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How long do people expect to live? Results and implications

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Note that this represents work in progress.

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HOW LONG DO PEOPLE EXPECT TO LIVE? RESULTS AND IMPLICATIONS

ABSTRACT

We report the results of a survey of over 3500 individuals in Great Britain, questioned on how long they expected to live. On average, they under-estimated by 4.62 years (males), 5.95 years (females) compared with the estimates of the Government Actuary's Department, although on average they were optimistic in the sense of thinking they would live longer than other people of their age and sex. Relevant risk factors seem to be taken into account in forming expectations, but not always accurately; in particular, smokers appeared to under-state risks significantly. A "reference group effect" was apparent: those in poor health, and smokers, gave relatively low answers for how long they thought people of their age and sex would live. We also find that people who under-estimated how long the population was expected to live were significantly less likely to have bought a pensions policy.

1. INTRODUCTION

The purpose of this research is to:

- Compare individuals' perceptions of mortality with official estimates of population mortality;
- Assess whether individuals' mortality perceptions are affected by relevant risk factors; and
- Determine the influence of mortality perceptions on purchases of life insurance and pensions.

The research aims to contribute to our understanding the way in which people form their expectations, which can be a key issue in their behaviour. In particular, mortality perceptions are potentially of great significance for the debate on pensions and savings, as already noted by the Pensions Commission (2004).

In section 2 we review the previous literature in this area, which is mainly from the USA, but the subject has begun to attract increasing interest in the UK.

In section 3 we develop our understanding of the topic and, in particular, examine the "reality" with which mortality perceptions can be compared. Section 4 describes how we carried out our research, and section 5 shows the main results. In section 6 we summarise our main findings and set out some implications.

2. PREVIOUS RESEARCH

Introduction

There have been several studies into mortality perceptions, carried out by psychologists, economists and other social scientists. Such studies typically ask people either:

- The age to which they expect to live (the subjective life expectancy, or SLE); and/or
- The probability that they will live to a specified age.

In addition some studies have asked people:

- How long do you think a person of your age and sex would expect to live to?
- How long do you wish to live to?

In section 4 we comment on how we designed the questions for our own research.

Appendix 1 summarises the previous surveys on mortality perceptions, explaining the questions asked, and the results obtained in comparison with actuarial life tables.

We now review in more detail:

- Two early US studies by economists: Hamermesh (1985) and Hurd & McGarry (1995);
- Some studies relating to the UK: Wardle & Steptoe (2003), Society of Financial Advisers (2004), Banks, Emmerson & Oldfield (2004) and Johns (2004);
- Psychologists' and similar research on subjective life expectancy;
- Research on optimism;
- Longitudinal surveys, which have examined whether mortality experienced over a period is related to mortality perceptions at the beginning of the period; and
- The limited research that has related mortality perceptions to insurance purchases.

US studies

Hamermesh (1985) sent questionnaires to two groups of respondents:

- 650 white male economists: 63% replied with usable responses, ages ranging from 26 to 65; and
- 975 people chosen randomly from the telephone directory: 47% responded, the study being based on the 363 who were aged between 20 and 70.

The questions asked included:

- How old do you expect you will live to be? … years
- What is your subjective probability of living to at least age 60?
- What is your subjective probability of living to at least age 80?

The results showed that people gave higher answers for their expected age at death compared with the then current life tables, based on then current mortality rates. In the table below, x is the respondent's current age, $x + e_x^s$ is the age to which they expect to live, and $x + e_x^o$ is the estimate in accordance with official tables (e_x^s being the number of years further that people expected to live, e_x^o being the official expectation of life).

Expected age at death

	Economists			Telephone directory sample		
Ages	26-39	40-65	26-65	20-39	40-70	20-70
$x + e_x^s$	75.91	76.41	76.19	75.81	77.74	76.79
$x + e_x^o$	73.49	75.47	74.60	73.24	76.56	74.92

Source: Hamermesh (1985)

Hamermesh concluded: "At the very least this suggests that subjective life expectancy reflects life expectancy from today's life tables. That subjective exceed actuarial life expectancies may even imply that respondents extrapolate past increases in longevity" (p. 393).

There was some evidence that people gave higher probabilities for survival to age 80 than might be expected, given the probabilities they gave for survival to 60.

He found that estimates of life expectancy were:

- Higher if the individual had longer-lived parents and grandparents;
- Lower if the individual smoked 5 or more cigarettes a day;
- Lower if the individual answered "Yes" to "Have you ever been diagnosed as having a medical condition that had a non-negligible probability of being diagnosed as fatal?"

Hamermesh referred to the "huge reliance on forbears' longevity" and was not clear whether this was justified by the data. Indeed, one of the issues with mortality perception data is that it is not always clear what is the "reality" to compare the results with.

We now turn to the work of Hurd & McGarry (1995), which is based on the Health and Retirement Study (HRS), a biennial panel survey of individuals in the US, born in 1931-41 and their spouses. It began in 1992, when the sample was aged about 51-61. The baseline sample contains 12,652 observations. The survey collects extensive information about health, economic status, work and family relationships (Juster & Suzman, 1995).

The study is of particular interest because it asks questions about mortality expectations. It asks:

'Using any number from 0 to 10 where 0 = absolutely no chance and 10 = absolutely certain, what do you think are the chances you will live to be 75 or more?'

The question was repeated, based on 85 rather than 75.

The same questions were asked in subsequent waves of the survey (the second wave being in 1994), except that respondents were asked to report the chances on a 0-100 point scale.

Hurd and McGarry (1995) analyse the responses from the first HRS wave. They refer to P75 and P85, based on the answers to the above questions, being the perceived probabilities of survival to aged 75 and 85 respectively. They found the average probabilities to be as follows, for those aged 51-61, and these are compared with the probabilities from actuarial life tables based on mortality rates in 1990.

Probabilities of survival

	Men		Women		All	
	P75	P85	P75	P85	P75	P85
HRS data	.62	.39	.66	.43	.65	.43
1990 life table	.60	.26	.75	.36	.68	.36

Source: Hurd and McGarry (1995)

The authors remark that the levels of P75 and P85 averaged over men and women are close to the life tables, but that both males and females overestimate the conditional survival rate to 85 given survival to 75. They then showed how the results varied with a number of factors:

Probabilities of survival: analysis with reference to relevant factors

	Men		Women		All	
	To 75	To 85	To 75	To 85	To 75	To 85
Income quartile						
Lowest					.59	.39
Second					.63	.40
Third					.66	.44
Highest					.70	.47
Education						
< high school					.57	.37
High school					.65	.42
> high school					.69	.48
Self-assessed health status						
Excellent	.75	.53	.78	.58		
Very good	.68	.42	.71	.50		
Good	.61	.37	.64	.44		
Fair	.47	.27	.53	.33		
Poor	.34	.16	.40	.23		
Smoking status						
Never smoked					.67	.47
Former smoker					.65	.43
Current smoker					.60	.38
Drinks per day						
0					.61	.41
< 1					.67	.45
1-2					.68	.44
3-4					.60	.36
> 4					.55	.33
Survivorship of mother						
Mother alive					.689	.480
Mother's age at death						
< 51					.595	.377
51-64					.572	.360
65-74					.594	.364
75-84					.644	.407
85+					.676	.478

Source: Hurd & McGarry (1995)

The importance of socio-economic variables is clear, as is the effect of smoking. For alcohol consumption there is evidence of a J-shaped curve (i.e. mortality is

lowest for those having a modest alcohol consumption), consistent with the medical evidence. They carried out a regression analysis; when they included self-assessed health status as an explanatory variable, it is very significant and the effect of other factors is attenuated though not eliminated.

The results on parental longevity are of particular interest. The authors comment that special importance is placed on the parents' survival to 75 in the respondent's forming a subjective probability of surviving to 75, but it is less important that the parents survived well past the age of 75. Similarly, in forming P85, particular importance is put on the parents' survival past 85, and less on whether they survived beyond the age interval 65-74 to the age interval 75-84. They also find that the longevity experience of the same-sex parent is more important than that of the opposite-sex parent.

UK studies

We mention specifically four recent surveys in the UK. First, Wardle & Steptoe (2003) found that expecting a lifespan of less than 80 years was associated with lower socioeconomic status, although the effect was less after adjusting for self-assessed health. Expectations of a limited span were independently associated with cigarette smoking and eating fruit less than daily. Men were more likely than women to think they would live to less than age 80; however, we do not know if this was consistent with actuarial tables as no comparison was given.

Second, a survey from the Society of Financial Advisers (2004) indicated that individuals (those who were questioned were advisers' clients) tended to under-estimate likely longevity. Appendix 1 gives further details.

Third, a much larger survey is the English Longitudinal Survey of Aging, in the first round of which respondents aged 50-64 were asked the probability of survival to age 75 (a higher reference age was used for older respondents). Some initial results are given by Banks, Emmerson & Oldfield (2004). Again, under-estimates were evident, as reported in Appendix 1.

Last, Johns (2004) used a postal questionnaire and found considerable variation in SLE, around an average of 53 years. While there is no comparison with actuarial life tables, it does look as if substantial under-estimation is taking place.[1]

Psychologists' and similar research on subjective life expectancy

There is plentiful evidence that relevant risk factors are taken into account but whether they are taken into account accurately is not always clear. However, one common finding is that men give relatively higher answers for longevity than women: this is in the sense that although men live less long than women, women do not expect to live longer than men by the amount of the difference in reality. This was reported by Nelson & Honnold (1980), and this finding has been repeated in subsequent surveys. Indeed, all 10 previous surveys where a

[1] The sample included equal numbers in groups aged 12-19 and 20-27; even if the average age were 27, then expected life span would be 27 + 53 = 80, which is below the Government Actuary's Department estimate of 86 (see below). The paper found a link between high SLE of the mother and the likelihood of the child born being male.

differential between males and females is given have found this result: 7 of the papers used data from the US,[2] 1 from Australia and 2 from the U.K.

One paper by psychologists did look at the male-female distinction in particular.[3] Tolor & Murphy (1967) studied 27 males and 21 females enrolled in an eight-week counsellor trainee programme. The average age of the males was 30.0 (standard deviation 9.6), of the females 28.0 (standard deviation 12.9). We do not have an analysis of the answers by age of respondent. The subjects were asked to indicate their subjective life expectancy and also the life expectancy for their sex (which appears to be the figure at birth, so it is not really comparable).

The answers demonstrated the way in which males' subjective life expectancy exceeded both their estimate of population longevity and the actual census data. This was also true of females but to a lesser extent.

Estimates of life expectancy

	Subjective life expectancy	Estimate of population expectation of life	US Bureau of the Census figures
Males: average	77.6	69.2	67.6
(standard deviation)	(11.90)	(4.16)	
Females: average	76.7	72.6	74.4
(standard deviation)	(10.31)	(3.70)	

Source: Tolor & Murphy (1967)

The subjects had completed the Edwards Personality Preference schedule, which gave measures on 15 personality variables. These were allocated into two groups:

- Some in which females scored significantly higher than males: deference, affiliation, intraception, succorance, abasement, nurturance and change; the authors indicated that these were revealed to be "self-directed"; and
- Others in which males scored more highly than females: including achievement, autonomy, dominance, heterosexuality and aggression: these were "outer-oriented".

The following table shows that the 10 males who scored relatively high on outer-oriented needs had a higher subjective life expectancy (SLE) than the 11 males who scored relatively low on outer-oriented needs. However, the 8 females relatively high on outer-oriented needs did not have a higher SLE than the 8 who scored low.

The females high on self-directed needs had a lower SLE than the females low on self-directed needs. However, the 10 males relatively high in self-directed needs had a lower SLE than the 11 males who had low self-directed needs.

[2] One of these, Pollock & Suyderhoud (1992), related to Hawaii.
[3] This is the first empirical survey of subjective life expectancy of which we are aware. It is not therefore trying to explain what we now know to be a persistent theme of a gender difference in SLE.

Subjective life expectancy and personality factors

	Outer-oriented		Self-directed	
	High	Low	High	Low
Males: average	77.9	73.0	73.5	77.45
(standard deviation)	(14.01)	(10.54)	(10.5)	(14.18)
Females: average	74.5	79.4	75.75	78.1
(standard deviation)	(10.51)	(10.44)	(11.08)	(10.29)

Source: Tolor & Murphy (1967)

This is some limited evidence that outer-orientedness (on which males tend to score more highly than females) is associated with a higher SLE, and self-directedness (where females tend to score more highly) is associated with a lower SLE. However, the evidence is not totally consistent with this and, indeed, only a limited number of the Tolor & Murphy results were statistically significant. However, there may be merit in further psychological research in this area, with a larger sample, in order to try to understand better what is driving the tendency in all surveys to date for males to have higher SLEs than females, relative to the real data from the population.

Tolor & Murphy also found:

- Whether the subject was an only child, and whether death had been discussed in the home, were both unrelated to SLE; and
- Whether the subject rated high or low on an anxiety scale was not related to SLE.

We briefly consider some of the other research in this area.

Handal (1969) surveyed 66 male and 50 female graduates at a US university, and suggested that SLE had different meanings for males and females, being, for males, a manifestation of a defensive attitude to death; and, for females, a critical indicator of attitudes towards death, this being based on his findings that:

- Males overestimated life expectancy relative to actuarial data, whereas females were more realistic; and
- For both males and females, their average estimate of population life expectancy was not significantly different from actuarial life tables.

He also rated each participant on a general anxiety scale and a death anxiety scale. The correlation of the scores was low but significant. For females, there was a significant trend for those who scored high on death anxiety to have a low SLE. However, no such relation existed for males.

Teahan & Kastenbaum (1970) studied 49 hard-core unemployed, who were on a training program. Some stayed on the job, others left. The stayers had higher SLEs, and they were also more optimistic (although a statistical association was not tested).

Nelson & Honnold (1980) studied 175 males and 334 females aged 19-29. The found that females (but not males) who had been exposed to early proximate death gave lower answers for SLE than others; females were particularly affected by early proximate death of a female.

Nam & Harrington (1984) studied 29 youths in Florida. They discovered that SLE was related to knowledge of mortality conditions in the US. Youths who under- and over-estimated life expectancy in the US tended to give relatively low and high SLEs respectively. Also, those who correctly said that college graduates have a higher life expectancy than high school graduates more often gave actuarially correct SLEs.

Robbins (1988a, 1988b) carried out two small-scale surveys. One was of 18 female undergraduates; the other was of 27 male and 49 female undergraduates. She found that high family life expectancy was associated with relatively high SLE, and also that, in a multiple regression equation, greater death anxiety was associated with lower SLE.

Denes-Raj & Ehrlichman (1991) surveyed 114 male and 249 female undergraduates. 36 students had a lost one or both parents due to illness at age under 55: they formed the "PD" group, and they were matched (on age, gender, ethnicity and religion) with 36 other students (the "PA" group). SLE was ascertained in two different ways:

- Cognitive SLE: "given everything that is objectively true about me, my best guess is that I will live until the age of …"; and
- Affective SLE: "my personal feeling is that I will live until the age of …"

They also established:

- Projective life expectancy for others: "I think that other people of my age, sex, race and socio-economic status can expect to live until the age of …"; and
- Desired life expectancy: "I would like to live to be … years old".

The PD group had significantly lower cognitive SLE and affective SLE than the PA group; however they did not differ significantly in their estimate of projected life expectancy for others. Within the PD group, both cognitive SLE and affective SLE were significantly lower than projected life expectancy for others. In the PD group cognitive SLE was significantly higher than affective SLE; in the PA group, affective SLE was significantly higher than cognitive SLE.

Joubert (1992) studied 84 males and 141 females enrolled in university-level general psychology classes. He found that happier females tended to be younger, expected to live more future years and expected to live a longer total life. However, the males' happiness ratings did not correlate with any of the life expectancy variables.

Research on Optimism

Weinstein (1980) reports a study of 120 female college students at Cook College, Rutgers University. The students were asked, "Compared to other Cook students, same sex as you, what do you think are the chances that the following events will happen to you [expressed as a percentage of the average chance]?" One of the events was "Living past 80". There were twice as many optimistic answers compared to pessimistic and the average chance was 112.5%: these results were significant at the 1% level. Living past 80 was one of several positive events (e.g. high salary, liking postgraduate job), and in almost all of them, the majority of students thought it was more likely than average that it would happen to them; and for negative events (e.g. attempting suicide or being fired from a job) they tended to think they were less likely than average to experience them.

There is a substantial body of evidence illustrating that most people tend to be optimistic, e.g. Weinstein & Klein (1996). De Meza & Maloney (2001) used the British Household Panel Survey, which asks people whether they expect to be better or worse off financially, or unchanged, in the next year: the expectations can then be compared with what happened. The overall picture they found was one of people being unrealistically optimistic. They also noted that men were more optimistic than women; the self-employed were more optimistic than employees; and smokers were more optimistic than non-smokers.

Longitudinal surveys

Moving on from the psychology research, an interesting development is papers that analyse experience between waves of a longitudinal survey, and consider whether mortality perceptions at the outset are a good predictor of mortality between waves[4]. Hurd & McGarry (2002) looked at the data from the first two waves of the HRS. They show that perceived probabilities of survival tended to decrease when the individual's self-assessed health status declined.[5] They were also able to calculate death rates between the waves. They found that the subjective probability of survival, as given at wave 1, was a (but not the only) significant factor in the mortality rates over the next 2 years (i.e. between waves 1 and 2).

Mortality perceptions and insurance

There has been only limited research on the relationship between mortality perceptions and life insurance. Cawley & Philipson (1999) investigated, empirically, the relationship between life insurance holdings and mortality perceptions, using US data from HRS and AHEAD (a survey: Asset and Health Dynamics among the Oldest Old). They found, from HRS, that respondents with the lowest perceived mortality risk are the most likely to have life insurance. In AHEAD it was the middle categories of perceived risk that were most likely to have life insurance. When testing the quantity of insurance that people had, the correlation with perceived risk was in many cases insignificant, though overall perhaps the high-risk individuals had a lower quantity of insurance.

These findings appear to contradict what we would expect with adverse selection, namely that high-risk individuals would buy more insurance. The authors suggest that the standard arguments about adverse selection may be exaggerated, and a potential explanation for their findings is that insurers can in fact distinguish risks and limit coverage to high-risk instead of low-risk individuals. Indeed, Eisenhauer (2004) presents a number of examples of insurance markets where adverse selection appears to be absent, and suggests that "advantageous selection" may be more relevant in some cases: for example, individuals with high risks may be carrying out risky activities precisely because they are risk-tolerant, and may not have the degree of risk aversion that would lead them to insure.

Bernheim et al (2003), also using HRS, find that low levels of insurance are not attributable to optimism concerning longevity.

[4] Smith et al (2001a), Hurd & McGarry (2002), Siegel et al (2003).
[5] Smith et al (2001b) showed how smokers respond to health shocks between waves, particularly smoking-related health shocks, in terms of changing perceived probabilities of survival.

However the data on life insurance holdings in HRS was not restricted to recent purchases, so we do not know what the mortality perceptions were when the policies were effected (and since HRS covers lives age over 50, most of the insurance purchases are likely to have been several years previously (see Chen et al, 2001)).

We are not aware of previous work on mortality perceptions and pensions. We expect that people who expect to live longer will buy more pensions:

- They would regard pensions as better value of money than others;
- They may be naturally low-risk people who wish to provide security through pensions;
- They may plan long-term and make long-term commitments, for which the security provided by pensions is important;
- Since pension policies are not usually underwritten, there are no major "supply" effects to offset what would be an increased demand for pensions arising from the above factors.

The relationship between mortality perceptions and life insurance purchases is less clear. There may be advantageous or adverse selection, and there may be offsetting supply-side factors from the underwriting process. Hence there may be a positive relationship between longevity perceptions and life insurance purchases, but with both demand and supply factors involved, it is not easy to deduce what would be the effect of changed longevity perceptions on life insurance purchases.

3. DEVELOPMENT

Introduction

We are looking to establish the comparison between perceptions and reality, and whether relevant risk factors are taken into account. We therefore need to collect evidence on what the "reality" is, and data on this is summarised below.

Population mortality

In our work we compare individuals' SLE with expectations consistent with population mortality, for which we have two sets of figures:

(i) expected age at death based on latest mortality rates, projected so as to be applicable at mid-2004 ("current life expectancy"); and

(ii) as in (i) but incorporating future improvements based on the mortality assumptions underlying the population projections of the Government Actuary's Department ("forecast life expectancy").

We are grateful to the Government Actuary's Department (GAD) for supplying us with these figures, as applicable at mid-2004. A summary of the expectations at various ages is as follows:

Life expectancy: Government Actuary's Department figures

Age	Males		Females	
	Current life expectancy	Forecast life expectancy	Current life expectancy	Forecast life expectancy
20	76.9	81.1	82.4	86.4
30	77.3	81.3	82.3	86.0
40	77.8	81.5	82.1	85.7
50	78.7	82.2	82.1	85.6
60	80.2	83.3	82.8	86.1
70	82.7	85.1	84.3	86.8
80	87.2	88.5	87.8	89.1

Social class

The effect on mortality of factors such as income, education and social class is well-known, with recent work having been stimulated by the "Black report" (Black et al., 1980).

We can show evidence of differences in life expectancy between social classes[6] based on recent mortality rates (Donkin et al, 2002). For males (and then, similarly, females) we show, for each class, the difference from males overall in life expectancy at birth and at age 65. The data relate to 1997-99 and are taken from the Office for National Statistics Longitudinal Study.

Life expectancy and social class

Social class	I	II	IIIN	IIIM	IV	V
Males						
At birth	3.5	2.5	1.2	-0.3	-2.3	-3.9
At age 65	2.1	1.4	0.9	-0.3	-1.6	-2.0
Females						
At birth	3.1	1.8	1.5	-0.5	-1.2	-2.6
At age 65	2.4	1.5	1.2	-0.5	-1.0	-2.1

Source: Donkin et al. (2002)

Smoking

The relative mortality of smokers and non-smokers raises some issues, as death certificates do not give information on the smoking habits of the deceased.

Evidence from the longitudinal study of British doctors (Doll et al, 2004) indicates a 10-year difference in the expectation of life between smokers and never-smokers:

"The experience of the 24,000 men in this study who were born in 1900-30 shows … Those who continued to smoke cigarettes lost, on average, about 10 years of life compared with non-smokers…"

The above study did not cover females, and there is evidence that the differences for females are higher than for males. We use data on insured lives over the period 1999-2002, given in Continuous Mortality Investigation (2004). We use these mortality rates to calculate the expectation of life (without incorporating

[6] The data use the Registrar-General's social class definitions: I professional, II managerial and technical/intermediate, IIIN skilled non-manual, IIIM skilled manual, IV partly skilled, V unskilled.

any future mortality improvements). The differences between smokers and non-smokers are shown below. We appreciate that not all of the differences are necessarily a result of smoking as such.

Difference in expectation of life between smokers and non-smokers

Age	Smoker/non-smoker differential (years)	
	Males	Females
20	5.8	6.4
30	5.6	6.4
40	5.5	6.4
50	5.3	6.2
60	4.7	5.8
70	3.6	4.6
80	1.6	2.4

Source: author's calculations from Continuous Mortality Investigation (2004)

The smoker/non-smoker differentials are noticeably lower than in Doll et al. (2004). However, there are several reasons to believe that the insured lives data understate the true difference between smokers and lifelong non-smokers, for example because "non-smoker" policies are available to smokers who have given up smoking, or smokers failing to admit to smoking (Willets et al, 2004).

We also include some overseas data. First is a table compiled from US mortality rates (whites only) in 1985-87 (Rogers & Powell-Griner, 1991).

Excess of life expectancy of never-smokers over current smokers

	Excess of life expectancy of never-smokers over current smokers (years)	
	Males	Females
25-29	7.5	6.9
30-34	7.4	6.8
35-39	7.0	6.8
40-44	6.9	6.8
45-49	6.6	6.7
50-54	6.2	6.6
55-59	5.6	6.0
60-64	4.9	5.3
65-69	4.4	5.0
70-74	3.3	4.2
75+	2.8	3.0

Source: Rogers & Powell-Griner (1991)

We would expect greater differences than the above in later surveys, as the prevalence of smoking has matured. Centers for Disease Control and Prevention (2002) found that adult male and female smokers lost an average of 13.2 and 14.5 years of life, respectively, because they smoked, although we note that they used a different methodology.

Last, data from Canada (Statistics Canada, 2001) shows noticeably greater differences for females than males. Their definition of non-smoker includes those who smoke only occasionally and those who smoked daily but stopped more than five years ago.

Excess of life expectancy of non-smokers over current smokers

Age	Excess of life expectancy of non-smokers over current smokers (years)	
	Males	Females
45	7.4	10.3
65	almost 6	8.5

Source: Statistics Canada (2001)

Doll et al. (2004) went on to consider those smokers who gave up smoking, and said, "… those who stopped at around age 60, 50, 40, or 30 gained, respectively, about 3, 6, 9 or 10 years of life expectancy compared with those who continued." Some more detailed evidence on the experience of ex-smokers in the US is given in Surgeon-General (1990).

Turning from data on smoke/non-smoker differences in experienced mortality, a number of researchers have examined perceptions of smoking risks. Viscusi's several investigations included the finding (Viscusi, 1990) that when people were asked, "Among 100 cigarette smokers, how many of them do you think will get lung cancer because they smoke?" the average response was far higher than reality, both for smokers and (even more so) non-smokers.

Lundborg & Lundgren (2004) asked the same question of Swedish adolescents aged 12-18, again finding over-estimation (again less for smokers than non-smokers), although it was also noticeable that the over-estimation was noticeably less for the older adolescents in the group.

However, our main concern is not the risk of contracting a particular disease, rather life expectancy. Surveys have regularly found that smokers expect to live less long than non-smokers, but have not always compared the difference with actuarial estimates of the true difference. Schoenbaum (1997) did make the comparison and found that, among current heavy (at least 25 cigarettes a day) smokers, expectations of reaching age 75 were nearly twice as high as actuarial predictions. In addition, the longitudinal survey using the Health and Retirement Survey by Hurd & McGarry (2002) found that smoking was a positive indicator of death in the period studied, having already taken into account mortality perceptions at the beginning of the period. This implies, therefore, that smokers were again under-estimating mortality.

There is also evidence that many smokers are optimistic about the health effects on themselves. For example:

- In a survey of 370 students in the US, aged 10-18, Hansen & Malotte (1986) found that smokers engaged in "significant denial": they gave lower probabilities of adverse health effects from smoking as they thought would apply to themselves compared with others.

- A survey in the UK by McKenna et al. (1993), of 60 smokers and 60 non-smokers, showed that both groups agreed that the average smoker was more likely to develop health-related problems, including a smoking-related disease, than the average non-smoker. However, smokers had an optimism bias in that they thought they personally were less likely to develop smoking-related diseases compared with the average smoker.

- Arnett (2000), in a survey of both adolescents and adults, found that both smokers and non-smokers recognised that smoking had risks. However, when asked whether they agreed with "I doubt if I would ever die from

smoking even if I smoked for 30 or 40 years", 29% of adolescent and 22% of adult smokers agreed, significantly higher than the 12% and 7% agreement from adolescent and adult non-smokers respectively.

Alcohol consumption

On the subject of alcohol consumption, a number of writers have concluded that there is a J-shaped curve, i.e. those consuming modest amounts of alcohol have lower mortality, controlling for other factors, than those who abstain or those who drink more. For example, Doll et al. (1994), in their survey of male British doctors, found, having standardised for age, calendar year and smoking habits, that those who drunk 8-14 units of alcohol a week had the lowest risks.

As referred to in section 2, Hurd & McGarry (1995) found evidence of a J-shaped curve in mortality perceptions in the US.

Parental longevity

We are also conscious of longevity being affected by the ages to which an individual's parents live. Hollingsworth (1964) carried out an analysis of the ages of death of the British peerage, and developed a relationship between the ages at death of mother and father, and then son or daughter. However, we would find it difficult to relate this to current conditions and to the population at large.

Previous studies of mortality perceptions have found parental longevity to be a significant factor.

Longitudinal survey

Cheung (2000) estimates the effect of a number of factors on the mortality of British females, aged 35+, using the Health and Lifestyle Survey, with data on deaths from the first wave of the study in 1984/85 up to 1997. The hazard rates (i.e. relative rates of mortality), with multiple adjustments for all variables shown and age and age squared were:

Relative rates of mortality

		Hazard rates
Marital status	Married	1.00
	Single	1.45
	Divorced	1.09
	Widowed	1.09
Self-reported health	Excellent	1.00
	Good	1.48
	Fair	2.08
	poor	2.80
Education	None	1.00
	O level or equivalent	0.90
	A level or equivalent	0.87
Smoking	Non-smoker	1.00
	Ex-smoker	1.38
	< 20 cigarettes a day	1.39
	> 20 cigarettes a day	2.13

Drinking	Non-drinker	1.00
	Ex-drinker	1.34
	Light drinker	0.92
	Moderate/heavy drinker	0.69

Source: Cheung (2000)

4. METHODOLOGY AND DATA

We now describe the survey of mortality perceptions that we carried out.

However, we considered carefully whether to ask a question concerning the probability that people would live to a certain age, or the age they expected to live to. We are aware that people can have difficulty with questions involving probabilities. Indeed, we note a number of problems identified by Hurd and McGarry (1995) in their analysis of the first wave data of HRS, and by Hurd and McGarry (2002) when examining the first and second waves together.

First, the distributions of P75 and P85 have a considerable bunching at 0, 0.5, and 1.0. There are also mini-spikes at 0.2 and 0.8. However, Smith et al (2001), in analysing HRS, adjusted for respondents at such 'focal points' and this did not significantly change their results.

Second, a number of respondents gave inconsistent answers for P75 and P85. In Hurd and McGarry (1995), we see 23% of respondents who gave an identical non-zero probability for survival to age 75 or 85, and indeed, in 2.5% of cases, they said it was more likely that they would live to 85 than to 75.

Thirdly, there are inconsistencies between answers in the first and second waves. 39% of respondents reported a lower value for P75 in wave two than in wave one, 34% reported a higher value, and 27% reported exactly the same value. Now, in some cases, an individual suffered an adverse health event between the first and second waves, and this was (as one might expect) associated with a decline in the reported P75. However, the overall observed reduction in probability of survival is inconsistent with simple probability laws (Hurd and McGarry, 2002).

We therefore decided to ask people the age to which they expected to live. We also felt this was appropriate as our sample was of the adult population as a whole, and we felt that probability questions would be very difficult for people under the age of 50, looking forward to whether they would survive some say 50 years ahead. Fischhoff et al. (2000) asked teenagers what was the chance that they would die before age 20; the mean response of 20.3% and median of 10% compare unrealistically with the authors' estimate of the true probability of 0.4%.[7]

We asked MORI to conduct a wide ranging public opinion survey covering various aspects of public perceptions of mortality, such as general level of health, smoking prevalence, alcohol consumption and life expectancy.[8]

[7] This result may reflect exaggerated views of low probabilities, consistent with Lichtenstein et al. (1978), but it gives us little confidence about people's abilities to cope with probabilities of life expectancies on a long-term basis.

[8] MORI interviewed a representative quota sample of 3,966 adults aged 16+ across Great Britain, conducted face-to-face, in-home as part of the MORI Omnibus. Interviews were conducted using CAPI (Computer Assisted Personal Interviewing) in 186 sampling points across two omnibus waves: the first between 3 and 9 June 2004 and the second between 17 and 23 June 2004. Data have been weighted to the known profile of the Great Britain population.

Summary demographic data of the sample

Gender		**Age**		**Social class**	
Male	49%	16-20	9%	AB	24%
Female	51%	21-24	6%	C1	27%
		25-34	19%	C2	21%
		35-44	18%	DE	28%
		45-54	16%		
		55-64	13%		
		65+	19%		

To our knowledge this is the largest survey ever carried out that has asked people the age to which they expected to live, as opposed to the chances of living to a specified age. 388 respondents answered 'don't know' to the question on the age that people expected to live to.

We also show the distribution of a number of mortality risk factors:

Mortality risk factors

Self-assessed health status	N	%
Excellent	836	21.10%
Good	1897	47.88%
Fair	774	19.54%
Poor	348	8.78%
Very poor	107	2.70%
Total	3962	100.00%
Self-reported smoking status		
Smoker[9]	1211	30.82%
Former smoker	999	25.21%
Never-smoker	1742	43.97%
Total	3962	100.00%
Alcohol consumption (units per week)		
0	953	26.54%
1-10	1854	51.63%
11-20	505	14.06%
21-30	169	4.71%
> 30	110	3.06%
	3591	100.00%

We were also concerned to establish what lies behind the formation of expectations. We therefore (first) asked a comparator question, "I would now like you to think of other people of the same sex and age as yourself. To what age would you expect them to live, on average?" This also allows us to comment on the optimism, or otherwise, of the respondents as a whole.

The questions concerning mortality perceptions, life insurance and pensions are shown at Appendix 2.

[9] Of the smokers, 1065 smoke daily, 156 less frequently than daily.

5. RESULTS

Overall results

We first set out the overall averages of the age to which people expect those of the same age and sex to live (people's "population estimate"), then their answer for themselves (the "self-estimate"). We also show the corresponding results in accordance with the GAD current and GAD forecast tables.

Overall averages of age to which people will live

	Population estimate	Self-estimate	GAD current	GAD forecast
Males	77.07	78.52	79.64	83.17
Females	79.45	80.30	82.76	86.35
Total	78.37	79.48	81.34	84.90

The highest answer given for a self-estimate was 100, which was also the highest answer given for population life expectancy.

We can construct survival curves using the mortality rates implicit in the perceived self-estimated life expectancies, for males and females separately, and these are shown in Appendix 3. Note that the curves have vertical lines at quinquennial ages where there was a bunching of answers, especially at age 80. Also in Appendix 3 we show the distribution of:

- Self-estimate minus population estimate: we note that many respondents gave the same answer to the two questions;
- Population estimate minus GAD current estimate; and
- Self-estimate minus GAD current estimate.

We now focus on the number of years remaining that people still expect to live, and we compare the results for people's population estimates and their self-estimates (this data is restricted to people who answered both questions). We also show figures for the GAD estimates (current and future) as calculated for the age and sex distribution of those in the corresponding row: for example, the figures for those in poor health are markedly lower than those for excellent health, but this, to a substantial extent, reflects the fact that these people are relatively old, where the years of life remaining are relatively low.

Overall, the results are relatively close if we compare people's estimates of their own mortality with the GAD estimates *if future expected improvements in mortality were ignored*.

Average years' lifetime remaining

		Population estimate	Self-estimate	GAD current expectation	GAD forecast expectation
Males	**Overall (N=1573)**	**31.32**	**32.51**	**33.49**	**37.13**
	Health				
	Excellent	38.73	40.96	39.69	43.92
	Good	32.50	34.14	34.59	38.34
	Fair	24.42	24.50	27.32	30.34
	Poor	21.71	20.64	25.81	28.79
	Very poor	22.88	20.65	25.96	28.93
	Smoking				
	Current smoker	35.11	34.99	38.24	42.35
	Ex smoker	21.30	22.82	23.43	26.13
	Never-smoker	35.80	37.75	37.23	41.21
Females	**Overall (N=1848)**	**35.10**	**35.86**	**38.09**	**41.81**
	Health				
	Excellent	40.19	42.06	42.07	46.13
	Good	36.84	37.75	39.63	43.47
	Fair	29.28	29.27	33.05	36.35
	Poor	27.80	26.31	32.26	35.54
	Very poor	26.50	28.02	31.65	34.94
	Smoking				
	Current smoker	38.73	39.04	43.00	47.15
	Ex smoker	29.11	30.29	31.71	34.92
	Never-smoker	35.36	36.22	37.66	41.34

We summarise the differences:

Differences in estimates of years' lifetime remaining

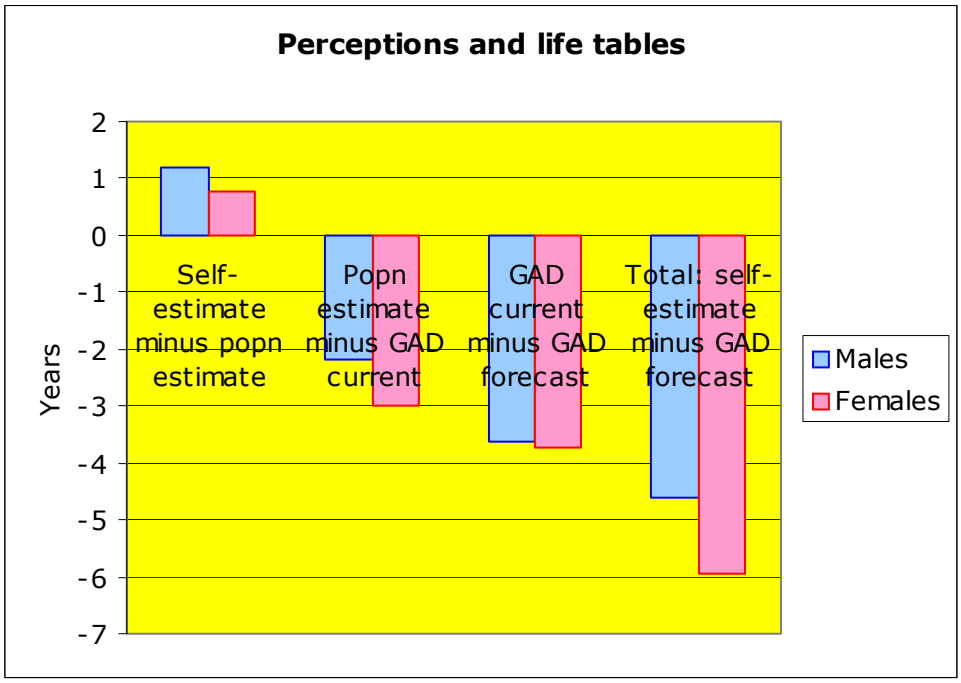
		Self-estimate minus population estimate	Population estimate minus GAD current estimate	Self-estimate minus GAD current estimate	GAD current minus GAD forecast estimate	Total: self-estimate minus GAD forecast estimate
Males	**Overall (N=1573)**	1.19	-2.17	-0.98	-3.64	-4.62
	Health					
	Excellent	2.23	-0.96	1.27	-4.23	-2.96
	Good	1.64	-2.09	-0.45	-3.75	-4.20
	Fair	0.08	-2.90	-2.82	-3.02	-5.84
	Poor	-1.07	-4.10	-5.17	-2.98	-8.15
	Very poor	-2.23	-3.08	-5.31	-2.97	-8.28
	Smoking					
	Current smoker	-0.12	-3.13	-3.25	-4.11	-7.36
	Ex smoker	1.52	-2.13	-0.61	-2.70	-3.31
	Never-smoker	1.95	-1.43	0.52	-3.98	-3.46

Females	**Overall (N=1848)**	0.76	-2.99	-2.23	-3.72	-5.95
	Health					
	Excellent	1.87	-1.88	-0.01	-4.06	-4.07
	Good	0.91	-2.79	-1.88	-3.84	-5.72
	Fair	-0.01	-3.77	-3.78	-3.30	-7.08
	Poor	-1.49	-4.46	-5.95	-3.28	-9.23
	Very poor	1.52	-5.15	-3.63	-3.29	-6.92
	Smoking					
	Current smoker	0.31	-4.27	-3.96	-4.15	-8.11
	Ex smoker	1.18	-2.60	-1.42	-3.21	-4.63
	Never-smoker	0.86	-2.30	-1.44	-3.68	-5.12

These results show that:

- People give self-estimates that are higher, on average, than their population estimates, by 1.19 years (males), 0.76 years (females): this may be regarded, in aggregate, as evidence of optimism;
- Individuals' self-estimates are below the GAD current figures by, on average, 0.98 years (males), 2.23 years (females);
- People are a long way short of GAD forecast figures: by, on average, 4.62 years (males), 5.95 years (females);

Note that people in less than excellent health give lower answers for life expectancy, though they also tend to give lower answers for population longevity than do people in better health.

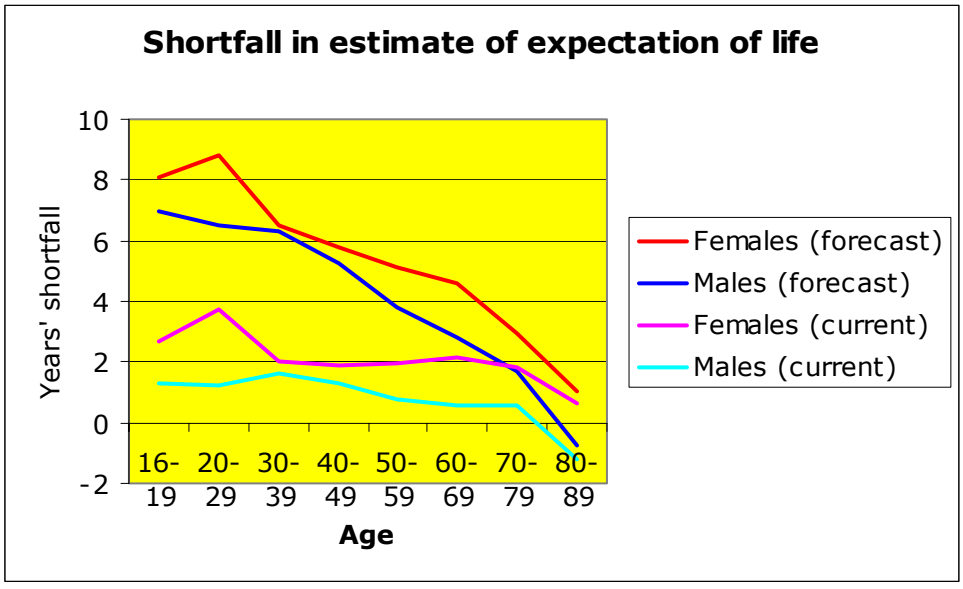


Analysis by age of respondent

We can also illustrate the differences between self-estimates and the GAD estimates as follows, analysed by age of respondent:

Age	Self-estimate minus GAD current expectation		Self-estimate minus GAD forecast expectation		
Males	Mean	Standard deviation	Mean	Standard deviation	N
16-19	-1.27	10.49	-6.94	10.48	162
20-29	-1.21	9.85	-6.51	9.83	231
30-39	-1.64	9.73	-6.30	9.75	276
40-49	-1.31	8.89	-5.24	8.89	239
50-59	-0.75	7.58	-3.79	7.55	257
60-69	-0.60	6.59	-2.83	6.60	215
70-79	-0.55	5.67	-1.66	5.72	182
80-89	1.20	4.81	0.77	4.82	66
90-99	2.39	4.99	2.30	4.99	4
Total	-0.97	8.47	-4.56	8.70	1632
Age	Self-estimate minus GAD current expectation		Self-estimate minus GAD forecast expectation		
Females	Mean	Standard deviation	Mean	Standard deviation	N
16-19	-2.68	9.27	-8.07	9.27	148
20-29	-3.75	10.47	-8.82	10.45	303
30-39	-2.04	9.03	-6.53	9.04	399
40-49	-1.89	8.13	-5.80	8.12	315
50-59	-1.95	7.85	-5.12	7.84	281
60-69	-2.18	6.85	-4.62	6.86	242
70-79	-1.83	5.43	-2.94	5.44	159
80-89	-0.66	4.02	-1.01	4.08	54
90-99	0.50	1.18	0.45	1.19	4
Total	-2.28	8.39	-5.97	8.57	1905

We can show the results graphically, using both the GAD current and forecast expectations.



At age 80 plus the under-estimates have been reduced significantly. However, the respondents excluded people in institutions such as hospitals, care homes, etc, which means that, at high ages, our sample is expected, on average, to be in better health than the population.

While the differences compared with the population are clearly greatest at young ages, the difference is still 2.83 years (males), 4.62 years (females) for people in their 60s, when they may be buying annuities. Since life insurers price annuities taking into account expected future mortality reductions[10], it may well be that purchasers of annuities under-estimate the value of annuities.

It may be useful to add in a table to illustrate the average answers for self-perceptions and the GAD forecast figures:

Perceptions by age

	Average self-perception	Average GAD forecast figure	Self-estimate minus GAD forecast figure
Males			
16-19	75.47	82.41	-6.94
20-29	75.83	82.34	-6.51
30-39	75.90	82.20	-6.30
40-49	76.84	82.09	-5.24
50-59	78.54	82.34	-3.79
60-69	80.61	83.45	-2.83
70-79	83.76	85.42	-1.66
80-89	89.97	89.19	0.77
90-99	98.75	96.45	2.30
Total	78.52	83.09	8.47
Females			
16-19	78.35	86.42	-8.07
20-29	77.40	86.22	-8.82
30-39	79.34	85.88	-6.53
40-49	79.85	85.66	-5.80
50-59	80.67	85.79	-5.12
60-69	81.82	86.44	-4.62
70-79	84.57	87.51	-2.94
80-89	89.44	90.46	-1.01
90-99	96.00	95.55	0.45
Total	80.31	86.28	-5.97

Smoking

The figures for smoking are of particular interest as we can compare the perceptions with figures on the relative life expectancy of smokers and non-smokers. The perceptions for males and females separately were given above; we can also show the totals.

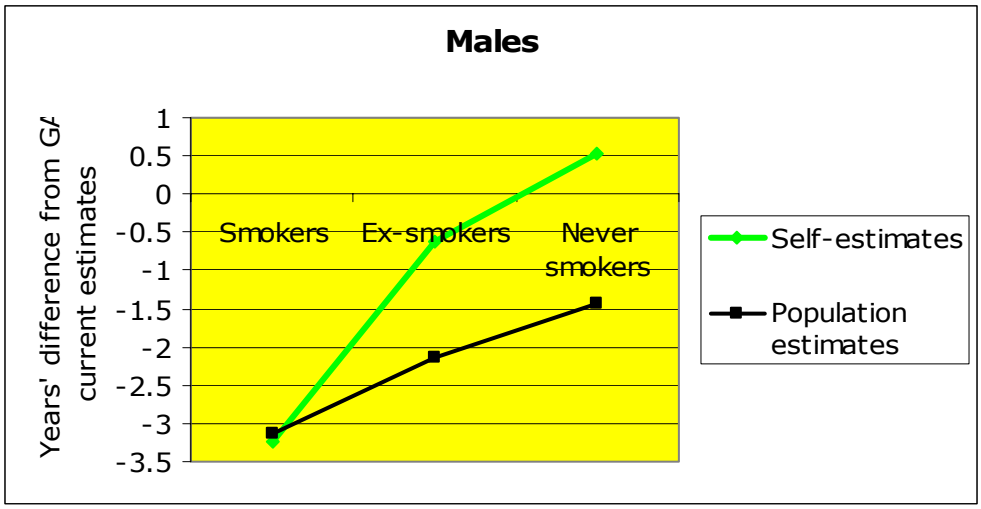
[10] Life insurers also take into account the lower mortality of annuitants compared to the general population.

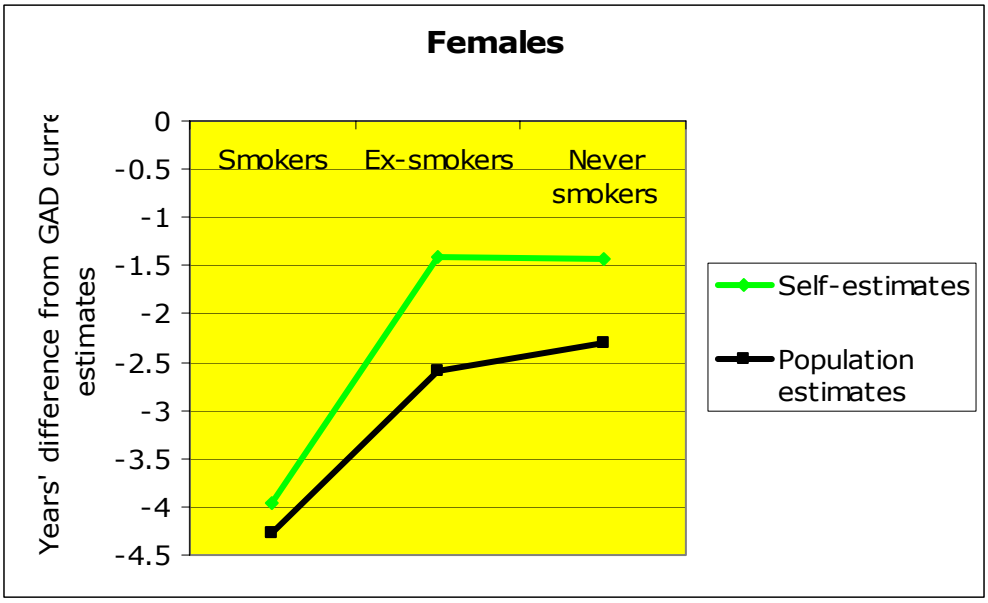
Estimates according to smoking status

		Self-estimate minus population estimate	Population estimate minus GAD current estimate	Self-estimate minus GAD current estimate
Total (N=3421)	Current smoker	0.12	-3.75	-3.64
	Ex smoker	1.37	-2.34	-0.98
	Never-smoker	1.32	-1.94	-0.63

In other words, smokers estimate that their life expectancy is 3.64 years less than GAD current estimates, whereas never-smokers are only 0.63 years less. However, the striking finding is that smokers think their life expectancy is about the same as (actually 0.12 years more than) their estimate for the population: they have a much lower estimate than non-smokers for the population life expectancy: they think the population will live 3.75 years less long than the GAD current estimate, compared with non-smokers thinking the population will live 1.94 years less long than the GAD current estimate.

We can illustrate this graphically, showing, for each of males and females the difference between each of their self-estimates and their population estimates, and the GAD current estimates.





We now set out the differences between smokers (current and ex) and never-smokers.

Estimates of smokers and ex smokers compared with never-smokers

	Smoking	Self-estimate minus population estimate	Population estimate minus GAD current estimate	Self-estimate minus GAD current estimate
Males	Current smoker	-2.08	-1.73	-3.77
	Ex smoker	-0.44	-0.70	-1.13
Females	Current smoker	-0.55	-1.98	-2.52
	Ex smoker	0.32	-0.29	0.03
Total	Current smoker	-1.20	-1.81	-3.01
	Ex smoker	0.05	-0.40	-0.35

The table shows that current smokers (males and females combined) expect to live 3.01 years less long than never-smokers. However, the real difference appears to be much greater. For example, Doll et al. (2004) found that, in reality, male British doctors who smoked lived 10 years less long than never-smokers. We conclude that the difference in life expectancy between smokers and never-smokers is significantly greater than the difference in perceptions between smokers and never-smokers.[11]

We also illustrate the difference between current and never smokers' self-estimates by age[12]:

Difference between current and never smokers' self-estimates analysed by age

[11] Some current smokers may be anticipating giving up smoking, with a consequential benefit to life expectancy.
[12] The figures are derived from self-estimates minus GAD current estimates; however GAD current estimates are, of course, the same for current and never smokers.

Age	Self-estimate minus GAD current estimate: current smokers minus never smokers	
	Males	Females
16-19	-5.68	-4.02
20-29	-2.62	-1.73
30-39	-3.97	-2.07
40-49	-6.26	-1.84
50-59	-3.51	-2.39
60-69	-1.15	-3.07
70+	-1.90	-1.57

Multivariant analysis

We can derive implicit mortality rates age-by-age by fitting a Gompertz curve to the data on perceived length of life. At any given age, the predicted mortality rate ("hazard of death" in economics terminology) can be modelled empirically using a Gompertz distribution for the baseline hazard. Using a proportional hazards regression approach, the impact of socio-economic characteristics and other known mortality factors can be modelled as shifting the baseline hazard up or down proportionately. The "hazard ratio" captures the proportional difference in the (predicted) hazard of death attributable to each factor in the regression. The omission of unknown risk factors ("frailty") from this model can lead to biased estimates; we control for this by assuming a Gamma distribution for the frailty and estimating its parameters.

We can show hazard ratios as follows. For example, the (perceived) mortality rate by females is 58.2% of that for males. For those in fair health it is 228.5% of those in excellent health.

Implicit relative mortality rates as perceived

		Hazard ratio	Robust p-value
Gender	Male	1.000	
	Female	0.582**	0.000
Age		0.973**	0.000
Marital status	Married	0.786	0.123
	Living together	0.554**	0.002
	Single	0.555**	0.001
	Widowed	0.719	0.111
	Separated/divorced	1.000	
Health status	Excellent	1.000	
	Good	1.541**	0.000
	Fair	2.285**	0.000
	Poor	2.742**	0.000
	Very poor	2.145*	0.082
Smoking status	Never smoked	1.000	
	Ex-smoker	1.067	0.513
	Current smoker	1.934**	0.000

Alcohol consumption	0 units	1.000	
	1-10	0.802*	0.075
	11-20	1.070	0.642
	21-30	0.854	0.450
	> 30	1.701**	0.033
Education level	None of below	1.000	
	Vocational (NVQ1+2)	0.878	0.508
	A levels	0.926	0.541
	Degree or PhD	0.741**	0.012
Household income		1.005	0.764
Parental age	Mother's age (alive)	0.989**	0.007
	Father's age (alive)	0.986**	0.000
	Mother's age (dead)	0.990**	0.025
	Mother's age (dead)	0.993	0.113
Social class	A	1.241	0.418
	B	1.035	0.856
	C1	0.891	0.514
	C2	0.860	0.388
	D	1.026	0.887
	E	1.000	

* significant at 10% level, ** significant at 5% level

Amongst the findings from the above is a J-shaped curve connecting alcohol consumption and perceived mortality.

We go on to show how self-perceptions differ from the GAD tables. We break the difference down into:

- The difference between self-estimates and individuals' population estimates; and
- The difference between individuals' population estimates and GAD (current) tables.

We show the results of the regression of predicted lifespan relative to the population, regressed on a number of factors.

Impact of individual factors on longevity perceptions

		Self-estimate minus Population estimate (years)	Population estimate minus GAD estimate (years)	Self-estimate minus GAD estimate (years)
Female		-0.335	-0.954**	-1.223**
Age		0.028	0.036**	0.056**
Marital status	Married	1.526**	-0.740	0.758
	Living together	1.410**	0.643	2.175**
	Single	1.619**	0.605	2.019**
	Widowed	0.848	0.044	1.264
Health status	Excellent	0	0	0
	Good	-0.910**	-0.827**	-1.976**
	Fair	-2.163**	-1.164**	-3.467**
	Poor	-3.091**	-1.514**	-4.763**
	Very poor	-2.979*	0.113	-3.132**
Smoking status	Current smoker	-0.401	-1.978**	-2.367**
	Ex-smoker	-0.154	-0.246	-0.263
	Non-smoker	0	0	0
Alcohol consumption	0 units	0	0	0
	1-10	-0.348	1.005**	0.602
	11-20	-1.177**	0.595	-0.551
	21-30	1.018	0.055	0.261
	> 30 units	-2.320**	-0.075	-2.346**
Education level	Vocational (NVQ1+2)	0.236	0.353	0.752
	A levels	-0.239	0.454	0.187
	Degree or PhD	0.397	0.912**	1.224**
Household income		-0.104	0.110	0.029
Parental age (10 years)	Mother's age (alive)	0.07	0.43**	0.49**
	Father's age (alive)	0.43**	0.23**	0.64**
	Mother's age (dead)	-0.01	0.27*	0.39**
	Mother's age (dead)	0.35**	0.03	0.35**

Social class	A	0.306	-1.419	-1.060
	B	0.500	-0.304	0.174
	C1	0.421	0.082	0.508
	C2	0.913	-0.215	0.835
	D	0.689	-0.557	0.197

* significant at 10% level, ** significant at 5% level

For example, people in poor health expect to live 4.763 years less long than people in excellent health, controlling for the other factors in the analysis (age, gender, smoking, etc). Part of this is because they expect to live less long (by 3.091 years) than they think the population will live. However, their estimate of population longevity is 1.514 years less than the estimate of people in excellent health.[13]

We also see that the impact of smoking (controlling for other factors) is to reduce the self-estimate of longevity by about 2.4 years. But smokers' lower estimate of population longevity accounts for 2.0 of this difference, and only 0.4 is attributed to a difference between themselves and the population (which is statistically insignificant).

We regard our findings as evidence of a "reference group effect", i.e. people view the population as similar to the group they are in (e.g. smokers, or those in poor health).

We regard this finding as a "reference group effect", i.e. people view the population as similar to the group they are in (e.g. smokers, or those in poor health).

There are also some statistically significant relationships between parental longevity and estimates of population mortality.

We also note that ex-smokers do not give significantly different answers for their self-estimates, from never-smokers, which is different from the evidence (Surgeon-General, 1990; Willets et al, 2004).

Life insurance and pensions

We now go on to regress the take-up of life insurance and pensions against a number of variables, including mortality perception differences.

We look for the factors that influence product purchases, with particular attention to purchases in the last five years. We find that the purchase of personal pension plans/stakeholder pensions is negatively influenced by a difference in the individual population-estimate of life expectancy and the GAD current tables.

Our probit regression results are shown in detail in Appendices 4 (all holdings of policies) and 5 (purchases in the last five years). Here we highlight some significant results, starting with the regression of holdings of voluntary pension policies (personal pensions, stakeholder pensions, AVCs), whole life and term insurance:

- Females are less likely than males to have voluntary pension policies;

[13] The figures do not add up precisely because these are separate regressions.

- People in company pension schemes are less likely to have voluntary pension policies;
- People with high incomes are more likely to have voluntary pension policies or life insurance policies;
- Smokers are less likely to have voluntary pension policies;
- The association with longevity factors is shown in the following table.

1.310% of our sample had effected a voluntary pension in the last 5 years[14]. However, our model found that every one year of higher population longevity estimate is associated with an increase in the proportion buying voluntary pensions by 0.154%. Now recall that if longevity expectations were the same as GAD forecast figures they would be around 5 years higher. So if the effect in our model can be extrapolated, a correction of the 5-year underestimate would enhance voluntary pension take-up by 0.75% to over 2% - a dramatic increase of 50%.

Effect of longevity estimates on holdings of pension and insurance policies

	Personal pension & stakeholder pension	Personal pension, stakeholder pension and AVC	Whole life	Term life	Any life
Holdings					
Mean probability of holding	6.610%	8.312%	17.163%	3.801%	51.155%
Marginal effects					
Self-estimate minus population estimate	0.009%	-0.019%	0.121%	0.070%	0.059%
Population estimate minus GAD estimate	0.091%	0.114%	-0.209%	0.148%**	-0.028%

More pertinent is the data we have on purchases within the last 5 years, as our variables, including life expectancy estimates, are current estimates. We note, in particular, that there are no significant effects from gender, age, marital status, health, alcohol consumption or parental longevity. The finding relating to health is of particular interest as it confirms we should not regard selection in life insurance markets as necessarily leading to high-risk individuals being those who effect most life insurance, and it is consistent with the suggestion by Cawley & Philipson (1999) that underwriting by insurers may be able to offset adverse selection effects. Smokers are less likely to buy voluntary pensions or whole life insurance, but are more likely to buy term insurance.

We find that higher income individuals effect more voluntary pensions[15], whole life and term insurance.

[14] This proportion appears rather low, and may reflect people having a poor understanding of their insurance and pension holdings.
[15] For recent purchases, our data on voluntary pensions is personal and stakeholder pensions only.

There are also significant associations with longevity estimates, as shown in the following table. Not only is this true for term insurance, but even more strongly for pensions. Whereas 1.31% of our sample had effected a voluntary pension in the last 5 years[16], the effect of a 1-year higher estimate of population longevity would be associated with this figure increasing by 0.15%.

Indeed, when we consider that, if longevity expectations were the same as GAD forecast expectations they would be over 5 years longer. Applying this to the above relationship implies that the proportion effecting personal pensions or stakeholder pensions would increase from 1.3% to 2.0% or more, i.e. potentially a 50% increase.

This suggests that pension providers may wish to do more to emphasise the value of pensions. Life insurers may, for example, wish to highlight the number of years that they expect to pay annuities; perhaps illustrating that their charges are lower than imagined by many people, who under-estimate the annuity payment period. Employers have been concerned that employees do not value sufficiently (Employers Task Force on Pensions, 2004): one part of the solution may be in demonstrating the value of expected pension instalments, for a longer lifetime than most employees think.

The table also suggests that there could be a significant association with purchases of term insurance. However, the outcome we observe reflects the interaction between supply and demand, and we do not feel able to suggest what effect on term insurance purchases may arise from changes in demand arising from amended estimates of longevity.

Effect of longevity estimates on pension and insurance purchase

	Personal pension & stakeholder pension	Whole life	Term life
Purchase within last 5 years			
Mean probability of purchase	1.310%	2.354%	1.483%
Marginal effects			
Self-estimate minus population estimate	-0.016%	-0.035%	0.077%
Population estimate minus GAD estimate	0.154%**	-0.059%	0.129%**

6. COMMENTS

Conclusions

Our key conclusions are:

- On average, people under-estimate how long they are likely to live: by over 5 years:
  - They tend to ignore expected mortality improvements;
  - The under-estimation for males is 4.62 years, but even greater for females, 5.95 years;

[16] This proportion appears rather low, and may reflect people having a poor understanding of their insurance and pension holdings.

    - The under-estimation is still significant in their 60s (when people may be buying annuities): the under-estimation is 2.83 years (males), 4.62 years (females).

- People are optimistic: they think they will live longer, on average, than people of their own age and sex: by 1.19 years (males), 0.76 years (females).

- People take into account the impact of health, smoking, alcohol and parental longevity on their own lifespan:
    - For example, those with a modest consumption of alcohol expect to live longer than those with zero or higher consumption;
    - But people are not always accurate - in particular:
        - The risks to smokers are significantly higher than they think;
        - Former smokers fail to recognise that they should expect to live less long than never-smokers.

- There is a link between the answers given for how long people expect to live, with how long they expect others of the same age and sex to live (a "reference group effect"):
    - Compared to people in excellent health, those in ill-health give lower answers for how long they expect the population to live;
    - Most of the difference between smokers' perceptions and those of never-smokers is a result of smokers thinking that the population tends to live less long: they do not perceive a significant difference between themselves and the population.
        - The impact of smoking (controlling for other factors) is to reduce the self-estimate of longevity by about 2.4 years. But smokers' lower estimate of population longevity accounts for 2.0 of this difference, and only 0.4 is attributed to a difference between themselves and the population (which is statistically insignificant).

- People with higher perceptions of population longevity have bought more personal/stakeholder pension policies:
    - If this effect can be extrapolated, a correction of the 5-year underestimate in longevity would enhance voluntary pension take-up by 0.75% to over 2% – a dramatic increase of 50%.

Suggested implications

We suggest the following implications:

- Were the population to have a better understanding of how long they were likely to live they may be more likely to buy pensions than they are now (perhaps there is a role for the Financial Services Authority here in connection with education);

- Insurers may wish to consider developing a way of stressing the value-for-money of annuities they offer;

- Employers may wish to consider using data on life expectancy to highlight the value of occupational pensions they are providing; and

- Those involved in health (including smoking) policy may wish to take into account the findings on perceptions and, in particular the way in which people tend to view the general population as having some similar characteristics to themselves.

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APPENDIX 1

Author	Subjects & date	Ages	Actuarial life table
Tolor & Murphy (1967)	27 male, 21 female Caucasian college graduates in counselor trainee program	M 30.0 (SD 9.6) F 28.0 (SD 12.9)	US Bureau of the Census: Caucasian children born in 1962
Handal (1969)	66 male, 50 female graduate students at a NW university	M 20-64, mean 29.0, SD 9.15 F 22-49, mean 33.4, SD 8.28	US Bureau of the Census: Caucasian children born in 1962
Teahan & Kastenbaum (1970)	29 hard-core unemployed Negro males	Range 21-44 Two subsets:	
		14 "stays" (successful), mean 27.3	
		15 "leaves" (unsuccessful), mean 34.3	
Sabatini & Kastenbaum (1973)	32 mortuary science students (avge age 25.1, range 20-40), 44 death class students (24.5, 20-59), 82 nursing home administrators (41.2, 19-71)		
Kastenbaum (1974)	146 tenth graders (59M 87F), 386 undergraduates (159M 227F): N.E. USA		
Nelson & Honnold (1980)	513 students (175M 338F) in sociology, anthropology or social science students at a large state university[17]	18-29	
Nam & Harrington (1984)	290 students in a public school in Florida (6th to12th grade)		
Hamermesh (1985) see also Hamermesh & Hamermesh (1983)	411 white male academic economist363 white males from phone book in Midwest	Economists: age 26-65, mean 42.6 Others, age 20-69, mean 42.8	US 1980 life tables for white males

[17] The following were excluded: those indicating they had been diagnosed with a terminal innless, two who answered subjective life expectancy > 150, four whose desired life expectancy > 200 years

Robbins (1988a)	18 female undergraduates	Mean 29.8 (range 20-43)	US Bureau of the Census tales for white females born in 1960s
Robbins (1988b)	76 upper level undergraduate students (27M 46F) on advanced psychology courses	Mean 26.9 SD 7.83 range 19-45	US census tables 1979-81
Denes-Raj & Ehrlichman (1991)	72 undergraduates in New York City area, of which 36 (PD group) had lost 1 or 2 parents due to illness before the parent reached age 55; matched with 36 controls (PA)	PD: 22 female, 14 male Mean age 24.5 (range 18-41). PA group matched by age, gender	
Joubert (1992)	84 men, 141 women in university level psychology classes		US Bureau of the census norms (1987)
Pollock & Suyderhoud (1992)	1100 from 3 unions in Hawaii; white collar & professional, teachers & university faculty: fall 1985	25-64	Hawaii cohort table
Hurd & McGarry (1995)	Health & Retirement Study (HRS) wave 1: 7946 observations of P75	Individuals born 1931-41: approx. 51-61 at interview	1990 life table (unspecified) of age-specific mortality rates in 1990, also 1980, 1988, 1990 & 2000 tables
Schoenbaum (1997)	HRS wave 1		Rogers & Powell-Griner tables (1991) smoking-specific tables
Mirowsky (1997), also see Mirowsky (1999), Mirowsky & Ross (2000), Ross & Mirowsky (2002)	2029 US respondents from phone survey of Aging, Status and the Sense of Control (ASOC)		1992 age-specific mortality rates, matched by race and sex to the sample in each age range
van Doorn & Kasl (1998) - *Australia*	1468 participants in Adelaide, from state electoral roll: baseline data fall 1992	70 and over, and spouses aged 65 & over Mean M 79.3 F 80.4	
Hurd, McFadden & Merrill (1999), also see Gan, Hurd & McFadden (2003)	AHEAD survey: wave 1 1993, 2 1995; baseline sample 8222	Age 70+ at baseline	?

Hurd & McGarry (2002)	HRS, 11090 individuals, waves 1 (1992) & 2 (1994)	Age 46-65 at 1st interview	1990 life table
Wardle & Steptoe (2003) - *UK*	1691 interviews of British adults	Approx 25% in each of: <35 yrs, 35-49, 50-64, >64	No comparison
Society of Financial Advisers (2004) – *UK*	UK: 718 clients of financial advisers, April 2004, excluding clients not in good health	Age range 25 to over 55	Not stated, supplied by Inst of Actuaries & CMIB
Banks, Emmerson & Oldfield (2004) - *UK*	UK: ELSA: population survey, >12000 respondents 2002/03	Aged 50-64 (for figs reported)	GAD projections 2003
Johns (2004) - *UK*	Mothers in Gloucestershire: 1759 questionnaires posted, 45% received from eligible respondents	Aged 12-27	No comparison

Author	Question			
	Subjective lifespan	Desired lifespan	Population lifespan	Subjective survival probability
Tolor & Murphy (1967)	[estimated life expectancy]		[estimated life expectancy of their own sex (at birth)	
Handal (1969)	Not stated		Life expectancy of their own sex (at birth)	
Teahan & Kastenbaum (1970)	How long do you expect to live?			
Sabatini & Kastenbaum (1973)	To what age do you expect to live?	To what age would you like to live?		
Kastenbaum (1974)	[how long he/she expects to live]	[how long he/she would like to live]		
Nelson & Hobbold (1980)	I expect to live to …	I want to live to …		
Nam & Harrington (1984)		Life expectancy for US males today? [also asked re 1900]		
Hamermesh (1985) see also Hamermesh &	How old do you expect you will live to be?			What is your subjective probability of living to age

Hamermesh (1983)				at least 60, 80?
Robbins (1988a)[18]	not specified			
Robbins (1988b)	not specified			
Denes-Raj & Ehrlichman (1991)	My personal feeling is that I will live until the age of …[19]	I would like to live to be … years old	I think that other people of my age, sex, race and socio-economic status can expect to live until the age of …	
Joubert (1992)	not specified			
Pollock & Suyderhoud (1992)	Based on your family history, to what age do you expect to live?			
Hurd & McGarry (1995)				Using any number from zero to ten where 0 equal absolutely no chance and 10 equal absolutely certain, what do you think are the chances you will live to be 75 or more?…85 or more?
Schoenbaum (1997)				As Hurd & McGarry (1995)
Mirowsky (1997), also see Mirowsky (1999), Mirowsky & Ross (2000) & Ross & Mirowsky (2002)	To what age do you expect to live?			

[18] Also asked subjective estimated 'rough' family life expectancy and ages at death of great-grandparents, grandparents, either parent and any sibling

[19] Also asked a question: Given everything that is objectively true about me, my best guess is that I will live until the age of … (referred to as Cognitive Subjective Life Expectancy, as distinct from "Affective Subjective Life Expectancy").

Van Doorn & Kasl (1998)				How likely do you think it is that you will live for another ten years? (very likely, likely, unlikely, very unlikely)
Hurd, McFadden & Merrill (1999), also see Gan, Hurd & McFadden (2003)				[Using any] number from 0 to 100 where ”0” means that you think there is absolutely no chance and “100” means that you think the event is absolutely sure to happen… What do you think the chances are that you will live to at least A?
Hurd & McGarry (2002)				Same as Hurd & McGarry (1995)
Wardle & Steptoe (2003)	Many people feel that they have some idea about their life span. Thinking about your life, what age do you think you will live to? Up to 70, 70-79, 80-89, 90-99 or over 100			
Society of Financial Advisers (2004)	If you were in a position to retire at 60, how long do you think you are going to live? (years)			
Banks, Emmerson & Oldfield (2004)				% chance you will live to 75 (different age for older groups)
Johns (2004)	If you had to take a guess			

	about how old you will be when you die, what would you say?			

Author	Answers (means)* *These are 10 independent surveys that demonstrate men give higher answers, in relation to actuarial tables, than women (no survey shows the opposite)				
	Subjective lifespan	Desired lifespan	Population lifespan	Subjective survival prob'y	Actuarial life table
Tolor & Murphy (1967)*(1)	M 77.6 SD 11.90 F 76.7 (SD 10.31)		M 69.2 (SD 4.16) F 72.9 (SD 3.70)		M 67.6 F 74.4
Handal (1969)	M 72.86, SD 9.01 F 72.12, SD 13.89		M 68.00 SD 8.04 F 70.67 SD 12.98		M 67.6 F 74.4
Teahan & Kastenbaum (1970)	Leaves 65.1 Stays 85.3				
Sabatini & Kastenbaum (1973)	mortuary science students 71.6; death class students 74.7; nursing home administrators 78.5	expected age at death > desired in 13% of cases			
Kastenbaum (1974)	12% showed a preference for dying before they expected to die				
Nelson & Hobbold (1980)*(2)	Exposed to early death: M 76.06, F 68.28 Not exposed to early death: M 74.48, F 74.53 Overall 73.92	M 86.77, F 83.77 Overall 84.75			
Nam & Harrington (1984)	79		71		
Hamermesh (1985) see also Hamermesh	Economists *26-39* 75.91 *40-65* 76.41 *All* 76.19 Others			Economists *26-39* .8358 (60) .3783 (80) *40-65* .8276	[20] Economists *26-39* 73.49 *40-65* 75.47 *All* 74.60

[20] Survival probabilities from actuarial life table:
Economists 26-39 .8443 (60), .3363 (80), *40-65* .8794 (60), .3628 (80)
Others *20-39* .8395 (60), .3344 (80), *40-70* .8878 (60), .3861 (80)

& Hamermesh (1983)	*20-39* 75.81 *40-70* 77.74 *All* 76.79			(60) .4078 (80) Others *20-39* .8027 (60) .4221 (80) *40-55* .8205 (60) .4597 (80)	Others *20-39* 73.24 *40-70* 76.56 *All* 74.92
Robbins[21] (1988a)	74.8 SD 12.1, range 40-85				74.1
Robbins (1988b)*(3)	M 77.6 F 77.2				M 72.4 F 79.2
Denes-Raj & Ehrlichman (1991)	SD in () PD 68.27 (13.53) PA 83.77 (8.96) Cognitive PD 72.22 (9.74) PA 79.05 (8.66)	PD not significantly different from PA though results not given	PD 77.67 (SD 10.98) PA 78.38 (SD 7.96)		
Joubert (1992)*(4)	M 80.7 (SD 13.1) F 80.1 (SD 12.1)				M 73.3 (for age 20) F 79.8
Pollock & Suyderhoud (1992)*(5)	M,F 25-29 etc 75.9, 76.6 78.5, 78.8 76.2, 78.1 77.0, 78,8 77.0, 78.4 77.4, 79.7 80.2, 81.5 79.6, 82.4 last=60-64				M,F 25-29 etc 79.8, 85.4 80.0, 85.3 80.1, 85.2 80.3, 85.1 80.3, 85.2 80.8, 85.4 81.5, 85.8 82.3, 86.4 last=60-64
Hurd & McGarry (1995)*(6)				Males 0.62 (75) 0.39 (85) Females 0.66 (75) 0.46 (85)	Males 0.60 (75) 0.26 (85) Females 0.75 (75) 0.45 (85)
Schoenbaum (1997)				Males (Females) Never smokers 0.670 (0.684) Former 0.631 (0.680) Current light 0.579 (0.625) Current	Males (Females) Never smokers 0.680 (8.828) Former 0.630 (0.696) Current light 0.594 (0.747) Current

[21] Subjective estimated 'rough' family life expectancy 75.0 (range 60-85, SD 8.0), age at death of all reported relatives 66.1 (range 43.5-81.7, SD 10.8)

				heavy 0.501 (0.601)	heavy 0.263 (0.308)
Mirowsky (1997), also see Mirowsky (1999), Mirowsky & Ross (2000) & Ross & Mirowsky (2002)*(7)	White males 81.139 Black males 81.901 White females 82.235 Black females 82.094				White males 77.981 Black males 71.553 White females 82.936 Black females 78.204
van Doorn & Kasl (1998)*(8)				M/F % Very likely 18.1/ 12.8 Likely 39.1/ 40.0 Unlikely 26.7/26.8 V unlikely 8.7/8.9	
Hurd, McFadden & Merrill (1999), also see Gan, Hurd & McFadden (2003)				To target age By baseline age in 5yr grp Waves 1, 2 Males 70- .508, .548 75- .382. .470 80- .332, .396 85- .314, .345 Females 70- .510, .558 75- .388, .469 80- .303, .399 85- .299, .376	To target age By baseline age in 5yr grp Waves 1, 2 Males 70- .389, .423 75- .226, .259 80- .098, .121 85- .034, .048 Females 70- .575, .605 75- .399, .432 80- .200, .228 85- .074, .091
Hurd & McGarry (2002)				Wave 1 Males 0.622 (75) 0.388 (85) Females 0.663 (75) 0.460 (85) Wave 2 Males 0.625 (75) 0.381 (85) Females 0.647 (75) 0.430 (85)	Wave 1 Males 0.594 (75) 0.42 (85) Females 0.746 (75) 0.438 (85) Wave 2 Males 0.608 (75) 0.247 (85) Females 0.756 (75) 0.444 (85)
Wardle & Steptoe (2003)	Answers reported in probability form			% expecting not to live beyond 80: Class I/II: 49.6M, 38.8F III: 40.5M, 39.8F IV/V: 50.9M, 44.9F	
Society of Financial Advisers	Under-estimate versus actuarial				

(2004)*(9)	table: 25-34: M 5.1, F 6.5 35-44: M 3.7, F 7.7 45-54: M 4.8, F 6.4 >55: M 2.2, F 7.0				
Banks, Emmerson & Oldfield (2004)[22] *(10)				M 50-54; .61 M 55-59: .63 M 60-64: .65 F 50-54: .66 F 55-59: .66 F 60-64: .66	M 50-54; .67 M 55-59: .70 M 60-64: .73 F 50-54: .77 F 55-59: .79 F 60-64: .82
Johns (2004)	SLE averaged 53.16 (SD 11.60, range 2.25-105.7)				

	Comments re male/female differences
Handal (1969)	Subjective lifespan exceeds actuarial estimate significantly ($p < 0.01$), for females, no significant difference. "for women, SLE appears to be a critical indicator of attitudes towards death, whereas, for men, it appears to be a manifestation of a defensive attitude towards death."
Joubert (1992)	SLE for men significantly > actuarial data ($t_{83} = 5.19$, $p < .001$) For women the difference was not significant ($t_{140} = 0.02$).
Mirowsky & Ross (2000)	Multiple regression for subjective life expectancy included a sex variable, where coefficient on male gender varied from -0.33 to -1.12

[22] The results are as assessed from the charts shown in the paper.

APPENDIX 2

Interview questions

Q1. We are going to ask you a few questions about your health, both now and in the future.
Firstly, thinking about your own health over the last 12 months, how would you describe your general level of health?

Excellent
Good
Fair
Poor
Very Poor
Don't know

Q2. Which of the statements on this card, if any, best applies to you?

I smoke every day
I smoke, but I don't smoke every day
I used to smoke but I have given up now
I have never smoked
Don't know

Q3. On average, approximately how many cigarettes do you smoke a day?

Q3a. On average, approximately how many cigarettes do you smoke a week?

Q4. Approximately how long ago did you give up smoking?

Q5. And approximately how many units of alcohol, if any, do you drink during an average week? One unit of alcohol is equal to half a pint of beer or larger, or a small glass of wine. Most alcopops are one and a half units.

Q6. The next couple of questions are asking about life expectancy. Even if you are unsure of your answers to the next three questions, please give us your best guess. I would now like you to think about other people of the same age and sex as yourself.
To what age would you expect them to live on average? Estimate if unsure.

Q7. And to what age would you expect yourself to live? Estimate if unsure.

The next few questions are asking about your parents. We are asking about them because there is a strong link between the health of a person and that of their parents.

Q8. Please could you tell me, whether your parents are still alive. Firstly your mother? Secondly your Father?

Q9a. IF MOTHER STILL ALIVE: How old is mother? Estimate is O.K. if unsure of exact age.

Q9b. IF FATHER STILL ALIVE: How old is your father? Estimate is o.k. if unsure of exact age.

Q10a IF MOTHER IS DEAD: And what age was your mother when she died? Estimate is o.k. if unsure of exact age.

Q10b. IF FATHER IS DEAD: And what age was your father when he died? Estimate is o.k. if unsure of exact age.

QLP3. This card explains various types of life assurance policies. Which, if any, of these do you have? PLEASE EMPHASISE: DO NOTinclude medical or accident insurance here. GIVE RESPONDENTS TIME TO READ CARD.

Whole of life
Mortgage life insurance
Death in service
Accidental death Insurance
Mortgage linked endowment policy
Have life assurance, don't know what type
Regular Long Term Savings Plan
Term Assurance/Protection
Other type of life insurance
Annuity
Don't have life assurance
Don't know
Any yes

QLP4. How long ago did you set up this (product) policy?

Up to 6 months
Over 6 months, up to 1 Year
Over 1 year, up to 5 years
Over 5 years, up to 10 years
More than 10 years
Don't know
Refused

QLP7a. I'd know like to ask you about pensions. Looking at this card, do you currently have contributions paid into any of the following pension schemes shown on this card?

Company/Employer Pension Scheme
Personal Pension Plan (PPPs)
State Earnings Related Pension Scheme (SERPS)
AVCs to company pension
Stakeholder Pension
FSAVCs (Free-standing additional)
Company Share Option Scheme
None of these
Don't know

QLP7b. Which type of company/employer pension scheme are you currently contributing to? Is it:

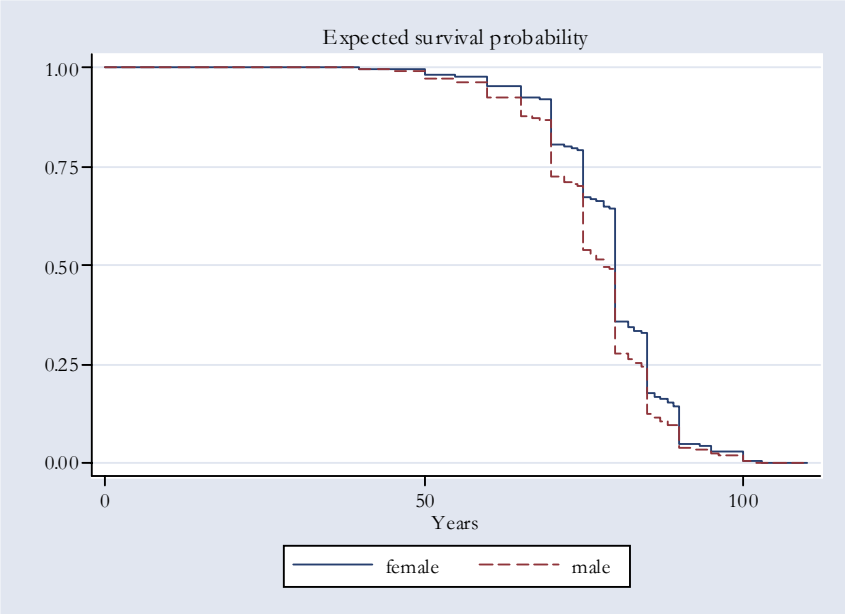
Final Salary Scheme (Sometimes called a Defined benefits scheme)
Money Purchase Scheme (Sometimes called a defined contributions scheme)
Other
Don't know

QLP8. And thinking about your PPP/Stakeholder Pension, how long did you set up this arrangement?

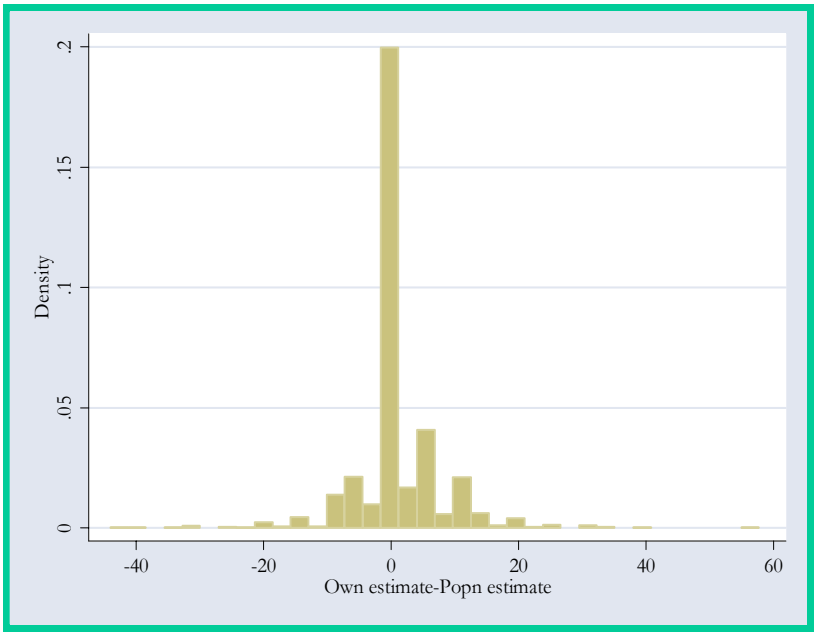
Up to 6 months
Over 6 months, up to 1 year
Over 1 year, up to 5 years
Over 5 years, up to 10 years
Don’t know
Refused

APPENDIX 3

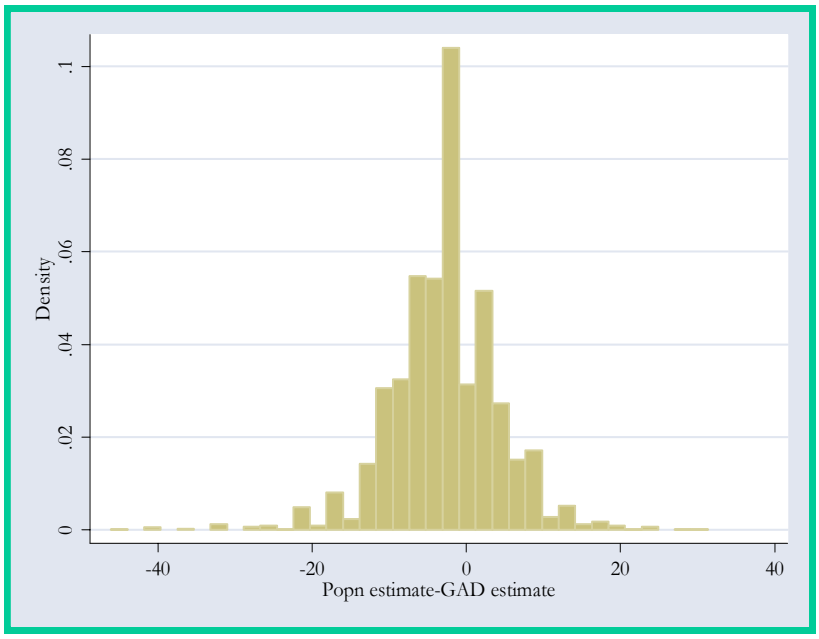
Survival curve based on self-perceptions



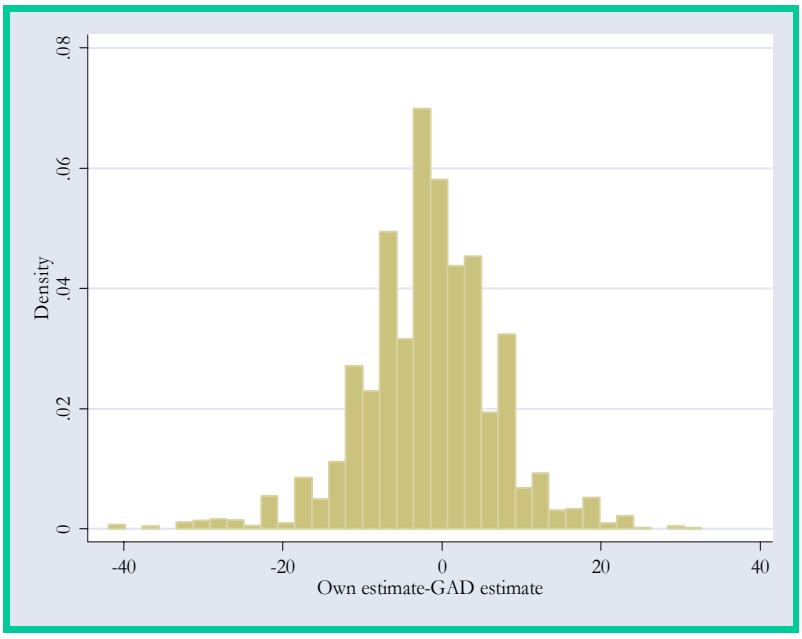
Distribution of difference between self-estimate and population estimate



Distribution of difference between population estimate and GAD current estimate



Distribution of difference between self-estimate and GAD current estimate



APPENDIX 4

Probit regression results: holdings of pensions and insurance

	(1)	(2)	(3)	(4)	(5)
	personal pensions	voluntary pensions	whole life	term life	all life
Own estimate-Popn estimate	0.0001	-0.0001	0.0013	0.0007	0.0006
	(0.912)	(0.910)	(0.404)	(0.375)	(0.785)
Popn estimate-GAD estimate	0.0009	0.0011	-0.0022	0.0015	-0.0003
	(0.360)	(0.318)	(0.153)	(0.036)	(0.893)
Female	-0.0532	-0.0604	-0.0155	0.0060	-0.0069
	(0.000)	(0.000)	(0.439)	(0.493)	(0.798)
Age	0.0004	0.0005	0.0048	0.0002	0.0017
	(0.691)	(0.587)	(0.000)	(0.718)	(0.281)
Married	-0.0119	-0.0276	0.0306	0.0226	0.0388
	(0.599)	(0.279)	(0.371)	(0.211)	(0.398)
Living together	-0.0073	-0.0359	-0.0895	-0.0042	-0.0534
	(0.781)	(0.186)	(0.025)	(0.847)	(0.352)
Single	-0.0382	-0.0578	-0.0712	-0.0226	-0.1813
	(0.118)	(0.028)	(0.064)	(0.267)	(0.001)
Widowed	-0.0219	-0.0455	0.0682	0.0599	0.0983
	(0.551)	(0.246)	(0.153)	(0.084)	(0.115)
Good health	-0.0200	-0.0136	-0.0026	-0.0002	-0.0259
	(0.154)	(0.396)	(0.910)	(0.983)	(0.416)
Fair health	-0.0071	-0.0039	-0.0514	0.0043	-0.0165
	(0.699)	(0.856)	(0.072)	(0.763)	(0.687)
Poor health	-0.0332	-0.0276	-0.0132	-0.0100	-0.0043
	(0.203)	(0.370)	(0.731)	(0.615)	(0.937)
Very poor health	-0.0324	0.0102	-0.0772	-0.0109	-0.0803
	(0.493)	(0.872)	(0.153)	(0.720)	(0.365)

Smoke daily	-0.1866	-0.2228	-0.2772	0.6673	-0.2981
	(0.017)	(0.012)	(0.057)	(0.000)	(0.323)
Smoke not daily	-0.1321	-0.1621	-0.2768	0.7230	-0.2587
	(0.051)	(0.037)	(0.047)	(0.000)	(0.395)
Ex-smoker	-0.1787	-0.2149	-0.3306	0.5637	-0.2714
	(0.059)	(0.044)	(0.046)	(0.000)	(0.374)
Post GCSE education	0.0036	-0.0007	-0.0383	0.0180	-0.0361
	(0.728)	(0.948)	(0.030)	(0.007)	(0.126)
Household income	0.0140	0.0180	0.0134	0.0073	0.0420
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
1-10 units alcohol	0.0057	0.0111	0.0135	0.0068	0.0437
	(0.748)	(0.583)	(0.580)	(0.582)	(0.193)
11-20 units alcohol	0.0222	0.0396	-0.0146	0.0071	0.0619
	(0.335)	(0.138)	(0.646)	(0.661)	(0.152)
21-30 units alcohol	0.0458	0.0495	-0.0221	0.0019	0.0457
	(0.181)	(0.188)	(0.621)	(0.925)	(0.474)
Over 30 units alcohol	-0.0140	-0.0138	-0.0050	0.0325	-0.0147
	(0.652)	(0.704)	(0.923)	(0.290)	(0.847)
Mother's age (alive)	0.0012	0.0015	0.0000	0.0005	0.0013
	(0.122)	(0.060)	(0.959)	(0.281)	(0.311)
Father's age (alive)	0.0003	0.0004	0.0000	0.0002	0.0007
	(0.577)	(0.508)	(0.984)	(0.563)	(0.553)
Mother's age (dead)	0.0011	0.0014	-0.0000	0.0002	0.0005
	(0.204)	(0.132)	(0.999)	(0.744)	(0.750)
Father's age (dead)	-0.0002	-0.0002	-0.0003	0.0003	0.0002
	(0.792)	(0.828)	(0.754)	(0.498)	(0.895)
Company pension	-0.0752	-0.0465			
	(0.000)	(0.001)			
Observations	1557	1557	1732	1732	1732
Robust p values in parentheses					

APPENDIX 5

Probit regression results: purchase within last 5 years of pensions and insurance

	(1)	(2)	(3)
	personal pensions	whole life	term life
Own estimate-Popn estimate	-0.0001	-0.0004	0.0008
	(0.741)	(0.391)	(0.131)
Popn estimate-GAD estimate	0.0014	-0.0007	0.0013
	(0.000)	(0.229)	(0.001)
Female	-0.0052	0.0087	0.0101
	(0.241)	(0.240)	(0.065)
Age	0.0001	-0.0002	-0.0004
	(0.872)	(0.660)	(0.309)
Married	0.0009	0.0001	0.0035
	(0.914)	(0.991)	(0.759)
Living together	0.0053	-0.0109	0.0066
	(0.643)	(0.386)	(0.673)
Single	-0.0164	-0.0139	-0.0126
	(0.071)	(0.291)	(0.273)
Good health	-0.0043	0.0060	0.0016
	(0.362)	(0.473)	(0.803)
Fair health	0.0022	0.0177	0.0016
	(0.763)	(0.161)	(0.857)
Smoke daily	-0.0839	-0.1121	0.4668
	(0.002)	(0.002)	(0.000)
Smoke not daily	-0.0585	-0.0949	0.5283
	(0.004)	(0.003)	(0.000)
Ex-smoker	-0.1468	-0.1571	0.3253
	(0.002)	(0.003)	(0.000)
Post GCSE education	0.0012	-0.0035	0.0023
	(0.745)	(0.598)	(0.614)
Household income	0.0022	0.0041	0.0029
	(0.003)	(0.001)	(0.001)

1-10 units alcohol	-0.0086	0.0140	0.0013
	(0.204)	(0.182)	(0.858)
11-20 units alcohol	0.0084	0.0295	0.0053
	(0.330)	(0.073)	(0.603)
21-30 units alcohol	-0.0087	0.0010	-0.0039
	(0.194)	(0.959)	(0.739)
Over 30 units alcohol	-0.0064	-0.0017	
	(0.527)	(0.941)	
Mother's age (alive)	-0.0004	0.0001	-0.0001
	(0.129)	(0.670)	(0.621)
Father's age (alive)	0.0003	-0.0001	0.0003
	(0.203)	(0.839)	(0.317)
Mother's age (dead)	-0.0004	0.0002	-0.0002
	(0.160)	(0.588)	(0.547)
Father's age (dead)	0.0002	-0.0003	0.0003
	(0.478)	(0.382)	(0.331)
Company pension	-0.0040		
	(0.399)		
Widowed		-0.0052	0.0227
		(0.790)	(0.343)
Poor health		0.0074	
		(0.664)	
Observations	1341	1689	1494
Robust p values in parentheses			