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Smile or Die: Can Subjective Well-Being Increase Survival in the Face of Substantive Health Impairments?[☆]

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Abstract

A robust relationship between subjective well-being and mortality has been established in the literature. While this relationship has been confirmed for many measures and data sets, few studies address how it is affected by concrete diseases. In this paper we assess for the British Household Panel Survey (BHPS) data set from 1991-2008 how life satisfaction interacts with twelve concrete health impairments. Specifically, we analyze whether subjective well-being predicts longer survival in the panel for individuals having the respective impairments. We find that cancer, chest pains and diabetes consistently decrease survival in our sample, even controlling for the severity of health problems. But our results cast doubt on strong claims for the benefits of well-being on mortality: while life satisfaction generally predicts longer survival in the data set, this finding is not robust to controlling for the endogeneity of subjective well-being, and we do not find significant interactions between substantive health impairments and life satisfaction. Higher subjective well-being may keep you healthy, but once you have gotten sick, it does not predict your survival.

Key words: subjective well-being, health, survival analysis, longevity, BHPS, life satisfaction

JEL-classification: I31, I12, C41

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1. Introduction

Happy people are more successful in life. The most straightforward explanation for this fact is that positive life events (such as health improvements, social activities, income raises and job success) make people happy. However, a growing body of research shows that happiness increases individuals' success in life (e.g., Lyubomirsky et al., 2005; Binder, 2014). Increases in well-being have been shown to be associated with subsequent improvements in health, income, employment success and a higher chance of getting married (Binder and Coad, 2010; Binder and Ward, 2013). Social and job success of happier individuals is not surprising insofar as these individuals seem more attractive and likable to others, in turn leading to larger networks of friends. If happy people are then perceived as more outgoing and friendly by their employers, they may more easily qualify for promotions. Similarly, a happy disposition plausibly helps individuals in service jobs to be perceived as more helpful and competent, thus increasing their job success (Graham et al., 2004).

The above findings also extend to the health domain, where happiness is conducive to a person's health in various ways (Veenhoven, 2008): happy people rate themselves as healthier, an effect that cannot be solely attributed to personality traits that influence self-assessments for both well-being and health. There is also evidence that happy individuals have better immune systems (Cohen et al., 2003) and lower levels of hypertension (Blanchflower and Oswald, 2008), and that they deal better with stress (Zorrilla et al., 2001). Finally, recent research has uncovered substantial evidence that associates happiness with longevity (Howell et al., 2007; Chida and Steptoe, 2008; Veenhoven, 2008; Diener and Chan, 2011; Frey, 2011).

In the present paper we focus on this latter relationship between happiness and longevity. Whether happy people live longer has been given increasing research attention in the past years (for overviews see Howell et al., 2007; Chida and Steptoe, 2008), stimulated by the famous "nun study" that has shown that optimistic and cheerful young nuns tended to outlive their more gloomy peers (Danner et al., 2001). A recent meta-analysis finds that this happiness differential in longevity amounts to a 14% increased probability of living longer (Howell et al., 2007). Another meta-study finds that happy individuals live between 7.5 and 10 years longer (Veenhoven, 2008).

In the wake of the nun study numerous studies have focused on the relationship between

subjective well-being and longevity, but few have tried to unpack this relationship any further: does happiness increase longevity only for healthy individuals, thus acting as a protective factor against sickness, or can happiness increase longevity also in the face of (severe) health problems? The answer to this question is especially relevant to assess claims from positive psychology that cultivating a cheerful attitude will help individuals to lead longer lives. The focus of the present study is thus to shed light on possible limits of the happiness-longevity relationship.[1] We conduct a survival analysis for individuals in the British Household Panel Survey (BHPS) data set from 1996-2008, using reports on respondents' substantive health problems (such as heart problems, cancer, anxieties, or migraines) to analyze whether happiness predicts longer survival in the panel for individuals having the respective health impairments. In this way we extend studies such as the one by Frijters et al. (2011) but focus on the interaction of happiness with individual substantive health problems. Extending the extant literature, we also pay attention to the severity of health problems and take into account potential issues of reverse causation, i.e. bad health lowering well-being as well as survival, by examining lagged effects of subjective well-being on mortality. Our results cast doubt on overly exuberant claims as to the positive mortality benefits of subjective well-being (adding to concerns expressed by Liu et al., 2015; Wiest et al., 2011): while happiness generally predicts longer survival in the data set, and cancer, chest pains and diabetes consistently decrease survival (even controlling for severity of health problems), there are no significant interactions between individual health problems and subjective well-being (irrespective of models and controlling for severity).

Our paper is structured in the following way. We begin by outlining the pertinent literature background for our study (Section 2). We then present our analysis in Section 3 by shortly describing our data set and variable selection, discussing our results and conducting a number of sensitivity analyses. We conclude and provide an outlook on further research in Section 4.

[1] We borrow our title from the eponymous book "Smile or Die", in which Barbara Ehrenreich criticizes positive psychology for overselling the benefits of positive affect/life satisfaction, somewhat sarcastically suggesting that regular smiling to yourself in the mirror will probably not cure you from whatever ill has befallen you (Ehrenreich, 2009).

2. Literature background

Subjective well-being (SWB) is influenced by a number of factors. Health is an important one of these factors (Graham, 2009; Layard et al., 2012).[2] The association between subjective well-being and health is well-researched and strong, with numerous studies showing that healthier individuals tend to be happier (Graham, 2008; Easterlin, 2003; Dolan and Kahneman, 2008; Dolan et al., 2008). Most studies analyze the relationship between individuals' subjective health ratings and subjective well-being (Easterlin, 2003; Dolan et al., 2008) or the impact of disability on subjective well-being (Brickman et al., 1978; Oswald and Powdthavee, 2008), mostly for lack of more detailed data on objective health impairments. Very few studies also extend the analysis to more detailed health conditions (see Shields and Wheatley Price, 2005; Graham et al., 2011; Dolan, 2011; Binder and Coad, 2013).

But causality in this domain runs in both directions. In this paper, we are interested in the reverse direction of causality. The literature here has established that happiness is conducive to various dimensions of health (Veenhoven, 2008; Diener and Chan, 2011; Frey, 2011): happy people rate themselves as healthier, tend have stronger immune systems (Cohen et al., 2003) and lower levels of hypertension (Blanchflower and Oswald, 2008), and are better able to deal with stress (Zorrilla et al., 2001).

Prior evidence also associates happiness with longevity (Howell et al., 2007; Chida and Steptoe, 2008; Veenhoven, 2008; Diener and Chan, 2011; Frey, 2011). On this relationship, numerous studies provide evidence from different populations and with different measures of well-being: depression and negative affect have been shown to increase all-cause mortality (Russ et al., 2012, with a one SD worsening in the GHQ-12 score resulting in a 21% increase in

[2]For more extensive surveys over recent advances in subjective well-being research, see Layard et al. (2012); Frey and Stutzer (2002b); Dolan et al. (2008); Clark et al. (2008). SWB serves as umbrella term for different well-being measures such as life satisfaction, positive or negative affect, mental well-being and so on (Ryff and Keyes, 1995; Easterlin, 2002; Frey and Stutzer, 2002a; Diener and Seligman, 2004). SWB measures have been proven to be valid and reliable (Diener et al., 1999; Helliwell and Wang, 2012; Layard et al., 2010): they correlate in the expected directions with objective factors, *inter alia* emotional expressions like smiling (Fernandez-Dols and Ruiz-Belda, 1995), biomarkers such as hypertension (Blanchflower and Oswald, 2008) and also overt behavior (Kahneman et al., 1993; Shiv and Huber, 2000), the most extreme of which is suicide (Helliwell, 2006). Individuals are able to compare and assess other individuals' happiness, for example when individuals' self-reports are correlated with reports of friends and family (Sandvik et al., 1993; Diener and Lucas, 1999). Test-retest reliabilities of subjective well-being lies between 0.5 and 0.7 (over two weeks, both for cognitive and affective measures, see Krueger and Schkade, 2008).

mortality), and depression also negatively impacts the immune system (Zorrilla et al., 2001; Beck and Katz, 2001; Smith et al., 2004). Separately from negative affect, positive affect has a positive impact on individual health (Steptoe and Wardle, 2005; Dockray et al., 2010) and mortality (Steptoe and Wardle, 2011). Favorable health outcomes of positive affect include lower rates of salivary cortisol, reduced fibrinogen stress responses and lower ambulatory heart rates (Steptoe and Wardle, 2005). As regards mortality, hazard rates for high positive affect groups are lower than those for low positive affect groups even when adjusting for a number of important covariates such as age, sex, socio-demographic status etc. (Steptoe and Wardle, 2011). This relationship is also present for more cognitive-centered well-being constructs such as life satisfaction and has been shown in various populations (Wiest et al., 2011; Koivumaa-Honkanen et al., 2000; Xu and Roberts, 2010; Guven and Saloumidis, 2013).

Meta-analyses confirm the effect of positive well-being on mortality (Howell et al., 2007; Chida and Steptoe, 2008; Veenhoven, 2008), for instance estimating hazard ratios of 0.82 in healthy and 0.98 in disease populations (Chida and Steptoe, 2008).[3] (Veenhoven, 2008, p. 455) finds that happy individuals live between 7.5 and 10 years longer in the studies he examined (these refer to initially healthy populations). The beneficial effects of well-being on mortality have also been shown in orang-utans (Weiss et al., 2011) pointing to a biological explanation of this relationship.

To explain why psychological well-being increases one's odds of survival, two competing (but probably not mutually exclusive models) exist (Pressman and Cohen, 2005): the "direct effects model" suggests "positive affect may directly affect health practices, decrease autonomic nervous system activity, regulate the release of stress hormones, influence the opioid system and immune responses, and affect social networks; these, in turn, impact health and disease outcomes" (Howell et al., 2007, p. 90). In line with this, Steptoe and Wardle (2005) suggest direct pathways between the neuroendocrine, autonomic, and immune systems (central nervous and immune system are anatomically and functionally directly linked) so that positive affect leads to reductions in baseline activations levels of these systems. But also

[3]Despite considerable heterogeneity between studies and the existence of publication bias, Chida and Steptoe (2008) conclude that the effect of positive psychological functioning on mortality is robust and significant, at least for initially healthy populations.

better health as a result of less destructive behaviours (see also, e.g., Veenhoven, 2008), such as drug abuse or risk-taking as a result of unhappiness, would fall within this explanatory model. The alternative model, the "stress-buffering model" of subjective well-being (Pressman and Cohen, 2005), suggests that negative effects of stress are mediated and ameliorated through positive affect by improving coping and resilience of the individual. The latter model is compatible with explanations brought forward in psychology, where well-being is argued to broaden and strengthen one's (personal and social) resources (Cohn et al., 2009; Tugade et al., 2004).

There remain unanswered questions, however. Not all the surveyed studies are of equal methodological rigor, e.g. differing in the control variables/covariates used, not or insufficiently controlling for baseline health, using short-time horizons, or focusing on specific, often small subgroups (such as local communities or the elderly) instead of giving a representative picture of the populace. Moreover, reverse causality, i.e. bad health decreasing subjective well-being, can lead survival studies to mistakenly find a relationship between unhappiness and mortality, whereas in reality conditions of bad health led to low well-being and ultimately death, and not vice versa.

Our study contributes to the literature in several ways. First, we analyze a large household sample data set for Great Britain instead of local community-level data. Second, we take into consideration that the happiness-longevity relationship may be heterogenous across individuals. Specifically, we analyze the impact of SWB on longevity not only for healthy individuals, but also for individuals having various specific health impairments (via the interaction between happiness and these health impairments). Doing so is important because while the relationship between happiness and longevity is quite strong and well-confirmed in (at baseline) healthy populations (which also helps to mitigate concerns about reverse causality), the extant evidence on diseased populations (and specific health impairments) is sparse and quite mixed (Veenhoven, 2008; Diener and Chan, 2011; Liu et al., 2015). A hazard ratio of 0.98 (in the meta-analysis cited above) may be so small as to be considered substantively meaningless, particularly when compared to the large positive hazard ratio of 0.82 for healthy populations (Chida and Steptoe, 2008). The differential role that subjective well-being may play for healthy versus sick individuals points to a protective rather than

curative effect. Third, to illuminate the happiness-longevity relationship for sick individuals we also pay close attention to the covariates used to establish health at baseline (objective health impairments vs. subjective health assessments). Finally, we begin to account for potential endogeneity issues by using lagged measures of subjective well-being as predictors of survival in the sample.

3. Survival analysis

3.1. Data

The British Household Panel Survey (BHPS) is a well-known longitudinal panel survey of British households, comprising about 10,000 individual interviews at the start and growing over time. It contains a wealth of information on respondents' lives, most important of which a number of health impairments respondents' might suffer from.[4]

For the subsequent analysis, we use unbalanced panel data over a time horizon of 12 years (from 1996 to 2008). We had to exclude waves that did not feature life satisfaction questions as well as one wave in which the subjective health assessment was coded differently from the other waves. This leaves us with 182, 238 observations (less for most models). Table 1 provides a summary of our variables.

Our main relevant variables for the survival analysis are life satisfaction and a number of objective health problems. The exit condition for the survival analysis is death, meaning that we focus on the subsample of individuals for whom survey reporters could actually ascertain that their attrition from the sample was due to death (as opposed to infirmity, refusal or other, sometimes unknown, causes of non-response). Focusing on these cases allows for a literal interpretation of "survival" in our analysis. 4.4% of our sample dies at one point or another during the sample horizon.

The life satisfaction question records an individual's answer to the question "How dissatisfied or satisfied are you with your life overall?". The question is answered on a seven-point

[4]The survey is undertaken by the ESRC UK Longitudinal Studies Centre with the Institute for Social and Economic Research at the University of Essex, UK (BHPS, 2010). Its aim is to track social and economic change in a representative sample of the British population (see Taylor, 2010). Starting in 1991, up to now, there have been 18 waves of data collected with the aim of tracking the individuals of the first wave over time (in general, attrition is quite low, see Taylor, 2010).

	mean	sd	min	max
life satisfaction	5.23	1.28	1	7
Health variables				
health==very poor	0.02	0.14	0	1
health==poor	0.07	0.26	0	1
health==fair	0.21	0.41	0	1
health==good	0.46	0.50	0	1
health==excellent	0.24	0.42	0	1
no health problems	0.40	0.49	0	1
docvisits: 1-2	0.36	0.48	0	1
docvisits: 3-5	0.21	0.41	0	1
docvisits: 6+	0.18	0.39	0	1
accidents: 1	0.09	0.29	0	1
accidents: 2	0.01	0.09	0	1
accidents: 3+	0.00	0.06	0	1
log(hosp. days)	0.19	0.62	0	5.90
no. cigs	0.20	0.40	0	4.05
Health problems				
arms/joints	0.28	0.45	0	1
sight	0.05	0.22	0	1
hearing	0.09	0.28	0	1
allergy	0.12	0.32	0	1
chest	0.13	0.34	0	1
heart	0.17	0.37	0	1
stomach	0.08	0.27	0	1
diabetes	0.03	0.18	0	1
anxiety	0.08	0.27	0	1
drugs	0.01	0.07	0	1
epilepsy	0.01	0.09	0	1
migraine	0.08	0.27	0	1
other	0.05	0.21	0	1
cancer	0.01	0.12	0	1
stroke	0.02	0.13	0	1
Control variables				
log(income)	9.92	0.63	-0.40	13.7
d_nevermarried	0.28	0.45	0	1
d_married	0.54	0.50	0	1
d_separated	0.02	0.14	0	1
d_widowed	0.09	0.28	0	1
d_divorced	0.08	0.27	0	1
d_employed	0.50	0.50	0	1
d_unemployed	0.04	0.19	0	1
d_selfemployed	0.07	0.25	0	1
d_retired	0.21	0.41	0	1
d_studyschool	0.05	0.22	0	1
d_maternityleave	0.00	0.06	0	1
d_longtermsick	0.04	0.20	0	1
d_familycare	0.08	0.26	0	1
d_other	0.01	0.08	0	1
d_disabled	0.08	0.28	0	1
gender	0.53	0.50	0	1
age	45.84	18.70	15	100
primary educ.	0.13	0.33	0	1
secondary educ.	0.33	0.47	0	1
tertiary educ.	0.30	0.46	0	1
children: 1	0.15	0.36	0	1
children: 2	0.13	0.34	0	1
children: 3+	0.06	0.23	0	1
Observations	182238			

Table 1: Descriptive statistics.

ordinal scale with (1) denoting "not satisfied at all" and (7) denoting "completely satisfied".

Individuals can report health impairments that belong to twelve different categories.

They respond to the question "Do you have any of the health problems or disabilities listed on this card?" The categories listed are "Problems or disability connected with: arms, legs, hands, feet, back, or neck (including arthritis and rheumatism)", "Difficulty in seeing (other than needing glasses to read normal size print)", "Difficulty in hearing", "Skin conditions/allergies", "Chest/breathing problems, asthma, bronchitis", "Heart/blood pressure or blood circulation problems", "Stomach/liver/kidneys", "Diabetes", "Anxiety, depression or bad nerves, psychiatric problems", "Alcohol or drug related problems", "Epilepsy", "Migraine or frequent headaches", "Cancer", "Stroke", and "Other health problems". Respondents only provide a binary "yes" or "no" answer, but not the degree or other specifics of the condition.

To control for baseline health and other confounding factors, we use both a subjective measure (self-reported subjective assessment of health; below denoted as SAH) and a number of objective health indicators. Individual subjectively assessed health (during the last 12 months) is ordinally scaled on a five-point Likert scale, which we have reverse-coded to range from "excellent" (5) to "very poor" (1). The objective health variables include the numbers of days spent in hospital, visits to a general practitioner, serious accidents and numbers of cigarettes smoked, as well as a dummy variable for disability (see Table 1).[5] Finally, we also make use of information on whether an individual's health status limits their daily activities. This information, which combines subjective and objective elements, is reflected in the variable HLLT. It is based on the survey item "Does your health in any way limit your daily activities compared to most people of your age?", to which one can respond with "yes"/"no".

Additional controls (see Table 1) include socio-economic and demographic variables such as log net equivalised annual household income (in British Pound Sterling, before housing costs and deflated to price level of 2008), as provided and detailed by Levy and Jenkins (2008).[6], gender, age, and age^2, marital status dummies (e.g., never married, separated, divorced or widowed), and number of children. Of our sample, 53% were female (the gender

[5]Hospital days are given as (log) days. Visits to the general practitioner are coded on a 5 point ordinal scale (from "none" to "more than ten") and number of serious accidents is quasi-cardinal with values from 0 to 4 giving the number of serious accidents, but the number of four also being used for coding cases with more than four serious accidents in this year. In all cases, higher values indicate worse health.

[6]As equivalence scales, we have used the widely-accepted McClements scale (McClements, 1977).

variable is one if female, zero if male) and 46 years old on average. Employment status is reported in a number of categories (being unemployed, self-employed, retired, long-term sick, on maternity leave, studying or being in school, caring for family members as well as "other" conditions not captured), with being employed as the omitted reference group. Education is measured by the ordinal CASMIN scale ranging from one ("none") to nine ("higher tertiary"), but we have collapsed these into primary, secondary and tertiary education dummies. Table 9 in the Appendix reports pairwise correlations between the variables of interest: most of our indicators are significantly correlated, but there are no problems of multicollinearity. We also present descriptive statistics broken down per substantive health conditions in Table 8 in the Appendix.

3.2. Analysis

We use hazard rate models to trace the relationship between subjective well-being, objective health problems and survival in our data set on British individuals. Our main approach is to estimate Cox regressions, which are conventionally adopted in this type of analysis. The Cox proportional hazard model is based on a variety of assumptions that may bias our results. We will subsequently address potential biases stemming from the continuous-time nature of the Cox model by re-doing our analysis assuming time-discreteness. Note, however, that the Cox model is usually quite robust to the violation of the assumption of time-continuous survival processes. As a technical note, we use heteroskedasticity-robust standard errors and cluster these in all models on the individual level.

Our first set of estimates conceptually replicates the typical design of prior studies seeking to model subjective well-being and its influence on mortality (Table 2). We estimate a set of nested models to which we successively add important covariates that have been used in the prior literature. We start with a bare-bones model of the survival process including only covariates for age and gender (column 1). Age is negatively related to survival (hazard ratio (HR) of 1.09, i.e. 9% higher odds of death for each year of age),[7] and being female is positively related to survival (HR 0.71, i.e. females have 29% lower odds of death).

[7] All models also contain a squared age term, which has never been statistically significant, so we do not report it in the tables to follow.

	(1) age/gender	(2) +edu/inc	(3) /SAH	(4) /health probs.	(5) +both	(6) SAH+LFS	(7) NHP+LFS	(8) BOTH+LFS	(9) +obj.health	(10) full	(11) discrete
age	1.094***	1.090***	1.083***	1.080***	1.081***	1.085***	1.086***	1.082***	1.087***	1.076***	1.076***
	(16.38)	(15.88)	(14.65)	(14.38)	(14.03)	(12.89)	(12.71)	(12.40)	(11.98)	(9.12)	(9.11)
d_female	0.707***	0.682***	0.637***	0.671***	0.636***	0.609***	0.624***	0.607***	0.633***	0.598***	0.597***
	(-5.66)	(-6.23)	(-7.37)	(-6.50)	(-7.41)	(-7.13)	(-6.78)	(-7.17)	(-6.52)	(-6.89)	(-6.91)
primary educ.		0.804*	0.921	0.807*	0.919	0.875	0.811	0.874	0.898	0.906	0.904
		(-2.19)	(-0.83)	(-2.15)	(-0.85)	(-1.19)	(-1.86)	(-1.20)	(-0.97)	(-0.89)	(-0.91)
secondary educ.		0.757**	0.917	0.770**	0.916	0.873	0.756**	0.872	0.922	0.941	0.942
		(-2.91)	(-0.90)	(-2.73)	(-0.91)	(-1.26)	(-2.60)	(-1.27)	(-0.76)	(-0.57)	(-0.56)
tertiary educ.		0.803*	1.033	0.823*	1.034	1.063	0.889	1.063	1.140	1.168	1.172
		(-2.49)	(0.37)	(-2.21)	(0.38)	(0.63)	(-1.22)	(0.64)	(1.37)	(1.64)	(1.67)
log(income)		0.825***	0.870**	0.827***	0.870**	0.879*	0.849**	0.880*	0.863**	0.884*	0.884*
		(-4.19)	(-2.83)	(-4.10)	(-2.83)	(-2.21)	(-3.00)	(-2.20)	(-2.62)	(-2.11)	(-2.12)
subj. health			0.514***		0.525***	0.549***		0.559***	0.672***	0.676***	0.680***
			(-22.37)		(-21.06)	(-16.48)		(-15.59)	(-9.49)	(-9.33)	(-9.23)
no health problems				0.377***	0.739*		0.466***	0.768	0.812	0.853	0.853
				(-7.35)	(-2.22)		(-5.19)	(-1.74)	(-1.33)	(-1.01)	(-1.01)
life satisfaction						0.903***	0.778***	0.904***	0.935**	0.938**	
						(-4.37)	(-11.40)	(-4.32)	(-2.88)	(-2.73)	
d_swbhigh											0.880
											(-1.58)
d_swblow											1.235*
											(2.22)
no. cigs									1.849***	1.797***	1.797***
									(7.88)	(7.34)	(7.36)
accidents: 1									0.946	0.945	0.946
									(-0.47)	(-0.48)	(-0.47)
accidents: 2									1.199	1.199	1.194
									(0.64)	(0.64)	(0.62)
accidents: 3+									0.953	1.005	1.003
									(-0.13)	(0.01)	(0.01)
docvisits: 1-2									0.939	0.944	0.946
									(-0.49)	(-0.45)	(-0.43)
docvisits: 3-5									1.052	1.055	1.057
									(0.39)	(0.42)	(0.43)
docvisits: 6+									1.019	1.020	1.023
									(0.14)	(0.15)	(0.18)
log(hosp. days)									1.256***	1.254***	1.253***
									(8.13)	(8.10)	(8.07)
d_disabled									1.449***	1.420***	1.418***
									(4.43)	(4.21)	(4.20)
d_longtermsick									1.249	1.770**	1.757**
									(1.65)	(2.91)	(2.86)
d_unemployed										1.984*	1.966*
										(2.11)	(2.08)
d_selfemployed										1.082	1.083
										(0.26)	(0.27)
d_married										0.725**	0.727*
										(-2.59)	(-2.56)
d_separated										0.609	0.604
										(-1.36)	(-1.38)
d_divorced										0.886	0.885
										(-0.74)	(-0.75)
d_widowed										0.879	0.881
										(-1.00)	(-0.98)
d_retired										1.596**	1.594**
										(2.69)	(2.68)
d_studyschool										0.786	0.788
										(-0.24)	(-0.23)
d_familycare										1.653*	1.647*
										(2.14)	(2.13)
d_other										2.105	2.110
										(1.24)	(1.24)
children: 1										0.970	0.967
										(-0.13)	(-0.15)
children: 2										0.703	0.702
										(-1.14)	(-1.15)
children: 3+										0.417	0.416
										(-1.50)	(-1.50)
Observations	133415	133415	133415	133413	133413	114531	114529	114529	114529	114529	114529

Table 2: Nested model: Influence of health and SWB on survival. Hazard ratios (exponentiated coefficients). z statistics in parentheses. Cluster-robust standard errors (clustered on individual). $^{*}p < 0.05,^{**}p < 0.01,^{***}p < 0.001$.

Column 2 adds measures of education and (log) household income, both of which are positively related to survival. Columns 3 to 5 add further health variables to our model. The first one is subjectively assessed health (SAH), which is positively related to survival and its coefficient is much larger than any of the previous factors (HR 0.514, i.e. a one-unit change in SAH is associated with a reduction in mortality of almost 50%). Note also that when SAH is included in the model, the measures of education are no longer significant. The same holds in all subsequent models that include both variables, suggesting that education does not have a direct effect on mortality, but rather exerts a positive influence on health behaviors that lead to better health outcomes and their subjective evaluation.

Considering that personality factors may drive one's health assessment, subjective assessment of health is not without problems as a measure of individual health status (Johnston et al., 2009; Jylhä, 2009; Au and Johnston, 2014). It is conceivable that more optimistic individuals rate themselves as quite healthy despite of objectively bad health (see Tables 3 and 4). Subjective health assessments could also be interpreted as a measure of health satisfaction and/or the severity of an objective health condition: having an illness and yet rating oneself as being in very good health could either be a sign of optimism or of having a rather mild form of illness. To deal with this issue, we exploit further information about individuals' health status, in particular the twelve categories of specific health problems mentioned above.

We begin by constructing an indicator variable "no health problems", which is 1 if an individual checked none of the twelve health impairment categories. We consider this our first "objective" health status variable, as it is less prone to distortions than self-assessed health. (Even though it is also self-assessed, it does not rely on a subjective assessment of one's overall health, but rather asks for whether one has a specific illness or ailment.)

Adding this variable to our model (column 4) leads to similar results as with the SAH variable. Having no health problems is strongly associated with longevity in our sample (HR of 0.377; i.e., 62% lower mortality for individuals with none of the 12 listed problems). When both the no health problem and SAH variables are included in the model (column 5), both remain statistically significant predictors of survival, but the objective health variable attenuates strongly, whereas SAH is still of the same magnitude as without the objective health variable. This suggests that SAH mostly captures the individual's attitude towards

	health problems	no health problems	Total
SAH = very poor	3065	42	3107
	98.65	1.35	100.00
SAH = poor	10566	368	10934
	96.63	3.37	100.00
SAH = fair	25380	4665	30045
	84.47	15.53	100.00
SAH = good	36602	28097	64699
	56.57	43.43	100.00
SAH = excellent	10575	22091	32666
	32.37	67.63	100.00
Total	86188	55263	141451
	60.93	39.07	100.00
χ^2	26414.5		
p	< 0.001		

Table 3: Cross-tabulation of subjectively assessed health (SAH; vertical) and no-health-problems dummy variable (horizontal). Distributional test rejects null hypothesis of equal distribution of SAH for different no-health-problem dummy values.

	no health limits	health limits daily activities	Total
SAH = very poor	330	2544	2874
	11.48	88.52	100.00
SAH = poor	2764	7197	9961
	27.75	72.25	100.00
SAH = fair	18274	9180	27454
	66.56	33.44	100.00
SAH = good	54948	4028	58976
	93.17	6.83	100.00
SAH = excellent	29258	580	29838
	98.06	1.94	100.00
Total	105574	23529	129103
	81.78	18.22	100.00
χ^2	43745.9		
p	< 0.001		

Table 4: Cross-tabulation of subjectively assessed health (SAH; vertical) and health limits daily activities dummy variable (HLLT; horizontal). Distributional test rejects null hypothesis of equal distribution of SAH for different health limit dummy values.

their health and not the objective presence of certain health conditions. The coefficient of SAH is twice as large as that of the objective condition. Figure 1 shows the raw survival rates conditional on both variables using Kaplan-Meier plots. Compared to the good health base categories, having health problems or assessing one's health as poor or very poor both decrease survival.

We now turn to subjective well-being and add our life satisfaction variable to the model (columns 6 to 8). Irrespective of whether SAH or the objective health variable are used to capture individuals' health status, the life satisfaction variable is significantly associated to survival (with hazard ratios of 0.903 and 0.778 respectively). Its implied effect is smaller when using the SAH variable (10% vs. 22% lower hazard of dying). To the extent that SAH

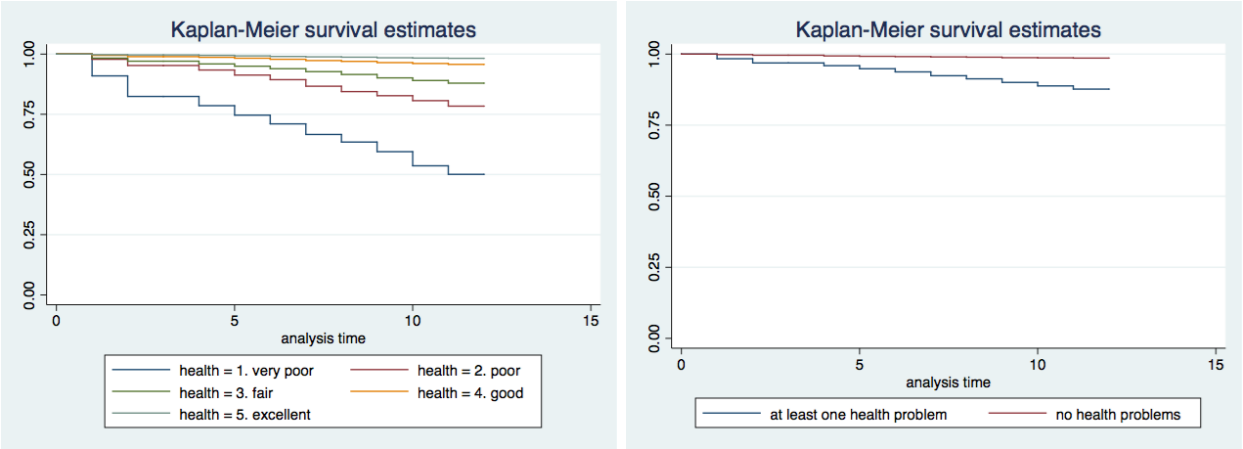

Figure 1: Kaplan-Meier plots with survival for different levels of subjectively assessed health (left) and objective no health problem variable (right). Having health problems or assessing one's health as worse than good decrease survival as opposed to the health base categories.

reflects the severity of one's health problems (with less severe health impairments leading to higher SAH ratings), the smaller effect on survival of life satisfaction suggested by our results may be considered a conservative estimate of the positive effect that life satisfaction in general (not related to one's health satisfaction) may have. Put differently: part of the larger implied effect of life satisfaction found with the objective health problem variable (which does not take into account severity of health problems) could be due to picking up cases of light illness (in which individuals are happier due to better health), something which is controlled for using the SAH variable. When using both objective and subjective health variable (column 8), the life satisfaction remains similar in magnitude to the model specification using SAH only.

We next add a set of further objective health variables (column 9) as well as further variables of job and family status (column 10). Among them, especially (log) days spent in hospital (HR 1.254), being registered as disabled (HR 1.420) and smoking cigarettes (measured in packs of 20 cigarettes per day, HR 1.797) significantly decrease survival, but also being long-term sick (as an employment status, HR 1.770) or unemployed (HR 1.984). Being retired (HR 1.596) or caring for family (HR 1.653) also predict shorter survival. Being married, on the other hand, is associated with longer survival (HR 0.725). These findings are similar to those obtained in other studies, where for example smoking is reliably found to increase mortality, and socio-economic status has a positive impact on survival (Chida and

Steptoe, 2008).

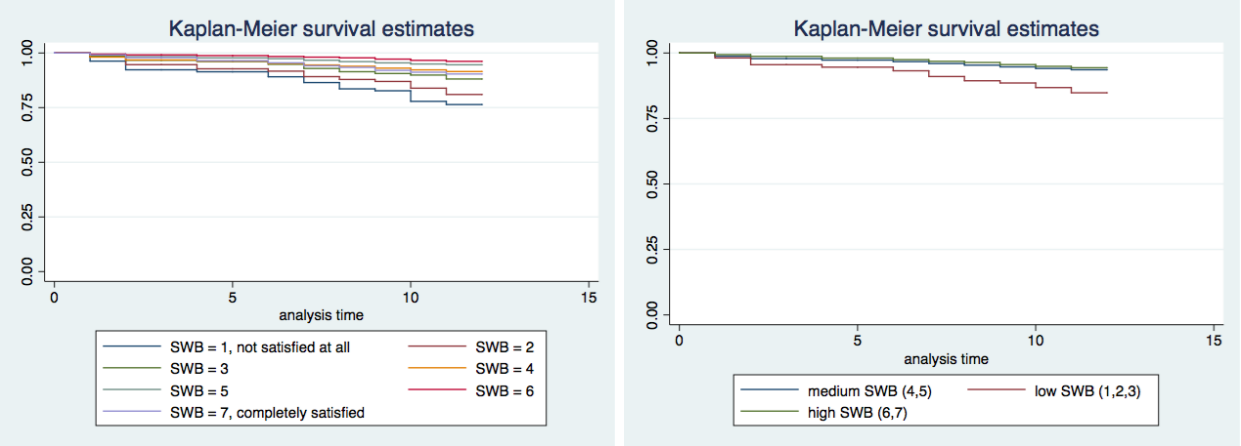

Figure 2: Kaplan-Meier plots with survival for different levels of subjective well-being. Low levels of life satisfaction decrease the odds of survival, whereas the differences between high and medium life satisfaction are small and statistically indistinguishable.

Before turning to an analysis of survival with regard to specific health impairments, it is instructive to see whether the impact of life satisfaction on survival is uniform or driven by the extremes in the life satisfaction distribution. To do so, the literature often collapses ordinal life satisfaction measures into binary measures of high, medium or low well-being. We follow this approach and collapse high life satisfaction values (values of 6 and 7 on our 7-pt-scale) into the dummy variable "high SWB" and the lower three values into a dummy "low SWB". Intermediate values are our base category (column 11). While hazard ratios go in the expected directions (HR 0.880 for high SWB and HR 1.235 for low SWB), only the lower SWB dummy variable has a statistically significant association with survival. Examining the Kaplan-Meier plots for these dummies and the original life satisfaction variable with seven categories (see Figure 2), we see that raw survival strongly differs only between low vs. medium/high values of life satisfaction, whereas medium and high values in life satisfaction do not have a strong differential impact on survival.[8]

[8] A similar model with SAH coded as dummy variables shows that the extreme categories ("excellent" and "very poor") have more than twice as high coefficients than their moderate counterparts ("very good" and "poor"). All four dummy variables are statistically significant, with poor help decreasing survival and good increasing it. We do not further explore these non-linearities. An interaction term between life satisfaction and SAH is statistically not significant. We also find no statistically significant non-linear effect for life satisfaction, e.g. by putting in a squared term. Results available on request.

3.3. Substantive health impairments

	(1) full	(2) sick	(3) sick+SAH	(4) sick+NHP	(5) sick*SWB	(6) +SAH	(7) +NHP
subj. health	0.567***		0.564***	0.570***		0.565***	0.570***
	(-15.22)		(-13.67)	(-13.51)		(-13.56)	(-13.40)
no health problems	0.774			0.691*			0.668*
	(-1.70)			(-2.30)			(-2.45)
life satisfaction	0.920***	0.812***	0.908***	0.908***	0.806***	0.914	0.934
	(-3.54)	(-8.88)	(-4.01)	(-4.03)	(-4.57)	(-1.89)	(-1.37)
Health problems							
arms/joints		1.138	0.903	0.859	1.208	0.887	0.894
		(1.70)	(-1.32)	(-1.93)	(0.73)	(-0.47)	(-0.45)
sight		0.941	0.862	0.857	1.069	0.933	0.945
		(-0.64)	(-1.56)	(-1.62)	(0.25)	(-0.27)	(-0.22)
hearing		0.955	0.958	0.939	1.057	1.085	1.108
		(-0.58)	(-0.54)	(-0.80)	(0.23)	(0.35)	(0.45)
allergy		0.978	0.948	0.934	1.170	1.108	1.114
		(-0.20)	(-0.49)	(-0.63)	(0.49)	(0.33)	(0.35)
chest		1.758***	1.353***	1.327***	1.123	0.952	0.963
		(7.23)	(3.80)	(3.58)	(0.50)	(-0.22)	(-0.17)
heart		1.051	0.914	0.887	1.107	1.048	1.069
		(0.68)	(-1.22)	(-1.62)	(0.46)	(0.22)	(0.31)
stomach		1.287**	1.095	1.086	1.097	0.967	0.972
		(2.61)	(0.96)	(0.87)	(0.34)	(-0.13)	(-0.11)
diabetes		1.629***	1.407***	1.385**	1.694	1.577	1.593
		(4.82)	(3.38)	(3.22)	(1.78)	(1.57)	(1.62)
anxiety		1.037	0.896	0.887	0.840	0.795	0.779
		(0.32)	(-0.98)	(-1.08)	(-0.64)	(-0.87)	(-0.95)
drugs		1.122	0.917	0.885	2.720	1.862	1.847
		(0.29)	(-0.22)	(-0.30)	(1.23)	(0.76)	(0.75)
epilepsy		1.315	1.165	1.141	1.140	0.953	0.963
		(0.72)	(0.40)	(0.35)	(0.16)	(-0.06)	(-0.05)
migraine		0.655*	0.631**	0.623**	0.944	1.021	1.008
		(-2.54)	(-2.79)	(-2.86)	(-0.14)	(0.05)	(0.02)
other		1.030	0.831	0.809	1.744	1.453	1.454
		(0.22)	(-1.37)	(-1.57)	(1.56)	(1.06)	(1.07)
stroke		1.543*	1.298	1.295	0.591	0.643	0.656
		(2.54)	(1.60)	(1.59)	(-1.22)	(-1.08)	(-1.03)
cancer		4.483***	3.497***	3.450***	5.624***	5.130***	5.240***
		(12.25)	(10.73)	(10.67)	(5.11)	(5.02)	(5.09)
Interactions							
arms × SWB					0.987	1.003	0.990
					(-0.26)	(0.06)	(-0.20)
sight × SWB					0.972	0.982	0.978
					(-0.52)	(-0.35)	(-0.43)
hearing × SWB					0.978	0.973	0.965
					(-0.47)	(-0.59)	(-0.79)
allergy × SWB					0.960	0.965	0.960
					(-0.60)	(-0.54)	(-0.62)
chest × SWB					1.101*	1.079	1.071
					(2.07)	(1.70)	(1.55)
heart × SWB					0.989	0.972	0.961
					(-0.25)	(-0.67)	(-0.94)
stomach × SWB					1.038	1.030	1.026
					(0.66)	(0.54)	(0.47)
diabetes × SWB					0.991	0.976	0.970
					(-0.16)	(-0.43)	(-0.54)
anxiety × SWB					1.058	1.033	1.035
					(0.89)	(0.54)	(0.57)
drugs × SWB					0.762	0.804	0.798
					(-1.02)	(-0.83)	(-0.85)
epilepsy × SWB					1.040	1.053	1.042
					(0.22)	(0.29)	(0.23)
migraine × SWB					0.915	0.891	0.891
					(-0.97)	(-1.25)	(-1.26)
other × SWB					0.883	0.876	0.870
					(-1.61)	(-1.73)	(-1.83)
stroke × SWB					1.258**	1.178*	1.171
					(2.63)	(1.97)	(1.90)
cancer × SWB					0.954	0.921	0.914
					(-0.67)	(-1.22)	(-1.34)
Observations	114529	114531	114531	114529	114531	114531	114529

Table 5: Health conditions and interactions with life satisfaction. Hazard ratios (exponentiated coefficients). Full set of covariates used in estimation but not depicted here. No. of observations for stroke/cancer = 83,357; z statistics in parentheses. Cluster-robust standard errors (clustered on individual). $^{*}p < 0.05,^{**}p < 0.01,^{***}p < 0.001$.

So far, our results echo existing research in that they suggest a positive impact of life satisfaction on survival. We have seen, however, that the strength of the association depends

crucially on how one controls for individuals' health conditions at baseline (this has also been observed recently in Liu et al., 2015; Wiest et al., 2011). Especially the SAH variable, which is most often used in the extant literature, is fraught with interpretational difficulties. To better understand the extent of a well-being effect survival and its interplay with individuals' initial health conditions, we now explore to what extent substantive health problems such as having cancer, a stroke, migraines etc. and their interaction with subjective well-being lead to different survival outcomes. We first estimate a Cox model to analyze how these conditions relate to survival while controlling for SWB (Table 5, columns 2-4; column 1 reproduces the baseline model from the previous section).[9] We then estimate another set of models in which we interact the SWB variable with the specific health problems (Table 5, columns 5-7).

A first result from these models is that only some of the substantive health problems are significantly associated to the hazard rates in our sample. Chest problems, stomach problems, diabetes, stroke and cancer significantly decrease survival in the sample, whereas surprisingly migraines have the opposite effect. These results are robust to including SAH or the no health problems variable into the models. All models suggest that life satisfaction has a positive impact on survival, but the impact decreases once we control for SAH. Looking at the interaction terms between different health problems and life satisfaction (columns 5-7), we only find significant interactions for stroke and chest problems, which moreover disappear once we control for SAH. In contrast to the findings in the previous sub-section, there appears to be no influence of life satisfaction on survival conditional on having some of the health problems. This suggests that the beneficial impact of life satisfaction on survival may be protective more than curative. To avoid the complexity of interpreting interaction effects in nonlinear models, we alternatively code life satisfaction in high/medium/low dummy form and interact these dummies with the health problem dummies (with medium life satisfaction as reference group). This does not yield additional insights: virtually none of the interaction terms are significant, i.e. neither high nor low life satisfaction appears to impact survival in the presence of our assorted health problems. In addition, differences between the interactions with high and low life satisfaction are generally small and do not suggest that lower mortality

[9]Note that the coefficients for stroke and cancer are added to the table from a different model with smaller sample size (n = 83,357) to conserve space.

is generally associated with higher levels of subjective well-being (see Table 6).

Table 6: Health conditions and interactions with life satisfaction, where life satisfaction is coded as dummy (low=1, 2, 3, high=6, 7 and base category of medium=4, 5). Hazard ratios. Dummy for drugs omitted due to low cell numbers. Full set of control variables included but not depicted here. z statistics in parentheses. Cluster-robust standard errors (clustered on individual). $^{*}p < 0.05,^{**}p < 0.01,^{***}p < 0.001$.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	full	sick	sick+SAH	sick+NHP	sick*SWB	+SAH	+NHP
subj. health	0.570***		0.566***	0.572***		0.565***	0.571***
	(-15.12)		(-13.61)	(-13.45)		(-13.65)	(-13.47)
no health problems	0.772			0.689*			0.661*
	(-1.71)			(-2.32)			(-2.49)
low_swb	1.340**	1.803***	1.357**	1.362**	2.236***	1.647*	1.568*
	(3.13)	(6.23)	(3.19)	(3.24)	(4.03)	(2.44)	(2.13)
hi_swb	0.876	0.694***	0.847*	0.849*	0.812	1.014	1.071
	(-1.63)	(-4.55)	(-2.04)	(-2.02)	(-1.38)	(0.09)	(0.42)
Health problems							
arms/joints		1.143	0.905	0.860	1.324*	1.049	0.993
		(1.76)	(-1.29)	(-1.91)	(2.26)	(0.39)	(-0.06)
sight		0.943	0.862	0.857	1.040	0.953	0.949
		(-0.62)	(-1.55)	(-1.62)	(0.27)	(-0.33)	(-0.36)
hearing		0.952	0.955	0.936	0.992	1.015	1.000
		(-0.62)	(-0.58)	(-0.84)	(-0.06)	(0.12)	(-0.00)
allergy		0.983	0.952	0.938	0.980	0.944	0.931
		(-0.16)	(-0.45)	(-0.59)	(-0.12)	(-0.35)	(-0.44)
chest		1.756***	1.352***	1.326***	1.739***	1.338*	1.314*
		(7.24)	(3.79)	(3.56)	(4.64)	(2.45)	(2.32)
heart		1.049	0.913	0.886	1.020	0.878	0.858
		(0.65)	(-1.23)	(-1.64)	(0.18)	(-1.12)	(-1.34)
stomach		1.286**	1.092	1.082	1.259	1.105	1.094
		(2.60)	(0.92)	(0.83)	(1.51)	(0.67)	(0.60)
diabetes		1.612***	1.401***	1.379**	1.617**	1.389*	1.374*
		(4.71)	(3.33)	(3.17)	(2.94)	(2.04)	(1.98)
anxiety		1.046	0.894	0.884	1.154	0.993	0.982
		(0.40)	(-1.00)	(-1.10)	(0.85)	(-0.04)	(-0.11)
epilepsy		1.322	1.160	1.136	2.631*	2.411*	2.318*
		(0.73)	(0.39)	(0.33)	(2.28)	(2.10)	(2.01)
migraine		0.656*	0.632**	0.624**	0.497*	0.455**	0.452**
		(-2.53)	(-2.77)	(-2.85)	(-2.48)	(-2.81)	(-2.84)
other		1.031	0.834	0.811	1.021	0.784	0.765
		(0.23)	(-1.35)	(-1.55)	(0.10)	(-1.16)	(-1.28)
stroke		1.570**	1.297	1.293	1.373	1.098	1.091
		(2.68)	(1.59)	(1.58)	(1.07)	(0.31)	(0.29)
cancer		4.510***	3.493***	3.445***	4.493***	3.602***	3.555***
		(12.44)	(10.72)	(10.66)	(7.79)	(6.90)	(6.85)
Interactions							
low_swb × arms					0.781	0.741	0.770
					(-1.19)	(-1.48)	(-1.30)
hi_swb × arms					0.782	0.796	0.780
					(-1.46)	(-1.38)	(-1.53)
low_swb × sight					0.882	0.854	0.859
					(-0.55)	(-0.70)	(-0.68)
hi_swb × sight					0.837	0.833	0.821
					(-0.79)	(-0.81)	(-0.88)
low_swb × hearing					1.060	1.030	1.043
					(0.29)	(0.15)	(0.21)
hi_swb × hearing					0.847	0.819	0.796

Table 6: (continued) Health conditions and interactions with life satisfaction. Hazard ratios.

					(-0.90)	(-1.10)	(-1.26)
low_swb × allergy					1.105	1.119	1.129
					(0.38)	(0.44)	(0.47)
hi_swb × allergy					0.899	0.899	0.882
					(-0.40)	(-0.40)	(-0.47)
low_swb × chest					0.839	0.876	0.886
					(-0.91)	(-0.70)	(-0.65)
hi_swb × chest					1.170	1.149	1.122
					(0.89)	(0.81)	(0.68)
low_swb × heart					1.095	1.170	1.188
					(0.49)	(0.86)	(0.95)
hi_swb × heart					1.021	1.004	0.969
					(0.13)	(0.03)	(-0.20)
low_swb × stomach					0.970	0.919	0.926
					(-0.13)	(-0.37)	(-0.34)
hi_swb × stomach					1.129	1.062	1.048
					(0.54)	(0.27)	(0.21)
low_swb × diabetes					0.958	1.018	1.022
					(-0.17)	(0.07)	(0.08)
hi_swb × diabetes					1.003	0.993	0.970
					(0.01)	(-0.03)	(-0.14)
low_swb × anxiety					0.736	0.746	0.744
					(-1.28)	(-1.23)	(-1.25)
hi_swb × anxiety					1.178	1.076	1.076
					(0.55)	(0.25)	(0.25)
low_swb × epilepsy					0.250	0.231	0.239
					(-1.63)	(-1.73)	(-1.69)
hi_swb × epilepsy					0.350	0.329	0.322
					(-0.96)	(-1.01)	(-1.04)
low_swb × migraine					1.970	2.252*	2.241*
					(1.81)	(2.18)	(2.18)
hi_swb × migraine					1.087	1.122	1.107
					(0.18)	(0.25)	(0.22)
low_swb × other					1.227	1.368	1.383
					(0.65)	(1.00)	(1.03)
hi_swb × other					0.775	0.815	0.793
					(-0.72)	(-0.58)	(-0.66)
low_swb × stroke					0.750	0.870	0.882
					(-0.70)	(-0.34)	(-0.31)
hi_swb × stroke					2.224*	1.987	1.959
					(2.06)	(1.76)	(1.73)
low_swb × cancer					1.219	1.207	1.230
					(0.73)	(0.71)	(0.79)
hi_swb × cancer					0.857	0.782	0.770
					(-0.55)	(-0.90)	(-0.96)
Observations	114529	114531	114531	114529	114531	114531	114529

While our data set offers a rich variety of control variables and has the benefit of not priming individuals towards the purpose of the survey (as small-scale surveys of sick populations in hospitals might do), arguably our information on health problems is coarse and provides no indication of how severe the problem is. One could thus speculate that whatever effect life satisfaction might have on survival in the diseased subsample might by obscured because light and severe problems are lumped together. To address this concern we use additional

health information that is present in the data set. We use three different approaches. First, we approximate the severity of one's health impairment by using the HLLT variable providing information on whether an individual's health status limits daily activities. Second, we alternatively use the (log) number of days an individual has spent in hospital to proxy for the severity of one's health condition, and third we interpret SAH as a subjective assessment of how severe one's health problem is (see above, the reasoning is that if an individual has a certain health impairment and simultaneously rates their health as, for example, "poor" this could (imperfectly) allow us to infer that the impairment is severe).

The results are presented in Table 7, which only includes coefficients for life satisfaction, health problem dummies and interaction terms (the estimated models contain the full set of controls used above). Again we find that in most cases there is no significant interaction between subjective well-being (measured as life satisfaction) and our set of health problems. This holds irrespective of the severity of the problem, and irrespective of how we proxy for it. Only chest pains, diabetes and cancer are associated with decreased survival consistently across all models, while the few significant interactions between health problems and subjective well-being are highly model-specific and not consistent across different model specifications. Given the large number of regressions, finding only a few significant interaction terms should not be considered reliable evidence for an effect. After all, one out of 20 regression coefficients will turn out statistically significant (at the 5% level) due to chance alone.[10] Taking the overall picture into account, it therefore seems fair to say that, at least for our sample of the British populace, a systematic effect of life satisfaction on survival when suffering from one of the analyzed health problems analyzed cannot be shown.

3.4. Sensitivity

Given that we find neither significant interaction terms for subjective well-being and our no health problem or SAH variables nor for subjective well-being and our substantive health impairments, one has to wonder how these (null) results can be squared with existing studies that find such an effect (at least for healthy populations). To assess whether our

[10] In reality the false-positive rate at a 5% significance level will be higher due to low power, if the sample size is too small to reliably detect a true effect (compare Ioannidis, 2005).

results may be artifacts of model choice, we re-estimated the above models to account for a number of features of our data set. One of these is the discrete number of time points, which deviates from the assumption of a continuous-time process underlying the Cox model. Results from estimating a cloglog specification (see Table 11 in the Appendix), however, lead to similar results.[11] In addition, Schoenfeld residuals do not suggest that the proportionality assumption of the Cox model is violated, which is in line with the graphical representation of the hazards in the Kaplan-Meier graphs shown above. We have also re-estimated our models using the GHQ-12 measure of psychological well-being instead of life satisfaction. Results of these models are similar to those reported above in that we find scant significant interaction effects (results provided on request).

Table 7: Health conditions and interactions with life satisfaction, where life satisfaction is coded as dummy (low=1, 2, 3, high=6, 7 and base category medium=4, 5). Hazard ratios. Full set of covariates used in estimations but not depicted here. Dummy for drugs and interaction term of epilepsy excluded due to low cell numbers. z statistics in parentheses. Cluster-robust standard errors (clustered on individual). $^{*}p < 0.05,^{**}p < 0.01,^{***}p < 0.001$.

	(1) HLLT		(2) SAH		(3) HOSP		(4) HLLT x		(5) SAH x		(6) HOSP x	
lo_swb	1.687***	(5.49)	1.596***	(4.83)	1.708***	(5.59)	2.453***	(5.13)	2.422***	(4.15)	2.186***	(3.84)
hi_swb	0.712***	(-4.21)	0.727***	(-3.93)	0.699***	(-4.46)	0.712*	(-2.42)	0.808	(-1.38)	0.821	(-1.29)
Health problems												
sev_arms	1.186	(1.50)	1.484*	(2.57)	1.444*	(2.14)	1.450*	(2.11)	1.939**	(2.73)	2.198**	(2.99)
lit_arms	0.836	(-1.68)	0.981	(-0.23)	1.066	(0.80)	0.901	(-0.66)	1.112	(0.79)	1.163	(1.14)
sev_sight	0.920	(-0.73)	0.808	(-1.46)	0.749	(-1.59)	0.928	(-0.41)	0.787	(-0.94)	1.033	(0.12)
lit_sight	0.888	(-0.62)	0.975	(-0.20)	1.013	(0.12)	1.052	(0.18)	1.120	(0.62)	1.023	(0.13)
sev_hearing	1.036	(0.34)	1.204	(1.40)	1.256	(1.48)	1.122	(0.70)	1.220	(0.87)	1.414	(1.47)
lit_hearing	0.729*	(-2.28)	0.824	(-1.92)	0.873	(-1.45)	0.781	(-1.15)	0.901	(-0.69)	0.894	(-0.78)
sev_allergy	0.932	(-0.48)	1.088	(0.52)	1.238	(1.10)	0.907	(-0.43)	0.929	(-0.28)	1.106	(0.35)
lit_allergy	0.897	(-0.54)	0.891	(-0.76)	0.878	(-0.96)	0.990	(-0.04)	0.999	(-0.00)	0.944	(-0.29)
sev_chest	1.812***	(5.78)	1.535**	(3.26)	1.709***	(3.40)	1.482*	(2.49)	1.654*	(2.47)	1.775*	(2.43)
lit_chest	1.305	(1.90)	1.648***	(5.04)	1.644***	(5.50)	1.419	(1.62)	1.555**	(2.86)	1.634***	(3.55)
sev_heart	1.036	(0.35)	1.197	(1.33)	1.345	(1.90)	0.970	(-0.19)	0.922	(-0.36)	0.952	(-0.20)
lit_heart	0.987	(-0.12)	0.921	(-0.93)	0.939	(-0.77)	0.858	(-0.84)	0.972	(-0.21)	0.975	(-0.19)
sev_stomach	1.044	(0.34)	1.146	(0.93)	1.350	(1.70)	0.976	(-0.12)	1.259	(0.93)	1.278	(0.88)
lit_stomach	1.572**	(2.76)	1.253	(1.71)	1.175	(1.36)	1.664*	(2.08)	1.179	(0.83)	1.097	(0.49)
sev_diabetes	1.824***	(4.69)	1.576**	(2.94)	1.502*	(2.10)	1.820**	(2.89)	1.610	(1.88)	1.300	(0.81)
lit_diabetes	1.160	(0.75)	1.468**	(2.83)	1.631***	(4.17)	1.249	(0.69)	1.457	(1.72)	1.754**	(3.01)
sev_anxiety	1.071	(0.51)	0.944	(-0.38)	1.101	(0.51)	1.436	(1.80)	1.138	(0.52)	1.698	(1.92)

[11] One could also consider using a parametric specification instead of the semi-parametric Cox regression that leaves the functional form of the unobserved baseline hazard unspecified. Theory suggests that a survival process using mortality data could best be modeled assuming Gompertz-distributed baseline hazards (Cleves et al., 2010, p. 267) and this is borne out using a specification test, where the AIC comes out in favor of Gompertz over Weibull and exponential distributions. Reestimating our models in such a parametric fashion is more efficient but leads to a very similar picture to the Cox model, which is why we omit it here to conserve space.

Table 7: (continued) Health conditions and interactions with life satisfaction. Hazard ratios.

lit_anxiety	0.926	(-0.33)	1.060	(0.36)	1.003	(0.02)	1.029	(0.09)	1.054	(0.23)	0.956	(-0.21)
sev_epilepsy	1.243	(0.48)	1.121	(0.20)	0.622	(-0.57)	2.412	(1.57)	3.096	(1.61)	1.585	(0.42)
lit_epilepsy	1.883	(0.88)	1.533	(0.92)	1.644	(1.23)	3.478	(1.70)	2.402	(1.66)	2.845*	(2.28)
sev_migraine	0.726	(-1.54)	0.649	(-1.83)	0.717	(-1.06)	0.370*	(-2.42)	0.464*	(-2.04)	0.191*	(-2.35)
lit_migraine	0.479*	(-2.08)	0.624*	(-1.98)	0.656*	(-2.12)	0.657	(-0.93)	0.455	(-1.90)	0.648	(-1.42)
sev_other	1.143	(0.81)	1.233	(1.10)	1.214	(0.86)	1.186	(0.69)	1.059	(0.18)	1.022	(0.06)
lit_other	0.632	(-1.49)	0.765	(-1.29)	0.899	(-0.61)	0.677	(-0.87)	0.822	(-0.66)	0.991	(-0.03)
sev_stroke	1.525*	(2.25)	1.093	(0.40)	1.163	(0.57)	1.257	(0.71)	0.610	(-0.95)	1.006	(0.01)
lit_stroke	1.193	(0.40)	1.570	(1.90)	1.372	(1.47)	0.611	(-0.50)	1.528	(1.21)	0.972	(-0.07)
sev_cancer	4.430***	(9.19)	4.966***	(9.39)	5.004***	(8.78)	4.021***	(5.06)	4.829***	(5.57)	3.597***	(3.77)
lit_cancer	3.366***	(5.18)	3.234***	(6.47)	3.420***	(7.62)	4.048***	(4.51)	3.025***	(4.09)	3.919***	(5.92)
Interactions												
lo_swb × sev_arms							0.582*	(-2.11)	0.550	(-1.76)	0.468	(-1.80)
hi_swb × sev_arms							0.784	(-0.96)	0.732	(-0.77)	0.537	(-1.62)
lo_swb × lit_arms							0.883	(-0.34)	0.710	(-1.33)	0.913	(-0.41)
hi_swb × lit_arms							0.915	(-0.40)	0.843	(-0.94)	0.835	(-1.00)
lo_swb × sev_sight							1.013	(0.05)	0.980	(-0.06)	0.486	(-1.62)
hi_swb × sev_sight							0.976	(-0.09)	1.216	(0.47)	0.760	(-0.64)
lo_swb × lit_sight							0.381	(-0.95)	1.040	(0.11)	1.184	(0.65)
hi_swb × lit_sight							0.816	(-0.52)	0.720	(-1.20)	0.860	(-0.57)
lo_swb × sev_hearing							0.915	(-0.36)	0.936	(-0.22)	0.715	(-0.93)
hi_swb × sev_hearing							0.824	(-0.73)	1.024	(0.06)	0.953	(-0.13)
lo_swb × lit_hearing							0.581	(-0.91)	0.949	(-0.17)	1.263	(0.97)
hi_swb × lit_hearing							0.959	(-0.14)	0.835	(-0.83)	0.823	(-0.91)
lo_swb × sev_allergy							0.984	(-0.05)	1.160	(0.42)	1.190	(0.40)
hi_swb × sev_allergy							1.109	(0.27)	1.419	(0.73)	1.305	(0.53)
lo_swb × lit_allergy							1.220	(0.32)	0.964	(-0.08)	1.000	(0.00)
hi_swb × lit_allergy							0.736	(-0.70)	0.728	(-0.94)	0.795	(-0.71)
lo_swb × sev_chest							1.094	(0.38)	0.806	(-0.78)	1.011	(0.03)
hi_swb × sev_chest							1.816*	(2.39)	1.074	(0.20)	0.925	(-0.22)
lo_swb × lit_chest							0.390	(-1.54)	0.796	(-0.74)	0.718	(-1.42)
hi_swb × lit_chest							1.031	(0.10)	1.225	(0.95)	1.218	(0.98)
lo_swb × sev_heart							1.242	(0.94)	1.677	(1.73)	1.547	(1.24)
hi_swb × sev_heart							0.927	(-0.30)	1.077	(0.20)	1.741	(1.51)
lo_swb × lit_heart							0.855	(-0.38)	0.581	(-1.93)	0.952	(-0.23)
hi_swb × lit_heart							1.371	(1.35)	1.036	(0.19)	0.937	(-0.35)
lo_swb × sev_stomach							1.095	(0.32)	0.807	(-0.66)	1.151	(0.34)
hi_swb × sev_stomach							1.235	(0.64)	1.101	(0.23)	0.859	(-0.35)
lo_swb × lit_stomach							0.950	(-0.09)	1.150	(0.37)	0.909	(-0.32)
hi_swb × lit_stomach							0.894	(-0.32)	1.091	(0.31)	1.320	(1.03)
lo_swb × sev_diabetes							0.871	(-0.45)	0.826	(-0.56)	1.146	(0.30)
hi_swb × sev_diabetes							1.152	(0.46)	1.190	(0.42)	1.286	(0.55)
lo_swb × lit_diabetes							0.449	(-0.76)	1.221	(0.46)	0.870	(-0.44)
hi_swb × lit_diabetes							0.944	(-0.14)	0.959	(-0.14)	0.888	(-0.46)
lo_swb × sev_anxiety							0.563*	(-2.07)	0.725	(-1.00)	0.511	(-1.67)
hi_swb × sev_anxiety							0.856	(-0.41)	0.908	(-0.20)	0.702	(-0.66)
lo_swb × lit_anxiety							0.698	(-0.62)	0.763	(-0.71)	0.898	(-0.36)
hi_swb × lit_anxiety							1.010	(0.02)	1.327	(0.74)	1.395	(0.92)
lo_swb × sev_migraine							2.753*	(2.00)	1.565	(0.87)	6.467*	(2.18)
hi_swb × sev_migraine							2.872	(1.82)	1.981	(1.00)	6.627*	(2.14)
lo_swb × lit_migraine							1.300	(0.30)	3.552*	(2.30)	1.505	(0.96)
hi_swb × lit_migraine							0.231	(-1.35)	0.832	(-0.28)	0.530	(-1.08)
lo_swb × sev_other							0.993	(-0.02)	1.323	(0.67)	1.260	(0.42)
hi_swb × sev_other							0.730	(-0.67)	0.826	(-0.31)	1.218	(0.33)
lo_swb × lit_other							0.768	(-0.24)	0.883	(-0.21)	1.093	(0.22)
hi_swb × lit_other							0.980	(-0.03)	0.871	(-0.31)	0.621	(-1.08)
lo_swb × sev_stroke							0.950	(-0.12)	1.747	(0.94)	0.630	(-0.71)
hi_swb × sev_stroke							2.436*	(2.00)	4.645*	(2.37)	3.184*	(1.98)
lo_swb × lit_stroke							0.000***	(-28.56)	0.223	(-1.34)	1.268	(0.44)

Table 7: (continued) Health conditions and interactions with life satisfaction. Hazard ratios.

hi_swb × lit_stroke				3.555	(1.16)	1.602	(0.96)	2.566	(1.83)	
lo_swb × sev_cancer				1.316	(0.78)	1.072	(0.20)	2.451*	(2.06)	
hi_swb × sev_cancer				0.909	(-0.24)	1.036	(0.08)	1.027	(0.05)	
lo_swb × lit_cancer				1.129	(0.14)	1.525	(0.67)	0.509	(-1.46)	
hi_swb × lit_cancer				0.565	(-1.12)	1.073	(0.18)	0.963	(-0.11)	
Observations	114531	114531	114531	114531		114531		114531		

Our results could also be affected by issues of endogeneity and reverse causality as regards our well-being and illness variables. If well-being variable and health or health impairments are elicited annually at the same point in time, it can be conjectured that processes of hedonic adaptation may distort our analysis: for individuals who experience deteriorating health between interview points, well-being might be negatively affected so that our models pick up the relationship between post-illness well-being and survival. One could argue that it makes more sense to actually model pre-illness well-being and its relationship with survival. Accordingly, one should include lagged well-being terms in the analysis. Following this line of reasoning we re-estimated our models using different forms of lagged well-being variables: first, previous year well-being as well, and second, average well-being levels from the previous three years.[12] We present analogous tables for the severity interactions between health impairments and these lagged variables in the Appendix (Table 10 for lagged life satisfaction; results for the average of lagged life satisfaction are provided on request). Comparing these with the results from Table 7 we see no qualitative differences in terms of interactions. Moreover, when accounting for possible reverse causality between health and subjective well-being in this way, any effect of lagged well-being on survival disappears once we add either subjective health assessment or the no-health-problem dummy variable. These findings lends credibility to doubts about previous studies that do not use lagged well-being variables. Future research should pay more attention to including a lagged well-being variable to ascertain that the well-being variable does not inadvertently pick up an association that runs from health decrease to well-being, which might then be mis-interpreted as lower well-being decreases survival.

We conclude that the evidence of a positive survival effect of well-being is not robust to

[12]To be precise: we have used the average well-being from up to three previous years, depending on availability, so that the second robustness analysis contains also cases where only two previous years or one previous year of well-being information was present.

controlling for severity of health conditions or for reverse causality between bad health and well-being. Any survival effect that subjective well-being might have (especially when ill) cannot be substantiated with our large household panel data set for the British populace. With these findings, we add to a growing stream of literature that casts some doubts on initial studies (Liu et al., 2015; Wiest et al., 2011), which often did not control sufficiently for baseline health and potential effects of reverse causality, where bad health causes low well-being and higher mortality.

4. Conclusion

Subjective well-being has been shown to interact with health in various ways. Bad health (both subjectively assessed and measured through the presence of more specific health impairments) impairs subjective well-being (Easterlin, 2003; Binder and Coad, 2013), but subjective well-being apparently also affects health (Blanchflower and Oswald, 2008; Cohen et al., 2003; Zorrilla et al., 2001; Steptoe and Wardle, 2005), and a large body of empirical evidence seems to indicate that happier people live longer (Howell et al., 2007; Chida and Steptoe, 2008; Veenhoven, 2008; Diener and Chan, 2011; Frey, 2011). The latter association has been shown in meta-analysis for healthy populations, whereas the evidence for those suffering from ailments has been much more mixed (Chida and Steptoe, 2008). Theories accounting for a beneficial health effect of happiness argue for direct effects of happiness through direct connections between neuroendocrine, autonomic, and immune systems, more healthy behaviors of the happy (less drug abuse and risk-taking). Alternative explanations argue that indirect effects exist because happiness acts as a buffer to bodily stress response. But these theories seem to find their limit when it comes to concrete debilitating diseases. While it might be the case that a cheerful disposition will make the hardship of illness more bearable for the individual, few studies can provide evidence for that survival when sick is positively affected by a person's well-being (but see Howell et al., 2007). Apart from better understanding interaction effects between well-being and concrete health impairments (Pressman and Cohen, 2005; Steptoe and Wardle, 2011), it is also important to account for health at baseline, which often leads to survival effects of well-being turn insignificant (Wiest et al., 2011; Liu et al., 2015).

The present paper has set out to explore this happiness-longevity nexus in more detail and unpack this relationship with the help a a large-scale survey of the British populace. Many studies that analyzed the happiness-longevity relationship looked at smaller samples and did not take into account specific health impairments or baseline health. Most of these studies also did not account for the distinction between pre- and post-illness well-being and might thus suffer from simultaneity bias regarding the two variables of interest and their interaction (Wiest et al., 2011; Liu et al., 2015). The present paper has attempted to account for the presence of objective health impairments, thus not relying on subjective health assessments that might be driven by the same systematic factors that also affect assessments of life satisfaction. It has moreover paid attention to the distinction between pre- and post-illness well-being. In addition, we have controlled in various ways for the severity of health impairments (using information on whether health status limits daily activities, how many days an individual has spent in hospital and how the individual subjectively assesses their health).

Analyzing the effect of well-being on survival and taking into account its interaction with concrete health impairments, we do not find strong evidence for any statistically significant interaction effects. While some health impairments lead to a decreased survival (i.e. earlier death) in our data set (e.g., cancer, chest pains, diabetes), and while subjective well-being leads to increased survival (most robustly, low life satisfaction decreases the odds of survival, HR 1.36 when also including health impairments and health variable; high levels of life satisfaction increases the odds of survival, HR 0.85, effects roughly comparable to Chida and Steptoe, 2008), virtually no interaction effects can be found consistently across models. This absence of effects is robust to using a different measure of well-being (GHQ-12) and to using varieties of lagged well-being measures (pre-illness life satisfaction and the (up to) three-year average of pre-illness life satisfaction).

Overall we cannot conclude that happiness increases survival if one is sick. Apart from a general effect of life satisfaction on survival, no positive effect is found otherwise. We hasten to add that absence of evidence should not be interpreted as evidence of absence, but given the large data set and the general cross-section of the British population that it represents, our results reinforce recent insights (Liu et al., 2015; Wiest et al., 2011; Pressman and Cohen,

2005) that one should pay more attention to endogeneity and more objective health measures when considering the happiness-longevity relationship.

10k. words (without tables/captions); Date: August 10, 2016

Appendix

	(1) all	(2) arms	(3) sight	(4) hearing	(5) allergy	(6) chest	(7) heart	(8) stomach	(9) diabetes	(10) anxiety	(11) drugs	(12) epilepsy	(13) migraine	(14) other	(15) cancer	(16) stroke
life satisfaction	5.23	5.02	4.95	5.18	5.02	4.92	5.15	4.76	5.10	4.05	3.68	4.66	4.81	4.87	4.98	4.62
Health variables																
health==very poor	0.02	0.05	0.07	0.04	0.03	0.07	0.06	0.09	0.07	0.10	0.13	0.07	0.05	0.09	0.14	0.11
health==poor	0.07	0.16	0.18	0.13	0.11	0.19	0.16	0.22	0.20	0.26	0.30	0.19	0.15	0.21	0.22	0.26
health==fair	0.21	0.33	0.32	0.31	0.25	0.33	0.34	0.35	0.36	0.36	0.33	0.31	0.28	0.33	0.35	0.36
health==good	0.46	0.37	0.33	0.40	0.44	0.34	0.37	0.29	0.30	0.24	0.20	0.34	0.40	0.30	0.25	0.24
health==excellent	0.24	0.08	0.09	0.12	0.17	0.08	0.07	0.05	0.06	0.04	0.04	0.10	0.12	0.07	0.04	0.03
no health problems	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
docvisits: 1-2	0.36	0.28	0.27	0.30	0.34	0.27	0.24	0.22	0.22	0.18	0.21	0.25	0.29	0.24	0.20	0.21
docvisits: 3-5	0.21	0.27	0.25	0.26	0.25	0.26	0.29	0.27	0.27	0.26	0.20	0.27	0.25	0.27	0.26	0.26
docvisits: 6+	0.18	0.33	0.35	0.30	0.26	0.37	0.40	0.44	0.44	0.50	0.48	0.40	0.32	0.41	0.47	0.46
accidents: 1	0.09	0.11	0.10	0.09	0.10	0.11	0.08	0.10	0.08	0.10	0.15	0.13	0.11	0.10	0.06	0.10
accidents: 2	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.03	0.02	0.01	0.01	0.01	0.02
accidents: 3+	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.01	0.03	0.01	0.01	0.01	0.00	0.01
log(hosp. days)	0.19	0.31	0.41	0.32	0.22	0.36	0.38	0.45	0.44	0.37	0.51	0.42	0.24	0.44	0.80	0.64
no. cigs	0.20	0.21	0.18	0.17	0.20	0.24	0.15	0.24	0.16	0.34	0.79	0.28	0.24	0.19	0.17	0.20
Health problems																
arms/joints	0.28															
sight	0.05															
hearing	0.09															
allergy	0.12															
chest	0.13															
heart	0.17															
stomach	0.08															
diabetes	0.03															
anxiety	0.08															
drugs	0.01															
epilepsy	0.01															
migraine	0.08															
other	0.05															
cancer	0.01															
stroke	0.02															
Control variables																
log(income)	9.92	9.85	9.79	9.84	9.96	9.84	9.85	9.86	9.85	9.77	9.62	9.82	9.87	9.91	9.90	9.88
d_nevermarried	0.28	0.14	0.18	0.12	0.32	0.26	0.10	0.18	0.13	0.23	0.50	0.33	0.26	0.19	0.09	0.12
d_married	0.54	0.56	0.48	0.57	0.51	0.49	0.59	0.55	0.56	0.46	0.22	0.51	0.54	0.57	0.62	0.53
d_separated	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.04	0.06	0.03	0.03	0.02	0.02	0.02
d_widowed	0.09	0.18	0.24	0.22	0.07	0.13	0.21	0.14	0.20	0.11	0.03	0.05	0.06	0.12	0.20	0.22
d_divorced	0.08	0.10	0.08	0.07	0.08	0.10	0.09	0.11	0.09	0.15	0.19	0.09	0.11	0.10	0.08	0.11
d_employed	0.50	0.31	0.22	0.25	0.52	0.36	0.23	0.34	0.25	0.31	0.21	0.35	0.51	0.37	0.15	0.19
d_unemployed	0.04	0.03	0.02	0.02	0.04	0.04	0.02	0.04	0.02	0.05	0.22	0.06	0.04	0.02	0.01	0.02
d_selfemployed	0.07	0.05	0.03	0.05	0.06	0.05	0.04	0.05	0.03	0.04	0.03	0.03	0.05	0.05	0.03	0.02
d_retired	0.21	0.41	0.50	0.55	0.18	0.31	0.54	0.34	0.50	0.24	0.10	0.18	0.14	0.31	0.62	0.53
d_studyschool	0.05	0.01	0.03	0.01	0.06	0.05	0.01	0.02	0.01	0.02	0.03	0.04	0.04	0.02	0.00	0.01
d_maternityleave	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
d_longtermsick	0.04	0.11	0.11	0.07	0.05	0.10	0.09	0.13	0.12	0.21	0.35	0.26	0.09	0.12	0.13	0.18
d_familycare	0.08	0.07	0.07	0.05	0.08	0.08	0.06	0.08	0.06	0.13	0.05	0.08	0.12	0.09	0.05	0.04
d_other	0.01	0.00	0.01	0.00	0.01	0.01	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.00
d_disabled	0.08	0.23	0.30	0.22	0.10	0.20	0.23	0.22	0.29	0.23	0.24	0.37	0.11	0.19	0.38	0.49
gender	0.53	0.58	0.60	0.46	0.63	0.55	0.56	0.59	0.46	0.69	0.33	0.54	0.75	0.67	0.53	0.54
age	45.84	57.39	60.80	63.22	43.08	49.80	63.15	53.88	61.60	49.13	40.93	44.15	43.37	52.22	65.66	62.26
primary educ.	0.13	0.13	0.12	0.14	0.11	0.13	0.13	0.13	0.12	0.13	0.16	0.19	0.13	0.12	0.13	0.15
secondary educ.	0.33	0.24	0.22	0.20	0.35	0.28	0.21	0.24	0.21	0.28	0.32	0.30	0.34	0.28	0.20	0.21
tertiary educ.	0.30	0.24	0.20	0.23	0.35	0.24	0.22	0.27	0.21	0.23	0.18	0.20	0.28	0.29	0.25	0.23
children: 1	0.15	0.09	0.08	0.06	0.15	0.13	0.06	0.11	0.08	0.13	0.15	0.13	0.17	0.12	0.06	0.08
children: 2	0.13	0.08	0.06	0.05	0.14	0.10	0.04	0.09	0.05	0.12	0.09	0.11	0.15	0.10	0.03	0.05
children: 3+	0.06	0.03	0.03	0.02	0.05	0.05	0.02	0.04	0.02	0.06	0.04	0.07	0.07	0.04	0.01	0.02
Observations	182238	50352	9743	15705	21286	24183	30301	14126	6317	14379	923	1485	14614	8207	1497	1654

Table 8: Descriptive statistics (means) by health impairment.

	life satisfaction	subj. health (neg.)	log(income)	d_disabled	d_unemployed	d_employed	education	age	gender
life satisfaction	1.0000								
subj. health (neg.)	-0.3345***	1.0000							
	(0.0000)								
log(income)	0.0744***	-0.1365***	1.0000						
	(0.0000)	(0.0000)							
d_disabled	-0.1523***	0.3589***	-0.0621***	1.0000					
	(0.0000)	(0.0000)	(0.0000)						
d_unemployed	-0.0871***	0.0183***	-0.1235***	-0.0279***	1.0000				
	(0.0000)	(0.0000)	(0.0000)	(0.0000)					
d_employed	0.0078**	-0.2223***	0.3082***	-0.2405***	-0.1963***	1.0000			
	(0.0066)	(0.0000)	(0.0000)	(0.0000)	(0.0000)				
education	-0.0007	-0.2027***	0.3152***	-0.1603***	-0.0541***	0.2744***	1.0000		
	(0.7964)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)			
age	0.0835***	0.1974***	-0.0438***	0.2489***	-0.1192***	-0.3798***	-0.2761***	1.0000	
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)		
gender	-0.0065*	0.0662***	-0.0630***	0.0017	-0.0657***	-0.0722***	-0.0649***	0.0370***	1.0000
	(0.0229)	(0.0000)	(0.0000)	(0.4679)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	
Observations	182238								

Table 9: Contemporaneous Correlations. P-values in parentheses. $^{*}p < 0.05,^{**}p < 0.01,^{***}p < 0.001$.

Table 10: Lagged model (lagged life satisfaction, one year before becoming sick). Health conditions and interactions with life satisfaction, where life satisfaction is coded as dummy (low=1, 2, 3, high=6, 7 and base category medium=4, 5). Hazard ratios. Interaction terms for drugs omitted due to low cell numbers. Full set of covariates used in estimation but not depicted here. z statistics in parentheses. Cluster-robust standard errors (clustered on individual). $^{*}p < 0.05,^{**}p < 0.01,^{***}p < 0.001$.

	(1) full	(2) sick	(3) sick+SAH	(4) sick+NHP	(5) sick*SWB	(6) +SAH	(7) +NHP
subj. health	0.541***		0.545***	0.552***		0.542***	0.548***
	(-15.31)		(-13.55)	(-13.40)		(-13.70)	(-13.56)
no health problems	0.702*			0.624**			0.617**
	(-2.12)			(-2.65)			(-2.65)
low_swb	1.085	1.307*	1.042	1.049	1.525	1.173	1.116
	(0.71)	(2.34)	(0.36)	(0.41)	(1.79)	(0.65)	(0.43)
hi_swb	0.949	0.775**	0.918	0.921	0.783	0.977	1.029
	(-0.62)	(-3.04)	(-1.02)	(-0.98)	(-1.57)	(-0.14)	(0.17)
Health problems							
arms/joints		1.170	0.905	0.851	1.262	0.969	0.913
		(1.88)	(-1.19)	(-1.92)	(1.72)	(-0.24)	(-0.69)
sight		0.872	0.801*	0.796*	0.923	0.829	0.826
		(-1.29)	(-2.10)	(-2.18)	(-0.49)	(-1.16)	(-1.19)
hearing		0.924	0.919	0.897	0.985	0.971	0.954
		(-0.91)	(-0.98)	(-1.26)	(-0.11)	(-0.22)	(-0.36)
allergy		0.987	0.960	0.943	1.043	1.069	1.049
		(-0.11)	(-0.35)	(-0.51)	(0.24)	(0.38)	(0.27)
chest		1.878***	1.414***	1.381***	1.842***	1.459**	1.427**
		(7.40)	(4.03)	(3.80)	(4.74)	(2.97)	(2.83)
heart		0.998	0.860	0.829*	0.911	0.776*	0.756*
		(-0.02)	(-1.89)	(-2.36)	(-0.74)	(-2.02)	(-2.26)
stomach		1.470***	1.261*	1.245*	1.671***	1.455**	1.434*
		(3.83)	(2.38)	(2.27)	(3.40)	(2.58)	(2.50)
diabetes		1.592***	1.337**	1.311*	1.468*	1.272	1.258
		(4.23)	(2.63)	(2.46)	(2.12)	(1.32)	(1.26)
anxiety		1.265*	1.039	1.026	0.992	0.843	0.834
		(2.00)	(0.33)	(0.22)	(-0.04)	(-0.91)	(-0.97)
drugs		0.981	0.809	0.780	0.628	0.552	0.537
		(-0.04)	(-0.43)	(-0.51)	(-0.44)	(-0.60)	(-0.63)
epilepsy		1.758	1.533	1.500	3.310**	3.150**	3.041**
		(1.61)	(1.20)	(1.15)	(3.15)	(2.93)	(2.87)
migraine		0.613**	0.598**	0.590**	0.562*	0.511*	0.507*
		(-2.63)	(-2.79)	(-2.87)	(-2.02)	(-2.38)	(-2.41)
other		1.270	0.991	0.961	1.286	0.916	0.891
		(1.66)	(-0.06)	(-0.28)	(1.13)	(-0.39)	(-0.52)
stroke		1.730***	1.348	1.338	1.510	1.179	1.172
		(3.43)	(1.88)	(1.85)	(1.64)	(0.62)	(0.60)
cancer		4.684***	3.407***	3.370***	5.494***	4.082***	4.053***
		(12.82)	(10.67)	(10.62)	(10.12)	(8.70)	(8.68)
Interactions							
low_swb × arms					0.718	0.708	0.736
					(-1.30)	(-1.38)	(-1.24)
hi_swb × arms					0.934	0.949	0.927
					(-0.39)	(-0.31)	(-0.45)
low_swb × sight					0.890	0.942	0.944
					(-0.41)	(-0.21)	(-0.20)
hi_swb × sight					0.949	0.962	0.945
					(-0.22)	(-0.17)	(-0.24)
low_swb × hearing					1.042	1.051	1.065
					(0.16)	(0.20)	(0.25)
hi_swb × hearing					0.836	0.849	0.830
					(-0.94)	(-0.88)	(-1.00)
low_swb × allergy					0.953	0.900	0.913
					(-0.15)	(-0.33)	(-0.28)
hi_swb × allergy					0.907	0.805	0.792
					(-0.37)	(-0.83)	(-0.89)
low_swb × chest					0.779	0.759	0.771
					(-1.01)	(-1.15)	(-1.09)
hi_swb × chest					1.163	1.048	1.034
					(0.84)	(0.27)	(0.19)
low_swb × heart					1.224	1.323	1.345
					(0.88)	(1.22)	(1.31)
hi_swb × heart					1.144	1.129	1.093
					(0.79)	(0.72)	(0.54)
low_swb × stomach					0.986	0.944	0.952
					(-0.05)	(-0.22)	(-0.19)
hi_swb × stomach					0.705	0.683	0.679
					(-1.51)	(-1.69)	(-1.73)
low_swb × diabetes					0.846	0.819	0.823
					(-0.48)	(-0.58)	(-0.57)
hi_swb × diabetes					1.235	1.158	1.134
					(0.90)	(0.63)	(0.54)
low_swb × anxiety					1.577	1.511	1.500
					(1.64)	(1.51)	(1.49)
hi_swb × anxiety					1.464	1.320	1.318
					(1.32)	(0.98)	(0.98)
low_swb × drugs					2.184	2.163	2.167

Table 10: (continued) Lagged model (lagged life satisfaction, one year before becoming sick). Sickness conditions and interactions with life satisfaction. Hazard ratios.

					(0.65)	(0.66)	(0.66)
low_swb × epilepsy					0.254	0.228	0.237
					(-1.61)	(-1.74)	(-1.70)
hi_swb × epilepsy					0.243	0.194	0.192
					(-1.36)	(-1.53)	(-1.54)
low_swb × migraine					1.562	1.899	1.892
					(1.03)	(1.49)	(1.49)
hi_swb × migraine					0.879	0.911	0.893
					(-0.27)	(-0.20)	(-0.24)
low_swb × other					1.108	1.357	1.377
					(0.28)	(0.83)	(0.87)
hi_swb × other					0.916	1.024	1.005
					(-0.27)	(0.08)	(0.02)
low_swb × stroke					1.046	1.169	1.177
					(0.11)	(0.37)	(0.39)
hi_swb × stroke					1.559	1.396	1.381
					(1.25)	(0.91)	(0.88)
low_swb × cancer					0.306**	0.366**	0.368**
					(-3.06)	(-2.62)	(-2.61)
hi_swb × cancer					1.033	0.913	0.903
					(0.14)	(-0.39)	(-0.44)
Observations	90492	90492	90492	90492	90492	90492	90492

Table 11: Discrete model specification (cloglog model). Health conditions and interactions with life satisfaction, where life satisfaction is coded as dummy (low=1, 2, 3, high=6, 7 and base category medium=4, 5). Hazard ratios. Full set of covariates used in estimations but not depicted here. Interaction term for drugs omitted due to low cell numbers. z statistics in parentheses. Cluster-robust standard errors (clustered on individual). $^{*}p < 0.05,^{**}p < 0.01,^{***}p < 0.001$.

	(1) full	(2) sick	(3) sick+SAH	(4) sick+NHP	(5) sick*SWB	(6) +SAH	(7) +NHP
subj. health	0.557***		0.554***	0.559***		0.553***	0.558***
	(-16.03)		(-14.35)	(-14.21)		(-14.40)	(-14.25)
no health problems	0.851			0.759			0.736
	(-1.14)			(-1.82)			(-1.95)
lo_swb	1.306**	1.768***	1.328**	1.331**	2.159***	1.594*	1.537*
	(2.83)	(6.00)	(2.93)	(2.96)	(3.94)	(2.29)	(2.06)
hi_swb	0.855*	0.678***	0.825*	0.827*	0.782	0.981	1.020
	(-1.97)	(-4.93)	(-2.41)	(-2.40)	(-1.68)	(-0.13)	(0.13)
Health problems							
arms/joints		1.127	0.883	0.850*	1.339*	1.054	1.009
		(1.61)	(-1.64)	(-2.10)	(2.41)	(0.44)	(0.08)
sight		0.932	0.855	0.852	1.022	0.932	0.930
		(-0.73)	(-1.62)	(-1.67)	(0.14)	(-0.47)	(-0.49)
hearing		0.952	0.961	0.945	0.952	0.976	0.965
		(-0.62)	(-0.51)	(-0.71)	(-0.40)	(-0.19)	(-0.29)
allergy		0.982	0.949	0.938	1.011	0.973	0.962
		(-0.17)	(-0.48)	(-0.58)	(0.07)	(-0.17)	(-0.24)
chest		1.810***	1.378***	1.357***	1.771***	1.353*	1.335*
		(7.70)	(4.06)	(3.88)	(4.83)	(2.57)	(2.47)
heart		1.053	0.902	0.882	0.984	0.839	0.824
		(0.71)	(-1.39)	(-1.70)	(-0.14)	(-1.54)	(-1.70)
stomach		1.273*	1.081	1.073	1.274	1.113	1.104
		(2.47)	(0.80)	(0.74)	(1.59)	(0.71)	(0.67)
diabetes		1.642***	1.406***	1.388**	1.693**	1.439*	1.427*
		(4.86)	(3.30)	(3.17)	(3.19)	(2.23)	(2.19)
anxiety		1.020	0.862	0.855	1.106	0.945	0.936
		(0.18)	(-1.32)	(-1.39)	(0.60)	(-0.34)	(-0.40)
drugs		1.066	0.853	0.829	1.139	0.925	0.897
		(0.15)	(-0.38)	(-0.45)	(0.12)	(-0.07)	(-0.10)
epilepsy		1.526	1.320	1.301	2.963**	2.603*	2.534*
		(1.20)	(0.77)	(0.74)	(2.68)	(2.37)	(2.31)
migraine		0.688*	0.661**	0.655**	0.555*	0.512*	0.509**
		(-2.35)	(-2.62)	(-2.68)	(-2.25)	(-2.57)	(-2.61)
other		1.066	0.860	0.842	1.033	0.789	0.774
		(0.48)	(-1.15)	(-1.31)	(0.16)	(-1.16)	(-1.25)
stroke		1.650**	1.329	1.325	1.355	1.070	1.064
		(2.87)	(1.62)	(1.62)	(1.00)	(0.22)	(0.20)
cancer		4.888***	3.786***	3.729***	4.654***	3.751***	3.700***
		(12.47)	(10.65)	(10.59)	(7.55)	(6.71)	(6.66)
Interactions							
lo_swb × arms					0.731	0.686	0.707
					(-1.53)	(-1.87)	(-1.73)
hi_swb × arms					0.759	0.769	0.759
					(-1.68)	(-1.63)	(-1.73)

Table 11: (continued) Discrete model specification (cloglog model). Health conditions and interactions with life satisfaction. Hazard ratios.

lo_swb × sight					0.916	0.912	0.916
					(-0.37)	(-0.39)	(-0.38)
hi_swb × sight					0.829	0.825	0.817
					(-0.83)	(-0.85)	(-0.89)
lo_swb × hearing					1.126	1.113	1.123
					(0.58)	(0.53)	(0.57)
hi_swb × hearing					0.921	0.887	0.867
					(-0.45)	(-0.66)	(-0.79)
lo_swb × allergy					1.016	1.033	1.040
					(0.06)	(0.12)	(0.15)
hi_swb × allergy					0.879	0.870	0.859
					(-0.49)	(-0.53)	(-0.59)
lo_swb × chest					0.905	0.950	0.956
					(-0.51)	(-0.27)	(-0.23)
hi_swb × chest					1.140	1.105	1.086
					(0.75)	(0.58)	(0.49)
lo_swb × heart					1.153	1.216	1.229
					(0.76)	(1.04)	(1.11)
hi_swb × heart					1.103	1.080	1.050
					(0.62)	(0.48)	(0.31)
lo_swb × stomach					0.953	0.908	0.912
					(-0.20)	(-0.41)	(-0.39)
hi_swb × stomach					1.061	1.012	1.001
					(0.26)	(0.05)	(0.00)
lo_swb × diabetes					0.927	0.966	0.968
					(-0.29)	(-0.13)	(-0.12)
hi_swb × diabetes					0.947	0.940	0.922
					(-0.24)	(-0.27)	(-0.36)
lo_swb × anxiety					0.770	0.775	0.773
					(-1.08)	(-1.07)	(-1.08)
hi_swb × anxiety					1.168	1.067	1.068
					(0.53)	(0.22)	(0.23)
lo_swb × drugs					1.551	1.426	1.443
					(0.39)	(0.32)	(0.33)
lo_swb × epilepsy					0.209	0.194	0.199
					(-1.86)	(-1.95)	(-1.92)
hi_swb × epilepsy					0.509	0.536	0.528
					(-0.81)	(-0.75)	(-0.77)
lo_swb × migraine					1.631	1.818	1.814
					(1.35)	(1.66)	(1.65)
hi_swb × migraine					1.195	1.235	1.223
					(0.44)	(0.52)	(0.50)
lo_swb × other					1.267	1.430	1.441
					(0.75)	(1.14)	(1.17)
hi_swb × other					0.844	0.894	0.876
					(-0.51)	(-0.34)	(-0.40)
lo_swb × stroke					0.835	0.925	0.940
					(-0.42)	(-0.18)	(-0.14)
hi_swb × stroke					2.373*	2.148	2.113
					(2.12)	(1.85)	(1.82)
lo_swb × cancer					1.404	1.413	1.436
					(1.15)	(1.17)	(1.24)
hi_swb × cancer					0.863	0.778	0.766
					(-0.50)	(-0.86)	(-0.92)
Year dummies							
6.year	1.537**	1.552**	1.564**	1.565**	1.554**	1.563**	1.564**
	(2.61)	(2.65)	(2.70)	(2.70)	(2.65)	(2.69)	(2.69)
7.year	1.531**	1.619**	1.559**	1.559**	1.621**	1.555**	1.555**
	(2.80)	(3.15)	(2.91)	(2.91)	(3.16)	(2.88)	(2.88)
8.year	1.359	1.518**	1.377*	1.380*	1.533**	1.394*	1.396*
	(1.96)	(2.67)	(2.03)	(2.04)	(2.73)	(2.10)	(2.12)
10.year	0.964	1.024	0.972	0.972	1.031	0.979	0.979
	(-0.23)	(0.15)	(-0.18)	(-0.18)	(0.19)	(-0.13)	(-0.14)
12.year	1.048	1.098	1.060	1.058	1.103	1.065	1.062
	(0.30)	(0.61)	(0.38)	(0.37)	(0.64)	(0.40)	(0.39)
13.year	1.257	1.307	1.263	1.262	1.322	1.274	1.273
	(1.54)	(1.82)	(1.58)	(1.57)	(1.89)	(1.63)	(1.62)
14.year	0.985	0.967	0.987	0.988	0.970	0.989	0.989
	(-0.10)	(-0.21)	(-0.08)	(-0.08)	(-0.19)	(-0.07)	(-0.07)
15.year	1.189	1.166	1.188	1.190	1.173	1.197	1.199
	(1.14)	(1.01)	(1.13)	(1.15)	(1.05)	(1.19)	(1.20)
16.year	1.129	1.120	1.116	1.117	1.127	1.124	1.126
	(0.80)	(0.75)	(0.72)	(0.73)	(0.78)	(0.77)	(0.78)
Constant	0.00139***	0.000201***	0.00129***	0.00143***	0.000179***	0.00115***	0.00131***
	(-8.74)	(-11.70)	(-8.83)	(-8.69)	(-11.82)	(-8.95)	(-8.77)
Observations	111690	111692	111692	111690	111453	111453	111451

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