DEMOGRAPHIC RESEARCH
A peer-reviewed, open-access journal of population sciences

DEMOGRAPHIC RESEARCH

VOLUME 42, ARTICLE 2, PAGES 15–56
PUBLISHED 7 JANUARY 2020
https://www.demographic-research.org/Volumes/Vol42/2/
DOI: 10.4054/DemRes.2020.42.2

Research Article

Factors incorporated into future survival estimation among Europeans

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Demographic Research: Volume 42, Article 2
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Abstract

BACKGROUND
Subjective survival probabilities are affected by individual-specific judgment and vary by factors known to differentiate actual mortality.

OBJECTIVE
The aim of this study is to evaluate whether sociodemographic characteristics, physical and mental health, and lifestyle are incorporated into subjective survival probabilities of Europeans aged 50 or higher.

METHODS
We use data from Wave 6 of the Survey of Health, Ageing and Retirement in Europe (SHARE) and period life tables from the Human Mortality Database (HMD). For the statistical analysis we employ multinomial logistic regression models.

RESULTS
Our results show that common factors drive the self-reported subjective survival probabilities. Certain factors affecting actual mortality are considered when forming subjective survival probabilities: income, education, poor physical and mental health, activities of daily living (ADLs), smoking, physical activity, diet, quality of life, and number of children. Other factors are not considered in a manner consistent with actual mortality patterns: age, gender, marital status, and body weight. The findings regarding cognitive function are inconclusive; whereas some aspects seem to be integrated in subjective survival probabilities (e.g., memory or self-writing skills), others are not (e.g., numeracy or orientation in time).

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CONTRIBUTION

The contribution of this study is the grouping of sociodemographic, health, and lifestyle characteristics according to the subjective survival probabilities' direction and consistency with general population mortality and actual mortality patterns. Hence, we assess which traits are incorporated in the formation of subjective survival probabilities among Europeans aged 50 or higher.

1. Introduction

It is well known that some people are more optimistic than others (Lyubomirsky 2001), a fact usually reflected in their expectations, including their future survival. Prior studies have noted that individuals consider their own experiences, history, and environmental influences when forming survival expectations (Griffin, Loh, and Hesketh 2013). Individual-specific judgment is the main reason that subjective survival probabilities (SSPs) exhibit greater variability compared to actual survival probabilities (Hamermesh 1985).

Nevertheless, there are also common factors influencing subjective survival expectations. One explanation is that people may have similar awareness and understanding about factors affecting future life expectancy through media, health campaigns, and their own experiences (Griffin, Loh, and Hesketh 2013). For example, the fact that smoking reduces life expectancy is widely known (Ferrucci et al. 1999; Doll et al. 1994). Identifying which factors are linked to greater accuracy of subjective survival probabilities is important as later life decisions related to pensions, finances, and health care are dependent on an individual's point of view.

1.1 Background

The main challenge for assessing the accuracy of survival predictions is the unavailability of longitudinal studies, which would cover a population for a long time period. To overcome this practical problem, some researchers have used panel surveys and the actual mortality of the respondents between waves. However, such analyses refer mainly to the US population, as they are based on data from the Health and Retirement Survey (d'Uva, O'Donnell, and van Doorslaer 2017; Elder 2007; Perozek 2008; Hurd and McGarry 2002). Only scarce cross-sectional studies have dealt with the accuracy of the survival predictions of the European population. Peracchi and Perotti (2010) compare age-specific averages of subjective survival probabilities with cohort

objective survival probabilities (OSP) for respondents of Wave 2 in the Survey of Health, Ageing and Retirement in Europe (SHARE). They conclude that both socioeconomic status (SES) and health matter in the assessment of own survival. Kutlu-Koc and Kalwij (2017) and Van Solinge and Henkens (2018) conclude that the subjective survival probabilities of Dutch respondents predict actual mortality.

Past analyses have shown that sociodemographic factors are related to the accuracy of survival prediction. Arpino, Bordone, and Scherbov (2018), using objective survival probabilities estimated from the Health and Retirement Study, conclude that males tend to overestimate survival compared to females. Older people also tend to overestimate survival. Other studies found a significant variation in subjective survival probabilities across Europe (Rappange, Brouwer, and Exel 2016). Liu, Tsou, and Hammitt (2007) and Mirowsky (1999), comparing subjective to actuarial survival probabilities, argue that respondents who live with children report higher survival expectations. Regarding socioeconomic status there is a consensus in the literature that those who are less educated, have lower income, and face financial strain tend to underestimate subjective life expectancy (Arpino, Bordone, and Scherbov 2018; Rappange, Brouwer, and Exel 2016; Liu, Tsou, and Hammitt 2007; Mirowsky 1999; Balia 2014).

Poor physical health is associated with lower survival expectations (Van Solinge and Henkens 2018; Rappange, Brouwer, and Exel 2016; Liu, Tsou, and Hammitt 2007; Balia 2014; Hurd and McGarry 1995). Other aspects of health, such as cognitive function and mental health, also seem to differentiate the predictive ability of individuals; several researchers (Griffin, Loh, and Hesketh 2013; Elder 2007; Rappange, Brouwer, and Exel 2016; Balia 2014) estimate significant associations between cognitive skills and subjective survival probabilities. Individuals with better education and cognitive skills are also better in predicting their own survival as they can fully incorporate additional information into their judgment (d'Uva, O'Donnell, and van Doorslaer 2017). In addition, better cognitive skills are also associated with less volatility in subjective survival probabilities.

Physical activity is positively associated with subjective survival probabilities, whereas obesity is negatively associated (Rappange, Brouwer, and Exel 2016; Liu, Tsou, and Hammitt 2007). Further, Khwaja, Sloan, and Chung (2007) note that current smokers in the United States are relatively optimistic, whereas people who have never smoked are relatively pessimistic in their survival predictions. Griffin, Loh, and Hesketh (2013), comparing subjective to actuarial life expectancy based on the Australian Bureau of Statistics estimates, find that dietary habits and, more specifically, the total number of servings of fruits or vegetables consumed per day are positively associated with subjective life expectancy. Furthermore, it has been shown that there is

a positive association between social connectedness, family support, optimism, and subjective life expectancy (Mirowsky 1999).

1.2 Objectives of the study

The objective of this study is twofold: first, to identify common factors driving subjective survival probabilities and, second, to allocate these factors into homogeneous groups based on the predictions' direction and consistency with general population mortality as well as with actual mortality patterns. Hence, in effect, the study explores which factors known to affect mortality are incorporated into subjective survival estimates by individuals.

The groups that individuals are classified into are as follows:

1) The first group consists of the common characteristics of individuals whose subjective survival probabilities are higher than the objective survival probabilities of the average population but, based on literature, they are also likely to exhibit lower actual mortality. Hence, this group includes characteristics linked to better mortality that seem to be taken into account in forming subjective survival probabilities. We call this the 'longer lifespan' group.
2) The second group consists of the common features of individuals whose subjective survival probabilities are lower than the objective survival probabilities of the average population but, based on literature, they are also likely to exhibit worse actual mortality. Hence, these features are linked to worse mortality, and they seem to be incorporated in the formation of subjective survival probabilities. We call this the 'shorter lifespan' group.
3) The third group consists of the common traits which differentiate the patterns of actual mortality and subjective survival probabilities. These traits are considered in forming subjective survival probabilities but not in a manner consistent with actual mortality. We call this the 'divergent survival' group.

Based on past analyses, our main hypotheses are as follows:

a) Demographic characteristics such as age, gender, number of children, and marital status as well as country of residence may differentiate the direction of subjective survival probabilities.
b) SES would have an impact on the predictive ability of individuals; lower SES is likely to be associated with lower subjective survival probabilities.

c) Physical health, functional limitations, mental health, and cognitive function are likely to affect the direction of subjective survival probabilities. Those in poor health are expected to report lower subjective survival probabilities while those with better cognitive skills are expected to incorporate additional information when forming subjective survival probabilities and, therefore, are expected to be more accurate.
d) Lifestyle and behavioural risk factors such as levels of physical activity, the presence or absence of smoking, body mass index (BMI), and dietary habits may affect the direction of subjective survival probabilities. We expect a healthier lifestyle and diet to be associated with higher subjective survival probabilities.
e) Quality of life and social support could differentiate the predictive ability of individuals; better quality of life and higher levels of social support would be associated with higher subjective survival probabilities.

1.3 Contribution of the study

The contribution of this study lies in the grouping of sociodemographic, health, and lifestyle characteristics according to the subjective survival probabilities' direction and consistency with general population mortality, while also considering actual mortality patterns in order to assess the extent that different traits are incorporated into the survival expectations of individuals. More specifically, the convergence (or divergence) of an individual's subjective survival estimate in comparison to general population mortality, while controlling for several sociodemographic- and health-related characteristics, can provide an indication of whether that individual is aware (or not) of the effect of a specific factor on mortality.

The categorisation emerged following the comprehensive analysis of a large, robust, and recent European data set, taking into consideration a multitude of factors pertaining to different domains of life, while also assessing the robustness of the findings using different models and tolerance levels. The present analysis fills in a gap in the literature by providing evidence for Europeans on the factors taken into account in forming subjective survival probabilities; additionally, the inclusion of four different indicators of cognitive function allows a concrete assessment of its relative effects.

2. Data and methods

2.1 Data

We used data from Wave 6 of SHARE, a cross-national and multidisciplinary panel database with information on health, SES, and social and family networks (Börsch-Supan et al. 2013). Its format is analogous to the US Health and Retirement Study and the English Longitudinal Study of Ageing. SHARE has been funded mainly by the European Commission and is coordinated centrally at the Mannheim Research Institute for the Economics of Ageing. The data collection of Wave 6 was completed in November 2015 (Börsch-Supan 2017) and the sampling was carried out in 18 countries (Austria, Belgium, Croatia, Czech Republic, Denmark, Estonia, France, Germany, Greece, Israel, Italy, Luxembourg, Poland, Portugal, Slovenia, Spain, Sweden, and Switzerland). It should be noted that response rates in the longitudinal and refresher samples vary by country; for instance, the household cooperation rates for the longitudinal sample vary from 54% in France to 88% in Croatia. More documentation and information on SHARE can be found at http://www.share-project.org. The original sample covered 67,346 individuals aged 50 or higher. Due to SHARE rules, information about subjective survival probabilities was not collected for 2,906 individuals (4.3%), for whom proxy interviews were conducted (Table A-1 in the Appendix). These individuals tend to be on average older while they also report poorer self-rated health, more chronic diseases, lower quality of life, and relatively high depression levels. In addition, there were 596 individuals with missing values in the variables of interest (less than 1%). Hence, the sample used in the analysis includes 63,844 individuals.

The objective survival probabilities were obtained from the Human Mortality Database (HMD). HMD provides period life tables and cohort death rates. However, the latter are incomplete for individuals aged 50 and above, and they have to be forecasted using appropriate statistical methods (Peracchi and Perotti 2010). While this approach clearly incorporates cohort effects into the overall analysis, which could provide more refined estimates, it is subject to additional estimation errors. Peracchi and Perotti (2010) note that the forecasted cohort life tables may underestimate actual mortality for certain countries. Therefore, in the present study we used complete life tables by country and sex which refer to the five-year period 2010–2014. SHARE Wave 6 was undertaken in 2015; thus, we consider these life tables relevant to our study (Post and Hanewald 2010; Balia 2014).

2.2 Variables

2.2.1 Subjective survival probabilities (SSPs)

In the 'Expectations' module of the SHARE questionnaire, respondents were asked to state their survival expectations on a scale from 0 to 100 as follows:

What are the chances that you will live to be age [T] *or more?*

The target age *T* depends on the age of the respondent at the interview; it is set at age 75 for respondents aged 50 to 65, at age 80 for respondents aged 66 to70, at age 85 for respondents aged 71 to 75, at age 90 for respondents aged 76 to 80, at age 95 for respondents aged 81 to 85, at age 100 for respondents aged 86 to 95, at age 105 for respondents aged 96 to 100, and at age 110 for respondents aged 101 and higher. The difference between the respondents' actual age and their target age is the prediction interval *N* in years. For example, a respondent aged 67 is asked to report his or her chances of surviving up to age 85; in this case, the target age is 85 years and the prediction interval is 18 years. The reported survival expectations were divided by 100 in order to derive the subjective survival probabilities (SSPs).

$$SSP = \frac{What\ are\ the\ chances\ that\ you\ will\ live\ to\ be\ age\ [T]\ or\ more?}{100}$$

2.2.2 Objective survival probabilities (OSPs)

The cumulative objective survival probabilities (OSPs) are calculated from the corresponding country and sex-specific complete period HMD life tables. Though ideally OSPs could have been based on the actual mortality of the panel respondents of SHARE, that was not possible due to high attrition between waves (Peracchi and Perotti 2010; Bergmann et al. 2017); for instance, retention rates between Waves 1 and 2 range from 55.1% (Germany) to 77.0% (Denmark). Further, as different countries participate at different waves, the final sample would have been limited to only 9 out of the 18 countries of Wave 6, and Eastern Europe would have been excluded.

The OSPs are compared subsequently to the SSPs. The reported SSPs correspond to a specific prediction interval, starting from respondents' current age up to the target age. Therefore, the OSPs should cover the same time horizon (Peracchi and Perotti 2010), hence,

$$OSP_{x,N} = \prod_{t=1}^{N}(1 - q_{x+t}),$$

where x is the age of the respondent, N is the prediction interval, and q_{x+t} is the probability of dying between ages $x + t$ and one year later.

2.2.3 Dependent variables

In our analysis we calculate the dependent variable in two steps. First, we calculate 'deviation,' a variable in continuous form representing the difference between subjective and objective cumulative survival probabilities:

$$Deviation_{x,N} = SSP_{x,N} - OSP_{x,N}$$

Second, we define categorical dependent variable with three levels as follows:

$$Y_{x,N} = \begin{Bmatrix} 1, if\ |Deviation_{x,N}| \leq tolerance\ (\%) \\ Else\ if\ |Deviation_{x,N}| > tolerance\ (\%): \\ 2, if\ Deviation_{x,N} > 0 \\ 3, if\ Deviation_{x,N} < 0 \end{Bmatrix}$$

The aim of 'tolerance' is to capture different levels of deviation of the reported SSPs; in this instance it was set to 10% (main model), 15%, and 20% (used for sensitivity analysis). Tolerance levels below 10% produce small samples of accurate survival predictions and, thus, unreliable results. The interpretation of the nominal dependent variable is as follows: 1 indicates that the respondent estimates his or her future survival will be close to that of the general population; 2 implies that future survival will exceed that of the average population; and 3 means that future survival will be lower. The estimated relative risk ratios (RRRs) in conjunction with the actual mortality patterns will be used to allocate covariates into the 'longer lifespan,' 'shorter lifespan,' or 'divergent survival' group.

It should be stressed here that as the life tables refer to the overall population by country and sex, they do not differentiate by factors known to affect chances of survival, such as marital status, SES, health, and behavioural risk factors. Hence, the observed deviation – if consistent with actual mortality patterns – can be interpreted as the tendency that people exhibit to incorporate characteristics influencing survival into their estimations. In other words, the fit (or not) between individual self-reported

survival estimation and general population mortality may indicate whether individuals are aware (or not) of factors related to survival.

2.2.4 Explanatory variables

The following variables quantify the socio-demographic and health profile of SHARE Wave 6 respondents.

Demographic characteristics: This group of variables includes age (in years), gender, marital status (widowed, divorced, having never been married, separated, married, or in a partnership), and the number of children of the respondent as well as country of residence.

Socioeconomic status: SES is represented by two indicators. First, the estimated 'equivalised' individual income in quartiles has been used. The equivalised income per individual was calculated using the reported household income and the OECD-modified equivalence scale. This scale, first proposed by Hagenaars, De Vos, and Asghar Zaidi (1994), assigns a value of 1 to the household head, 0.5 to each additional adult member, and 0.3 to each child. Second, educational attainment is considered in four categories, based on the ISCED-97 classification, including primary (code 1), lower secondary (code 2), upper secondary (codes 3 and 4), and tertiary (codes 5 and 6).

Physical and mental health: Physical health includes the number of chronic conditions (out of a list of 13), the number of limitations in activities of daily living (ADL; out of a list of six basic everyday tasks), and self-rated health (ranging from 1 = excellent to 5 = poor). Mental health is represented by the EURO-D depression scale (ranging from 0 to 12 symptoms) and cognitive function by the score of a memory test (1 = excellent to 5 = poor), the score of a numeracy test (1 = bad to 5 = good), the score of self-rated writing skills (1 = excellent to 5 = poor), and the score of orientation in time test (0 = bad to 4 = good). Biomarkers such as grip strength and peak flow were also included to check the robustness of the models' estimates.

Lifestyle and behavioural risk factors: This group of variables includes the BMI in four categories (underweight, normal weight, overweight, and obese), whether the respondent does vigorous or moderate physical activities, whether the respondent ever smoked daily, and the frequency of eating meat, fruits or vegetables, legumes or eggs, and dairy products (1 = almost daily to 5 = less than once a week).

Quality of life and social support: This group of variables includes the quality of life CASP index (covers the domains control, autonomy, self-realisation, and pleasure in life; ranging from 12 to 48), the life satisfaction score (ranging from 0 to 10), and the number of times the respondent received help from others (ranging from 0 to 3).

Finally, the prediction interval in years is also included as an explanatory variable.

2.3 Statistical modelling

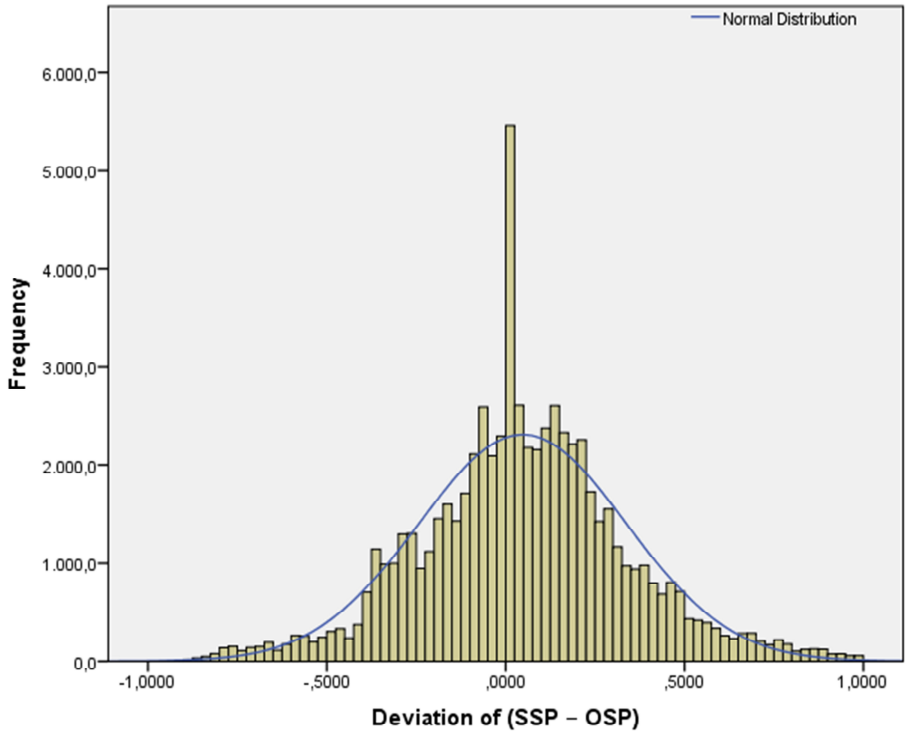
The analysis was conducted in two stages. First, we estimated two multinomial regression models with a tolerance level of 10% in order to investigate the impact of the explanatory variables on the accuracy of the subjective survival expectations. The first model includes only demographic and socioeconomic variables, whereas the second includes all available variables. This two-step modelling process allows us to evaluate separately the effect of demographic and socioeconomic characteristics on the respondents' prediction deviation compared to general population mortality. In the second part of the analysis we use two multinomial regression models with tolerance levels of 15% and 20%, respectively, in order to evaluate the sensitivity of the RRRs. It should be noted that all independent variables included in the models pass the multicollinearity diagnostic tests. SPSS 21 has been used to conduct the analyses.

3. Results

3.1 Descriptive characteristics

The sample characteristics are presented in Table 1. The mean of subjective survival probabilities is 0.64, slightly higher than the mean of objective survival probabilities (0.59). The distributions of subjective and objective survival probabilities are presented in the Appendix (Figure A-1 shows the distribution of SSPs whereas Figure A-2 shows the distribution of OSPs). SSPs exhibit a strong tendency of heaping on rounded probabilities (e.g., 0.30, 0.40, and especially 0.50 and 0.80 to 1.00) in contrast to the OSPs, whose distribution is more uniform though skewed towards the right. The distribution of the deviation between subjective and objective survival probabilities is bell-shaped (Figure 1) but does not pass the normality test (Kolmogorov-Smirnov $Z = 9.669$, $p<1\%$). Thus, the main analysis is based on multinomial regression models.

Figure 1: Distribution of the deviation between subjective (SSPs) and objective (OSPs) survival probabilities



The average respondent is 68 years old; males represent 44% of the sample, and seven out of ten respondents are married. Luxemburg represents the lowest proportion of the total sample, 2%, whereas Belgium represents the highest, 9%. The proportion of individuals aged 90 or higher in the SHARE Wave 6 sample is on average below 2% (see Table A-2 in the Appendix). The figure also indicate that, only for females, there is an undersampling of the older respondents in certain countries (e.g., Italy, Germany, and Luxemburg). The average respondent has two children. The majority of respondents (60%) have completed post-secondary education. The average equivalised income for the first three quartiles increases gradually; however, for the fourth quartile the increase is marked.

Regarding health, the average person reports 1.8 chronic diseases, 0.3 ADL limitations, and 2.4 depressive symptoms. Furthermore, 65% of the respondents rate

their health as fair or good. Seven out of ten persons are overweight or obese while nine out of ten do some sort of physical activity. Respondents eat fruits or vegetables and dairy products on a nearly daily basis. On the other hand, they eat meat three to six times per week and eggs or legumes twice a week. The average prediction interval is 14 years.

Table 1: Sample characteristics (n = 63 844)

Variable	Descriptive measures
Subjective survival probabilities (mean [SD])	0.64 [0.28]
Objective survival probabilities (mean [SD])	0.59 [0.26]
Dependent variables	
Deviation of SSPs – OSPs (mean [SD])	0.05[0.29]
Independent variables	
Prediction interval (years) (mean [SD])	14 [3.6]
Demographic characteristics	
Age (mean [SD])	68 [10]
Male	44%
Marital status	
Widowed	15%
Divorced	9%
Never married	6%
Separated	1%
Partnership	2%
Married	68%
Country of residence	
Austria	5%
Belgium	9%
Croatia	4%
Czech Republic	7%
Denmark	6%
Estonia	8%
France	6%
Germany	7%
Greece	7%
Israel	3%
Italy	8%
Luxembourg	2%
Poland	3%
Portugal	2%
Slovenia	6%
Spain	8%
Sweden	6%
Switzerland	4%
Number of children (mean [SD])	2.1 [1.3]

Table 1: (Continued)

Variable	Descriptive measures
Socioeconomic status	
Education level	
ISCED-97 code 0 and 1 (primary)	22%
ISCED-97 code 2 (lower secondary)	18%
ISCED-97 codes 3 and 4 (upper secondary)	37%
ISCED-97 codes 5 and 6 (tertiary)	23%
Equivalised income	
Equivalised income Q1 (mean [SD] in €)	4,700 [2,732]
Equivalised income Q2 (mean [SD] in €)	12,932 [2,05]
Equivalised income Q3 (mean [SD] in €)	25,464 [4,996]
Equivalised income Q4 (mean [SD] in €)	74,060 [65,416]
Physical and mental health	
Chronic conditions (mean [SD])	1.8 [1.6]
Number of ADLs (mean [SD])	0.3 [0.9]
Self-rated health	
Excellent	7%
Very good	18%
Good	36%
Fair	29%
Poor	10%
Depression (mean [SD])	2.4 [2.2]
Numeracy (mean [SD])	3.4 [1.03]
Writing skills (mean [SD])	2.4 [1.14]
Orientation in time (mean [SD])	3.8 [0.51]
Memory (mean [SD])	3 [0.95]
Lifestyle and behavioural risk factors	
BMI	
Underweight	1%
Normal	29%
Overweight	45%
Obese	25%
Physically active	90%
Ever smoked daily	44.7%
Dietary habits	
Meat (mean [SD])	1.9 [0.9]
Fruits or vegetables (mean [SD])	1.3 [0.7]
Legumes and eggs (mean [SD])	2.9 [1.13]
Dairy products (mean [SD])	1.6 [1.03]
Quality of life and social support	
Quality of life (mean [SD])	34 [11.1]
Life satisfaction (mean [SD])	7.6 [1.7]
Times received help (mean [SD])	0.37 [0.7]

3.2 Multivariable analyses

3.2.1 Demographic characteristics

Age is negatively correlated with SSPs (Table A-4 in the Appendix) and positively correlated with the difference of SSPs to OSPs. The multinomial regression models (Table 2) show that older individuals tend to estimate higher survival probabilities compared to the general population. The average gap between SSPs and OSPs is statistically different between males and females (t-test, $t = 53.29$). The RRRs of the sociodemographic model in Table 2 show clearly that males estimate that their future survival will be higher than that of the general population compared to females.

People who are widowed, divorced, and have never been married tend to estimate that their future survival will exceed that of the general population compared to married persons (Figure 2). The coefficients of country of residence as well as the gap between SSPs and OSPs vary considerably (ANOVA, F = 76.7); countries are grouped into three buckets based on whether the RRRs of the sociodemographic model are above or below unity or do not differentiate compared to Austria (Figure 3). For example, residents of north-central European countries as well as Czechs and Greeks tend to estimate that their future survival will be lower than that of the average population compared to Austrians. It is worth noting that the significant variation of household cooperation rates by country – from 54% in France to 88% in Croatia – and the relative representation of high, middle, and low socioeconomic classes may affect the estimated differentiations. The number of a respondent's children is positively correlated with the gap between SSPs and OSPs. Our regression results show that individuals with more children are optimistic concerning their future survival.

Figure 2: Difference between subjective (SSPs) and objective (OSPs) survival probabilities by marital status

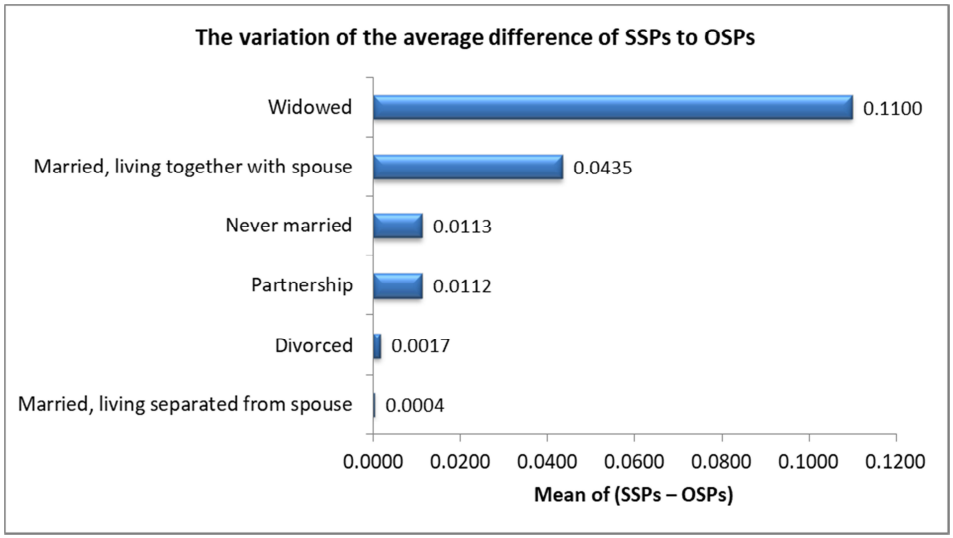
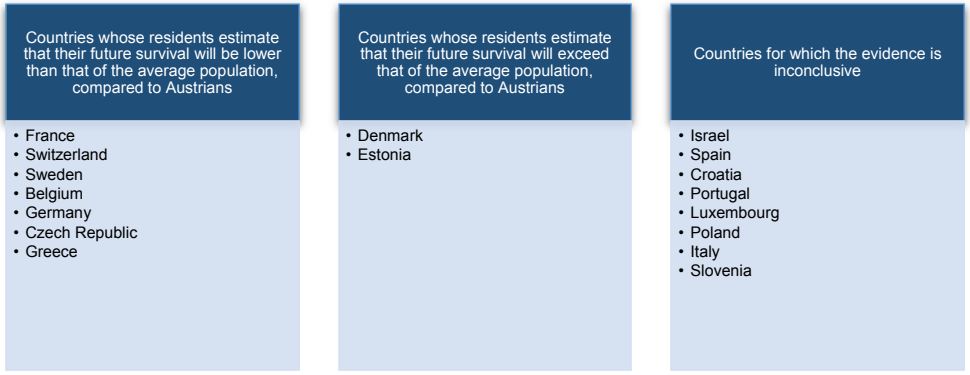


Figure 3: Classification of countries in groups compared to Austria



Note: Austria is used as a reference category in our models. The aim of this figure is to present the variation of SSPs across countries in Europe.

3.2.2 Socioeconomic status

Respondents who earn more income report higher SSPs (ANOVA, F = 856) and, consequently, they exhibit a wider gap between SSPs and OSPs (ANOVA, F = 20.5). Our regression results suggest that low and medium income earners estimate that their future survival will be lower than that of the general population when compared to high income earners. Respondents with tertiary educational qualifications report higher SSPs than those who have completed only primary education (ANOVA, F = 458). The RRRs of the sociodemographic model indicate that those with fewer qualifications tend to estimate that their future survival is either lower or higher than that of the general population when compared to those who have completed tertiary education; hence, persons in the latter category predict survival closely to the average population. It should be noted that the introduction of health status, lifestyle, behavioural risk factors, and quality of life in the full model do not, essentially, differentiate the findings of the sociodemographic model.

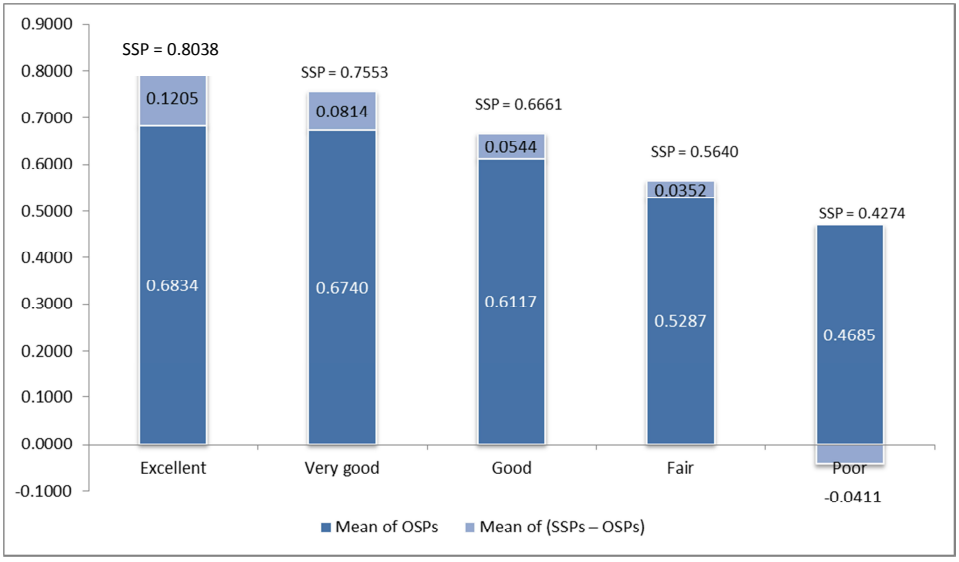
3.2.3 Physical and mental health

The number of chronic diseases is negatively correlated with the SSPs as well as with the gap between SSPs and OSPs. The RRRs of the full model show that an additional chronic disease increases chances of estimating that future survival will be lower than that of the general population by about 6.4%. Self-rated health differentiates the reported SSPs (ANOVA, F = 2585) as well as the gap between SSPs and OSPs (ANOVA, F = 306). Those who report excellent health also report the highest SSPs and exhibit the largest positive deviation (Figure 4). The RRRs of the full model consistently show that those with excellent, very good, good, and fair health have higher chances of estimating that their future survival will exceed that of the general population compared to those in poor health; for instance, those with excellent health exhibit about 2.4 times higher chances.

The number of ADLs is negatively correlated with the SSPs as well as with the gap between SSPs and OSPs. The regression results show that individuals with more ADLs tend to estimate a lower future survival than that of the average population. Depression is negatively associated with SSPs as well as with the gap between SSPs and OSPs. The RRRs of the full model indicate that an additional symptom of depression increases chances of estimating that future survival will be lower than that of the general population by 6.3%. The score of memory test is negatively associated with SSPs as well as with the gap between SSPs and OSPs. The regression results show that the poorer a respondent's memory is, the higher are the chances of estimating that

future survival will be lower. The score of numeracy test is positively associated with SSPs as well as with the gap between SSPs and OSPs. The RRRs of the full model show that respondents with better numeracy skills have lower chances to estimate that future survival is either lower or higher than that of the general population; hence, better numeracy skills are closely linked to survival predictions to the general population average. Self-rated writing skills are negatively associated with SSPs, indicating that better writing skills are related to higher SSPs; the RRRs also suggest that better writing skills are related to a higher future survival compared to the general population average. Orientation in time is positively associated with SSPs and negatively associated with the gap between SSPs and OSPs. The regression results show that respondents who have a better orientation-in-time score are more likely to estimate a lower future survival compared to the general population.

Figure 4: Decomposition of the mean of subjective survival probabilities (SSPs) across self-rated health status



Note: The average subjective survival probability for each self-rated health status consists of the average objective survival probability plus the average deviation of (SSPs – OSPs).

Table 2: Relative risk ratios (RRRs) based on multinomial logistic regression

Independent variables	Higher vs close to population survival predictions [a]		Lower vs close to population survival predictions [a]	
	Demographic and socioeconomic model	Full model	Demographic and socioeconomic model	Full model
Prediction interval	1.098**	1.116**	0.940**	0.917**
Demographic characteristics				
Age	1.072**	1.088**	0.921**	0.917**
Gender (reference: female)				
Male	1.754**	1.793**	0.669**	0.680**
Country of residence (reference: Austria)				
France	0.573**	0.639**	1.563**	1.363**
Switzerland	0.709**	0.692**	1.144	1.290**
Sweden	0.738**	0.685**	1.007	1.157*
Belgium	0.593**	0.627**	1.304**	1.142*
Germany	0.760**	0.867*	1.321**	1.147*
Czech Republic	0.759**	0.895	1.212**	1.156*
Luxembourg	1.085	1.126	1.476**	1.243*
Israel	0.721**	0.852*	0.856	0.780**
Spain	0.765**	0.829**	0.896	0.882
Greece	0.688**	0.832**	1.104	1.032
Croatia	0.969	1.015	1.289**	1.162
Poland	0.895	1.088	1.384**	1.087
Italy	0.962	1.096	1.174*	1.037
Slovenia	1.181**	1.331**	1.395**	1.210*
Portugal	0.949	1.206*	1.297*	0.872
Denmark	1.822**	1.656**	0.790**	0.839**
Estonia	1.144**	1.572**	1.074	0.785**
Marital status (reference: married)				
Widowed	1.017	1.072*	1.058	1.015
Divorced	1.037	1.115**	1.011	0.926
Never married	1.014	1.112*	1.038	0.951
Separated	0.966	1.022	1.073	0.9699
Partnership	1.054	1.096	1.015	0.978
Number of children	1.034**	1.029**	1.007	0.997

Table 2: (Continued)

Independent variables	Higher vs close to population survival predictions [a]		Lower vs close to population survival predictions [a]	
	Demographic and socioeconomic model	Full model	Demographic and socioeconomic model	Full model
Socioeconomic status				
Education (reference: tertiary education)				
Primary	1.048	1.204**	1.553**	1.098*
Lower secondary	1.014	1.122**	1.446**	1.119**
Upper secondary	1.076**	1.138**	1.301**	1.132**
Equivalised income quartiles (reference: Q4)				
Equivalised income Q1	0.929	1.046	1.557**	1.165**
Equivalised income Q2	1.021	1.086	1.491**	1.220**
Equivalised income Q3	0.999	1.026	1.223**	1.098**
Physical and mental health				
Chronic diseases		0.994		1.064**
ADLs		0.970		0.996
Self-rated health (reference: poor)				
Excellent		2.467**		0.500**
Very good		1.705**		0.491**
Good		1.458**		0.672**
Fair		1.324**		0.859**
Depression		1.002		1.063**
Numeracy		0.965**		0.982
Writing skills		0.984		1.015
Orientation		0.985		1.041
Memory		0.950**		1.027
Lifestyle and behavioural risk factors				
BMI (reference: obese)				
Underweight		0.858		0.925
Normal		0.883**		0.966
Overweight		0.956		0.973
Physical activity (reference: physically inactive)				
Physically active		1.050		0.943

Table 2: (Continued)

Independent variables	Higher vs close to population survival predictions [a]		Lower vs close to population survival predictions [a]	
	Demographic and socioeconomic model	Full model	Demographic and socioeconomic model	Full model
Ever smoked daily (reference: yes)				
Never smoked daily		1.029		0.943**
Dietary habits				
Meat		0.992		0.980
Dairy		1.031**		1.028*
Egg or legumes		0.961**		1.009
Fruit or vegetables		0.970*		1.036*
Quality of life and social support				
Quality of life		1.018**		0.990**
Times received help		1.029		0.935**
Life satisfaction		1.106**		0.912**
Pseudo R^2	0.168	0.278		

[a] The dependent variable is an unordered categorical variable reflecting the deviation of subjective survival probabilities compared to objective survival probabilities. The tolerance level is 10%. * p<5% , ** p<1%. The RRRs in conjunction with the actual mortality patterns serve to allocate the explanatory variables in the "longer lifespan," "shorter lifespan," or "divergent survival" groups.

3.2.4 Lifestyle and behavioural risk factors

BMI differentiates the reported SSPs (ANOVA, F = 43.84) as well as the gap of SSPs and OSPs (ANOVA, F = 87.78). Those who are underweight report the lowest SSPs, whereas normal weight persons report the highest SSPs. On average, those who are overweight have the largest positive gap between SSPs and OSPs. The RRRs of the full model indicate that persons of normal weight are 11.7% less likely to estimate that future survival will be higher than that of the general population compared to the obese. Moreover, persons of normal weight are 3.4% less likely to estimate that future survival will be lower than that of general population compared to the obese. This also holds for underweight and overweight persons. In other words, obese persons estimate that their future survival will be higher than that of the general population. Individuals who are physically active report higher SSPs (t-test, $t = 45.68$) and are more optimistic about future survival compared to the life table figures (t-test, $t = 2.57$). The regression results show that physically active respondents estimate that their future survival will exceed

that of the general population when compared to those who are not physically active. Smoking is taken into account when forming subjective survival probabilities. Our regression results suggest that non-smokers are more likely to estimate that future survival will exceed that of the general population compared to smokers.

The frequency of consumption of dairy products, meat, eggs or legumes, and fruits or vegetables is negatively correlated with the SSPs. Less frequent consumption is associated with lower subjective survival probabilities. The RRRs of the full model suggest that respondents who consume fruits or vegetables and eggs or legumes less frequently tend to estimate that their future survival will be lower than that of the general population. On the other hand, respondents who consume dairy products less frequently tend to estimate that their future survival will be either lower or higher compared to the general population. Finally, those consuming meat less frequently have subjective survival predictions close to the general population.

3.2.5 Quality of life and social support

Quality of life is positively associated with SSPs as well as with the gap between SSPs and OSPs. The regression results show that respondents who report better quality of life predict that their future survival will exceed that of the general population. Life satisfaction is also positively associated with SSPs as well as with the gap between SSPs and OSPs. The models indicate that respondents who are more satisfied with their lives tend to estimate that their future survival will exceed that of the general population. The number of times a person received help is positively associated with SSPs and negatively associated with the gap between SSPs and OSPs. Our regression results show that respondents who receive help frequently tend to estimate that future survival will exceed that of the general population.

The prediction interval is positively associated with SSPs and negatively associated with the gap between SSPs and OSPs. The RRRs show that the longer the time horizon, the greater the chances of estimating that future survival will exceed that of the general population; each additional year increases chances by about 11%.

3.3 Sensitivity analysis

Two additional models have been estimated in order to evaluate the robustness of the main models' estimates. Moreover, two biomarkers, grip strength and peak flow, were added to these models in order to further evaluate the findings of the main models by including objective indicators of health and especially the reliability of self-rated health

RRRs as tolerance level increases. Overall, the results of the additional models (Table A-3 in the Appendix) confirm those of the main analysis. More specifically, associations estimated by the multinomial regression models with tolerance levels of 15% and 20% point to the same direction as the main models and are similar or even stronger in magnitude. For example, the RRRs of self-rated health are considerably stronger even after the addition of the biomarkers grip strength and peak flow in the multinomial models.

4. Discussion

In the context of the scarcity of analyses considering factors taken into account in forming subjective survival probabilities among Europeans, the objective of this study is twofold. First, we identify common factors driving subjective survival probabilities and, second, we allocate these factors into three groups based on the SSPs' direction compared to the general population as well as on actual mortality patterns. The consistency of subjective survival probabilities with actual mortality patterns can be used as a proxy validation criterion. The main findings of the analysis are discussed below and summarised in Table 3.

Table 3: Grouping of sociodemographic characteristics based on the subjective survival probabilities' direction and consistency, compared to actual mortality

Sociodemographic characteristics	Factors related to the 'longer lifespan' group	Factors linked to the 'shorter lifespan' group	Factors related to the 'divergent survival' group
Demographic characteristics			
Age			✗
Gender			✗
Marital status			✗
Number of children	✓		
Socioeconomic status			
Higher education	✓		
Better income	✓		
Physical and mental health			
Chronic diseases		✓	
ADLs		✓	
Poor self-rated health		✓	
Depression		✓	
Better numeracy			✗
Better writing skills	✓		
Better orientation in time			✗
Poor memory		✓	

Table 3: (Continued)

Sociodemographic characteristics	Factors related to the 'longer lifespan' group	Factors linked to the 'shorter lifespan' group	Factors related to the 'divergent survival' group
Lifestyle and behavioural risk factors			
BMI			✗
Frequent physical activity	✓		
Smoking status		✓	
Egg or legumes	✓		
Fruit or vegetables	✓		
Quality of life and social support			
Better quality of life	✓		
Times received help	✓		
Greater life satisfaction	✓		

For every explanatory variable, the direction of SSPs is compared to the direction of actual mortality. If the patterns are consistent, this is indicated by a ✓ sign. If the patterns are inconsistent, this is indicated by ✗ sign.

4.1 Factors related to the 'longer lifespan' group

A greater number of children, higher SES, physical activity, frequent consumption of fruits or vegetables and eggs or legumes, and better quality of life are associated with higher SSPs in the present study. These findings are consistent with previous evidence on subjective survival probabilities as well as on actual mortality. Respondents who live with young or adult children report higher survival expectations (Liu, Tsou, and Hammitt 2007; Mirowsky 1999; Ross and Mirowsky 2002) and the lifespan of parents increases in line with the number of children (McArdle et al. 2006). Higher SES is associated with higher subjective life expectancy (Rappange, Brouwer, and Exel 2016; Liu, Tsou, and Hammitt 2007; Hurd and McGarry 1995; Kutlu-Koc and Kalwij 2017) as well as lower mortality (Nandi, Glymour, and Subramanian 2014). These findings support our second hypothesis.

Physical activity is a factor related to higher subjective survival probabilities (Griffin, Loh, and Hesketh 2013; Rappange, Brouwer, and Exel 2016; Liu, Tsou, and Hammitt 2007) as well as lower mortality (Gregg et al. 2003). The total number of servings of fruits or vegetables per day is positively associated with subjective life expectancy (Griffin, Loh, and Hesketh 2013). Furthermore, Knoops et al. (2004) note that elderly people who adopted a Mediterranean diet and healthy lifestyle reduced by more than 50% their actual mortality rates. These findings support our fourth hypothesis. A positive relationship between self-efficacy, life satisfaction, emotional support, and subjective life expectations has been noted in past research (Van Solinge and Henkens 2018; Ross and Mirowsky 2002). Furthermore, better quality of life, better

life satisfaction, and higher social connectedness are associated with greater longevity (Netuveli et al. 2012; Buono, Urciuoli, and de Leo 1998). It should be noted here that 'receiving help from others' frequently reflects a higher degree of perceived social support, which is associated with lower mortality (Lyyra and Heikkinen 2006; Kaplan et al. 1988). These findings support our fifth hypothesis.

Overall, we conclude that these traits are linked to higher subjective survival probabilities and lower actual mortality. This implies that individuals take into account these traits in a manner consistent with actual mortality patterns.

4.2 Factors related to the 'shorter lifespan' group

Poor self-rated health, more limitations in activities of daily living, a larger number of chronic diseases, poor memory, poor writing skills, and depression are associated with lower SSPs in the present study. These findings are consistent with previous evidence on subjective survival probabilities as well as on actual mortality. Several analyses conclude that poor health is associated with lower survival expectations (Van Solinge and Henkens 2018; Rappange, Brouwer, and Exel 2016; Liu, Tsou, and Hammitt 2007; Hurd and McGarry 1995). Self-rated health is a strong predictor of mortality, even after including other covariates known to predict mortality (Idler and Benyamini 1997); this also holds for disability and chronic diseases (Verropoulou 2014). Recent research concludes that psychological distress and depression are negatively associated with survival expectations (Griffin, Loh, and Hesketh 2013; Rappange, Brouwer, and Exel 2016). Further, depression is associated with higher mortality (Wulsin, Vaillant, and Wells 1999), and this also holds regarding poor cognitive function (Smits et al. 1999). Overall, we find evidence showing that worse physical and mental health as well as some aspects related to poor cognitive function lead to lower SSPs and may provide valid survival predictions compared to population life tables. These findings support our third hypothesis.

Smokers report lower SSPs compared to people who have never smoked in our analysis. However, there is a debate in the literature about the degree to which smokers take into account the negative impact of smoking when reporting subjective survival probabilities. On the one hand, past analyses note that current smokers report lower survival expectations (Hurd and McGarry 1995; Rappange, Brouwer, and Exel 2016), whereas those who stopped smoking report higher survival expectations (Rappange, Brouwer, and Exel 2016). On the other hand, several analyses show that current smokers overestimate survival (Liu, Tsou, and Hammitt 2007; Balia 2014). It is well known that smoking increases chances of mortality (Ezzati and Lopez 2003); our results

suggest that smokers take into account that fact when forming subjective survival probabilities.

4.3 Factors related to the 'divergent survival' group

According to our findings, males estimate that their future survival will be higher than that of the general population compared to females. This is broadly consistent with past research (Arpino, Bordone, and Scherbov 2018; Liu, Tsou, and Hammitt 2007; Mirowsky 1999). Possible explanations include that males have on average higher socioeconomic status, levels of education, and income while they also exhibit lower levels of morbidity. An additional explanation can be provided by the well-documented 'gender paradox'; women live longer but report worse health than men (Mathers et al. 2001; Austad 2006). Hence, gender is not taken into account in a manner consistent with actual mortality.

Older people tend to report higher SSPs. This does not support the 'cohort improvement hypothesis,' which states that the gap between SSPs and OSPs diminishes with age. In contrast, in the present study the gap between SSPs and OSPs increases with age. Several researchers also estimate a positive association between age and subjective life expectancy (Griffin, Loh, and Hesketh 2013; Mirowsky 1999; Ross and Mirowsky 2002) and conclude that people become more optimistic with age. It is worth noting that respondents who provided proxy interviews and thus no information on subjective survival expectations were omitted from the analysis. These persons were, on average, older and had somewhat worse health compared to the remainder of the sample, a fact that might have affected slightly the estimated effect of age on the gap between SSPs and OSPs. In addition, Freund and Baltes (2002) find that individuals who reported using life-management behaviours, such as the selection-optimization-compensation model, also reported higher levels of subjective well-being. This theory could, at least partly, explain the optimism about own survival observed among older respondents for whom information about SSPs was collected. Overall, we conclude that age is related to optimism about own future survival, as documented in the literature, and, thus, it is not taken into account in a manner consistent with actual mortality.

Our findings suggest that respondents who are widowed, divorced, and have never been married tend to estimate that their future survival will exceed that of the general population compared to married persons. These are partly in agreement with findings of past analyses. In fact, the impact of marital status on SSPs is not fully understood. On the one hand, it has been suggested that widows report higher SSPs (Balia 2014), while living alone is negatively associated with subjective survival (Liu, Tsou, and Hammitt 2007; Rappange, Brouwer, and Exel 2016). On the other hand, prior studies note that

partnership status is not associated with subjective life expectancy (Van Solinge and Henkens 2018). Actual mortality patterns are not homogeneous with regards to marital status. In particular, excess mortality for widows is observed during the first year following bereavement (Kaprio, Koskenvuo, and Rita 1987) but that risk is reduced over the following years. This could be a possible explanation regarding widows in the present analysis reporting high SSPs compared to the general population, as the sample probably includes mostly survivors who face a lower mortality risk. Further, respondents who are divorced and have never been married in the present sample are, on average, younger (by about two years) compared to married persons, while they also have slightly better educational attainment, a fact that may partly account for their optimism regarding future survival. Nevertheless, married persons exhibit lower mortality (Manzoli et al. 2007; Kaplan and Kronick 2006). Hence, the findings imply that marital status is not taken into account in a manner consistent with actual mortality. Overall, we find evidence showing that demographic factors differentiate the direction of SSPs, which supports our first hypothesis.

A better numeracy score is associated with reporting SSPs close to the general population, whereas better orientation in time is associated with reporting lower SSPs. Hence, in the present study, the association of subjective survival probabilities with numeracy and orientation in time differentiates compared to that with memory and writing skills. Past research notes that persons with better numeracy as well as better immediate and delayed recall scores may form more accurate probability assessments (d'Uva, O'Donnell, and van Doorslaer 2017; Elder 2007). Poor cognitive function is linked to worse actual mortality (Kelman et al. 1994). Overall, it seems that findings regarding cognitive ability are not entirely consistent, depending largely on the indicator used in the analysis. We conclude that only certain aspects of cognitive skills are taken into account in a manner consistent with actual mortality when forming subjective survival probabilities.

Our findings suggest that obese people tend to report higher SSPs compared to those who maintain a normal weight. By contrast, past analyses note that obesity is negatively associated with survival expectations (Rappange, Brouwer, and Exel 2016; Liu, Tsou, and Hammitt 2007). Nevertheless, in our data obese persons are more frequently younger males – features associated with higher SSPs – compared to normal weight persons. Furthermore, Ross and Mirowsky (2002) argue that obese people tend to misestimate their survival expectations compared to persons of normal weight. Our findings suggest that while obesity is a factor related to higher mortality (Solomon and Manson 1997), it is not taken into account in a manner consistent with actual mortality.

5. Limitations

Some limitations of the study should be taken into account when considering the findings. First, SHARE includes only one SSP question. This does not allow estimation of the whole distribution of SSPs for each individual. However, the impact of this limitation is reduced due to the significant number of individuals who report SSPs in Wave 6. Second, all measures used in the analysis are self-reported; as such they may be subject to misreporting. Nevertheless, if misreporting is not systematic the estimated associations will hold. Moreover, the inclusion of the biomarkers grip strength and peak flow in the robustness checking models further mitigate the risk of bias. Third, we have used the HMD period life tables to estimate OSPs, which are based on the whole population by country and sex. On the one hand, this choice reduces parameter error because the estimation of the mortality rates is robust. On the other hand, these life tables reflect general population mortality and do not vary by other characteristics known to have an impact on life expectancy, such as SES or health status. Further, as period life tables are constructed based on the mortality levels and patterns of several cohorts, they reflect the average mortality across these cohorts. Goldstein and Wachter (2006) note that for populations whose mortality patterns change, period life expectancy is a lagged measure of cohort life expectancy, the lag depending on the pace of mortality improvement. As life expectancy at age 65 for individuals in Europe has, on average, increased annually by 0.92% for males and by 0.69% for females (Figure A-3), we expect OSPs to be more accurate for females.

Further, we would expect SSPs for older individuals to be closer to cohort OSPs compared to period OSPs, as the longevity improvement of the cohort would have been incorporated properly. This could reduce the magnitude of the estimated RRRs related to age.

Overall, this is expected to have a minute effect on our findings, as: (a) they seem consistent across different tolerance levels and (b) the interpretation is based mainly on the direction of the gap between SSPs and OSPs and not its magnitude. Finally, ideally OSPs should have been based on the actual mortality of the panel respondents of SHARE; however, due to high attrition rates between waves that was not possible (Peracchi and Perotti 2010; Bergmann et al. 2017).

6. Conclusion

This study shows that there are common factors driving the views of individuals on subjective survival probabilities. Further, the differential impact of some of these factors on mortality is considered when forming subjective survival probabilities. Such

factors include SES (income and educational attainment), poor physical and mental health, activity restrictions (ADLs), behavioural risks (smoking, physical activity levels, and healthy diet), quality of life, life satisfaction, and number of children. By contrast, other factors are not taken into account in a manner consistent with actual mortality; these include age, gender, marital status, and body weight. The findings regarding cognitive function are inconclusive; whereas some aspects of it seem to be integrated in subjective survival probabilities (memory and self-writing skills), others are not (numeracy and orientation in time).

Future research should involve a more detailed examination of the relative effects of various cognitive function indicators, differences by country of residence, the exploration of the significance of marital status, and the interactions between the predictors. It would also be essential to evaluate the accuracy of subjective survival probabilities using a panel data set, which would include information from previous SHARE, Health Retirement Survey, and English Longitudinal Study of Ageing waves and data about the actual survival of the respondents.

7. Acknowledgements

This paper uses data from SHARE Wave 6 (DOI: 10.6103/SHARE.w6.600), see Börsch-Supan et al. (2013) for methodological details. The SHARE data collection has been primarily funded by the European Commission through FP5 (QLK6-CT-2001-00360), FP6 (SHARE-I3: RII-CT-2006-062193, COMPARE: CIT5-CT-2005-028857, SHARELIFE: CIT4-CT-2006-028812), and FP7 (SHARE-PREP: N°211909, SHARE-LEAP: N°227822, SHARE M4: N°261982). Additional funding from the German Ministry of Education and Research, the Max Planck Society for the Advancement of Science, the U.S. National Institute on Aging (U01_AG09740-13S2, P01_AG005842, P01_AG08291, P30_AG12815, R21_AG025169, Y1-AG-4553-01, IAG_BSR06-11, OGHA_04-064, HHSN271201300071C), and various national funding sources is gratefully acknowledged (see www.share-project.org).

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Appendix

Table A-1: Characteristics of respondents for whom proxy interviews were contacted and have been excluded from the analysis (N = 2906)

Self-rated health	Excellent	Very good	Good	Fair	Poor
Proportion of respondents	2%	5%	18%	29%	46%
Average number of chronic diseases	0.6	0.9	1.5	2.6	3.5
Average number of ADLs	0.2	0.1	0.5	1.2	3.2
Average age (in years)	65.6	65.4	69.7	76.5	78.6
Average depression score	1.4	1.4	2.7	3.2	3.5
Average life satisfaction score	8.3	8.3	7.4	7.2	7.1
Average quality of life score	5	3	3.4	2.4	1.6

Table A-2: Proportion of older individuals by country and gender

Country	Proportion aged above 80 years		Proportion aged above 85 years		Proportion aged above 90 years	
Males	**SHARE W6***	**Eurostat****	**SHARE W6***	**Eurostat****	**SHARE W6***	**Eurostat****
Austria	11.32%	8.38%	4.85%	3.29%	1.83%	0.77%
Belgium	12.06%	9.45%	5.24%	3.61%	1.71%	0.88%
Czech Republic	11.27%	6.52%	3.43%	2.27%	0.67%	0.47%
Switzerland	13.66%	8.70%	5.00%	3.54%	0.71%	0.94%
Germany	8.81%	8.14%	3.42%	3.03%	0.53%	0.66%
Denmark	8.68%	7.53%	3.44%	3.05%	1.05%	0.80%
Estonia	11.67%	6.88%	3.98%	2.31%	0.54%	0.43%
Spain	18.38%	10.74%	7.80%	4.27%	2.51%	1.13%
France	13.79%	10.30%	5.47%	4.34%	1.55%	1.18%
Greece	11.95%	11.96%	4.71%	4.64%	0.56%	1.20%
Croatia	5.57%	6.83%	1.64%	2.03%	0.36%	0.38%
Italy	11.49%	10.47%	3.34%	4.14%	0.75%	1.06%
Israel	17.85%	N/A	8.17%	N/A	3.38%	N/A
Luxembourg	8.05%	7.69%	2.54%	2.64%	0.42%	0.56%
Poland	9.97%	6.50%	3.41%	2.26%	1.39%	0.50%
Portugal	8.91%	9.62%	3.06%	3.50%	0.80%	0.86%
Sweden	15.67%	9.44%	6.88%	4.10%	1.96%	1.16%
Slovenia	11.26%	6.81%	3.64%	2.27%	0.83%	0.47%
Females						
Austria	13.48%	14.15%	7.07%	7.13%	2.12%	2.30%
Belgium	13.96%	15.42%	6.53%	7.27%	1.94%	2.27%
Czech Republic	10.32%	11.50%	3.44%	4.89%	0.89%	1.25%
Switzerland	13.57%	14.10%	6.01%	6.93%	2.00%	2.31%
Germany	8.87%	13.80%	3.81%	6.75%	0.69%	2.12%
Denmark	10.91%	11.85%	4.41%	5.99%	1.74%	2.14%
Estonia	15.23%	14.23%	5.60%	6.09%	1.20%	1.51%
Spain	21.04%	16.33%	9.99%	7.76%	2.82%	2.54%
France	18.01%	16.47%	9.22%	8.38%	3.27%	2.90%
Greece	11.66%	14.83%	4.09%	6.27%	0.85%	1.68%
Croatia	7.80%	12.23%	3.22%	4.50%	0.64%	1.07%
Italy	10.31%	16.43%	4.42%	8.03%	1.37%	2.62%
Israel	16.47%	N/A	7.39%	N/A	1.95%	N/A
Luxembourg	9.81%	13.24%	3.39%	6.12%	1.17%	1.79%
Poland	11.80%	11.97%	5.03%	5.05%	1.35%	1.31%
Portugal	11.04%	14.41%	4.22%	6.28%	1.08%	1.81%
Sweden	14.44%	14.50%	6.65%	7.50%	1.75%	2.67%
Slovenia	13.18%	13.87%	4.89%	6.06%	1.04%	1.62%

Notes: *The proportion is calculated as the number of respondents (older than 80, 85, or 90 years) over the total number of respondents aged 50 or above. **The proportion of individuals (older than 80, 85, or 90 years) over the total population aged 50 or above.

Table A-3: Relative risk ratios (RRRs) based on multinomial regression models

Independent variables	Higher vs close to population survival predictions [a]		Lower vs close to population survival predictions [a]	
	Tolerance 15%	Tolerance 20%	Tolerance 15%	Tolerance 20%
Prediction interval	1.174**	1.208**	0.910**	0.898**
Demographic characteristics				
Age	1.128**	1.154**	0.906**	0.894**
Gender (reference: female)				
Male	2.143**	2.592**	0.716**	0.644**
Country of residence (reference: Austria)				
France	0.561**	0.693**	1.661**	1.635**
Switzerland	0.553**	0.669**	1.554**	1.609**
Sweden	0.565**	0.656**	1.308**	1.276*
Belgium	0.661**	0.716**	1.246**	1.266**
Germany	0.956	0.964	1.260**	1.278**
Czech Republic	1.025	1.177*	1.378**	1.211*
Luxembourg	1.223	1.144	1.317**	1.444**
Israel	0.798**	1.007	0.986	0.966
Spain	0.764**	1.000	0.912	0.787**
Greece	0.855*	0.975	1.189*	1.076
Croatia	1.106	1.428**	1.304*	1.277**
Poland	1.407**	1.569**	1.312*	1.274*
Italy	0.926	1.298**	1.119	1.051
Slovenia	1.276**	1.236**	1.291**	1.197*
Portugal	1.137	1.492**	0.920	0.943
Denmark	2.059**	1.970**	0.954	0.840
Estonia	2.222**	2.513**	0.921	0.893
Marital status (reference: married)				
Widowed	1.068	1.089*	1.032	1.043
Divorced	1.201**	1.269**	0.930	0.971
Never married	1.114*	1.119*	0.932	0.948
Separated	0.985	1.075	1.009	0.985
Partnership	1.049	0.992	0.981	0.9686
Number of children	1.022*	1.023*	0.989	1.003
Socioeconomic status				
Education (reference: tertiary education)				
Primary	1.300**	1.292**	1.138**	1.126**
Lower secondary	1.155**	1.157**	1.131**	1.113**
Upper secondary	1.126**	1.121**	1.106**	1.073*
Equivalised income quartiles (reference: Q4)				
Equivalised income Q1	1.083	1.080	1.178**	1.196**
Equivalised income Q2	1.113**	1.012**	1.202**	1.205**
Equivalised income Q3	1.050	1.060	1.088*	1.098**

Table A-3: (Continued)

Independent variables	Higher vs close to population survival predictions [a]		Lower vs close to population survival predictions [a]	
	Tolerance 15%	Tolerance 20%	Tolerance 15%	Tolerance 20%
Physical & mental health				
Chronic diseases	0.991	0.991	1.064**	1.069**
ADLs	0.949**	0.978	0.996	1.007
Self-rated health (reference: poor)				
Excellent	2.602**	2.883**	0.447**	0.407**
Very good	1.930**	2.158**	0.475**	0.426**
Good	1.591**	1.686**	0.660**	0.615**
Fair	1.375**	1.377**	0.848**	0.810**
Grip strength	1.005**	1.008**	1.000	1.000
Peak flow	1.000**	1.000**	1.000**	0.999**
Depression	1.002	0.997	1.064**	1.068**
Numeracy	0.943**	0.934**	0.971*	0.969*
Writing skills	0.983	0.983	1.005	1.000
Orientation	0.963	0.947*	1.037	0.991
Memory	0.935**	0.932**	1.037**	1.041**
Lifestyle and behavioural risk factors				
BMI (reference: obese)				
Underweight	0.825*	0.749	0.913	0.864
Normal	0.862**	0.855**	0.950	0.949
Overweight	0.956	0.958	0.992	0.991
Physical activity (reference: physically inactive)				
Physically active	1.068	1.009*	0.972	0.910*
Ever smoked daily (reference: yes)				
Never smoked daily	1.016	1.023	0.906**	0.895**
Dietary habits				
Meat	1.009	1.006	1.003	1.009
Dairy	1.024*	1.022	1.028*	1.023
Egg or legumes	0.950**	0.958**	1.015	1.015
Fruit or vegetables	0.959*	0.974	1.028	1.047**
Quality of life and social support				
Quality of life	1.022**	1.022**	0.987**	0.986**
Times received help	1.003	1.003	0.913**	0.921**
Life satisfaction	1.108**	1.113**	0.899**	0.891**
Pseudo R^2	0.290	0.309		

Notes: [a] The dependent variable is an unordered categorical variable reflecting the deviation of subjective survival probabilities compared to objective survival probabilities. * p<5% , ** p<1%.

Table A-4: Pearson and Spearman correlation coefficients of the subjective survival probabilities and the deviation of subjective and objective survival probabilities with independent variables

Independent variable	Subjective survival probabilities		Deviation of subjective and objective survival probabilities	
	Pearson	Spearman's rho	Pearson	Spearman's rho
Age	–37%**	–24.5%**	38.4%**	23%**
Number of children	–0.3%	0.9%*	2.2%**	1.9%**
Number of chronic diseases	–2.8%**	–2%**	–5%**	–3.7%**
Number of ADLs	–1.95%**	–1.9%**	–2.9%**	–3.5%**
Depression	–27%**	–24%**	–17.9%**	–16.4%**
Memory	–21.5%**	–21%**	–0.9%**	–1.9%**
Numeracy	12.6%**	11.6%**	0.7%	0.2%**
Self-rated writing skills	–16.9%**	–6.3%**	0.5%	–0.9%*
Orientation in time	13%**	11.1%**	–5.4%**	–3.4%**
Dairy products	–3.3%**	–3.7%**	–4.3%**	–4.4%**
Meat	–6.8%**	–4.4%**	–3.5%**	–3.5%**
Eggs or legumes	–4.1%**	–7.1%**	–4.8%**	–5%**
Fruits or vegetables	–6%**	–5.3%**	–4.2%**	–3.2%**
Quality of life	29.3%**	34.7%**	12.1%**	19.2%**
Life satisfaction	27.7%**	26.4%**	22%**	21.7%**
Number of times received help	11.5%**	11.5%**	–2.9%**	–2.7%**
Prediction interval	13%**	10.2%**	–12%**	–6.8%**

Notes: * p<5% , ** p<1%.

Figure A-1: Distribution of subjective survival probabilities

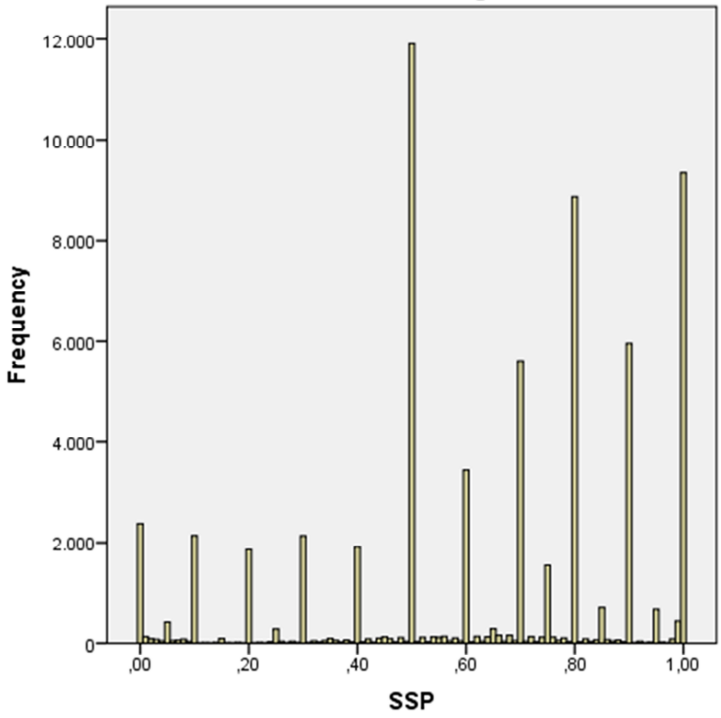


Figure A-2: Distribution of objective survival probabilities

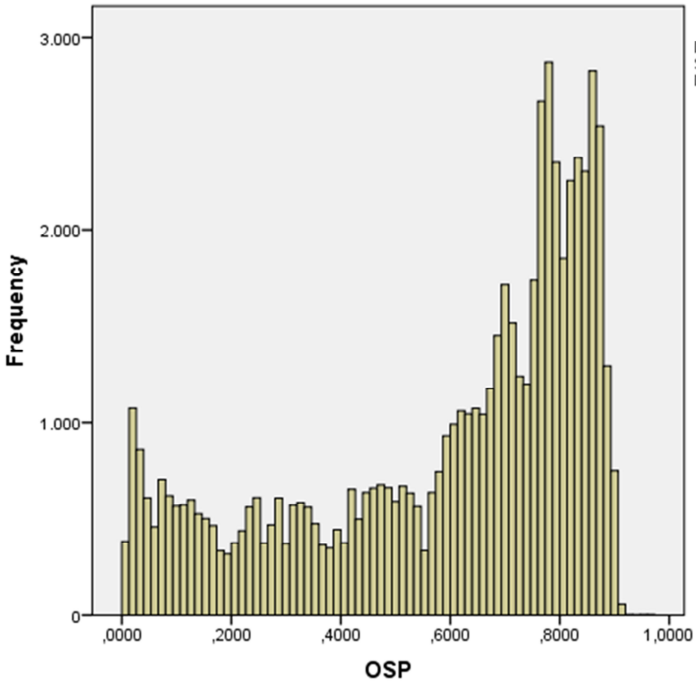
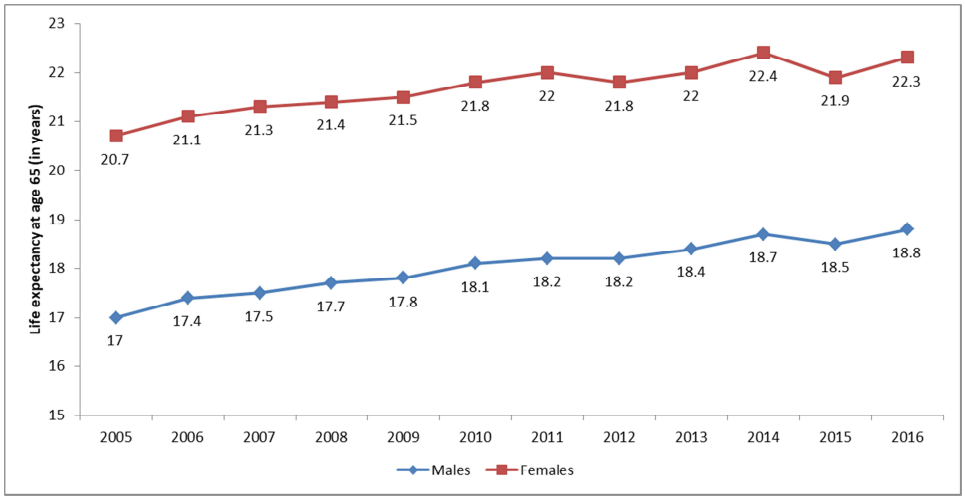


Figure A-3: Average life expectancy at age 65 for the European area of study (18 countries)



Source: Eurostat, life expectancy at age 65 by sex.