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Abstract

Eudaimonic happiness (measured in terms of sense of life) is a relatively unexplored subjective wellbeing indicator. The empirical findings presented in this paper show that it has a significant and quantitatively remarkable correlation with the future insurgence of some chronic diseases and the reduction of most functionalities in the ageing population. These results document that eudaimonic happiness is a relevant leading indicator of future health outcomes and expenditure and that its impact is independent from that of the traditional life satisfaction measure.

Keywords: eudaimonic satisfaction, health outcomes, functionalities, life satisfaction.

JEL Numbers: I12 Health Behavior; I31 General welfare, wellbeing.

1.Introduction

The four most used measures of subjective wellbeing in statistical surveys include a cognitive measure (life satisfaction), two affective measures (positive and negative affect) and an eudaimonic measure (purpose of life). The latter is probably the most recently introduced in statistical surveys[1] and the least explored in the literature, even though the importance of taking it under scrutiny is increasingly emphasized at institutional level (OECD, 2013).[2] Our claim is that this gap must be filled

[1] "In the 2006 wave of the European Social Survey, a module was included to collect detailed information on the "eudaimonic" aspects of wellbeing (i.e. meaning, purpose, flourishing), thus expanding the range of subjective wellbeing concepts measured beyond evaluations and affect." (OECD, 2013, p.23).

[2] *"The evidence base for eudaimonic measures is less clear. While some specific measures – such as those relating to "meaning" and "purpose" clearly capture unique and meaningful information, the picture with respect to eudaimonia as a whole is more ambiguous. This suggests that further work is needed before a definitive position can be taken on the validity of these measures." (OECD, 2013 p, 13) "the guidelines do also attempt to provide advice on people's evaluations of particular domains of life, such as satisfaction with their financial status or satisfaction with their health status as well*

since eudaimonic wellbeing is a leading indicator anticipating changes in objective variables of great relevance such as the insurgence of chronic illnesses and the deterioration of the most important body functionalities. This is exactly the focus of our paper where we test the nexus between self-declared purpose of life and changes in several health indicators for a large sample of Europeans aged above 49.

The concept of eudaimonic wellbeing hinges on the Aristotle's Nichomachean Ethics principle that any individual should strive for excellence in order to achieve her/his own specific potential, based on the Greek philosopher's distinction between good and bad desires. Bad desires can give momentary pleasure but are in contrast with freedom of pursuing one's own goals and therefore satisfy more the "freedom of" than the "freedom from" and the "freedom for". The concept of eudaimonic wellbeing therefore is more akin than positive affect to self-fulfillment, life flourishing and self-actualisation, and more distant from hedonic measures of subjective wellbeing. According to Ryff and Singer (2008) eudaimonic wellbeing challenges the prevailing identification of the concept of wellbeing with feeling good and contentment. Along this line Waterman (1993) argues that, whereas happiness is hedonically defined, eudaimonic wellbeing calls upon people to live in accordance with their *daimon*, or true self.[3]

These differences between eudemonia and life satisfaction clearly indicate that the two variables are not perfect substitutes and that inquiries on the determinants and impact of the former are of great interest and relevance.

Even though, as shown above, the concept of eudaimonic wellbeing related to Aristotle's philosophy is multifaceted, in our paper we focus only on what is considered one of its main aspects - the simpler

as "eudaimonic"aspects of subjective wellbeing. These measures are both of high interest for policy purposes and also methodologically similar to the more general questions on overall subjective wellbeing" (OECD, 2013 p, 24).

[3] With reference to extreme life events, the psychologist Victor Frankl, observed during his experiences in a concentration camp that life can be meaningful even under conditions of extreme adversity and that having a sense of purpose is essential to maintaining psychological health and wellness. In these extreme cases life satisfaction and eudaimonic happiness may clearly diverge.

concept of purpose of life - in a pragmatic and ethically neutral perspective. As it occurs in the standard approach of the happiness and life satisfaction literature we do not choose a "philosophical party" and define conditions under which life has to be considered purposeful, but we simply take seriously respondents' declarations on whether their life is meaningful and examine the statistical correlation with chronic diseases and functionalities.

The well-known expressions "having a broken heart" or "you will die of heartbreak" reveals that it has always been common sense to believe in a significant association and/or causality nexus between sorrow, poor sense of life and insurgence of some pathologies. However, the nexus between a specific aspect of eudaimonic wellbeing, measured in terms of purpose of life, and health started being studied only recently and mainly in the psychological and medical literature. From a theoretical point of view Midlarsky (1991) argues that higher meaningfulness and superior eudaimonic wellbeing generated by voluntary work in older adults may positively impact upon health through active lifestyles contrasting the cultural pressure toward passivity and reducing those depressive symptoms that may negatively affect health (Musick and Wilson, 2003). From an empirical point of view life meaningfulness has been recently shown to reduce the risk of Alzheimer's disease (Boyle et al. 2010), the risk of heart attack among individuals with coronary heart disease (Kim et al. 2013) and has been demonstrated to increase longevity in both American and Japanese samples (Koizumi et al., 2008). Along the same line, Friedman and Ryff (2011) find a negative correlation between levels of purpose in life and levels of inflammation - Serum concentrations of interleukin-6 (IL-6) and C-reactive protein (CRP) - after controlling for the number of chronic illnesses in a cross-sectional sample but cannot verify the causality nexus. Another potential channel indicating a positive causal link between eudaimonic wellbeing and health relates to the fact that individuals with higher purpose in life may be more proactive in taking care of their health and more likely to make preventive tests. Kim et al. (2014) find that this is the case in a sample of American adults traced for 6 years showing as well that

purpose in life is negatively associated with days spent in hospital. Another recent strand in the medical literature on this topic tries to verify whether genetic factors may be at the root of the association between depression and insurgence of pathologies. In this respect Amadio et al. (2015) show that a variation in the sequence of the BDNF gene (BDNFVal66Met), associated with depression and anxiety has an impact on thrombosis.

The few novel contributions across psychology and medical science mentioned above support the hypothesis that sense of life and eudaimonic happiness may impact positively upon (or are in any case significantly correlated with) health. The contribution of this paper aims to bring this relevant issue in the (health) economic literature by testing for the first time the hypothesis on a large sample of European countries and for a wide range of pathologies and functionalities.

In a more general sense this paper also contributes to the widely debated issue of the validity of subjective wellbeing indicators in the economic and social science literature. As is well-known methodological problems in terms of cardinality and interpersonal (and inter-country) comparability arising when using such indicators are widely debated (Frei and Stutzer, 2002, Clark et al., 2006, Becchetti and Pelloni, 2015). One of the best approaches to test for the usefulness of subjective wellbeing indicators is to investigate whether they are associated to future changes in objective outcomes.[4] In this respect our paper documents a significant association between eudaimonic wellbeing measured in terms of sense of life and future changes in health. Even though causality is difficult to ascertain, this finding is relevant per se since it documents that eudaimonic happiness is a synthetic and easily measurable leading indicator of future changes in health, a variable that is likely to affect significantly economic outcomes such as human capital and public expenditure.

[4] Relevant examples on this point are contributions showing how job satisfaction affects objective outcomes such as employment status, productivity, likelihood of job change and job quit (see among others Judge, 1992; Staw and Barsade, 1993; Judge et al., 2001).

2. The outline of our hypothesis

In this section we provide some theoretical grounds and rationales for the main hypothesis tested in this paper (the nexus between sense of life and mortality). In this direction recent medical studies focus on the mechanisms that allow meaning in life to promote health and deter disease. Preliminary results in this literature suggest that the association might be explained either physiologically due to buffering of bodily responses to stress, or behaviorally, via a healthier lifestyle.

The first possibility is that having a greater sense of purpose in life help maintain optimal functioning of biological systems and thereby confer protective benefit in the face of illness or disease (Ryff, Singer and Love 2004, Lindfors and Lundberg 2002). Researchers have also focused on the potentially important stress-buffering properties of meaning in life. More specifically, Krause (2007) suggests that the effect of traumatic life events on depressive symptoms is offset for older people who have a deeper sense of meaning in life. Salovey et al. (2000) report that positive emotions have a beneficial effect on a range of immune functioning measures including secretory immunoglobulin A, lymphocyte proliferation, and natural killer cell activity. Other works, like that of Ryff, Singer and Love (2004) has linked purpose to better regulation of physiological systems (e.g., reduced inflammatory markers and cardiovascular risk factors) as well as brain-based mechanisms (e.g., insular cortex volume, reduced amygdala activation, sustained ventral striatum activation). Finally, a study that examined gene transcriptional profiles found that eudaimonic wellbeing was associated with enhanced expression of antiviral response genes and reduced expression of proinflammatory genes (Fredrickson et al. 2013). Altogether these studies suggests that high levels of psychological wellbeing, and in particular the sensation of having a purpose in life, are likely to trigger biological mechanisms that determine positive or negative health outcomes.

An alternative - or complementary - explanation for the observed link between purpose in life and the insurgence of illnesses is that people with higher purpose are more proactive in taking care of their health. Park (2007) proposes that people who do not have a strong sense of meaning in life are more likely to engage in

detrimental health behaviors. In a similar study Dyer, Pickens and Burnett (2007) suggest that older people who do not have a strong sense of meaning in life lose the will to live and become self- neglectful. A major contribution in this literature comes from the study of Kim, Ryff and Strecher (2014) who found that on a large sample of American adults over the age of 50, people with higher eudaimonic wellbeing were more likely to pursue preventive health care services (e.g., flu shots, cholesterol tests, colonoscopies, mammograms, pap smears, and prostate examinations).

3. Our data set and the main variables of interest

Information for our empirical analysis comes from the "Survey of Health, Ageing and Retirement in Europe (SHARE)",[5] a cross-national panel dataset on health, socio-economic status, and the social and family networks of more than 45,000 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 20 countries: Austria, Germany, Sweden, Netherlands, Spain, Italy, France, Denmark, Greece, Switzerland, Belgium, Israel, Czech Republic, Poland, Ireland, Hungary, Portugal, Slovenia, Estonia and Luxembourg.

Our main variable of interest is the eudaimonic measure of meaning of life assessed through the question: "*How often do you feel that your life has meaning?*" for which the SHARE database allows respondents to select one of the four following modalities: "*often, sometimes, rarely, never"*

[5] 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, 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 U.S. 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.

parameterized by the database on a 1-4 scale. The variable has obviously pros and cons. An advantage is that it has a lower degree of abstraction than the standard 0-10 life satisfaction variable since it presents a correspondence between numbers and verbal expressions of intensity of sense of life expressed through adjectives. A disadvantage of the variable is its relatively low number of modalities (four values). The variable appears as well unbalanced toward negative judgements with only one positive adjective (often) where presumably most of the evaluations of those who have a positive judgement toward the sense of their own life should converge. Another original characteristic is that the measure is expressed in terms of time frequency (how often the respondent fells that her/his life has meaning) and is not an overall judgment of one's own life given at a single point in time by the respondent. Given all these pros and cons the SHARE database has however the unique property of allowing us to investigate in a multi-country panel the relationship between a proxy of eudaimonic happiness and a very detailed range of measures of pathologies and functionalities which we describe in what follows.

As main health outcome variables we consider a wide range of chronic diseases and limitations with activities of daily living. The SHARE survey measures chronic diseases by asking whether respondents received a doctor's diagnosis for one or more major chronic diseases in a list presented on a show-card where the set of chronic conditions which follow are considered: 1. A heart attack including myocardial infarction or coronary thrombosis or any other heart problem including congestive heart failure; 2. High blood pressure or hypertension; 3. High blood cholesterol; 4. A stroke or cerebral vascular disease; 5. Diabetes or high blood sugar; 6. Chronic lung disease such as chronic bronchitis or emphysema; 7. Cancer or malignant tumor, including leukemia or lymphoma, but excluding minor skin cancers; 8. Stomach or duodenal ulcer, peptic ulcer; 9. Parkinson disease; 10. Cataracts; 11. Hip fracture or femoral fracture; 12. Other fractures; 13. Alzheimer's disease,

dementia, organic brain syndrome, senility or any other serious memory impairment.[6] An important characteristic of the chronic disease question is its "objective" nature. The SHARE survey does not ask respondents to evaluate by themselves whether they have or not an illness, but to report whether they received a diagnosis of disease from a doctor.

The number of limitations with activities of daily living are measured by asking respondents whether they experience any difficulty in doing each of the everyday activities on a show-card in which the following two sets of activities are considered (excluding any difficulties they expect to last less than three months): (Set 1) 1. Walking 100 meters, 2. Sitting for about two hours, 3. Getting up from a chair after sitting for long periods, 4. Climbing several flights of stairs without resting, 5. Climbing one flight of stairs without resting, 6. Stooping, kneeling, or crouching, 7. Reaching or extending your arms above shoulder level, 8. Pulling or pushing large objects like a living room chair, 9. Lifting or carrying weights over 10 pounds/5 kilos, like a heavy bag of groceries, 10. Picking up a small coin from a table; (Set 2): 1. Dressing, including putting on shoes and socks, 2. Walking across a room, 3. Bathing or showering, 4. Eating, such as cutting up your food, 5. Getting in or out of bed, 6. Using the toilet, including getting up or down, 7. Using a map to figure out how to get around in a strange place, 8. Preparing a hot meal, 9. Shopping for groceries, 10. Making telephone calls, 11. Taking medications, 12. Doing work around the house or garden, 13. Managing money, such as paying bills and keeping track of expenses.

In order to have synthetic health outcome measures for chronic illnesses and functionalities as dependent variables we generate the variable "number of chronic illnesses" and use the popular ADL (number of limitations with activities of daily living) and IADL (number of limitations with instrumental activities of daily living) index measures. The ADL is a 0-6 index describing the number

[6] Note that other diseases were included in different versions of the questionnaire, such as Asthma, Arthritis, Osteoporosis, Benign tumor, Other affective or emotional disorders, Rheumatoid Arthritis, and Osteoarthritis.. However, since we base our analysis only on wave 4 and 5, the final diseases considered for the computation of the number of chronic diseases are only those listed in the text.

of limitations with six activities of daily living: dressing, walking across a room, bathing or showering, eating, getting in and out of bed, using the toilet. The IADL is a 0-7 index reflecting the number of limitations with seven instrumental activities of daily living: using a map, preparing a hot meal, shopping for groceries, making telephone calls, taking medications, doing work around the house or garden, managing money.

Given the above described variable characteristics our contribution in the empirical health literature falls among those using self-reported and not administrative data. This choice has obvious pros and cons but one advantage is that our source of data allows to control for a much wider range of concurring variables producing higher goodness-of-fit estimates and providing a homogeneous multi-country sample which is not available under the second choice.

4. Hypothesis testing and Econometric analysis

Our empirical analysis uses the 4th and 5th waves of the SHARE database in order to test whether poor sense of life is a significant predictor of the future insurgence of pathologies and/or the reduction of functionalities.[7] In order to do so we estimate the following model:

$$(1)\quad \Delta Y_t = \alpha_0 + \alpha_1 PoorSenseOfLife_{t-1} + \sum_k \gamma_k\, DAgeClass_{t-1} + \alpha_2 Male_{t-1} + \alpha_3 LogPerCapitaTotIncome_{t-1} + \\ + \alpha_4 EduYears_{t-1} + \sum_j \delta_j\, DMaritalStatus_{t-1} + \sum_l \theta_l\, DJobStatus_{t-1} + \sum_n \varphi_n\, DLifeStyles_{t-1} \\ + \alpha_5 UnderWeight_{t-1} + \alpha_6 OverWeight_{t-1} + \alpha_7 Obese_{t-1} + \sum_m \lambda_m\, DCountry_{t-1} + \varepsilon_t$$

[7] The rationale for using the last two waves is that SHARE waves are irregularly spaced and the database contains a discontinuity between the second and fourth wave (the third wave has a completely different structure with respondents being asked to record experiences of the past related to their health). In addition to it the question we use as dependent variable has been slightly changed after the second wave. While individuals in the first wave were asked - *"Has a doctor ever told you that you had any of the conditions on this card?"* from the second wave on the question becomes *"[Has a doctor ever told you that you had/Do you currently have any] of the conditions on this card? [With this we mean that a doctor has told you that you have this condition, and that you are either currently being treated for or bothered by this condition.]"*. The limit of the first question is that respondents may report also illnesses from which patients recovered in the past (for those pathologies for which recovery is possible).

where the dependent variable measures in first differences ($\Delta Y_t = Y_t - Y_{t-1}$) health conditions in t in three possible ways: i) the number of chronic diseases for which the respondent has received a doctor diagnosis; ii) the ADL index of limitations with activities of daily living; iii) the IADL index of limitations with instrumental activities of daily living. The estimate is restricted to the subsample of individuals who had not received a doctor diagnosis of chronic illnesses at t-1 under i) and to individuals with full functionalities (no limitations) under ii) and iii). We do so in order to avoid potential endogeneity problems. Evidently, people with ex ante chronic diseases (or limitations with activity of daily living) are more likely to report lower levels of eudaimonic wellbeing and, at the same time, lower positive changes in the number of chronic diseases (or in the limitations with activity of daily living). Confining our analysis to those who do not report any health problem at baseline allows us to remove this source of bias.

The distribution of the dependent (nonnegative count) variables under all of the three cases indicate that a Poisson model would be more likely to fit our data (figure 1). Anyway LR tests indicate a problem of over dispersion (variance higher than mean) for these three dependent variables, so that the best choice becomes a negative binomial regression model.[8] Since our sample is restricted to individuals with no illnesses (or full functionalities) at t_0, this guarantees that there are no negative values for the dependent variables. Our estimates report incidence rate ratios for the coefficients (standard errors follow the same metric).

Among other regressors, the main variable of interest is *PoorSenseOfLife* (the variable, described in the previous section, takes value one if in t_0 the person declared that her/his life has never, rarely or sometimes sense and zero otherwise). The rationale for aggregating the first three items of the variable comes from the analysis of significance of the different attributes. "Never", "rarely" and "sometimes"

[8] The negative binomial model can be considered as a generalization of the Poisson model having the same mean structure as Poisson plus an extra parameter - α - to model the over-dispersion (so we test if $\alpha = 0$).

are similar judgments having in common a quite negative evaluation. There is just a small difference among them, while a strong difference with the last item ("life has often sense"). Other controls included in the estimates are gender, years of education,[9] the logarithm of household income per family member,[10] three weight variables corresponding to the standard underweight, overweight and obese classes based on the body mass index (BMI)[11] and four set of dummies for age classes, marital status, job status and life styles respectively. We use five-year age classes and not age since we reasonably assume that the impact of age on the dependent variables is nonlinear (age below 55 is the omitted benchmark). Marital status dummies pick up the following conditions: registered partnership, separated, divorced, never married, widowed (with 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 include a dummy taking value one if the respondent is a smoker and dummies measuring different intensities of alcohol consumption (less than once a month, once or twice a month, once or twice a week, three or four days a week, five or six days a week, almost every day) with "not drinking at all" being the omitted benchmark. The specification further includes country effect and time effects and is estimated with heteroscedasticity robust standard errors.[12]

[9] 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 number of pathologies. The more parsimonious specification with number of education years is therefore preferred.

[10] As is well known there are different measures of equivalised income that can be alternatively used to divide household income for the number of its members (Schwarze, 2003). Our findings are substantially unaffected by such changes. Evidence is omitted for reasons of space and available upon request

[11] Following 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. The normal weight class is therefore our omitted benchmark.

[12] We deliberately do not introduce fixed effects in the estimates. This is because we assume that poor sense of life acts with a mix of between and within effects that is, the insurgence of pathologies may be determined both by a deterioration of sense of life or by a inherited time invariant poor sense of life effect related to personality traits producing its negative effect when individuals get older. We are therefore interested in the aggregate (between plus within) effect of eudaimonic happiness on health.

Our null hypothesis is H_0: α_1=0, that is, the poverty of sense of life has no impact on the insurgence of chronic illnesses and/or reduction of functionalities. The alternative in which we are interested is H_1: α_1>0, that is, poor sense of life is associated to a future increase in chronic illnesses and/or to a deterioration of functionalities (higher ADL and IADL values indicate a deterioration in functionalities) for the reasons explained in our introduction.

Survivorship bias is an important factor that needs to be taken into account in our estimates even though we are just working on differences between two waves. This is because a response in the fourth wave followed by a non-response in the fifth wave is likely to be significantly affected by factors related to health deterioration. We follow the standard approach and regress a dummy taking value one for non response on a set of lagged socio-demographic regressors. The estimated probit specification is

$$A_{i,t} = \alpha + \sum_{k} \beta_k \; Controls_{i,t-1} + \sum_{g} \kappa_g \; DCountry_{i,g} + \; \epsilon_{i,t}$$

where A measures the probability of not being present in the two consecutive waves and controls include age, gender, marital status, poor sense of life, reported chronic illnesses and symptoms. Results from this estimate show that controls are significant in the expected direction with male gender, age, symptoms, chronic illnesses and poor sense of life negatively affecting the probability of responding in both waves. These findings suggest that worsening of health conditions may be one of the main causes of nonresponses. The inverse of the predicted probability from this estimate is used to weight our base specification in (1). Following what is standard in this literature the set of controls used in the attrition estimate does not coincide with that used in our main specification. [13]

5. Empirical findings

[13] For a similar approach on the attrition weighting procedure in the literature see, among others, Raab et al. (2005), Nicoletti and Peracchi (2005) and Vandecasteele and Debels (2007).

Table 1 displays descriptive findings for the observations used in the econometric analysis across different waves. Male gender accounts for 44 percent of observations, average education years are around 10.4 and 66.1 percent of observations correspond to married respondents. The retired status accounts for 56.4 percent observations, while the employed status for only 27,3 percent of them (which is reasonable giving the age breakdown of our sample). The share of overweight and obese observations is quite high (around 41 and 21 percent respectively).

Tables 2.1-2.2 present our findings for the "insurgence of illness" hypothesis tested on the synthetic variable of the change in the total number of illnesses, corrected/not corrected for attrition. In the different specifications we progressively introduce controls up to the fully augmented version of the base model presented in (1) (column 5).

Our null hypothesis is rejected since the impact of the *PoorSenseOfLife* variable is positive and significant. The magnitude of the coefficient ranges between around 1.26 and 1.19 and does not change substantially when corrected for attrition across the different specifications (Table 2.2). Coefficients presented in the tables are incidence rate ratios and therefore imply that for those recording poor sense of life the probability of incurring in a chronic illness when starting from a healthy condition is between 19 and 26 percent higher than for the reference benchmark. The high magnitude of these coefficients reflects the fact that we are measuring probability of incurring not in a specific illness but in one of the several diseases considered by our estimate.

Our findings document that the impact of the *PoorSenseOfLife* variable is robust to the inclusion of country and year effects, after controlling for age, gender, education, marital status, work status and life styles. Note that, due to missing observations on the BMI, the introduction of weight dummies significantly reduces the number of observations. Among other controls we find that education,[14] the

[14] Findings on education confirm the well-known positive nexus between education and health in the literature (for a survey on this literature see Grossman, 2006)

employment status, moderate alcohol consumption and the male gender are negatively correlated with the insurgence of pathologies, while the overweight and obese status are positively correlated with it.

In Tables 3.1-4.2 we test the same hypothesis on the synthetic indicators of functionalities. We find that the hypothesis is rejected as well, with poor sense of life strongly affecting the deterioration of functionalities when considering both ADL and IADL indicators, corrected or not for attrition. In terms of economic significance the *PoorSenseOfLife* ranges between 1.93 and 1.76 implying that the probability of incurring in a reduction of functionality for individuals declaring poor sense of life is between 7 and 24 percent higher than for the reference group when we consider the ADL indicator corrected/non corrected for attrition (Tables 3.1-3.2). The impact is somewhat higher when we consider the IADL indicator with probabilities of insurgence being between 21 and 44 percent higher than those of the reference group. These findings seem to indicate that poverty of sense of life impairs even more severely (or is more significantly correlated with) instrumental activities than merely physical activities. When looking at other regressors we find that in ADL estimates both the retired and employed status here are negatively correlated with the deterioration in functionalities vis-à-vis the unemployed omitted benchmark while gender is not significant (Tables 3.1-3.2). IADL estimates reveal as well the significance of gender and smoking status.

5.1 Econometric findings on individual diseases and functionalities

The general effect on the number of pathologies obviously hides heterogeneous effects on specific illnesses being the specific focus of this section. When estimating the impact of poor sense of life on individual diseases and functionalities we must consider that our dependent variable assumes a different distribution with respect to the previously considered aggregate health indicators. We therefore rearrange the model specification so as to consider only individuals that ex ante did not report the specific disease/functionality under investigation and use as dependent variable a first difference taking value one if the respondent reports a doctor diagnosis for the specific chronic disease

(or the deterioration of the given functionality) and zero otherwise. More specifically, our model here has the same regressors as in (1) with the difference that the dependent variable is i) a 0/1 dummy measuring whether the respondent has contracted a specific disease; ii) a 0/1 dummy measuring whether the respondent has experienced a reduction of a specific functionality (when considering ADL and IADL indicators).

In both cases the estimated model is a probit and the sample is restricted to those who in t_0 had not contracted that disease (under case i)) or not reported in t_0 the reduction of that specific functionality (under case ii)).

Synthetic results on chronic diseases are presented in Table 5 and provide coefficient, standard errors and significance for specifications with/without attrition (detailed estimate results are provided in our online Appendix). Given the probit specification and the characteristics of the dependent variable we directly provide in Table 5 marginal effects, that is, the probability differential on the insurgence of illnesses and/or the reduction of functionalities between those who declare that their life has rarely, never or sometimes sense and the rest of the sample.

Estimated findings show that our null hypothesis is rejected (the impact of *PoorSenseOfLife* is positive and significant) for the following pathologies: cholesterol, diabetes, stomach ulcer, and heart attack (while it is not rejected for the other illnesses, even though weakly rejected for lung diseases). In terms of magnitude the stronger effect is on cholesterol where individuals declaring poor sense of life have a 2.5 percent higher probability of being diagnosed the chronic disease in the following wave. The impact on the other three diseases (diabetes, stomach ulcer, other fractures and heart attack) is as well remarkable and around 1 percent.

Results on individual functionalities presented in Table 6 show that poor sense of life has a negative and significant effect on all of them individually taken. When we consider the attrition corrected specification in column 2, the magnitude of the effect ranges from the highest impact on climbing

several flights (around 4.6 percent higher probability of losing that functionality if the respondents declared poor sense of life in the previous wave) to the lowest impact on eating (around 0.5 percent).

6. Robustness checks

As a robustness check we re-estimate the fully augmented specification of our base model (with the set of regressors from column 5 in Tables 2.1 - 4.2) including among explanatory variables a measure of cognitive wellbeing, i.e. satisfaction with life as a whole. The SHARE questionnaire contains the popular question on satisfaction with life as a whole allowing respondents to choose a value between 0 and 10. Results are shown in Table 7. The first three rows show that poor sense of life remains strongly significant with magnitude that becomes slightly lower for the number of illnesses while larger for ADL and IADL dependent variables. Results on individual illnesses are confirmed with the exception of heart attack where the significance of life satisfaction weakens the effect of the poverty of sense variable. These results confirm that eudaimonic wellbeing has its own effect (distinct from that of overall life satisfaction) on the insurgence of pathologies and deterioration of body functionalities. Our interpretation of this finding is that eudaimonic and cognitive measures of wellbeing do not capture the same phenomenon.[15]

We as well check whether our main findings on the number of illnesses and functionalities is robust in sample splits according to gender, age, education years and income (Tables 8.1-8.3). For age, education and income the median value is used as sample split. The impact of poor sense of life

[15] Individuals with high ideals and high gap between aspirations and realizations may have low life satisfaction and high sense of life where the latter captures their strong willed pursuit of such aspirations and the former the frustration of not seeing them realized. On the opposite individuals may have low levels of aspirations that are fully realized and be satisfied with their life even though they see not much sense on it. Even though in most cases eudaimonic and cognitive subjective wellbeing should coincide these cases cannot be neglected and explain why the two variables do not overlap.

remains significant in all these splits but gets weaker for the more educated (and for the younger in the number of illnesses variable).

7. Conclusions

Our results aims to fill a gap in the emerging literature on the relevance of subjective wellbeing measures and, more specifically, on the nexus between an unexplored dimension of subjective wellbeing - eudaimonic happiness (measured under the specific dimension of perceived sense of life) - and health outcomes. The relative advantage of our approach is that of testing this nexus on a wide range of pathologies and, for the first time, on functionalities on a large cross-country sample of Europeans aged above 49. We as well control for a wide range of concurring factors and for attrition bias.

Empirical findings presented in the paper document that low levels of eudaimonic happiness (measured under the sense of life dimension) have a significant and positive impact on the insurgence of several pathologies and on the deterioration of most functionalities.

Overall, these findings confirm that subjective wellbeing indicators need to be taken seriously into account as they anticipate significant changes in economically sensitive outcomes such as health variables. More specifically on this point, our work documents that the less explored eudaimonic aspect of subjective wellbeing does not overlap with the more commonly used life satisfaction variable and has an independent and significant effect on several health outcomes and functionalities.

Our findings have straightforward policy implications. Policies of active ageing aimed at increasing wellbeing and minimizing health expenditure should concentrate on all those factors that can reinforce the sense of life in the ageing population.

References

Amadio, P., Colombo, G. I., Tarantino, E., Gianellini, S., Ieraci, A., Brioschi, M., ... & Tremoli, E. (2015). BDNFVal66met polymorphism: a potential bridge between depression and thrombosis. *European heart journal*, ehv655.

Becchetti, L. and A. Pelloni, (2013). "What are we learning from the life satisfaction literature?", *International Review of Economics*, Springer, vol. 60(2), pages 113-155, June.

Boyle, P. A., Buchman, A. S., Barnes, L. L., & Bennett, D. A. (2010). Effect of a purpose in life on risk of incident Alzheimer disease and mild cognitive impairment in community-dwelling older persons. *Archives of general psychiatry*, *67*(3), 304-310.

Clark, A.E., Frijters, P. and Shields, M.A., 2006. Income and Happiness: Evidence, Explanations and Economic Implications. Paris Jourdan Sciences Economiques, working paper 2006-24.

Dyer, C. B., Goodwin, J. S., Pickens-Pace, S., Burnett, J., & Kelly, P. A. (2007). Self-neglect among the elderly: a model based on more than 500 patients seen by a geriatric medicine team. American Journal of Public Health, 97(9), 1671-1676.

Frey, B. and Stutzer, A., 2002, What can Economists learn from Happiness Research. Journal of Economic Literature, Vol. 40, pp. 402-435.

Friedman, E. M., & Ryff, C. D. (2012). Living well with medical comorbidities: a biopsychosocial perspective. *The Journals of Gerontology Series B: Psychological Sciences and Social Sciences*, gbr152.

Fredrickson BL, et al. (2013) A functional genomic perspective on human well-being. Proc Natl Acad Sci USA 110(33):13684–13689.

Grossman, M. (2006). Education and nonmarket outcomes. *Handbook of the Economics of Education*, *1*, 577-633.

Judge, T. A. (1992, August). Job satisfaction and subjective well-being as determinants of job adaption. In *Academy of Management Proceedings* (Vol. 1992, No. 1, pp. 222-226). Academy of Management.

Judge, T. A., Thoresen, C. J., Bono, J. E., & Patton, G. K. (2001). The job satisfaction–job performance relationship: A qualitative and quantitative review. *Psychological bulletin*, *127*(3), 376.

Kim, E. S., Sun, J. K., Park, N., & Peterson, C. (2013). Purpose in life and reduced incidence of stroke in older adults: 'The Health and Retirement Study'.*Journal of psychosomatic research*, *74*(5), 427-432.

Kim ES, Strecher VJ & Ryff CD (2014) Purpose in life and use of preventive health care services. *Proc Natl Acad Sci U S A. 2014 Nov 18;111(46):16331-6*

Kim, E. S., Sun, J. K., Park, N., Kubzansky, L. D., & Peterson, C. (2013). Purpose in life and reduced risk of myocardial infarction among older US adults with coronary heart disease: a two-year follow-up. *Journal of behavioral medicine*, *36*(2), 124-133.

Kim ES, Strecher VJ & Ryff CD (2014) Purpose in life and use of preventive health care services. Proc Natl Acad Sci U S A. 2014 Nov 18;111(46):16331-6

Koizumi, M., Ito, H., Kaneko, Y., & Motohashi, Y. (2008). Effect of having a sense of purpose in life on the risk of death from cardiovascular diseases. *Journal of Epidemiology*, *18*(5), 191-196.

Krause, N. (2007). Evaluating the stress-buffering function of meaning in life among older people. Journal of Aging and Health, 19, 792–812.

Lindfors P, Lundberg U. (2002) Is low cortisol level an indicator of positive health? Stress Health;18:153–60.

Midlarsky E. (1991). Helping as coping in Prosocial Behavior: *Review of Personality and Social Psychology*, 12, 238–264.

Musick, M. A., & Wilson, J. (2003). Volunteering and depression: The role of psychological and social resources in different age groups. *Social science & medicine*, *56*(2), 259-269.

Nicoletti, C., & Peracchi, F. (2005). Survey response and survey characteristics: microlevel evidence from the European Community Household Panel. *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, *168*(4), 763-781.

OECD (2013), *OECD* Guidelines on Measuring SWB, *OECD Publishing*. http://dx.doi.org/10.1787/9789264191655-en

Park, C. L. (2007). Religiousness/spirituality and health: A meaning systems perspective. Journal of behavioral medicine, 30(4), 319-328.

Raab, G., Purdon, S. and Buckner, K. (2005). Practical Exemplars and Survey Analysis, URL: 5http://www.napier.ac.uk/depts/fhls/peas/4

Ryff, C. D., & Singer, B. H. (2008). Know thyself and become what you are: A eudaimonic approach to psychological well-being. *Journal of happiness studies*,*9*(1), 13-39.

Ryff CD, Singer BH, Dienberg Love G. (2004) Positive health: connecting well-being with biology. Philos Trans R Soc Lond B Biol Sci;359:1383–94.

Salovey, P., Rothman, A. J., Detweiler, J. B., & Steward, W. T. (2000). Emotional states and physical health. American psychologist, 55(1), 110.

Schwarze, J. (2003). Using panel data on income satisfaction to estimate equivalence scale elasticity. *Review of Income and Wealth*, *49*(3), 359-372.

Staw, B. M., & Barsade, S. G. (1993). Affect and managerial performance: A test of the sadder-but-wiser vs. happier-and-smarter hypotheses. *Administrative Science Quarterly*, 304-331.

Vandecasteele, L., & Debels, A. (2007). Attrition in panel data: the effectiveness of weighting. *European Sociological Review*, *23*(1), 81-97.

Waterman, A. S. (1993). Two conceptions of happiness: Contrasts of personal expressiveness (eudaimonia) and hedonic enjoyment. *Journal of personality and social psychology*, *64*(4), 678.

Figures 1A-1D – Distributions of synthetic measures of chronic illnesses and functionalities in the SHARE survey database

Figure 1.A Distribution of the sense of life variable

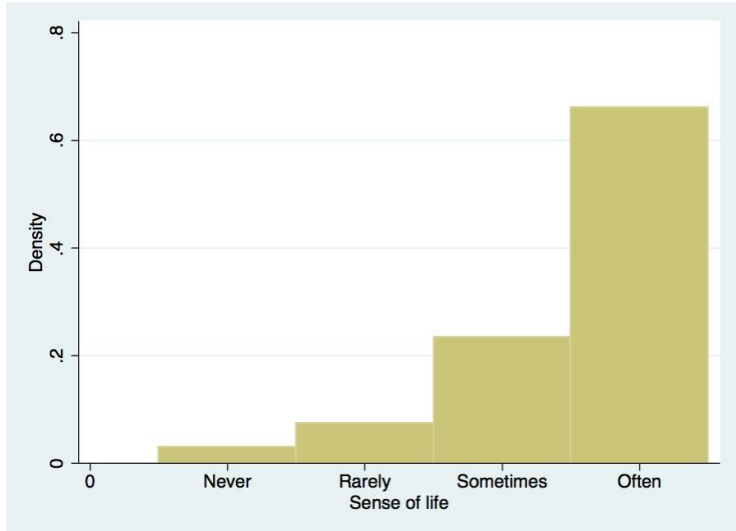


Figure 1.B First difference of number of chronic illnesses

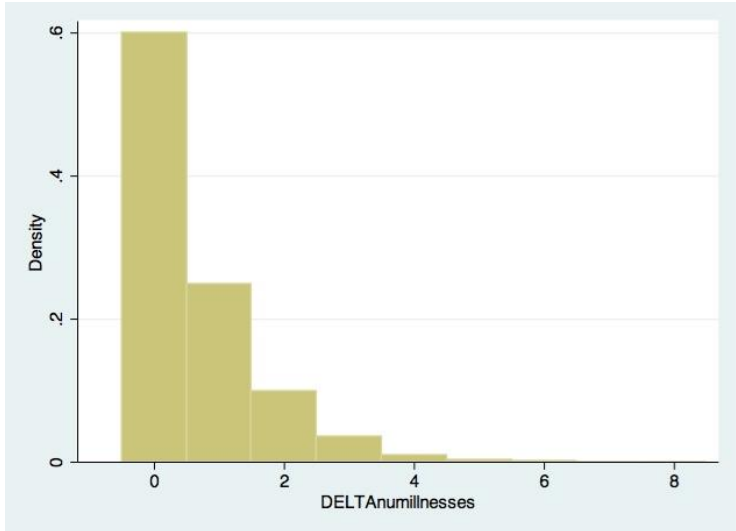


Figure 1.C First difference of IADL

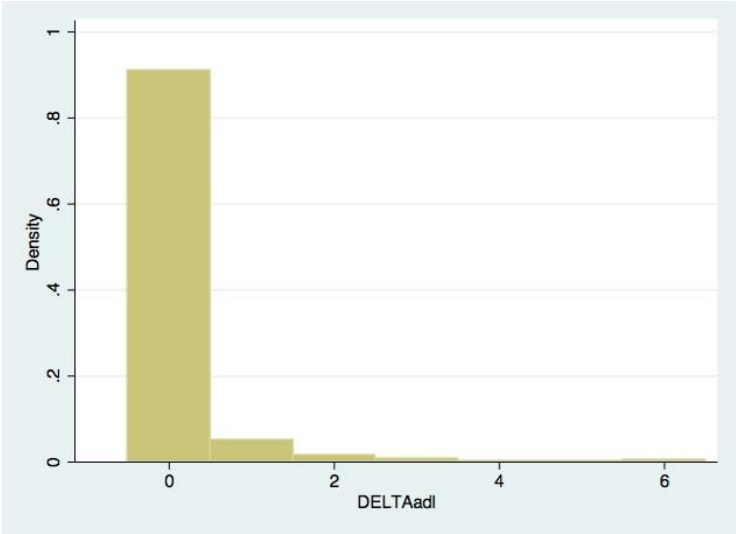
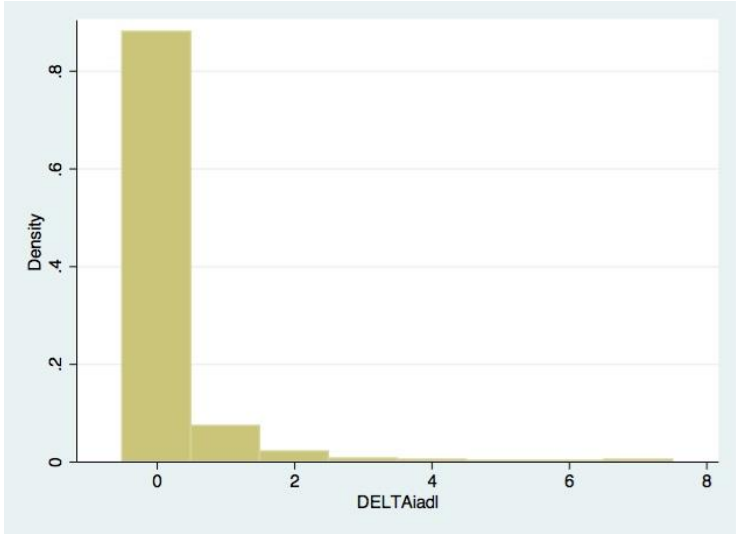


Figure 1.D Distribution of ADL



Legend: ADL (number of limitations with activities of daily living) and IADL (number of limitations with instrumental activities of daily

living) index measures. For details on variable definitions see section 3.

Table 1 - Summary descriptive statistics of the variable used in econometric analysis

Variable	Observations	Mean	Std. Dev.	Min	Max
Age < 55	59599	0.0204701	0.1 416031	0	1
Age 55-59	58462	0.1211214	0.3262711	0	1
Age 60-64	58462	0.1698881	0.3755377	0	1
Age 65-69	58462	0.1804591	0.3845727	0	1
Age 70-74	58462	0.1555711	0.3624514	0	1
Age 75-79	58462	0.1327871	0.3393474	0	1
Age 80-84	58462	0.100886	0.3011803	0	1
Age 85-89	58462	0.0706442	0.2562317	0	1
Age 90-94	58462	0.0357497	0.1856671	0	1
Age > 95	58462	0.0120249	0.1089978	0	1
Male	59599	0.4357288	0.4958562	0	1
Log percapita income	58167	9.031427	1.437086	-19,27382	14,2223
Education years	55598	10.44128	4.443694	0	25
Married	39009	0.6616678	0.4731482	0	1
Registered partnership	39009	0.0167141	0.1281997	0	1
Separated	39009	0.0129457	0.1130419	0	1
Never married	39009	0.0593965	0.2363684	0	1
Divorced	39009	0.0964906	0.2952666	0	1
Widowed	39009	0.1527853	0.359785	0	1
Retired	57684	0.5641772	0.4958685	0	1
Employed	57684	0.2734554	0.4457364	0	1
Alcohol not at all	59599	0. 3161295	0.464968	0	1
Alcohol < 1 a month	57726	0.1101064	0.313025	0	1
Alcohol 1 or 2 a month	57726	0.1187853	0.3235385	0	1
Alcohol 1 or 2 a week	57726	0.1695943	0.3752792	0	1
Alcohol 3 or 4 a week	57726	0.0654818	0.2473761	0	1
Alcohol 5 or 6 a week	57726	0.0281156	0.1653045	0	1
Alcohol almost every day	57726	0.18153	0.38546	0	1
Smoking	57909	0.1879673	0.3906895	0	1
Normal weight	59599	0.2276045	0.4192894	0	1
Under weight	37210	0.0130341	0.1134222	0	1
Over weight	37210	0.4082505	0.4915165	0	1
Obese	37210	0.2141629	0.4102458	0	1
Life satisfaction	56864	7.56046	1.864018	0	10

Table 2.1 - The determinants of changes in the number of chronic diseases

Negative binomial estimates with coefficients measuring incident rate ratios - <(>)1 coefficients indicate negative (positive) effects on the dependent variable

	(1)	(2)	(3)	(4)	(5)
Poor sense of life	1.261***	1.244***	1.200***	1.190***	1.235***
	(0.036)	(0.036)	(0.046)	(0.045)	(0.070)
Age 55 - 59	1.305**	1.287**	1.297**	1.311**	1.348*
	(0.137)	(0.137)	(0.149)	(0.151)	(0.218)
Age 60 - 64	1.784***	1.747***	1.667***	1.693***	1.609***
	(0.183)	(0.181)	(0.192)	(0.195)	(0.260)
Age 65 - 69	1.997***	1.970***	1.732***	1.764***	1.949***
	(0.204)	(0.204)	(0.206)	(0.210)	(0.326)
Age 70 - 74	2.574***	2.540***	2.052***	2.108***	2.107***
	(0.266)	(0.266)	(0.256)	(0.265)	(0.379)
Age 75 - 79	3.137***	3.000***	2.632***	2.692***	2.366***
	(0.327)	(0.318)	(0.335)	(0.344)	(0.437)
Age 80 - 84	3.538***	3.364***	2.985***	3.070***	3.179***
	(0.375)	(0.364)	(0.395)	(0.410)	(0.615)
Age 85 - 89	3.939***	3.552***	3.058***	3.100***	3.433***
	(0.439)	(0.402)	(0.429)	(0.439)	(0.734)
Age 90 - 94	3.548***	3.370***	2.606***	2.656***	2.125**
	(0.450)	(0.446)	(0.442)	(0.455)	(0.657)
Age > 95	2.856***	2.403***	1.528	1.554	0.208
	(0.546)	(0.511)	(0.445)	(0.456)	(0.210)
Male	0.819***	0.824***	0.884***	0.894***	0.862***
	(0.022)	(0.022)	(0.032)	(0.034)	(0.049)
Log per capita income		0.980*	0.995	1.000	0.998
		(0.010)	(0.013)	(0.013)	(0.017)
Education years		0.980***	0.981***	0.982***	0.988*
		(0.003)	(0.004)	(0.004)	(0.006)
Registered partnership			1.213	1.195	1.075
			(0.168)	(0.165)	(0.222)
Separated			0.917	0.905	0.842
			(0.143)	(0.140)	(0.180)
Never married			1.080	1.078	1.090
			(0.079)	(0.079)	(0.119)
Divorced			1.040	1.031	0.987
			(0.059)	(0.058)	(0.080)
Widowed			1.044	1.030	0.899
			(0.057)	(0.056)	(0.080)
Retired			1.018	1.027	0.983
			(0.060)	(0.060)	(0.087)

Employed			0.811***	0.829***	0.789***
			(0.046)	(0.047)	(0.064)
Alcohol < 1 a month				0.894*	0.962
				(0.052)	(0.085)
Alcohol 1 or 2 a month				0.843***	0.892
				(0.049)	(0.078)
Alcohol 1 or 2 a week				0.882**	0.895
				(0.047)	(0.072)
Alcohol 3 or 4 a week				0.732***	0.812*
				(0.059)	(0.088)
Alcohol 5 or 6 a week				0.898	1.059
				(0.086)	(0.149)
Alcohol almost every day				0.909*	0.948
				(0.051)	(0.081)
Smoking				1.100**	1.124*
				(0.049)	(0.075)
Underweight					0.971
					(0.266)
Overweight					1.289***
					(0.074)
Obese					1.812***
					(0.127)
Country effects	Yes	Yes	Yes	Yes	Yes
Observations	13,060	12,345	7,775	7,773	4,023
Log Likehood	-13314	-12533	-7589	-7573	-3568

Robust s.e. in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2.2 - The determinants of changes in the number of chronic diseases – adjusted for attrition

Negative binomial estimates with coefficients measuring incident rate ratios - <(>)1 coefficients indicate negative (positive) effects on the dependent variable

	(1)	(2)	(3)	(4)	(5)
Poor sense of life	1.260***	1.242***	1.200***	1.189***	1.232***
	(0.036)	(0.037)	(0.046)	(0.046)	(0.070)
Age 55 - 59	1.328***	1.306**	1.313**	1.329**	1.364*
	(0.140)	(0.140)	(0.152)	(0.154)	(0.223)
Age 60 - 64	1.805***	1.765***	1.673***	1.701***	1.623***
	(0.186)	(0.184)	(0.193)	(0.197)	(0.265)
Age 65 - 69	2.022***	1.987***	1.742***	1.776***	1.971***
	(0.208)	(0.207)	(0.207)	(0.213)	(0.333)
Age 70 - 74	2.603***	2.562***	2.051***	2.110***	2.122***
	(0.270)	(0.269)	(0.257)	(0.266)	(0.385)
Age 75 - 79	3.200***	3.055***	2.666***	2.731***	2.374***
	(0.335)	(0.325)	(0.341)	(0.351)	(0.443)
Age 80 - 84	3.579***	3.388***	2.980***	3.070***	3.181***
	(0.380)	(0.368)	(0.395)	(0.412)	(0.621)
Age 85 - 89	3.972***	3.570***	3.050***	3.099***	3.441***
	(0.443)	(0.405)	(0.429)	(0.439)	(0.739)
Age 90 - 94	3.588***	3.395***	2.607***	2.663***	2.117**
	(0.456)	(0.451)	(0.442)	(0.455)	(0.655)
Age > 95	2.868***	2.409***	1.520	1.548	0.216
	(0.549)	(0.511)	(0.439)	(0.450)	(0.218)
Male	0.824***	0.829***	0.893***	0.903***	0.869**
	(0.022)	(0.023)	(0.033)	(0.035)	(0.050)
Log per capita income		0.981*	0.996	1.001	0.999
		(0.010)	(0.013)	(0.013)	(0.018)
Education years		0.979***	0.980***	0.982***	0.987*
		(0.003)	(0.004)	(0.004)	(0.006)
Registered partnership			1.221	1.202	1.073
			(0.172)	(0.169)	(0.228)
Separated			0.891	0.879	0.825
			(0.139)	(0.136)	(0.178)
Never married			1.086	1.082	1.092
			(0.080)	(0.080)	(0.121)
Divorced			1.047	1.037	0.999
			(0.060)	(0.059)	(0.082)
Widowed			1.052	1.036	0.909
			(0.058)	(0.057)	(0.082)
Retired			1.018	1.028	0.988
			(0.060)	(0.061)	(0.089)

Employed			0.809***	0.827***	0.790***
			(0.047)	(0.048)	(0.065)
Alcohol < 1 a month				0.895*	0.957
				(0.053)	(0.086)
Alcohol 1 or 2 a month				0.843***	0.888
				(0.050)	(0.078)
Alcohol 1 or 2 a week				0.874**	0.887
				(0.046)	(0.072)
Alcohol 3 or 4 a week				0.744***	0.823*
				(0.060)	(0.090)
Alcohol 5 or 6 a week				0.900	1.057
				(0.087)	(0.149)
Alcohol almost every day				0.908*	0.950
				(0.051)	(0.082)
Smoking				1.101**	1.125*
				(0.049)	(0.076)
Underweight					0.993
					(0.279)
Overweight					1.288***
					(0.075)
Obese					1.808***
					(0.128)
Country effects	Yes	Yes	Yes	Yes	Yes
Observations	13,060	12,345	7,775	7,773	4,023
Log Likehood	-16272	-15350	-9539	-9519	-4496

Robust s.e. in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.1 -The determinants of changes in the ADL index of functionalities

Negative binomial estimates with coefficients measuring incident rate ratios - <(>)1 coefficients indicate negative (positive) effects on the dependent variable

	(1)	(2)	(3)	(4)	(5)
Poor sense of life	1.939***	1.810***	1.816***	1.795***	1.760***
	(0.100)	(0.097)	(0.116)	(0.115)	(0.175)
Age 55 - 59	1.402	1.378	1.445	1.478	1.374
	(0.380)	(0.394)	(0.459)	(0.465)	(0.648)
Age 60 - 64	1.713**	1.680*	1.659	1.683*	1.721
	(0.449)	(0.467)	(0.513)	(0.516)	(0.793)
Age 65 - 69	2.113***	2.065***	1.682*	1.739*	2.064
	(0.553)	(0.575)	(0.529)	(0.542)	(0.969)
Age 70 - 74	2.556***	2.451***	1.901**	1.985**	2.237*
	(0.665)	(0.677)	(0.605)	(0.627)	(1.066)
Age 75 - 79	3.938***	3.771***	3.203***	3.305***	3.110**
	(1.018)	(1.036)	(1.014)	(1.040)	(1.475)
Age 80 - 84	5.649***	5.081***	3.938***	4.129***	4.997***
	(1.458)	(1.397)	(1.253)	(1.308)	(2.404)
Age 85 - 89	8.857***	7.617***	6.170***	6.296***	6.518***
	(2.300)	(2.102)	(1.979)	(2.009)	(3.179)
Age 90 - 94	14.199***	13.022***	9.588***	9.985***	14.066***
	(3.773)	(3.672)	(3.144)	(3.266)	(7.208)
Age > 95	23.017***	21.380***	22.323***	22.758***	36.360***
	(6.745)	(6.598)	(8.208)	(8.309)	(21.599)
Male	0.930	0.973	1.025	1.032	0.980
	(0.048)	(0.052)	(0.070)	(0.075)	(0.109)
Log per capita income		0.903***	0.952*	0.961	0.979
		(0.022)	(0.025)	(0.024)	(0.030)
Education years		0.953***	0.951***	0.955***	0.969**
		(0.007)	(0.009)	(0.009)	(0.016)
Registered partnership			0.944	0.935	0.673
			(0.272)	(0.277)	(0.295)
Separated			1.471	1.474	1.569
			(0.374)	(0.360)	(0.501)
Never married			1.203	1.187	1.107
			(0.159)	(0.154)	(0.226)
Divorced			0.932	0.929	1.009
			(0.113)	(0.114)	(0.181)
Widowed			1.004	1.005	0.942
			(0.082)	(0.082)	(0.121)
Retired			0.627***	0.636***	0.502***
			(0.063)	(0.062)	(0.075)

Employed			0.326***	0.343***	0.345***
			(0.037)	(0.040)	(0.055)
Alcohol < 1 a month				0.636***	0.615***
				(0.061)	(0.090)
Alcohol 1 or 2 a month				0.688***	0.745*
				(0.075)	(0.125)
Alcohol 1 or 2 a week				0.749***	0.796
				(0.075)	(0.118)
Alcohol 3 or 4 a week				0.546***	0.494**
				(0.110)	(0.153)
Alcohol 5 or 6 a week				0.587***	0.567*
				(0.116)	(0.169)
Alcohol almost every day				0.879	0.917
				(0.091)	(0.154)
Smoking				1.231**	1.299**
				(0.108)	(0.173)
Underweight					0.598
					(0.265)
Overweight					1.162
					(0.146)
Obese					2.129***
					(0.262)
Country effects	Yes	Yes	Yes	Yes	Yes
Observations	33,551	31,908	20,856	20,849	10,379
Log Likehood	-11234	-10557	-6943	-6914	-2863

Robust s.e. in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3.2 - The determinants of changes in the ADL index of functionalities– adjusted for attrition

Negative binomial estimates with coefficients measuring incident rate ratios - <(>)1 coefficients indicate negative (positive) effects on the dependent variable

	(1)	(2)	(3)	(4)	(5)
Poor sense of life	1.939***	1.809***	1.814***	1.794***	1.771***
	(0.102)	(0.098)	(0.118)	(0.117)	(0.177)
Age 55 - 59	1.406	1.399	1.472	1.507	1.483
	(0.379)	(0.397)	(0.460)	(0.467)	(0.694)
Age 60 - 64	1.734**	1.720**	1.712*	1.739*	1.879
	(0.452)	(0.474)	(0.522)	(0.526)	(0.861)
Age 65 - 69	2.107***	2.084***	1.705*	1.763*	2.271*
	(0.548)	(0.576)	(0.531)	(0.545)	(1.062)
Age 70 - 74	2.594***	2.517***	1.962**	2.048**	2.479*
	(0.671)	(0.690)	(0.619)	(0.642)	(1.179)
Age 75 - 79	4.004***	3.879***	3.288***	3.392***	3.467***
	(1.029)	(1.058)	(1.032)	(1.059)	(1.641)
Age 80 - 84	5.777***	5.266***	4.059***	4.249***	5.542***
	(1.482)	(1.436)	(1.281)	(1.337)	(2.658)
Age 85 - 89	9.020***	7.860***	6.392***	6.511***	7.265***
	(2.328)	(2.151)	(2.034)	(2.063)	(3.533)
Age 90 - 94	14.536***	13.496***	9.938***	10.321***	15.818***
	(3.838)	(3.775)	(3.235)	(3.357)	(8.094)
Age > 95	23.475***	22.001***	23.052***	23.386***	41.538***
	(6.851)	(6.743)	(8.427)	(8.491)	(24.770)
Male	0.936	0.980	1.026	1.034	0.985
	(0.049)	(0.053)	(0.071)	(0.076)	(0.110)
Log per capita income		0.905***	0.954*	0.964	0.980
		(0.022)	(0.025)	(0.025)	(0.030)
Education years		0.952***	0.951***	0.954***	0.969*
		(0.007)	(0.009)	(0.009)	(0.016)
Registered partnership			0.931	0.922	0.664
			(0.267)	(0.272)	(0.294)
Separated			1.459	1.465	1.546
			(0.379)	(0.366)	(0.503)
Never married			1.229	1.211	1.151
			(0.164)	(0.159)	(0.238)
Divorced			0.935	0.931	1.039
			(0.114)	(0.115)	(0.189)
Widowed			0.998	1.000	0.935
			(0.083)	(0.083)	(0.121)
Retired			0.632***	0.641***	0.498***
			(0.064)	(0.064)	(0.075)

Employed			0.326***	0.344***	0.344***
			(0.038)	(0.040)	(0.055)
Alcohol < 1 a month				0.631***	0.607***
				(0.062)	(0.090)
Alcohol 1 or 2 a month				0.678***	0.740*
				(0.074)	(0.125)
Alcohol 1 or 2 a week				0.741***	0.785
				(0.075)	(0.117)
Alcohol 3 or 4 a week				0.552***	0.479**
				(0.111)	(0.145)
Alcohol 5 or 6 a week				0.578***	0.561*
				(0.114)	(0.168)
Alcohol almost every day				0.881	0.928
				(0.092)	(0.157)
Smoking				1.218**	1.298*
				(0.107)	(0.174)
Underweight					0.576
					(0.254)
Overweight					1.175
					(0.148)
Obese					2.138***
					(0.265)
Country effects	Yes	Yes	Yes	Yes	Yes
Observations	33,551	31,908	20,856	20,849	10,379
Log Likehood	-13472	-12686	-8478	-8444	-3507

Robust s.e. in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4.1 - The determinants of changes in the IADL index of functionalities

Negative binomial estimates with coefficients measuring incident rate ratios - <(>)1 coefficients indicate negative (positive) effects on the dependent variable

	(1)	(2)	(3)	(4)	(5)
Poor sense of life	1.789***	1.664***	1.545***	1.501***	1.552***
	(0.080)	(0.077)	(0.085)	(0.083)	(0.123)
Age 55 - 59	1.074	1.043	1.002	1.033	0.854
	(0.217)	(0.209)	(0.215)	(0.222)	(0.250)
Age 60 - 64	1.358	1.301	1.090	1.128	0.991
	(0.266)	(0.253)	(0.231)	(0.238)	(0.291)
Age 65 - 69	1.742***	1.669***	1.245	1.327	1.148
	(0.338)	(0.322)	(0.269)	(0.285)	(0.350)
Age 70 - 74	1.956***	1.889***	1.367	1.436	1.221
	(0.380)	(0.365)	(0.301)	(0.316)	(0.373)
Age 75 - 79	3.543***	3.332***	2.473***	2.601***	1.741*
	(0.680)	(0.638)	(0.544)	(0.573)	(0.537)
Age 80 - 84	5.984***	5.172***	3.640***	3.928***	3.510***
	(1.145)	(0.991)	(0.799)	(0.867)	(1.085)
Age 85 - 89	9.334***	7.753***	5.400***	5.625***	5.073***
	(1.798)	(1.492)	(1.216)	(1.273)	(1.628)
Age 90 - 94	16.973***	15.294***	10.449***	10.890***	11.638***
	(3.361)	(3.055)	(2.449)	(2.566)	(4.019)
Age > 95	23.658***	20.080***	16.879***	17.645***	12.959***
	(5.456)	(4.819)	(5.270)	(5.422)	(5.904)
Male	0.778***	0.816***	0.862**	0.884*	0.811**
	(0.036)	(0.039)	(0.051)	(0.057)	(0.077)
Log percapita income		0.882***	0.911***	0.922***	0.924***
		(0.019)	(0.022)	(0.021)	(0.026)
Education years		0.943***	0.945***	0.949***	0.959***
		(0.006)	(0.007)	(0.007)	(0.012)
Registered partnership			0.871	0.804	1.160
			(0.216)	(0.187)	(0.318)
Separated			1.352	1.369	1.270
			(0.263)	(0.270)	(0.348)
Never married			1.269**	1.240**	1.097
			(0.127)	(0.125)	(0.175)
Divorced			1.001	0.982	1.106
			(0.096)	(0.096)	(0.154)
Widowed			0.966	0.958	1.030
			(0.068)	(0.068)	(0.114)
Retired			0.712***	0.730***	0.710***
			(0.060)	(0.061)	(0.087)

Employed			0.366***	0.392***	0.414***
			(0.037)	(0.039)	(0.058)
Alcohol < 1 a month				0.731***	0.639***
				(0.058)	(0.080)
Alcohol 1 or 2 a month				0.631***	0.575***
				(0.059)	(0.079)
Alcohol 1 or 2 a week				0.685***	0.628***
				(0.061)	(0.075)
Alcohol 3 or 4 a week				0.535***	0.522***
				(0.075)	(0.099)
Alcohol 5 or 6 a week				0.616***	0.492***
				(0.098)	(0.114)
Alcohol almost every day				0.829**	0.638***
				(0.075)	(0.083)
Smoking				1.271***	1.443***
				(0.095)	(0.151)
Underweight					1.243
					(0.474)
Overweight					1.019
					(0.103)
Obese					1.770***
					(0.182)
Country effects	Yes	Yes	Yes	Yes	Yes
Observations	31,577	30,058	19,625	19,620	9,961
Log Likehood	-13684	-12860	-8381	-8347	-3532

Robust s.e. in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4.2 - The determinants of changes in the IADL index of functionalities– adjusted for attrition

Negative binomial estimates with coefficients measuring incident rate ratios - <(>)1 coefficients indicate negative (positive) effects on the dependent variable

	(1)	(2)	(3)	(4)	(5)
Poor sense of life	1.804***	1.675***	1.554***	1.509***	1.554***
	(0.082)	(0.079)	(0.088)	(0.085)	(0.125)
Age 55 - 59	1.068	1.042	0.996	1.027	0.859
	(0.217)	(0.209)	(0.215)	(0.222)	(0.254)
Age 60 - 64	1.347	1.296	1.078	1.117	1.001
	(0.265)	(0.253)	(0.229)	(0.237)	(0.296)
Age 65 - 69	1.713***	1.650***	1.214	1.298	1.166
	(0.333)	(0.319)	(0.264)	(0.281)	(0.359)
Age 70 - 74	1.937***	1.884***	1.356	1.428	1.252
	(0.378)	(0.365)	(0.302)	(0.317)	(0.386)
Age 75 - 79	3.530***	3.337***	2.450***	2.585***	1.777*
	(0.681)	(0.640)	(0.544)	(0.576)	(0.554)
Age 80 - 84	5.940***	5.148***	3.576***	3.873***	3.587***
	(1.142)	(0.989)	(0.792)	(0.864)	(1.119)
Age 85 - 89	9.252***	7.726***	5.312***	5.549***	5.141***
	(1.791)	(1.491)	(1.207)	(1.269)	(1.664)
Age 90 - 94	16.987***	15.405***	10.402***	10.880***	12.171***
	(3.378)	(3.086)	(2.462)	(2.596)	(4.251)
Age > 95	23.510***	20.094***	16.846***	17.592***	13.346***
	(5.450)	(4.845)	(5.305)	(5.454)	(6.104)
Male	0.778***	0.815***	0.859**	0.881*	0.811**
	(0.036)	(0.039)	(0.052)	(0.057)	(0.078)
Log percapita income		0.882***	0.912***	0.923***	0.924***
		(0.019)	(0.022)	(0.021)	(0.027)
Education years		0.942***	0.944***	0.948***	0.959***
		(0.006)	(0.007)	(0.007)	(0.012)
Registered partnership			0.886	0.816	1.185
			(0.228)	(0.197)	(0.327)
Separated			1.344	1.362	1.275
			(0.264)	(0.271)	(0.357)
Never married			1.286**	1.257**	1.126
			(0.130)	(0.128)	(0.181)
Divorced			1.010	0.991	1.123
			(0.098)	(0.098)	(0.160)
Widowed			0.962	0.955	1.025
			(0.069)	(0.068)	(0.113)
Retired			0.718***	0.736***	0.704***
			(0.062)	(0.063)	(0.087)

Employed			0.366***	0.392***	0.415***
			(0.036)	(0.039)	(0.058)
Alcohol < 1 a month				0.726***	0.637***
				(0.057)	(0.079)
Alcohol 1 or 2 a month				0.626***	0.570***
				(0.059)	(0.079)
Alcohol 1 or 2 a week				0.685***	0.631***
				(0.062)	(0.076)
Alcohol 3 or 4 a week				0.524***	0.508***
				(0.073)	(0.095)
Alcohol 5 or 6 a week				0.611***	0.479***
				(0.100)	(0.112)
Alcohol almost every day				0.830**	0.643***
				(0.076)	(0.084)
Smoking				1.272***	1.448***
				(0.096)	(0.152)
Underweight					1.294
					(0.500)
Overweight					1.020
					(0.105)
Obese					1.757***
					(0.183)
Country effects	Yes	Yes	Yes	Yes	Yes
Observations	31,577	30,058	19,625	19,620	9,961
Log Likehood	-16381	-15424	-10233	-10190	-4330

Robust s.e. in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 5 –The impact of poor sense of life on specific chronic diseases

Probit estimates (column1 not corrected for attrition, column 2 corrected for attrition) - marginal effects

	(1)	(2)
Heart attack	0.010**	0.011**
	(0.004)	(0.004)
High blood	0.014*	0.014
	(0.009)	(0.009)
Cholesterol	0.025***	0.025***
	(0.007)	(0.007)
Stroke	0.005*	0.004
	(0.003)	(0.003)
Diabetes	0.010***	0.010***
	(0.004)	(0.004)
Lung disease	0.006*	0.007**
	(0.003)	(0.003)
Cancer	0.002	0.002
	(0.003)	(0.003)
Stomach ulcer	0.009***	0.010***
	(0.003)	(0.003)
Parkinson	0.000	0.000
	(0.001)	(0.001)
Cataract	0.007*	0.007*
	(0.004)	(0.004)
Hip fracture	0.003	0.003*
	(0.002)	(0.002)
Other fractures	0.010***	0.010***
	(0.004)	(0.004)
Alzheimer's disease	0.001	0.001
	(0.002)	(0.002)

Robust s.e. in parentheses

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

Table 6 – The impact of poor sense of life on single difficulties

Probit estimates (column1 not corrected for attrition, column 2 corrected for attrition) - marginal effects

	(1)	(2)
Walking 100 meters	0.022***	0.023***
	(0.004)	(0.004)
Sitting for about two hours	0.026***	0.027***
	(0.006)	(0.006)
Getting up from a chair	0.043***	0.043***
	(0.007)	(0.007)
Climbing several flights	0.046***	0.046***
	(0.008)	(0.008)
Climbing one flight of stairs	0.027***	0.027***
	(0.005)	(0.005)
Stooping, kneeling, or crouching	0.043***	0.044***
	(0.009)	(0.009)
Extending arms above shoulder level	0.027***	0.027***
	(0.005)	(0.005)
Pulling or pushing large objects	0.024***	0.024***
	(0.006)	(0.006)
Lifting weights over 5 kg	0.032***	0.031***
	(0.007)	(0.007)
Picking up a small coin	0.014***	0.014***
	(0.003)	(0.003)
Dressing	0.021***	0.021***
	(0.004)	(0.004)
Walking across a room	0.010***	0.010***
	(0.002)	(0.002)
Bathing or showering	0.018***	0.018***
	(0.003)	(0.003)
Eating	0.005**	0.005**
	(0.002)	(0.002)
Getting in or out of bed	0.016***	0.016***
	(0.003)	(0.003)
Using the toilet	0.011***	0.011***
	(0.002)	(0.002)
Using a map	0.022***	0.021***
	(0.004)	(0.004)
Preparing a hot meal	0.012***	0.011***
	(0.003)	(0.003)
Making telephone calls	0.008***	0.008***
	(0.002)	(0.002)

Shopping for groceries	0.019***	0.019***
	(0.003)	(0.003)
Taking medications	0.009***	0.008***
	(0.002)	(0.002)
Doing work around the garden	0.030***	0.030***
	(0.005)	(0.005)
Managing money	0.016***	0.015***
	(0.003)	(0.003)

Robust s.e. in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 7 – Robustness check – life satisfaction included among regressors

First three rows: Negative binomial estimates with coefficients measuring incident rate ratios - <(>)1 coefficients indicate negative (positive) effects on the dependent variable
Other rows: probit estimates - marginal effects

VARIABLES	Poor sense of life	SE	Life satisfaction	SE	Observations	Log likelihood
No. Chronic illnesses	1.134**	(0.069)	0.933***	(0.016)	4,014	-4474
ADL	0.434***	(0.110)	-0.128***	(0.027)	10,356	-3473
IADL	0.303***	(0.086)	-0.131***	(0.024)	9,940	-4289
Heart attack	0.005	(0.004)	-0.057***	(0.014)	9,827	-1588
High blood pressure	0.008	(0.009)	-0.025**	(0.013)	7,126	-2458
Cholesterol	0.020***	(0.008)	-0.019*	(0.011)	8,785	-2823
Stroke	0.001	(0.003)	-0.069***	(0.018)	10,781	-872.1
Diabetes	0.010**	(0.004)	-0.015	(0.015)	9,876	-1307
Lung disease	0.005	(0.004)	-0.017	(0.017)	10,567	-1236
Cancer	0.000	(0.003)	-0.019	(0.017)	10,620	-961.6
Stomach ulcer	0.007**	(0.003)	-0.036**	(0.018)	10,495	-968.8
Parkinson	-0.001	(0.001)	-0.106***	(0.024)	8,594	-200.1
Cataracts	0.005	(0.004)	-0.025*	(0.014)	10,120	-1512
Hip fracture	0.003	(0.002)	-0.019	(0.024)	10,525	-479
Other fractures	0.007*	(0.004)	-0.037**	(0.016)	10,109	-1270
Alzheimer's disease	0.000	(0.002)	-0.032	(0.025)	10,192	-399.5

Table 8.1 – Robustness check – sample split findings for the number of illnesses estimate

Negative binomial estimates with coefficients measuring incident rate ratios - <(>)1 coefficients indicate negative (positive) effects on the dependent variable

	Poor sense of life	SE	Observations	Log likelihood
All	1.232***	(0.070)	4,023	-4496
Male	1.166	(0.110)	1,609	-1769
Female	1.272***	(0.090)	2,414	-2694
Younger	1.259***	(0.087)	3,220	-2324
Older	1.144	(0.112)	803	-2148
Less educated	1.278***	(0.102)	1,833	-2916
More educated	1.210**	(0.098)	2,190	-1553
Low income	1.227***	(0.094)	1,902	-2337
High income	1.206**	(0.102)	2,121	-2127

Table 8.2 – Robustness check – sample split findings for the ADL estimate

Negative binomial estimates with coefficients measuring incident rate ratios - <(>)1 coefficients indicate negative (positive) effects on the dependent variable

	Poor sense of life	SE	Observations	Log Likelihood
All	1.771***	(0.177)	10,379	-3507
Male	1.796***	(0.268)	4,413	-1433
Female	1.749***	(0.234)	5,966	-2025
Younger	1.711***	(0.247)	7,052	-1011
Older	1.824***	(0.241)	3,327	-2478
Less educated	2.027***	(0.256)	5,157	-2543
More educated	1.469**	(0.224)	5,222	-921
Low income	1.813***	(0.212)	5,588	-2327
High income	1.609***	(0.286)	4,791	-1148

Table 8.3 – Robustness check – sample split findings for the IADL estimate

Negative binomial estimates with coefficients measuring incident rate ratios - <(>)1 coefficients indicate negative (positive) effects on the dependent variable

	Poor sense of life	SE	Observations	Log Likelihood
All	1.554***	(0.125)	9,961	-4330
Male	1.562***	(0.197)	4,395	-1658
Female	1.579***	(0.159)	5,566	-2628
Younger	1.534***	(0.186)	6,860	-1252
Older	1.541***	(0.159)	3,101	-3055
Less educated	1.645***	(0.160)	4,882	-3186
More educated	1.425***	(0.186)	5,079	-1105
Low income	1.354***	(0.130)	5,314	-2833
High income	2.066***	(0.274)	4,647	-1446