$$\log it(\pi) = \log\left(\frac{\pi}{1-\pi}\right) = \boldsymbol{x}'\boldsymbol{\alpha}$$

where $\mathbf{x}'$ is the matrix of our explanatory variables in (1) and $\boldsymbol{\alpha}$ the vector of coefficients. Coefficients in this specification represent the change in the logit of the probability (i.e. the logarithm of the odds) associated with a unit change in the *j*-th predictor holding all other predictors constant.

However, since the change in the dependent variable for a change in the covariate is easier to understand and to explain, we decide to present and comment our results in terms of marginal effects The latter are linked to the estimated coefficients. In particular, the effect of the *j*-th predictor on the probability π that y = 1 depends on the coefficient α_j and the value of the probability itself in the following way:

$$\frac{d\pi}{dx_j} = \alpha_j \pi (1 - \pi)$$

In this setting the prediction at the average of the covariates is different from the average of the predictions. The first is the expected probability of a person with average characteristics, the second is the average probability among actual persons in the data. With the command we used in Stata calculations are made at the observational level and are then averaged. Thus, in general, the average marginal effects of the type we estimated represent the expected difference in outcome probability associated with a 1-unit increase in the predictor variable, adjusted to the sample distributions of all the variables in the model.

Considering that the main regressors of interest are the dummy variables *Never-Rarely* and *Sometimes,* the computed marginal effect represents the discrete change from the base level (*Often*). It means that the coefficient shown in the first row of Table 4 answers the question: "What is the average change in the probability of dying the next year for an individual who feels that his life has never or rarely a meaning compared to an individual who feels that life has often a meaning?". The same reasoning applies for the "sometimes" coefficient in the second row.

Standard additional socio-demographic controls included in the estimates are gender, education years,[3] the logarithm of household income[4] per family

[3] We alternatively use 1997 ISCED (International Standard Classification of Education) standards and, specifically, dummies for primary education or first stage basic education, lower secondary or second stage of basic education, (upper) secondary education, post-secondary non-tertiary education, first stage of tertiary education, second stage of tertiary education (with pre-primary education being the omitted benchmark). Results are not substantially different and do not exhibit particular nonlinearities in the relationship between education degrees and the number of pathologies. The more parsimonious specification with the number of education years is therefore preferred.

[4] As is well-known the SHARE dataset presents several missing-values for some variables such as income. Following what is standard for research on this database we use the supplementary datasets downloadable from the SHARE website where the missing information is imputed by Christelis (2011) using Fully Conditional Specification method (FCS) (Van Buuren et al. 2006). In its Frequently Asked Question page SHARE discusses the use of imputed data. Its suggestion is to take into account of the variability of the different five imputations since they are five independent draws from the estimated distribution of missing values. The less advisable solution is therefore that of choosing one imputation among the five. The more advisable solutions are those of using averages of the five imputed values or performing a robustness check using alternatively the different imputations (http://www.share-project.org/group-faq/faqs.html). The use of averages of the five iterations is a common approach. The differences are very small, and nothing changes in our findings if we choose one of the five iterations instead of the average. Findings on a robustness check using each time one of the different imputations are omitted for reasons of space.

Table 4 The impact of poor sense of life on mortality: marginal effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Never/rarely	0.024***	0.023***	0.024***	0.022***	0.021***	0.038***	0.031***	0.030***	0.025***	0.025***	0.022***	0.010***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)
Sometimes	0.012***	0.011***	0.009***	0.008***	0.007***	0.017***	0.014***	0.013***	0.010***	0.010***	0.008**	0.005*
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.003)
Male	0.015***	0.015***	0.017***	0.018***	0.018***	0.032***	0.032***	0.032***	0.032***	0.030***	0.031***	0.017***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)	(0.006)	(0.003)
LogPerCapit-aIncome		− 0.002***	− 0.002***	− 0.002***	− 0.002***	− 0.004***	− 0.004***	− 0.004***	− 0.004***	− 0.004***	− 0.004***	− 0.001**
		(0.001)	(0.001)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
LogPerCapit-aIncome		− 0.001*	− 0.001***	− 0.001**	− 0.001*	− 0.001	− 0.001	− 0.001	− 0.001	− 0.001	− 0.001	− 0.000
		(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)
Married			− 0.009**	− 0.007	− 0.005	0.004	0.003	0.002	0.003	0.003	0.003	
			(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	
Divorced			− 0.011***	− 0.010**	− 0.010**	− 0.011**	− 0.011**	− 0.011**	− 0.013**	− 0.010**	− 0.012**	
			(0.004)	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)	(0.006)	
Widowed			− 0.005	− 0.002	− 0.002	0.010	0.008	0.009	0.008	0.009	0.008	
			(0.006)	(0.005)	(0.005)	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	
Retired				− 0.002	− 0.001	− 0.000	0.002	0.003	0.003	0.005	0.005	0.004
				(0.005)	(0.005)	(0.008)	(0.007)	(0.008)	(0.008)	(0.007)	(0.007)	(0.003)
Employed				− 0.031***	− 0.027***	− 0.044***	− 0.040***	− 0.038***	− 0.036***	− 0.032***	− 0.030***	− 0.019***
				(0.006)	(0.006)	(0.010)	(0.010)	(0.010)	(0.009)	(0.009)	(0.009)	(0.004)
Drinking alcohol												
Less than once a month					− 0.010*	− 0.021**	− 0.014*	− 0.013*	− 0.012	− 0.011	− 0.011	− 0.003
					(0.005)	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.005)
Once a month					− 0.007	− 0.016*	− 0.008	− 0.006	− 0.008	− 0.004	− 0.005	− 0.003
					(0.005)	(0.009)	(0.008)	(0.007)	(0.007)	(0.008)	(0.007)	(0.004)

Table 4 (continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Once a week					− 0.011**	− 0.027***	− 0.019***	− 0.017**	− 0.018***	− 0.015**	− 0.016**	− 0.005
					(0.005)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.003)
Three times a week					− 0.014***	− 0.025***	− 0.019**	− 0.018**	− 0.017*	− 0.014	− 0.014	− 0.007
					(0.005)	(0.009)	(0.008)	(0.009)	(0.009)	(0.010)	(0.010)	(0.005)
Five times a week					− 0.018***	− 0.035***	− 0.030***	− 0.027***	− 0.027***	− 0.025**	− 0.024**	− 0.009*
					(0.005)	(0.010)	(0.009)	(0.009)	(0.009)	(0.010)	(0.010)	(0.005)
Almost every day					− 0.008*	− 0.017*	− 0.010	− 0.007	− 0.007	− 0.004	− 0.004	− 0.003
					(0.005)	(0.010)	(0.008)	(0.009)	(0.008)	(0.009)	(0.008)	(0.003)
Smoking					0.020***	0.033***	0.032***	0.033***	0.032***	0.031***	0.031***	0.014***
					(0.003)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.003)
UnderWeight						0.055***	0.053***	0.053***	0.053***	0.052***	0.051***	
						(0.008)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)	
OverWeight						− 0.010**	− 0.009**	− 0.010**	− 0.009**	− 0.010**	− 0.010**	
						(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	
Obese						− 0.004	− 0.006	− 0.006	− 0.005	− 0.007	− 0.007	
						(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	
Inactivity							0.044***	0.042***	0.041***	0.035***	0.035***	0.021***
							(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.002)
N.Doctor-Visits								0.001***	0.001***	0.001**	0.001**	0.000***
								(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Life satisfaction									− 0.003***		− 0.002*	− 0.001
									(0.001)		(0.001)	(0.001)
Health satisfaction										0.015***	0.014***	0.010***
										(0.004)	(0.004)	(0.001)

Table 4 (continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Stroke	0.017***	0.017***	0.016***	0.014***	0.013***	0.026***	0.018***	0.017***	0.016***	0.014**	0.014**	0.006**
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.006)	(0.007)	(0.006)	(0.006)	(0.006)	(0.006)	(0.003)
Diabetes	0.010***	0.010***	0.009***	0.009***	0.008***	0.015***	0.012***	0.011***	0.010***	0.007*	0.007*	0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.002)
Lung disease	0.018***	0.018***	0.014***	0.014***	0.012***	0.020***	0.017***	0.016***	0.016***	0.013***	0.012***	0.010***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)	(0.002)
Asthma	0.007**	0.002	− 0.000	− 0.004	− 0.005	− 0.009	− 0.014	− 0.015	− 0.016	− 0.017	− 0.017	− 0.006
	(0.003)	(0.004)	(0.007)	(0.009)	(0.009)	(0.023)	(0.024)	(0.024)	(0.024)	(0.021)	(0.022)	(0.005)
Arthritis	− 0.005*	− 0.005**	− 0.004	− 0.005*	− 0.004*	− 0.008	− 0.010*	− 0.011*	− 0.010*	− 0.014***	− 0.013**	− 0.010***
	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)	(0.005)	(0.006)	(0.006)	(0.006)	(0.005)	(0.005)	(0.003)
Osteoporosis	0.001	0.000	− 0.002	− 0.001	− 0.001	0.000	0.002	0.001	0.001	− 0.002	− 0.001	− 0.001
	(0.011)	(0.011)	(0.014)	(0.015)	(0.015)	(0.027)	(0.025)	(0.025)	(0.024)	(0.024)	(0.024)	(0.011)
Cancer	0.033***	0.033***	0.028***	0.027***	0.028***	0.045***	0.042***	0.039***	0.039***	0.035***	0.035***	0.026***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.008)	(0.009)	(0.009)	(0.009)	(0.008)	(0.008)	(0.003)
Stomach ulcer	− 0.009**	− 0.009**	− 0.005	− 0.005	− 0.006*	− 0.009	− 0.008	− 0.009	− 0.009	− 0.011	− 0.011	− 0.010***
	(0.004)	(0.003)	(0.003)	(0.003)	(0.003)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.007)	(0.003)
Parkinson	0.017***	0.016***	0.015***	0.013***	0.011**	0.019**	0.005	0.004	0.006	0.001	0.003	0.003
	(0.006)	(0.006)	(0.004)	(0.004)	(0.005)	(0.008)	(0.008)	(0.008)	(0.009)	(0.008)	(0.009)	(0.006)
Cataracts	− 0.007***	− 0.007***	− 0.005*	− 0.005*	− 0.005	− 0.008	− 0.006	− 0.008	− 0.008	− 0.008	− 0.008	− 0.006***
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.002)
Hip fracture	0.004	0.005	0.008***	0.007***	0.006**	0.001	− 0.004	− 0.005	− 0.007	− 0.007	− 0.008	− 0.003
	(0.004)	(0.003)	(0.002)	(0.003)	(0.002)	(0.008)	(0.008)	(0.009)	(0.008)	(0.008)	(0.008)	(0.002)
Heart attack	0.009***	0.009***	0.008***	0.008***	0.008***	0.014***	0.011***	0.009**	0.009**	0.005	0.006	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.002)
Hypertension	− 0.003**	− 0.003*	− 0.005***	− 0.004***	− 0.004**	− 0.003	− 0.001	− 0.002	− 0.002	− 0.004	− 0.003	− 0.003*
	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.004)	(0.003)	(0.004)	(0.003)	(0.003)	(0.003)	(0.002)

Table 4 (continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Cholesterol	− 0.010***	− 0.009***	− 0.012***	− 0.012***	− 0.011**	− 0.023***	− 0.022***	− 0.022***	− 0.021***	− 0.022***	− 0.021***	− 0.008**
	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.004)
Age class dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country dummy	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	37,921	36,040	23,545	23,428	23,418	11,874	11,874	11,874	11,831	11,874	11,831	35,697
Log likelihood	− 4554	− 4328	− 2824	− 2741	− 2712	− 2005	− 1963	− 1953	− 1932	− 1936	− 1918	− 3975

Standard errors in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

member[5] and three dummies picking up the underweight, overweight and obese conditions (respectively) based on the standard body mass index (BMI) thresholds,[6] with normal weight being the omitted benchmark. Age is controlled for with 5-year age classes in order to account for its nonlinear effects on the dependent variable (age above 95 is the omitted benchmark). Additional sets of dummies control for marital status, job status and life styles respectively. For marital status we build (0/1) dummies picking up the married, divorced and widowed conditions (with single/never married being the omitted benchmark). Job status dummies pick up the employed and retired conditions (with the unemployed status being the omitted benchmark). Among life style dummies we use separate dummies for different intensities (less than once a month, once or twice a month, once or twice a week, three or 4 days a week, five or 6 days a week, almost every day) of alcohol consumption by considering here as well the inherent nonlinearity in the nexus between this variable, health and mortality, with "not drinking at all" being the omitted benchmark. We as well include in the estimate a dummy taking value one if the respondent is a smoker and a dummy measuring whether the respondent has not practiced any physical activity in the last year (*Inactivity*). We then add as controls (0/1) illness-specific dummies (*DIllnesses*) indicating whether the individual has received a diagnosis for one of the following pathologies: (1) heart attack (heart attack including myocardial infarction or coronary thrombosis or any other heart problems including congestive heart failure); (2) high blood pressure or hypertension; (3) high blood cholesterol; (4) stroke or cerebral vascular disease; (5) diabetes; (6) chronic lung diseases; (7) asthma; (8) arthritis or rheumatism; (9) osteoporosis; (10) cancer or malignant tumor; (11) ulcer (stomach or duodenal ulcer, peptic ulcer); (12) Parkinson disease; (13) cataracts; (14) hip fracture or femoral fracture.

In order to capture the unobservable severity of illnesses we add in the fully augmented specification the number of doctor visits and the level of health satisfaction. Note as well that this last variable, together with the number of doctor visits and the underweight category, allows us to capture the unobservable severity of illnesses that, if not properly measured, could produce a spurious correlation between sense of life and mortality. We finally control as well for life satisfaction in order to test whether our eudaimonic wellbeing measure captures a subjective wellbeing component different from the standard cognitive measure of subjective wellbeing.

The specification further includes country effects and is estimated with standard errors clustered at country level. The estimate is limited to the last two waves of the

[5] As is well-known several different measures of equivalised income have been developed in the literature to account for household economies of scale according to the different age structure of members (Schwarze 2003). The use of different scales however produces negligible effects on our main findings and we therefore remain on the simpler per capita income variable. Evidence is omitted for reasons of space and available upon request.

[6] According to the standard international classification the underweight class starts below a body mass index of 18.5, the overweight class above 24.99 and the obese class above 30.

SHARE survey in order to avoid problems of irregular spacing and changes in measurement of some crucial variables.[7]

5.1 Econometric findings

Our econometric findings (presented in terms of marginal effects) show that respondents declaring that their life never or only rarely has a meaning (lowest response in terms of eudaimonic wellbeing) have a mortality probability between 1 and 3.8% higher vis à vis those declaring that their life has often sense (Table 4). Besides, those declaring that their life has sometimes a meaning have a mortality probability between 0.5 and 1.7% higher with respect to those who declare that their life has often sense.

Note that the magnitude of the estimated marginal effects has a small upward jump between column 5 and column 6 in correspondence of the introduction of the BMI variables. We wonder here whether this change is due to the inclusion of the BMI controls in the estimate or to the sharp reduction of the sample size (due to missing BMI data in the SHARE survey). In order to check it we re-estimate specifications up to column 5 excluding observations that have missing BMI data. The magnitude of the poor sense of life coefficient and marginal effects remains identical as in the estimates with the larger sample presented in columns 1–5 of Table 4 (estimates are omitted for reasons of space and available upon request). We therefore conclude that the change in magnitude is due to the introduction of the BMI variable and not to the simultaneous sample selection.

We remark as well that the magnitude of the sense of life marginal effects does not fall very much when we progressively introduce all life style variables (Table 4, from column 5 to column 9) that may be somewhat correlated with the behavioural channel in our estimates (the inactivity dummy, the three extra weight categories and the number of doctor visits variable). This evidence indicates that the impact of poor sense of life on mortality acts mainly through the physiological channel in our estimates. Said in other terms, when we control for the fact that individuals with poor sense of life take less care of themselves, we still remain with an effect whose magnitude is substantially unchanged and measures essentially the physiological channel net of the behavioral channel. This occurs even though the maintained hypothesis that individuals with poor sense of life take less care of themselves is confirmed by our data since the share of those not doing any physical activity raises to around 20% among those declaring that their life makes never, rarely or sometimes sense (compared to the 6% in the benchmark group of those declaring that their life makes often sense) (t-stat − 80.62, *p* value 0.000, n. of obs. 59,599). The difference persists even if we repeat the analysis on the subsample of individuals not having illnesses to control for the impact of diseases on the decision of doing physical activity, even though it gets narrower (11% against 4% t-stat − 30.21, p value

[7] As shown in Bachelet et al. (2016) the question on diagnosed pathologies is different in wave 1 with respect to waves 2 and 4 of the SHARE survey and this creates problems of homogeneity in this important regressor in our analysis.

0.000, n. of obs. 59,294) confirming as well that the variable also proxies unobserved health components.

Among other regressors age dummies have the expected declining negative path, with younger age class dummies having a significantly negative effect on mortality compared to the omitted benchmark represented by the highest age class in the sample (respondents aged 95 or plus). Male gender has always a positive and significant effect on mortality of relevant magnitude (from 1.5 to 3.2% across the different specifications), consistently with the well-known gender difference in life expectancy. Log of per capita income has a negative and significant effect on mortality as it is reasonable to be, given the cost of health expenditure and the increase in out of pocket (i.e. not covered by NHSs) health expenditure in the recent years. The employed status is significant as well and reduces up to 4% the probability of mortality across waves. Lack of physical activity is as well a factor of risk that raises by the same amount (up to 4%) the probability of mortality. Note that having a job and active life styles are objective factors that are highly likely to be correlated with positive sense of life. It is therefore reasonable that the magnitude of the impact of the sense of life variable falls when we introduce them in the estimates and that the total sense of life effect is larger than the net sense of life effect measured in our estimates after controlling for the above mentioned variables.

Consider as well that moderate drinking has a positive effect on health and a negative effect on mortality. More specifically intermediate drinking intensity between once a week and once a day reduces mortality by 2–3% vis-à-vis not drinking at all. As expected smoking raises the probability of mortality (between 1.4 and 3.3% according to different specifications), while the underweight status is clearly a proxy of both psychological and physical status increasing the probability of mortality by around 5%. The negative and significant impact of the overweight (non obese) status could indicate that the BMI weight categories are too severe and too narrow in the definition of normal types.

Marital status variables are no more significant and therefore the differences found in descriptive statistics (i.e. the higher share of the widowed among the deceased group) disappear when controlled for the other regressors included in the estimate. Education as well is not significant even though we may presume that it has indirect effects on mortality via its impact on income and sense of life.

As expected, among specific illnesses stroke, lung disease and cancer are positively and significantly correlated with the dependent variable. The highest impact among illness dummies is that of cancer (around 4%) measuring an average impact given the well-known heterogeneous impact on mortality of different types of cancer.[8]

An important check to our findings is to see whether they are robust to the inclusion of self-assessed health (SAH) among regressors. This variable, not available in administrative data, is relevant since its inclusive and comprehensive nature allows

[8] As is well known mortality rates of different types of cancer are extremely variable, being highest for pancreas cancer and lowest for thyroid and testicle cancer. For reasons of simplicity we here provide an average estimate since the question is out of the specific focus of our paper.

to capture health dimensions generally not measured by standard objective measures and, among them, the severity of respondents' chronic diseases (see among others Au and Johnston 2014 and Doiron et al. 2015). We therefore repeat our estimates by adding the variable among regressors and find that our main result is substantially unchanged after controlling for SAH (Table 4, column 10), with poor SAH (high value of the indicator) positively affecting mortality as expected. Another important control we add in the estimate is life satisfaction. The inclusion of this standard cognitive measure of subjective wellbeing ("*how satisfied are about your life on a 0–10 scale*") helps us to check whether there is a specific eudaimonic component different from the standard life satisfaction measure affecting mortality, that is, whether sense/purpose of life captures something non overlapping with life satisfaction. Again our findings document that the impact of sense of life is significant after controlling for this additional subjective regressor, with or without including self-assessed health among regressors (Table 4, column 9).

We complete our set of results by repeating the estimation of the full augmented model without controls relative to the BMI and the marital status of the respondents, since they imply the lost of a sizable amount of observations. (column 12 of Table 4).

In Table 5 we compare marginal effects and regression coefficients to check whether statistical significance corresponds to economic significance. We find that this is indeed the case: coefficients are all positive and significant for both the "never/rarely" and the "sometimes" variables. When moving from column 5 to column 6 the estimated coefficients change in the same direction of the marginal effects. In the same table we also present odd ratios, which represent the odds that death will occur given a particular answer, compared to the odds of death in the absence of that particular answer to the "eudaimonic wellbeing" question. We find that, in the fully augmented estimate of column 12, the odd ratio for never/rarely is 1.416 meaning that the odds of dying for a respondent declaring that her/his life never makes sense are about 42% higher than the odds for a respondent declaring otherwise. We conclude that all previously commented results in Table 4 are confirmed.

6 Robustness checks

Our main robustness check is driven by a potential limit in the SHARE survey. We are in fact fully confident of our transition information across waves when it relates to the two groups of survived and deceased, while information on non survived non deceased (i.e. individuals answering in t-1, while not answering in t but not reported as deceased) may be potentially subject to measurement error (Schulz and Doblhammer 2011). Some of the individuals belonging to this third group lived alone in $t - 1$, some in households with other family members, while other in health structures and both households and health structures may be not so ready and efficient in reporting timely deceases. The problem is however most likely to occur for individuals living alone in $t - 1$ since in most cases information on deceases in SHARE is collected with an "end of life interview" with neighbours, relatives or family members.

Table 5 The impact of poor sense of life on mortality: marginal effects, coefficients and odds ratios

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Marginal effects												
Never/rarely	0.024***	0.023***	0.024***	0.022***	0.021***	0.038***	0.031***	0.030***	0.025***	0.025***	0.022***	0.010***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)
Sometimes	0.012***	0.011***	0.009***	0.008***	0.007***	0.017***	0.014***	0.013***	0.010***	0.010***	0.008**	0.005*
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.003)
Coefficients												
Never/rarely	0.828***	0.792***	0.829***	0.789***	0.743***	0.838***	0.699***	0.682***	0.571***	0.569***	0.503***	0.348***
	(0.103)	(0.100)	(0.095)	(0.102)	(0.102)	(0.104)	(0.111)	(0.114)	(0.125)	(0.114)	(0.123)	(0.101)
Sometimes	0.412***	0.390***	0.308***	0.282***	0.254***	0.373***	0.313***	0.297***	0.234***	0.223***	0.188**	0.170*
	(0.075)	(0.091)	(0.083)	(0.085)	(0.083)	(0.077)	(0.076)	(0.076)	(0.081)	(0.081)	(0.084)	(0.098)
Odds ratio												
Never/rarely	2.289***	2.207***	2.290***	2.201***	2.102***	2.312***	2.011***	1.978***	1.769***	1.766***	1.654***	1.416***
	(0.236)	(0.220)	(0.218)	(0.224)	(0.215)	(0.241)	(0.223)	(0.225)	(0.221)	(0.202)	(0.203)	(0.143)
Sometimes	1.510***	1.477***	1.360***	1.326***	1.290***	1.452***	1.368***	1.345***	1.264***	1.250***	1.207**	1.185*
	(0.114)	(0.135)	(0.113)	(0.113)	(0.107)	(0.112)	(0.105)	(0.102)	(0.103)	(0.102)	(0.101)	(0.116)

Standard errors in parentheses

***p < 0.01, **p < 0.05, *p < 0.1

We therefore repeat our estimates on the overall sample limiting it to individuals living together with another person where the measurement error on deaths is reasonably nil or negligible. In Table 6A each column has the same specification of the corresponding column in Table 4. Our findings are substantially unchanged and confirm that the nexus between sense of life and mortality is not a spurious finding produced by a measurement error on the dependent variable.

We then check whether the impact of poor sense of life is significant in subsamples using as a delimiter the median age of our sample (above 70 year old) and find that it is the case (Table 6B).

In a further robustness check we control whether our results are robust across gender and education sample splits. Our findings show that poor sense of life effect is robust in all subsamples (Table 6C, D). As well, the final robustness check on gender does not show particular differences across sexes on the poor sense of life-mortality nexus (Table 6E, F).

Our final robustness check looks at whether our findings are modified when we introduce a separate dummy for each life sense modality using "rarely" as omitted benchmark. Our main result on the direction of the nexus between sense of life and mortality is robust to this change and still indicates that finding "often" sense of life reduces between 2 and 4% the likelihood of mortality vis-à vis the "rarely" benchmark. Finding "sometimes" sense of life has a negative and significant effect as well (about half the magnitude), while "never" is not significantly different from the "rarely" omitted benchmark. Our findings are confirmed in the estimates on the sample with only respondents living with a partner in order to control for eventual measurement errors in the dependent variable (see Table 6G, H)

Finally, we estimate our model for different geographical areas to test whether the effect varies across Europe. We therefore aggregate countries into three European regions[9] and obtain consistent and significant results, except for the Central-Southern region, where observations are limited (Table 7B). In the other two European regions the results are significant and consistent with our main findings; the coefficient for the "never/rarely" option is always positive, varying between 0.012 and 0.055. It is worth noting that the magnitude of the "never/rarely" coefficient is systematically larger than that of the "sometimes" coefficient, reproducing the result already observed in the overall sample. These findings suggest that the farther from "often" is the individual, the greater the effect of absence of meaning in life on mortality.

7 Conclusions and policy considerations

The long term trend of increasing life expectancy and the negative demographic dynamics are progressively making active ageing one of the crucial topics in high-income countries.

[9] Central-Southern Europe: Austria, France, Switzerland, Spain and Italy; Central-Northern Europe: Germany, Sweden, The Netherlands, Denmark, Belgium, Eastern Europe: Czechia, Slovenia, Estonia.

Table 6 The impact of poor sense of life on mortality: subgroups findings

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(A) Only respondents living with another person												
Never/rarely	0.021***	0.020***	0.021***	0.020***	0.019***	0.033***	0.026***	0.025***	0.019***	0.019***	0.016***	0.008***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)	(0.003)
Sometimes	0.012***	0.011***	0.008***	0.007**	0.007**	0.017***	0.013***	0.012***	0.009**	0.009**	0.007	0.005*
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)
Observations	29,207	27,748	17,985	17,954	17,948	9130	9130	9130	9099	9130	9099	27,619
(B) Only respondents aged above 70												
Never/rarely	0.041***	0.040***	0.045***	0.043***	0.041***	0.079***	0.066***	0.065***	0.059***	0.055***	0.053***	0.019***
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.008)	(0.009)	(0.009)	(0.010)	(0.009)	(0.010)	(0.004)
Sometimes	0.021***	0.021***	0.018***	0.017***	0.016***	0.040***	0.034***	0.034***	0.030***	0.028***	0.027***	0.011***
	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)	(0.005)	(0.004)	(0.005)	(0.004)
Observations	18,732	17,707	10,572	10,481	10,477	4788	4788	4788	4762	4788	4762	17,445
(C) Low educated												
Never/rarely	0.028***	0.028***	0.029***	0.027***	0.025***	0.047***	0.039***	0.038***	0.034***	0.032***	0.030***	0.012***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.007)	(0.008)	(0.008)	(0.009)	(0.008)	(0.009)	(0.004)
Sometimes	0.012***	0.012***	0.010***	0.009***	0.008***	0.019***	0.015***	0.014***	0.011**	0.011**	0.009*	0.004
	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)
Observations	21,606	20,409	13,253	13,175	13,167	6243	6243	6243	6216	6243	6216	20,180
(D) High educated												
Never/rarely	0.018***	0.016***	0.017***	0.015***	0.015***	0.028***	0.022***	0.022***	0.015***	0.017***	0.012**	0.006***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)	(0.002)
Sometimes	0.010***	0.010***	0.006	0.006	0.006	0.014*	0.014*	0.012	0.009	0.009	0.007	0.005
	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.004)
Observations	16,315	15,631	10,228	10,189	10,187	5598	5598	5598	5582	5598	5582	15,517

Table 6 (continued)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(E) Females												
Never/rarely	0.021***	0.020***	0.021***	0.019***	0.018***	0.033***	0.028***	0.027***	0.021***	0.024***	0.019***	0.009***
	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.007)	(0.007)	(0.007)	(0.008)	(0.006)	(0.007)	(0.003)
Sometimes	0.010***	0.009***	0.010***	0.009***	0.008***	0.017***	0.014***	0.013***	0.009**	0.011***	0.008*	0.004**
	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)	(0.004)	(0.002)
Observations	21,489	20,427	13,381	13,293	13,286	6666	6666	6666	6639	6666	6639	20,192
(F) Males												
Never/rarely	0.028***	0.027***	0.028***	0.027***	0.026***	0.043***	0.034***	0.034***	0.029***	0.026***	0.024***	0.010**
	(0.005)	(0.005)	(0.003)	(0.003)	(0.003)	(0.005)	(0.006)	(0.006)	(0.006)	(0.007)	(0.006)	(0.004)
Sometimes	0.014***	0.014***	0.008*	0.007	0.006	0.015**	0.012*	0.011*	0.009	0.006	0.005	0.006
	(0.003)	(0.004)	(0.004)	(0.005)	(0.004)	(0.007)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.004)
Observations	16,432	15,613	10,126	10,097	10,094	5191	5191	5191	5175	5191	5175	15,505

Standard errors in parentheses

***$p<0.01$, **$p<0.05$, *$p<0.1$

Table 7 The impact of poor sense of life on mortality across European regions

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
(A) Eastern Europe (Czechia, Slovenia, Estonia)												
Never/rarely	0.039***	0.036***	0.032***	0.031***	0.029***	0.055***	0.045***	0.045***	0.034***	0.044***	0.034***	0.020***
	(0.006)	(0.007)	(0.003)	(0.003)	(0.004)	(0.007)	(0.006)	(0.007)	(0.008)	(0.007)	(0.009)	(0.007)
Sometimes	0.018***	0.016*	0.012**	0.011*	0.010*	0.029***	0.024***	0.024***	0.019**	0.023***	0.019**	0.009
	(0.007)	(0.008)	(0.006)	(0.006)	(0.006)	(0.010)	(0.009)	(0.009)	(0.009)	(0.008)	(0.009)	(0.008)
Observations	11,461	11,352	10,312	10,289	10,281	4918	4918	4918	4896	4918	4896	11,240
(B) Central-Southern Europe (Austria, France, Switzerland, Spain and Italy)												
Never/rarely	0.009	0.006	0.013**	0.011	0.010	0.023***	0.021**	0.020*	0.016	0.019*	0.015	− 0.000
	(0.006)	(0.004)	(0.006)	(0.007)	(0.007)	(0.009)	(0.011)	(0.011)	(0.017)	(0.011)	(0.017)	(0.005)
Sometimes	0.005***	0.004***	0.005	0.004	0.003	0.008	0.007	0.009	0.006	0.008	0.006	0.000
	(0.002)	(0.001)	(0.003)	(0.003)	(0.004)	(0.005)	(0.005)	(0.005)	(0.008)	(0.005)	(0.008)	(0.002)
Observations	10,565	9730	3381	3334	3220	1861	1861	1861	1856	1861	1856	9614
(C) Central-Northern Europe (Germany, Sweden, Netherlands, Denmark, Belgium)												
Never/rarely	0.023***	0.022***	0.020***	0.019***	0.018***	0.028**	0.023**	0.021**	0.023**	0.021*	0.023**	0.012**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.011)	(0.011)	(0.011)	(0.009)	(0.011)	(0.009)	(0.005)
Sometimes	0.016***	0.015***	0.010***	0.009***	0.007***	0.011	0.009	0.008	0.008	0.007	0.008	0.009***
	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.007)	(0.003)
Observations	15,895	14,958	9852	9805	9803	5022	5022	5022	5006	5022	5006	14,843

Standard errors in parentheses

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

Our empirical analysis provides relevant statistical and econometric background for active ageing policies showing that poor sense of life (low eudaimonic wellbeing) is significantly and positively correlated with mortality. We also document that the effect is robust across gender and education and that it does not fall in magnitude after controlling for life styles. This last finding indicates that the physiological rationale is stronger than the behavioural rationale in explaining our results.

Would these findings be interpreted in the sense of causality their policy implications would be clear.

The most effective and important thing to do in order to promote active ageing is to invest in activities that may stimulate sense of life in the elders (i.e. lifelong learning, social activities and relational life of the elderly, voluntary activities, storytelling activities where memories can be transmitted and shared, with the young generations) and not just in promotion of correct life styles and diagnostic checks. Further work could shed more light in this sense by testing whether these activities are effectively producing positive effects on eudaimonic wellbeing. Even in absence of a clear-cut causality indication the correlations observed in this paper nonetheless indicate that eudaimonic wellbeing can be interpreted as a leading mortality indicator.

Compliance with ethical standards

Conflict of interest All authors declare that they have no conflicts of interest.

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