

WORKING P A P E R

Attrition and Health in Ageing Studies

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RAND LABOR AND POPULATION

Attrition and health in ageing studies: Evidence from ELSA and HRS

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Abstract

In this paper we present results of an investigation into observable characteristics associated with attrition in ELSA and the HRS, with a particular focus on whether attrition is systematically related to health outcomes and socioeconomic status (SES). Investigating the links between health and SES is one of the primary goals of the ELSA and HRS, so attrition correlated with these outcomes is a critical concern. We explored some possible reasons for these differences. Survey maturity, mobility, respondent burden, interviewer quality, and differing sampling methods all fail to account for the gap. Differential respondent incentives may play some role, but the impact of respondent incentive is difficult to test. Apparently, cultural differences between the US and Europe population in agreeing to participate and remain in scientific surveys are a more likely explanation.

Introduction

In recent years, we have witnessed the development of large longitudinal studies of ageing in many countries around the world. The U.S. Health and Retirement Study (HRS), launched in 1992, provided a template for studies such as the English Longitudinal Study of Ageing (ELSA), the Survey of Health, Ageing and Retirement in Europe (SHARE), the Korean Longitudinal Study of Ageing (KLOSA), the Chinese Health and Retirement Survey (CHARLS), the Longitudinal Ageing Survey in India (LASI), and several more surveys in the field or in development in other countries.

These new ageing studies, which share a comparable template, provide rich sources of information for researchers interested in the dynamics of health, socioeconomic status, retirement, and wellbeing among ageing populations. Their panel nature allows us to investigate the nature and determinants of within-person and within-household experiences in retirement and

health onsets, and the manner in which these central life domains co-relate. There are now more than 25 countries in the world who have initiated such comparable longitudinal ageing studies and more countries are certainly on the way.

An important concern with all panel studies, and particularly those focused on an older population, is the potential for bias caused by individuals non-randomly dropping out of the survey over time. If attrition from a survey is systematically related to outcomes of interest or to variables correlated with these outcomes, then not only will the survey cease to be representative of the population of interest, but estimates of the relationships between different key outcomes, especially in a longitudinal context, may also be biased.

The issue of non-response in longitudinal surveys—both initial non-response and subsequent attrition—has a distinguished history in survey research and statistics (Sudman and Bradburn, 1974, Groves and Couper, 1998, Little and Rubin, 1987). Most of the existing literature has focused on non-ageing panels in the United States, especially during earlier time periods when attrition rates typically were considerably lower (Beckett et al., 1988; Fitzgerald et al., 1998; Lillard and Panis, 1998; Zapel, 1998).

In this paper we present results of an investigation into observable characteristics associated with attrition in ELSA and the HRS, with a particular focus on whether attrition is systematically related to health outcomes and socioeconomic status (SES). Investigating the links between health and SES is one of the primary goals of the ELSA and HRS, so attrition correlated with these outcomes is a critical concern.

We begin by looking at raw rates of attrition in the two surveys, and show that panel attrition is a far greater problem in ELSA than in HRS. We consider several possible explanations for ELSA's poorer retention rates, including the greater 'maturity' of HRS (which

has been running for ten years longer than ELSA), differences in sampling rules and procedures used in the two surveys, the ‘quality’ of the two respective survey organizations, and differences in incentives offered to respondents. We conclude that none of these explanations alone or together seems sufficient to account for the disparity in attrition rates between the two surveys.

Having documented raw attrition rates in ELSA and HRS, we then consider the possible bias such attrition could introduce into estimates of disease prevalence derived from the two surveys. In recent papers, we have used data from these surveys to demonstrate that middle-aged and older Americans are substantially less healthy than their English counterparts, across a range of important illnesses (Banks et al., 2006; Banks, Muriel, and Smith, 2010). In the same research, we highlighted a substantial socioeconomic gradient in health in both countries, a gradient which is present whether education, income, or financial wealth is used as a measure of socioeconomic status (SES). This gradient persists (in both countries) even after controlling for behavioral risk factors. However, if attrition is systematically related to health and/or SES in ELSA or HRS, this attrition may have implications for our estimates of disease prevalence or for the SES gradient in health. Since our earlier research focused on two age groups in England and the United States—those aged 55 to 64, and an older group aged 70 to 80—it is those same age groups on which we focus in this paper.

Having established that attrition does not change the core conclusion of this work—that Americans have higher rates of disease prevalence at older ages—we go on to a broader investigation of observable characteristics which systematically predict attrition in the two surveys. We find few observable characteristics that predict attrition in either study among those in their seventies. In the group aged 55-64, wealth appears to predict attrition in the U.S. (but not in England), and low education predicts attrition in England (but not the U.S.). Since the more

serious attrition problem exists in ELSA, we conduct additional analysis of attrition in that survey. We find that respondents' level of numeracy strongly predicts attrition, but does not account for the education gradient in attrition in ELSA.

Many modern longitudinal surveys have adopted the practice of attempting to convince attritors from prior waves to return as participants in the panel. This retrieval of prior wave attritors may be important in maintaining the long-run viability of the panel. Given the rising importance of returnees in panel studies, we present a 'returnee' analysis for both the HRS and ELSA surveys.

This paper is divided into six sections. Section 1 summarizes the data used in our analysis, while the following section describes the most salient patterns of attrition in HRS and ELSA. The third section evaluates some possible reasons for the much higher rate of attrition in ELSA compared to HRS. Section 4 sets out comparative patterns of disease prevalence in the two countries, and explores how these patterns might be altered when we take into account attrition. Section 5 presents models that attempt to identify personal attributes that appear to predict subsequent attrition in both countries. The final section contains our main conclusions.

1. Data

This research presents evidence from two comparable designed ageing studies in the U.S. and England respectively. The studies were purposely designed to be very comparable in terms of population sampling, periodicity, broad content, and in many cases even the specific wording of questions. The Health and Retirement Study (HRS) is a nationally representative sample of the population aged 50 and over in the United States (Juster and Suzman, 1995). The initial HRS cohorts were sampled in the early 1990s and subsequent cohorts have been added to establish and maintain full age representation of the post age 50 population. Follow-ups have taken place

at two-year intervals since 1992. In this research, we will use a sample of Non-Hispanic Whites, to ensure greater comparability with the English sample. For example, it is well known that African-Americans suffer much worse health outcomes in the U.S (Hayward et al., 2000), and we want our cross-country comparisons to be independent of the quite distinct racial and ethnic composition of the countries.

Questions were asked in each HRS wave about self-reports of general health status, the prevalence and incidence of many chronic conditions, functional status and disability, and medical expenditures. Other related health variables include depression scales, health insurance, smoking and physical exercise.

Data from England come from the English Longitudinal Study of Ageing (ELSA). In ELSA, around 12,000 respondents from three separate years of the Health Survey for England (HSE) survey were recruited to provide a representative sample of the English population aged 50 and over. Detailed employment, income, wage, and asset modules have been fielded and the quality of the baseline data appears to be quite high. The first wave of ELSA was conducted in 2002, and three waves are available for this research.

ELSA content is especially rich in the health domain. Its health module collects information on self-reported general health, specific diagnoses of disease (hypertension, heart disease, diabetes, stroke, chronic lung diseases, asthma, arthritis and osteoporosis, cancer, and emotional and mental illness including depression, memory and cognitive assessment, disability and functioning status (e.g., ADLs and IADLs), health behaviors (smoking, alcohol consumption, and physical activity), and symptoms of heart disease (dizziness and chest pain (the Rose Angina Questionnaire)). While not identical, many of these modules closely parallel

those available in HRS. For prior lifetime prevalence, both surveys collect data on individual self-reports of specific diseases of the general form ‘Did a doctor ever tell you that you had ...’

Both HRS and ELSA are known to have directly comparable high quality measurement of several dimensions of social-economic status—importantly, for our purposes, education and income—as well as demographic variables. A unique aspect of both these surveys is that they also contain high-quality wealth modules using a comprehensive and detailed set of questions on the important components of wealth (Juster and Smith, 1997).

Finally, both surveys also track the mortality of survey participants, even among those who left the survey in the years before their death. Each survey is matched to the relevant country’s National Death Index (which includes information about date and cause of death of all respondents regardless of their participation in subsequent waves of the survey).¹ These matches with the national death indexes are highly successful—over 95% of individuals give permission for their records to be linked and are successfully matched.

This mortality information is important for our analysis, since it allows us to distinguish between those who dropped out of each survey voluntarily (despite still being alive) from those who simply died. In this paper we define individuals as having ‘attrited’ if they do not respond to the survey, but are not dead according to the mortality data.

For the purpose of maintaining comparability, in this paper we use the 2002, 2004, and 2006 waves from ELSA as well as from the HRS, since these are the only years for which ELSA data is currently available. We will discuss below the implications of this choice for the conclusions that we derive from the HRS.

¹ In each country, the linked data (the National Death Index in the U.S. and the National Health Service Central Register Database in England) is the data which, at the population level, is used to compute official life tables.

2. Patterns of attrition in ELSA and the HRS

Losses from the sample in panel surveys of the elderly can be traced to two main sources—mortality and sample attrition. Sample attrition is more complicated given that both HRS and ELSA have, as part of their design, an attempt to bring back into the panel respondents who previously attrited. Another complication in comparing these surveys is that by the time of the beginning of the ELSA panel, HRS was a more mature panel in that some respondents had been interviewed for as many as six waves. In this section, we highlight the most salient patterns of sample lost in HRS and ELSA over the same period of time—calendar years 2002 to 2006—the maximum window allowed in ELSA.

Figure 1 compares rates of attrition and mortality among 55-64 year olds in ELSA and the HRS between 2002 and 2006 (these years comprise the first and third waves of ELSA). For HRS respondents, the years 2002 and 2006 correspond to different wave numbers depending on which cohort they belonged to, extending from the sixth and eighth wave for the original HRS cohort (51-61 years old in 1992) who would have largely aged out of the 55-64 year old age group in 2002, to the third to fifth wave for those cohorts added to the HRS in 1998. (Further details regarding the HRS's cohort design are given in Section 3, below.)

We divide individuals who responded in 2002 into four mutually exclusive categories: (1) Those who responded to all three survey waves (2002, 2004 and 2006). (2) Those who responded in 2002 but did not respond in 2006 (having dropped out of the survey either in 2004 or in 2006). We refer to these individuals as 'attriters.' (3) Those who responded in 2002, did not respond in 2004, but returned to the survey in 2006. We refer to these individuals as 'returners.' (4) Those who responded in 2002, but subsequently died. It should be noted that the category

whom we label ‘attriters’ may become ‘returners’ in future waves if they come back into the survey. Our categories only apply for events that occurred within the survey window 2002-2006.

Looking at the two leftmost bars in Figure 1, which show attrition rates for the 55-64 year old sample in both HRS and ELSA, it is immediately apparent that attrition is substantially higher in ELSA. A total of 88% of HRS respondents in this age group responded to all three waves, while in ELSA this fraction is just 68%. Moreover, this large difference in retention is not accounted for by differential mortality in the two countries, which shows broadly similar overall mortality rates in both countries (around 4% in this age group). It is differential attrition which accounts for the disparity—with ELSA having an attrition rate across two waves nearly four times higher than the rate in HRS (less than 7% of HRS respondents drop out of the survey between 2002 and 2006, compared with more than 26% in ELSA). Our final category, the ‘returners’ who drop out in 2004 but return in 2006, comprise 2.6% of the ELSA sample, and 1.3% of the HRS sample. As a fraction of those who did attrit between 2002 and 2004, HRS was also more successful in ‘recovering’ individuals who drop out of the survey. A total of 15% of HRS attriters subsequently return, compared with less than 10% of attriters in ELSA.

The remaining bars in Figure 1 illustrate how rates of retention, attrition and mortality vary according to disease prevalence in 2002, among four diseases for which we have comparable information in the HRS and ELSA—cancer, stroke, diabetes and arthritis. Not surprisingly, among individuals who had been diagnosed with cancer at baseline, retention rates are lower than for the full sample (83% in the HRS, 62% in ELSA), and the same holds true for individuals diagnosed with stroke (83% retention in the HRS, 55% in ELSA). However, much of this lower retention stems from mortality, rather than attrition, with mortality rates of 10-12% in both countries among respondents diagnosed with stroke or cancer. Rates of attrition among

cancer sufferers are actually lower than those for the full sample in both countries (5% in the HRS, 23% in ELSA). Among individuals diagnosed with stroke, attrition rates are lower than the rate for the full sample in the HRS (4% of stroke victims attrited), but higher in ELSA (32% attrition among stroke victims). For the two less severe conditions, diabetes and arthritis, retention rates are broadly unchanged from those observed in the full sample (around two-thirds retention in ELSA, and four-fifths in the HRS).

Figure 2 provides the same breakdown of retention, attrition and mortality for our older age group—individuals aged 70 to 80. Retention rates are once again higher in the HRS, which retained over 78% of 70-80 year olds between 2002 and 2006, compared with less than 63% in ELSA. Again mortality rates are broadly similar in both countries (around 15%), with the difference in retention driven entirely by ELSA's higher attrition—nearly 23%, compared with just 6% in the HRS.

Turning to rates arrayed by baseline disease prevalence, we again find lower retention rates among individuals who had been diagnosed with cancer at baseline—74% of cancer sufferers are retained in the HRS, and 53% in ELSA. For stroke victims, retention rates are lower still in both surveys—62% in the HRS, 51% in ELSA. As with the younger age group, these differences in retention are driven by mortality rather than attrition. The mortality rate among cancer sufferers is 23% in the HRS, 25% in ELSA. Among those diagnosed with stroke, the mortality rate is 32% in the HRS, 24% in ELSA. Similarly, diabetes is not associated with significantly higher attrition in this age group, but is associated with higher mortality—25% of diabetes sufferers in the HRS had died by 2006, as had 20% of those in ELSA. Arthritis, however, is not associated with either higher attrition or mortality.

In summary, we have demonstrated that attrition is a far greater problem in ELSA than in the HRS, with attrition rates nearly four times higher in the English study. This is true in both the 55-64 and 70-80 year old age groups. When we examine how rates of attrition vary by baseline disease prevalence, we find similar patterns in both countries, with significantly lower retention among cancer and stroke victims. However, this difference appears to be driven largely by mortality, rather than different rates of attrition.

It is important to point out that the attrition rates in ELSA are not high by the standard of other ageing panels in Europe. For example, in the SHARE survey of twelve continental European countries the combined lost to sample from attrition and mortality between the first and second waves alone was 40%.² Since mortality rates are if anything lower in continental Europe, this higher sample lost is due to even greater rates of attrition in SHARE.

Our primary interest in this paper concerns the effects of differential attrition and not lost to sample due to mortality, which has been investigated elsewhere (Attanasio and Hoynes, 2000; Banks, Muriel, and Smith, 2010)). With that objective in mind in Table 1 we repeat the division of individuals in these age groups into those who remain in all three waves, those who attrit, and those who return—but we now remove individuals who died between 2002 and 2006 from the sample. Table 1 also adds an extra category: ‘healthy’ individuals, who are not suffering from any of the conditions listed in the table and are also free from heart conditions³. Removing deaths from the sample in this way makes clear that, among the 55-64 year old age group, attrition appears to be slightly *lower* among individuals who are suffering from health problems

² <http://www.share-project.org>

³ Heart problems are not included directly in Table 1, as we do not have a perfectly comparable measure of heart complaints between the two surveys. ELSA asks about a series of specific conditions: angina, congestive heart failure, heart murmur, and heart attack. The HRS, in contrast, asks a generic question about heart problems in general.

at baseline (with the exception of stroke victims in ELSA, whose attrition rate is 36% compared with 27% for the healthy sample). In the 70-80 year old age group, there is no clear association between baseline health and attrition. In general, attrition among individuals with baseline health problems is of similar magnitude to attrition among the healthy sample.

3. Explaining the higher attrition rate in ELSA

Why is the attrition rate in ELSA so much higher than in HRS? Numerous factors contribute to a panel survey's retention rate, so it is worth considering potential explanations for ELSA's high rate of attrition compared with HRS. One obvious place to start is the differing 'maturity' of the two panels in 2002. More mature panels may be characterized by lower rates of attrition since the least committed respondents may have long since gone.

Gauging the relative 'maturity' of the ELSA and HRS panels is not that straightforward. On the HRS side, in 2002 some respondents (the original birth cohort ages 51-61 in 1992 who would be 61-71 years old in 2002) were in their sixth wave of participation. The AHEAD cohort was initially sampled in 1995 when they were 70 years old or over so that the 2002 wave was their fifth wave. In 1998, two new cohorts were added—the Children of the Depression (CODA-62-69 years old in 1992), and the War Babies cohort (born between 1942 and 1947 and between ages 55-62 in 2002). These two new cohorts were in their third wave of participation in 2002. In summary, HRS respondents in 2002 had previously participated in the survey from anywhere from three to six waves. It is possible, therefore, that individuals with a high propensity to drop out had already left the HRS by 2002.⁴

The 'maturity' of the ELSA sample is not entirely straightforward either. As explained above, all ELSA respondents were recruited from a prior wave of the Health Survey for England

⁴ Even this is not a full summary since new spouses can join the survey at any wave.

(HSE) so that 2002 actually represented their second wave of participation in a survey with varying years of periodicity depending on the year of the initial wave of the HSE. But it does remain true that, on average, HRS respondents had been members of the panel for more waves than ELSA respondents and had initially joined the survey in an earlier calendar year.

We can look for evidence of this effect by examining retention rates among new HRS cohorts, who were being interviewed for the first time. While there was no new HRS cohort in 2002, there was a new cohort of 51 to 56 year olds added to the HRS in 2004. One problem with using this new cohort is their relatively young age, since younger working respondents tend to exhibit higher attrition. The attrition rate for this cohort between 2004 and 2006 was just 10.6%. A new cohort was also added to the HRS in 1998—and attrition rates for this cohort were lower still: just 7.3% to the next wave in 2000, perhaps indicating that attrition rates in surveys in western countries have risen over time. Among ELSA respondents aged 51 to 56, between their first and second waves (2002 to 2004), attrition was 19%. The ‘mature survey’ explanation, therefore, cannot by itself explain the disparity in attrition rates.

Another possible explanation would center on different levels of mobility in the two countries. A key challenge for any household panel study is simply keeping track of families as they move over time. But mobility at older ages is actually much higher in the United States than it is in England (Banks, Oldfield, and Smith, 2009), which would argue for higher attrition in the U.S. than in England. This, clearly, cannot explain the higher rates of attrition in ELSA.

Differential ‘respondent burden’ is another oft-cited reason for non-response (Groves and Couper, 1998; Zabel, 1998). Given how closely ELSA’s questionnaire was modeled on the HRS, this explanation is unlikely—average interview length is almost identical (around one and a half hours) in both surveys.

The ‘incentives’ offered to respondents to take part in the two surveys may be a driver of differential retention (Hill and Willis, 2001). Both ELSA and the HRS offer ‘rewards’ to respondents to thank them for taking part. The reward offered by the HRS is larger than that offered by ELSA: \$100 per person in the HRS, compared compared to £10 per person (around \$15 at current exchange rates) in ELSA. ELSA respondents may be under-incentivized compared to HRS respondents so that differential incentives may be a contributing factor.

ELSA and HRS also differ somewhat in their sampling methodology in the treatment of individuals and households. ELSA is a sample of *households*, so that if a household is randomly chosen for interview, *all age* eligible individuals in that household (everyone aged 50 and over) will be added to the ELSA sample. HRS, in contrast, is a sample of *families*, so that when an individual aged over 50 is selected for interview, their *partner* (if they are part of a couple) will also be sampled for the HRS. But other members of the household will not be added to the HRS sample, regardless of whether or not their age would make them eligible.

Table 2 addresses this issue directly, by investigating attrition rates at the household level between 2002 and 2004 according to the number of respondents in the household. In this Table, we exclude all households in which a death occurred. We divide households into three categories: (1) households which don’t attrit at all (no household members leave the survey); (2) households which *partially* attrit (some but not all household members leave the survey); and (3) households which *completely* attrit (all members of the household leave at the same time).

Overall ELSA attrition is quite high when there are three or more respondents in the household, casting some doubt on whether that is a viable sampling strategy in industrialized Western countries. However, this situation involves only 30 households in ELSA, so it cannot account for differential attrition between the surveys.

The more relevant case is when there are two respondents in the household—typically the wife and husband. Sampling partners was an innovation of both HRS and ELSA and stands in sharp contrast to typical panels such as the PSID and BHPS which rely on a single respondent who answers questions for both partners (Fitzgerald et al., 1998). Existing research has shown that the quality of health information reported for the partner is much lower (Weir and Smith, 2007; Smith, 2007). Is this gain in data quality about the partner offset by greater difficulty in keeping people in the sample when there are two of them?

The data in Table 2 suggest there is no additional attrition loss by making both partners panel members. In both HRS and ELSA, overall attrition in two person households is almost identical to that in one person households. Attrition decisions are certainly correlated between spouses, since if one person attrits the probability that the other partner also attrits is about 70% in both ELSA and HRS. This often occurs when one irate spouse may deny access to the other in the interviewing process. However, different sampling procedures of households and families in ELSA and HRS design fails to explain any of the differential attrition between the two surveys.

In addition to this difference in sampling, the two surveys also differ in their default mode of interview. All ELSA interviews are conducted face to face but HRS interviews can take place either by phone or face to face. However, attrition rates in HRS do not vary by mode of interview, indicating that this once again is unlikely to be a significant explanation of the attrition difference between the surveys.

With the exception of the very different financial incentives for participation, none of the other structural differences in survey design appears to be able to account for the substantial difference in attrition between these two surveys. We therefore move on to investigate the extent to which other differences in survey implementation could play a role. After all, one hypothesis

that has to be considered is that the HRS survey interview team may be better-trained, more experienced, or otherwise better equipped to retain sample members compared with the ELSA team. We attempt to cast some light on this question by using information on the retention rates of individual interviewers in ELSA.

ELSA links respondents to the interviewer who administered their 2002 survey questionnaire. For each interviewer, we observe the fraction of their 2002 respondents who remained in the survey in 2004. For each ELSA respondent we calculate their interviewer's 'leave one out' retention rate (that is, the interviewer's retention rate for all respondents *apart from* the individual we are currently considering). This is a number between zero and one, with zero implying that no other respondents questioned by this interviewer remained in the survey (100% attrition), and one implying that all were retained (0% attrition). We take this as an imperfect but useful indicator of 'interviewer quality.'⁵

Figure 3 shows a histogram of interviewer retention rates (at the interviewer level) between 2002 and 2004. We see that although the distribution is reasonably dense around the mean retention rate of 75.8%, the distribution is quite wide.⁶ The bottom 10% of interviewers see less than two-thirds of their respondents retained in the survey, while the top 10% see retention of close to 90% and above.

One way of gauging whether the 'quality' of interviewers could account for differential attrition is to eliminate the bottom tail of the ELSA interviewer distribution, and calculate the impact this would have on ELSA's retention rate. As a first calculation, we compute the ELSA

⁵ We use the word 'imperfect' since occasionally ELSA respondents who prove difficult to contact (or reluctant to respond) are handed to some of the most experienced members of the interview team, so that the 'best' interviewers are often allocated the hardest cases. Since cases are therefore not completely randomly assigned, the attrition rate of an interviewer is therefore not a perfect guide to interviewer quality. This is less of a problem at baseline.

⁶ 75.8% is the mean retention rate without weighting to take into account the number of interviews conducted by each interviewer. When we weight by number of interviews, the mean retention rate matches ELSA's overall retention rate of 77.6%.

retention rate if the bottom 25% of interviewers had the same mean retention rate as the top 75%. This would improve ELSA's overall (weighted by number of interviews) retention rate by just three percentage points, from 77.6% to 80.6%. As a more extreme truncation of the interviewer distribution, we compute the ELSA retention rate if the bottom 50% of interviewers had the same mean retention as the top 50%. This would increase ELSA's overall retention by less than seven percentage points, from 77.6% to 84.3%. In fact, for ELSA to match HRS's retention rate of 95.5%, we would need to remove the bottom 90% of the interviewer distribution, and allocate them the same mean retention rate as the top 10%. This is an extremely large change in the distribution of interviewer retention, suggesting that differential interviewer quality is not the primary reason for the ELSA's higher between wave attrition. This should not be surprising since both survey organizations (NatCen in England and ISR in America) have stellar reputations.

In summary, the causes of ELSA's higher attrition rates compared with HRS remain elusive. Survey maturity, mobility, respondent burden, interviewer quality, and differing sampling methods all fail to account for the gap. Differential respondent incentives may play some role, but the impact of respondent incentives is difficult to test in this case, given the absence of experimental variation. Existing research on respondent incentives does indicate that this is too large an attrition gap for incentives alone to explain (Groves and Couper, 1998).

Our research instead suggests that conducting panel surveys with high initial response rates and low rates of attrition is simply more difficult in England (and by extension Western European countries, in light of the SHARE experience) than in the U.S. Apparently, cultural differences between the North America and European population in agreeing to participate and remain in scientific surveys are the more likely explanation. Even in the United States, initial

response rates of new HRS cohorts have been declining and attrition rates have been rising somewhat, indicating that the scientific challenges in conducting high-quality panel surveys are becoming more daunting. In contrast, these challenges appear to be much less severe in developing countries where attrition rates appear to be considerably lower (Thomas et al., 2001).

4. The impact of attrition on estimates of disease prevalence

We turn next to the impact attrition has on a key outcome of interest—estimates of disease prevalence in the two countries. One of the primary uses of HRS and ELSA involves conducting longitudinal analysis of health status. A concern for both surveys, but particularly ELSA, is the impact attrition has on key outcomes of interest, such as health and the SES-health gradient. In this section, we examine the effect of attrition on estimates of disease prevalence

In previous work (Banks et al., 2006), we compared the prevalence a number of diseases (stroke, lung disease, cancer, hypertension, diabetes, and heart problems) among middle-age adults (aged 55-64 years old) in England and in the United States. We found that Americans were much less healthy than their English counterparts. These differences were large along all points of the socioeconomic status distribution and were present in biological measures of health as well as self-reported disease prevalence.

In a recent extension of this work (Banks, Muriel, and Smith, 2010), we examined disease prevalence for an older age group (70-80 year olds), and explored patterns in new onsets of disease (‘incidence’) among both 55-64 and 70-80 year olds. Using data from ELSA and HRS, Table 3 summarizes the main results. We find that disease incidence and prevalence are both higher among the Americans in age groups 55-64 and 70-80, indicating that Americans suffer not only from higher past cumulative disease risk (as indicated by their higher disease

prevalence), but also experience higher immediate risk of new disease onset or incidence compared to the English.

Table 4 examines the extent to which the health status of the baseline sample (respondents in 2002) is altered when we restrict the sample in various ways to take account of sample retention. The top row of each panel (“All 2002 respondents”) shows disease prevalence for the full 2002 sample—the same numbers shown in Table 3. In the rows below, we show baseline disease prevalence among four subsamples: (1) individuals who responded in 2002 and were still alive in 2007; (2) individuals who responded in 2002 and were dead by 2007; (3) individuals who responded in 2002 and attrited from the survey by 2006 (but did not die); and (4) the balanced sample—individuals who responded to all three waves, in 2002, 2004, and 2006.

Among our first subgroup, those who remained alive to 2007, we see not surprisingly somewhat lower baseline disease prevalence in both surveys (this is true of both the 55-64 and 70-80 age groups). Among those who died between 2002 and 2007, baseline disease prevalence is substantially higher—especially among the most serious conditions (stroke, heart attack, lung disease, cancer) where 2002 prevalence is often more than twice as high as in the whole sample.

Our key concern is the effects of attrition on disease prevalence and incidence. Starting with the 55-64 year old age group in ELSA (the top panel of Table 4), baseline disease prevalence among attriters is almost identical to prevalence in the full sample. For the same age group in the HRS, attriters appear if anything to be slightly healthier than the full sample. Turning to the older age group (the lower panels of Table 4); we again observe very small differences in estimated disease prevalence between the attritor and full sample in either ELSA or HRS.

The final row of each panel of Table 4 displays disease prevalence among the three wave balanced panel (individuals who responded to the 2002, 2004, and 2006 surveys). Among 55-64 year olds, in both ELSA and HRS, disease prevalence in the balanced panel remains similar to that in the full baseline sample, but is slightly lower for all conditions, largely due to mortality bias and not attrition. In this age group, even the ‘survivor’ bias is small since mortality is not high. Among 70-80 year olds, this bias is slightly larger—with lower disease prevalence among the balanced panel for almost all conditions with ‘survivor’ bias accounting for almost all the difference.

While this analysis reveals that a balanced panel does have somewhat lower disease prevalence than the full sample, this bias is driven by mortality, rather than attrition. In addition, the key result is that, no matter how we restrict the sample, Americans have higher disease prevalence than the English in both age groups. This is true whether we look at the full 2002 sample, only those who remain alive, or at the full three-wave balanced panel. Differential sample attrition does not alter that result.

5. Predictors of attrition

While individuals who drop out of ELSA and the HRS appear to differ little from the full non-mortality sample in terms of their health, a relation could appear in multivariate analysis or there could be systematic attrition based on socioeconomic status (SES) and other baseline characteristics that one may want to relate to these health outcomes. In this section, we examine these issues by estimating full multivariate models of attrition in HRS and ELSA.

Table 5 contains estimated marginal effects from multivariate probit models with associated z statistics in parenthesis. This model is estimated on a dependent variable (‘attrited’) which is equal to one if an individual dropped out of the survey between 2002 and 2006, and

equal to zero if they remained in the survey (responding to both the 2002 and 2006 waves). To highlight the role of attrition, individuals who died have been removed from the sample. Separate attrition models were estimated for those 55-64 and those 70-80 in 2002 in each country.

The model includes measures of individuals socioeconomic status (quintiles of baseline wealth and baseline household income and education level⁷) and a dummy variable for labor market status (1= working). 2002 baseline health status is measured in several ways—a set of dummy variables for the presence of specific diseases at baseline and separate indicators that your health is excellent or very good, good, fair, with the poor response the left out group. There are also a set of demographic controls for marital status (married, separated, divorced, separated, and widowed, with never married the excluded class) and housing tenure (1= home owner). Finally, the model includes a full set of single-year age dummies within each age interval which are interacted with sex. For ease of exposition, these age/gender effects are not displayed in Table 5.

Perhaps the most striking result of these probit models is that even when estimated in a multivariate context, health variables - whether through disease prevalence or self-reported health—in either country and in both age groups, do not predict subsequent attrition from the survey. The only exception to that summary is that respondents suffering from arthritis are less likely to attrit in both countries among those 55-64 years old. Our results from the previous section (finding little evidence of a systematic relationship between health and attrition) are apparently robust to the introduction of a standard set of controls for other attributes.

Turning next to the variables measuring socioeconomic status, we find very different patterns in the two countries. Among 55-64 year olds in ELSA, there is strong evidence that the

⁷ These variables differ between the models for the U.S. and England, reflecting the different education systems in the two countries

least-educated individuals are more likely to drop out of the survey than their more educated peers. There are no education effects for this age group in HRS. In contrast, the least-wealthy respondents in HRS in this age group are the most likely to attrit with no statistically significant income or wealth effects on attrition in ELSA. Among older ELSA and HRS respondents, there appear to be no strong SES correlates of attrition—neither education, income, nor wealth.

In the HRS, there is some evidence that housing tenure predicts attrition among 55-64 year olds, with individuals who own their home slightly less likely to attrit, holding all other attributes constant. The strongest predictors of attrition in ELSA actually have nothing to do with personal attributes at all—they are the ‘self-reported health missing’ dummy variables, indicating that an individual did not answer the self-reported health questions in ELSA’s health module. Since refusing to answer questions is likely to indicate that an individual was not wholly committed to the survey, it is perhaps unsurprising that such individuals are less likely to respond to requests for a repeat interview in subsequent waves.

In summary, the only strong indication of SES bias in attrition in ELSA comes from the 55-64 year old age group where it appears that less-educated individuals in this age group are more likely to drop out of the survey. Given ELSA’s much higher attrition rate, it is worth investigating the reasons why differential attrition by education might arise.

One possibility is that less-educated respondents simply found the ELSA survey more burdensome to answer than higher-educated respondents did. Having agreed to take part in ELSA’s first wave, it is possible that these individuals didn’t fully appreciate the demands of the interview and questionnaire. ELSA is a long survey that probes domains of life (and especially the economic domain) that were not addressed in the prior HSE wave. If this was the explanation, we would expect the bulk of attrition of lower-educated respondents to take place

between ELSA's first and second waves (2002 to 2004). Between 2004 and 2006, we would anticipate that the education effect would diminish as all respondents now know what to expect from the survey. This explanation fails our test. We re-estimated models in Table 5 separately for attrition from 2002 to 2004, and attrition from 2004 to 2006. For both waves, the coefficients on the education variables are of similar magnitude and statistical significance.⁸

Another possibility is that the education gradient is accounted for by less-educated respondents also having lower levels of numeracy. The ELSA interview involves many questions with numerical answers (notably the income and wealth questions, but also many other sections of the questionnaire), which less numerate respondents may find quantitatively demanding and be less comfortable answering. We can examine this possibility directly, since ELSA contains a measure of respondent's numeracy level, based on an 'adaptive' numeracy test.

The 2002 ELSA questionnaire asked respondents up to five basic questions involving successively more complex numerical calculations. The six possible questions are presented in Appendix 1. Answers to all questions are unprompted (i.e., respondents are not given a menu of possible answers to choose from). Each respondent initially receives questions q2, q3 and q4. If all of these are answered incorrectly the respondent receives question q1 and that is the end of their numeracy module. Otherwise the respondent receives question q5. If the respondent reports a correct answer to any (or all) of questions q3, q4, and q5, they receive the final and most difficult question q6 that requires an understanding of compound interest.

The ELSA numerical ability measure is designed to place individuals into one of four groups according to their broad numerical ability. This has the advantage of allowing us to choose groups that have some prevalence in the population since a simple count of correct answers does not take into account the relative difficulty of the questions and may lead to some

⁸ Results available from the authors on request.

clusters where there are many observations, with relatively few individuals at the extremes. Hence for our analysis we separate numerical ability in four broad groups according to which of the questions were correctly answered. This coding is indicated in Appendix 1.

In Table 6, we repeat the probit model of Table 5, but add dummy variables for the numeracy groups (with group 1, the least numerate, the omitted group). We only report marginal effects of these numeracy variables and education to see whether the education effect among 55-64 year olds is diminished when numeracy is taken into account.

The results show that numeracy is strongly predictive of attrition, with the two most numerate group more than 10% less likely to attrit 55-64 year olds, and more than 12% less likely to attrit among the 70-80 year olds. However, inclusion of numeracy does little to diminish the size or significance of the education effect, suggesting that numeracy is not the principal explanation for the education gradient in attrition in ELSA. Attrition by numerical ability is, however, a serious cause for concern.

Table 6 also includes additional variables relating to the *administration* of the ELSA interview for each respondent. These are certain procedural factors available in ELSA, which may be ‘early warning signs’ of subsequent attrition. For example, we know whether or not a respondent returned their ‘self-completion questionnaire’ to the ELSA survey team. This questionnaire is given to all respondents at baseline, but many respondents (particularly those who are single) are left to fill this questionnaire in at their leisure, and return it to ELSA by post.⁹ We have included a dummy variable for whether an individual failed to return this questionnaire completely, and another to indicate whether they returned it only after being sent a postal reminder by the ELSA team. As we might expect, failure to return the questionnaire is strongly

⁹ For couples who are interviewed simultaneously, however, one member of the couple is asked to fill in the questionnaire while the other undergoes the face to face interview, so that no posting is required.

predictive of subsequent attrition, being associated with a 17% (for 55-64 year olds) or 21% (for 70-80 year olds) increase in attrition. For many ELSA attritors, the decision to leave the survey may have occurred immediately after the baseline interview. Requiring a postal reminder, however, is not predictive of attrition (provided the individual did eventually return their questionnaire).

Another procedural parameter included in Table 6 relates to the success rate of the interviewer who conducted a respondent's first ELSA interview, the construction of which was described in the previous section. This variable ('Interviewer retention' in Table 6) has a large and highly significant association with attrition in both the 55-64 and 70-80 year old age groups—with individuals interviewed by someone who successfully retained many of their other subjects also more likely to remain in the survey themselves.

Our final line of investigation considers factors that are associated with *return from* attrition. As demonstrated in Figures 1 and 2, a subset of individuals who dropped out of these surveys between 2002 and 2004 subsequently return in 2006 with a return rate slightly higher in HRS than in ELSA. Table 7 summarizes results obtained from a probit model using a sample of respondents who attrited between 2002 and 2004. The dependent variable equals one if an individual returned to the sample in 2006.

Given the smaller sample sizes of attritors in each survey, we pooled the entire sample aged 50 and above. We find few observable factors systematically associated with return from attrition. There is some evidence that college-educated individuals are more likely to return to the HRS, and that divorced individuals are more likely to return to ELSA, but the evidence is not strong. Targeting the potential returnees based on observable attributes may be quite difficult.

6. Conclusions

In this paper, we investigate the relative importance of sample attrition in two of the most important existing ageing longitudinal studies—the English Longitudinal Survey of Ageing (ELSA) and the Health and Retirement Study (HRS). While attrition exists in both surveys, it is considerably higher in ELSA than in HRS. We explored some possible reasons for these differences. Survey maturity, mobility, respondent burden, interviewer quality, and differing sampling methods all fail to account for the gap. Differential respondent incentives may play some role, but the impact of respondent incentive is difficult to test. Apparently, cultural differences between the U.S. and Europe population in agreeing to participate and remain in scientific surveys are a more likely explanation.

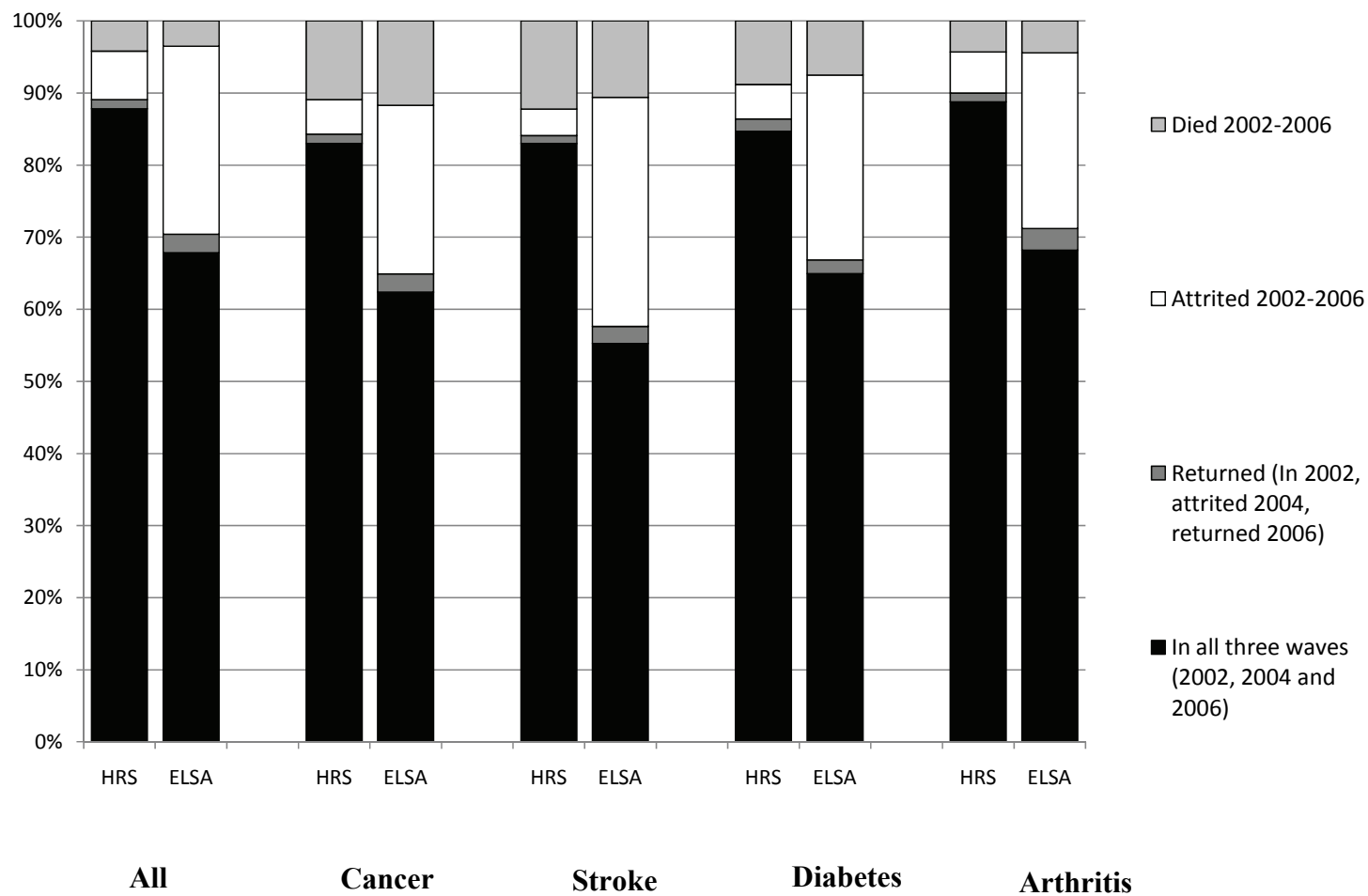
The impact of sample attrition on the parameters of interest is not context free. In our application, we examine the impact of attrition on estimates of disease prevalence in the two countries. We find that sample attrition does not significantly affect estimates of disease prevalence in part because either in a univariate or multivariate context attrition does not appear to be related to prior disease prevalence. We do find among those ages 55-64 years old that attrition is negatively related to prior wave wealth in the HRS and negatively related to prior wave education and numerical ability in ELSA. Across these two dimensions at least, in this age group more care must be exercised on the nature of the SES health-wealth gradient in HRS and the SES health-education gradient in ELSA. In neither survey do we find any attributes that appear to successfully identify who, among the prior wave attritors, the survey is able to bring back into the fold in future waves.

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**Figure 1—Retention, attrition and death in ELSA and the HRS, 2002-2006
55-64 year olds, by health condition at baseline (2002)**



**Figure 2—Retention, attrition and death in ELSA and the HRS, 2002-2006
70-80 year olds, by health condition at baseline (2002)**

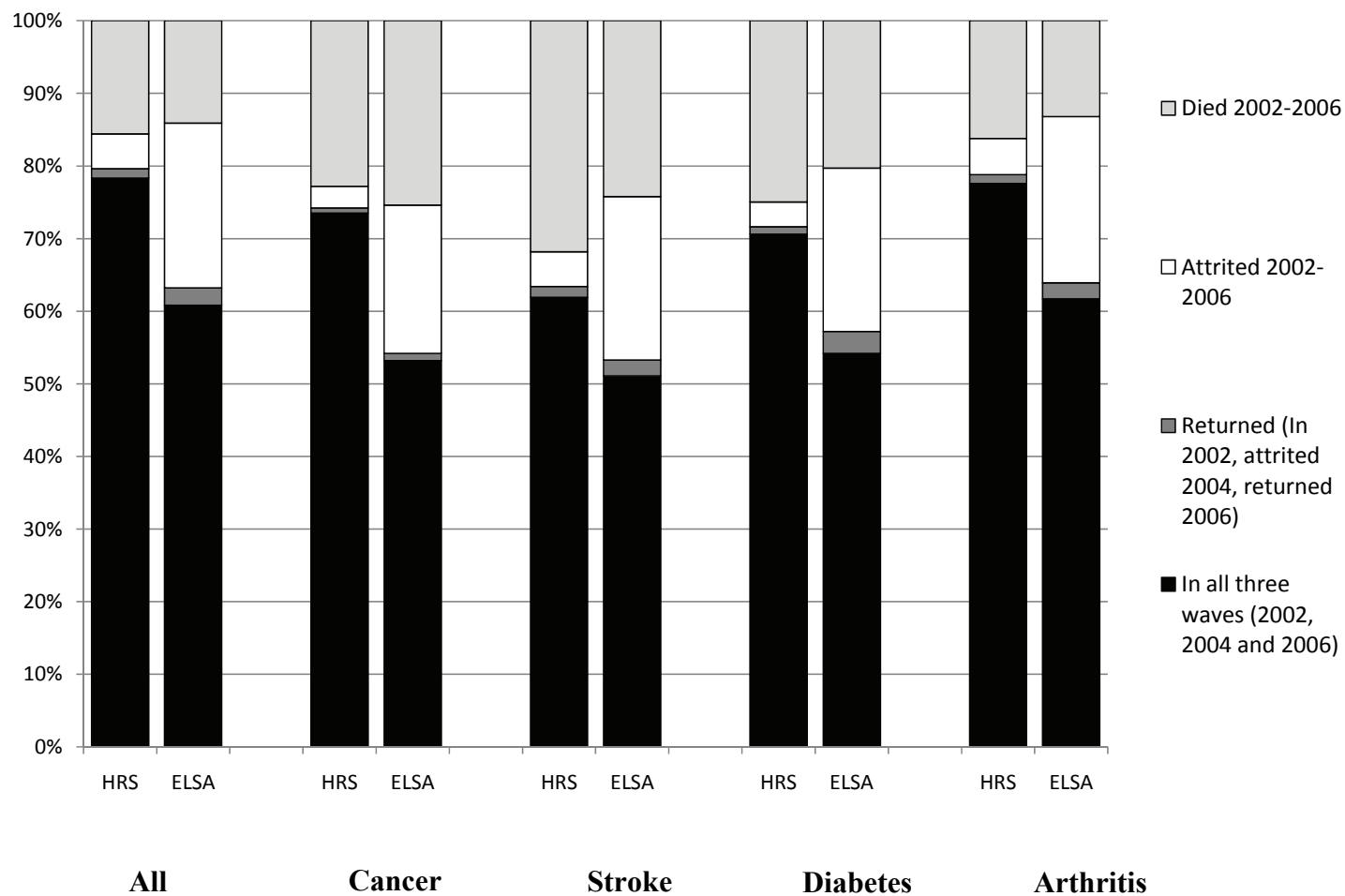
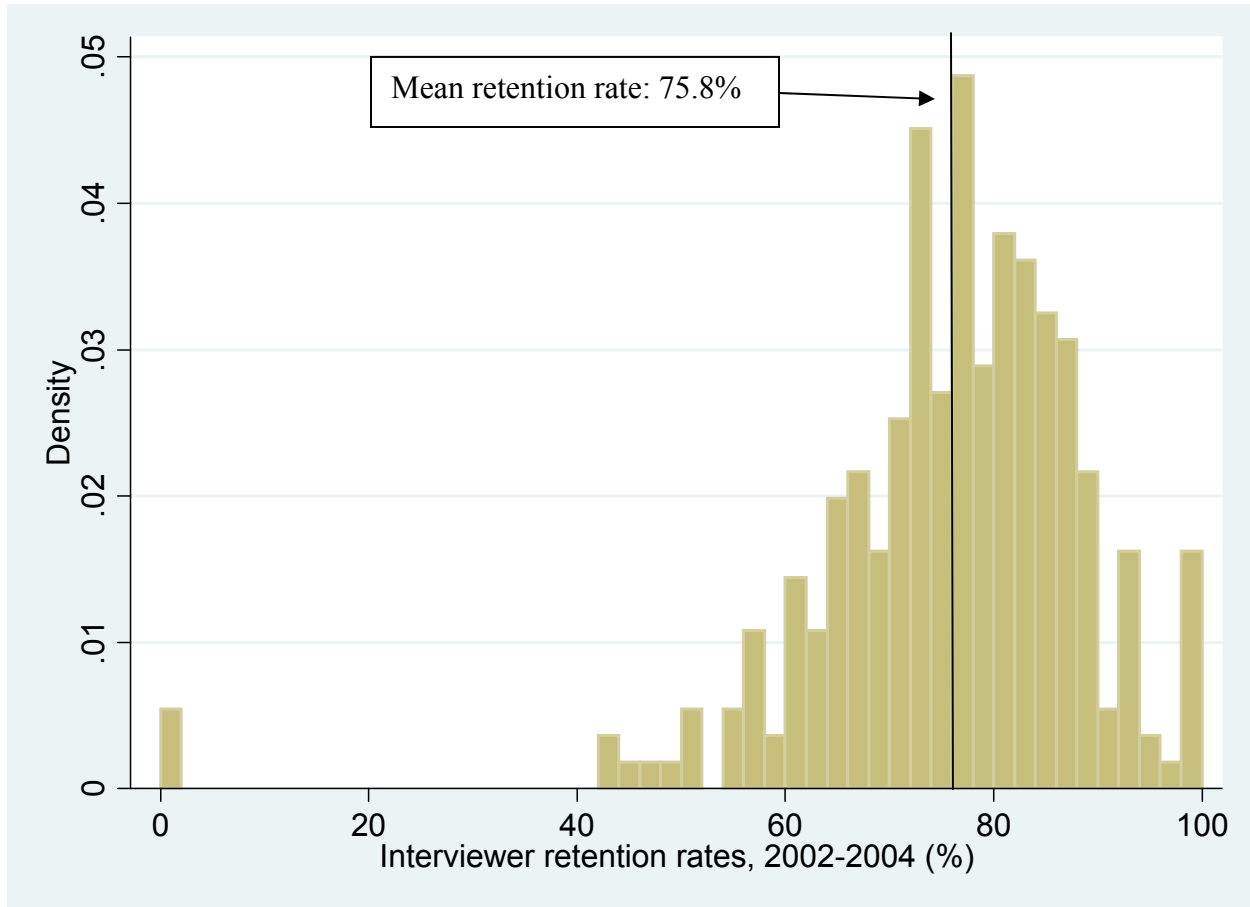


Figure 3—Interviewer effects in ELSA (retention rates)



Mean (interviewer level) retention rate if the bottom 25% of interviewers had the same (mean) retention rate as the top 75%: 81.5%.
This would make ELSA's overall retention rate: 80.6%.

Mean (interviewer level) retention rate if the bottom 25% of interviewers had the same (mean) retention rate as the top 75%: 85.2%.
This would make ELSA's overall retention rate: 84.3%.

Table 1—Attrition in HRS and ELSA (2002-2006), by pre-existing health condition (excluding deaths)

		In all three (2002, 2004 and 2006) waves	Attrited 2002-2006	In 2002, attrited 2004, returned 2006
55 to 64 year olds (%) :				
All	HRS	91.7	7.0	1.4
	ELSA	70.3	27.0	2.7
Healthy*	HRS	90.1	8.6	1.3
	ELSA	70.8	26.6	2.7
Cancer	HRS	93.2	5.4	1.5
	ELSA	70.7	26.4	2.9
Stroke	HRS	94.6	4.2	1.2
	ELSA	61.8	35.5	2.6
Diabetes	HRS	92.9	5.2	1.9
	ELSA	70.2	27.8	2.0
Arthritis	HRS	92.8	6.0	1.3
	ELSA	71.3	25.5	3.1
70 to 80 year olds (%) :				
All	HRS	92.9	5.6	1.5
	ELSA	70.7	26.5	2.8
Healthy*	HRS	92.9	5.6	1.6
	ELSA	71.7	24.8	3.5
Cancer	HRS	95.3	3.9	0.9
	ELSA	71.3	27.3	1.3
Stroke	HRS	90.8	7.0	2.2
	ELSA	67.4	29.7	2.9
Diabetes	HRS	94.2	4.6	1.3
	ELSA	68.1	28.2	3.7
Arthritis	HRS	92.6	6.0	1.5
	ELSA	71.0	26.4	2.6

* Note: ‘Healthy’ individuals are those free from all conditions listed in this table and free from heart problems. As explained in footnote 2, heart problems are not included directly in Table 1, as we do not have a perfectly comparable measure of heart complaints between the two surveys.

Table 2—Attrition at the household level

	Number of respondents in household							
	1		2		3		All	
	ELSA	HRS	ELSA	HRS	ELSA	HRS	ELSA	HRS
No household members attrit	75.2%	92.7%	73.0%	95.1%	43.3%	NA	74.0%	94.9%
Some household members attrit	0.0%	0.0%	8.0%	1.4%	46.7%	NA	4.2%	0.7%
All household members attrit	24.8%	5.3%	19.0%	3.5%	10.0%	NA	21.8%	4.4%
Total	100%	100%	100%	100%	100%	NA	100%	100%
Number of households	3,802	5,850	3,921	5,352	30	0	7,761	11,202

Note: Deaths have been excluded from the sample, so do not count as attrition.

Table 3—Disease prevalence and incidence in older adults in the U.S. and England

Prevalence in 2002 (%)	Stroke	Lung	Cancer	HBP	Diabetes	Heart	Heart Attack
<i>Age 55-64</i>							
England	2.28	5.62	5.48	33.40	5.88	8.21	4.05
U.S.	3.52	8.22	9.57	42.65	12.07	15.50	NA
<i>Age 70-80</i>							
England	7.17	8.28	7.80	47.67	10.38	20.99	10.01
U.S.	8.42	12.26	17.92	59.00	17.23	32.06	NA

Incidence 2002-2006 (%)	Stroke	Lung	Cancer	HBP	Diabetes	Heart	Heart Attack
<i>Age 55-64</i>							
England	1.70	2.00	2.99	10.17	3.33	2.61	1.85
U.S.	2.07	3.08	4.26	10.03	6.00	6.25	3.31
<i>Age 70-80</i>							
England	4.68	2.78	4.80	9.83	4.44	4.80	3.38
U.S.	5.51	3.89	5.88	8.31	4.66	9.28	5.42

NA-not available.

Source: England-English Longitudinal Survey of Ageing (ELSA; United States-Health and Retirement Survey (HRS). See Banks, Muriel, and Smith (2010).

Table 4—Disease prevalence in the U.S. and England (2002)—the impact of attrition

Prevalance in 2002 (%)	Stroke	Lung	Cancer	HBP	Diabetes	Heart	Heart Attack
<i>Age 55-64—England</i>							
All 2002 respondents	2.28	5.62	5.48	33.40	5.88	8.21	4.05
Responded 2002 and—							
Alive in 2007	2.11	5.18	4.91	33.14	5.65	7.69	3.63
Dead in 2007	6.67	17.78	18.52	39.26	12.59	20.74	14.07
Attrited by 2006	2.81	6.73	4.72	34.17	5.93	8.04	3.52
Balanced Panel, all waves	1.84	4.55	5.06	32.97	5.57	7.61	3.69
<i>Age 55-64—U.S.</i>							
All 2002 respondents	3.52	8.22	9.57	42.65	12.07	15.50	NA
Responded 2002 and—							
Alive in 2007	3.24	7.52	8.88	41.66	11.37	14.08	NA
Dead in 2007	7.74	18.06	24.47	52.49	26.04	33.04	NA
Attrited by 2006	0.77	6.01	6.86	38.97	8.76	11.26	NA
Balanced Panel, all waves	3.43	7.57	8.97	41.78	11.44	14.28	NA
Prevalance in 2002 (%)	Stroke	Lung	Cancer	HBP	Diabetes	Heart	Heart Attack
<i>Age 70-80—England</i>							
All 2002 respondents	7.17	8.28	7.80	47.67	10.38	20.99	10.01
Responded 2002 and—							
Alive in 2007	6.23	6.74	6.83	47.39	9.16	19.96	9.54
Dead in 2007	12.66	16.38	13.15	48.88	15.14	27.05	13.40
Attrited by 2006	7.15	6.02	6.83	46.83	9.76	22.44	11.06
Balanced Panel, all waves	5.86	7.28	7.03	48.00	9.38	18.94	8.76
<i>Age 70-80—U.S.</i>							
All 2002 respondents	8.42	12.26	17.92	59.00	17.23	32.06	NA
Responded 2002 and—							
Alive in 2007	6.83	9.66	16.33	57.01	15.26	28.94	NA
Dead in 2007	17.87	23.20	26.85	64.05	27.85	46.88	NA
Attrited by 2006	8.76	6.48	10.63	62.24	14.45	37.45	NA
Balanced Panel, all waves	6.63	9.87	16.74	56.64	15.30	28.47	NA

**Table 5—Models of attrition in ELSA and HRS
(Probits, marginal effects with z statistics in parenthesis below)**

	ELSA	HRS	ELSA	HRS
	55-64	55-64	70-80	70-80
Income quintile 1	0.015 (0.53)	-0.016 (1.09)	0.046 (1.17)	-0.026 (1.73)
Income quintile 2	-0.004 (0.15)	-0.028 (2.18)*	-0.006 (0.18)	-0.024 (1.89)
Income quintile 3	0.001 (0.04)	-0.000 (0.01)	0.010 (0.29)	-0.014 (1.15)
Income quintile 4	-0.008 (0.34)	0.016 (1.53)	0.019 (0.61)	0.001 (0.10)
Wealth quintile 1	0.055 (1.42)	-0.016 (1.21)	0.071 (1.31)	0.020 (0.99)
Wealth quintile 2	0.017 (0.61)	-0.033 (3.03)**	0.023 (0.64)	0.001 (0.11)
Wealth quintile 3	0.002 (0.06)	-0.027 (2.68)**	0.018 (0.55)	-0.006 (0.49)
Wealth quintile 4	-0.004 (0.17)	-0.021 (2.25)*	0.043 (1.36)	0.006 (0.59)
Degree	-0.160 (6.41)**	NA	-0.068 (1.63)	NA
Below degree	-0.140 (5.85)**	NA	-0.053 (1.48)	NA
A level	-0.113 (3.72)**	NA	-0.091 (1.71)	NA
O level	-0.065 (3.12)**	NA	-0.030 (0.94)	NA
CSE	0.034 (0.93)	NA	-0.078 (2.03)*	NA
Foreign qual.	-0.080 (2.85)**	NA	-0.044 (1.36)	NA
Ed. 13 to 15 (HRS)	NA	0.006 (0.64)	NA	-0.007 (0.76)
Ed. 16+ (HRS)	NA	-0.013 (1.34)	NA	-0.002 (0.25)
In work	0.031 (1.69)	0.004 (0.50)	0.015 (0.36)	-0.000 (0.01)
Angina	-0.035 (1.02)	NA	-0.012 (0.41)	NA
Heart attack	-0.035 (0.77)	NA	0.033 (0.92)	NA
Heart failure	-0.095 (0.88)	NA	0.139 (1.23)	NA

Heart prob. (HRS)	NA	-0.003	NA	0.015
	NA	(0.31)	NA	(1.69)
Stroke	0.070	-0.038	-0.001	0.011
	(1.26)	(1.94)	(0.02)	(0.74)
Lung disease	0.066	-0.002	-0.050	-0.014
	(1.85)	(0.18)	(1.36)	(1.16)
Cancer	0.022	-0.008	0.022	-0.018
	(0.61)	(0.64)	(0.58)	(1.91)
High blood press.	0.005	-0.005	-0.006	0.010
	(0.31)	(0.63)	(0.32)	(1.36)
Diabetes	-0.003	-0.017	0.004	-0.013
	(0.10)	(1.53)	(0.13)	(1.35)
Arthritis	-0.035	-0.017	-0.011	0.005
	(1.96)*	(2.29)*	(0.56)	(0.68)
Married	0.022	-0.047	0.020	-0.005
	(0.61)	(1.91)	(0.43)	(0.18)
Separated	-0.052	-0.040	0.119	0.082
	(0.71)	(1.35)	(0.90)	(0.87)
Divorced	-0.018	-0.132	-0.114	0.007
	(0.43)	(0.62)	(2.02)*	(0.21)
Widowed	-0.057	-0.005	-0.065	0.014
	(1.28)	(0.19)	(1.41)	(0.47)
Health ex./v. good	-0.036	-0.013	-0.052	-0.008
	(1.00)	(0.66)	(1.27)	(0.48)
Health good	-0.057	0.000	0.027	-0.003
	(1.63)	(0.01)	(0.66)	(0.19)
Health fair	-0.039	0.004	-0.008	0.010
	(1.12)	(0.17)	(0.19)	(0.57)
Tenure: owner	0.286	-0.032	0.405	0.002
	(3.04)**	-(2.19)*	(3.47)**	(0.15)
In work	0.049	0.038	-0.035	0.012
	(1.17)	(1.51)	(0.65)	(0.57)
Observations	3431	4255	2189	3395
Robust z statistics in parentheses				
* significant at 5%; ** significant at 1%				

**Table 6—The effect of numeracy and interview effectiveness—ELSA
(Probits, marginal effects)**

	(1)	(2)
	55-64	70-80
	Attritw1_3	Attritw1_3
Numeracy group 2	-0.046	-0.073
	(1.78)	(2.81)**
Numeracy group 3	-0.096	-0.124
	(3.43)**	(4.12)**
Numeracy group 4	-0.106	-0.146
	(3.32)**	(3.50)**
Partial interview	0.021	-0.047
	(0.27)	(0.50)
Self completion not ret.	0.173	0.211
	(4.89)**	(5.10)**
Self completion remind.	0.040	0.075
	(0.86)	(1.24)
Interviewer retention	-0.485	-0.304
	(5.63)**	(2.92)**
Degree	-0.142	-0.048
	(5.35)**	(1.10)
Below degree	-0.123	-0.031
	(5.00)**	(0.84)
A level	-0.086	-0.075
	(2.72)**	(1.40)
O level	-0.046	-0.005
	(2.09)*	(0.15)
CSE	0.036	-0.070
	(0.99)	(1.80)
Foreign qual.	-0.063	-0.032
	(2.18)*	(0.97)
Observations	3398	2165
Robust z statistics in parentheses		
* significant at 5%; ** significant at 1%		

Table 7—Returns from attrition—respondents aged 50 and over

	ELSA	HRS
Income quintile 1	0.014	0.053
	(0.36)	(0.74)
Income quintile 2	0.067	0.024
	(1.71)	(0.42)
Income quintile 3	0.042	-0.052
	(1.16)	(1.11)
Income quintile 4	0.074	-0.056
	(2.12)*	(1.40)
Wealth quintile 1	-0.005	-0.037
	(0.10)	(0.59)
Wealth quintile 2	0.002	0.042
	(0.06)	(0.83)
Wealth quintile 3	-0.002	0.019
	(0.05)	(0.44)
Wealth quintile 4	-0.033	-0.008
	(1.08)	(0.20)
Degree	0.057	NA
	(1.37)	
Below degree	0.050	NA
	(1.33)	
A level	-0.009	NA
	(0.19)	
O level	0.022	NA
	(0.76)	
CSE	-0.050	NA
	(1.22)	
Foreign qual.	-0.038	NA
	(1.08)	
Ed. 13 to 15 (HRS)	NA	0.018
		(0.52)
Ed. 16+ (HRS)	NA	-0.083
		(2.19)*
Age	-0.003	0.004
	(0.72)	(0.62)
Age squared	0.000	-0.000
	(1.03)	(0.08)
In work	-0.011	0.011
	(0.42)	(0.29)
Angina	0.035	NA

	(0.91)	
Heart attack	-0.001	NA
	(0.03)	
Heart failure	-	NA
	-	
Heart prob. (HRS)	NA	0.001
		(0.03)
Stroke	0.019	-0.024
	(0.38)	(0.42)
Lung disease	-0.037	0.010
	(1.00)	(1.87)
Cancer	-0.026	0.017
	(0.62)	(0.37)
High blood press.	-0.019	0.047
	(0.96)	(1.67)
Diabetes	-0.013	0.027
	(0.36)	(0.60)
Arthritis	0.012	-0.002
	(0.58)	(0.05)
Married	0.020	0.047
	(0.49)	(0.45)
Separated	0.001	0.042
	(0.01)	(0.20)
Divorced	0.124	0.065
	(2.20)*	(0.54)
Widowed	0.032	-0.034
	(0.63)	(0.31)
Health ex./v. good	0.010	-0.083
	(0.25)	(1.34)
Health good	-0.035	-0.045
	(0.96)	(0.77)
Health fair	-0.015	-0.067
	(0.39)	(1.14)
Tenure: owner	-0.054	0.078
	(1.35)	(1.65)
Male	0.005	-0.020
	(0.25)	(0.67)
Observations	1658	885
Robust z statistics in parentheses		
* significant at 5%; ** significant at 1%		

APPENDIX
Derivation of numeracy classification variables

Box 1a. Numeracy items in ELSA questionnaire

q1) If you buy a drink for 85 pence and pay with a one pound coin, how much change should you get?

q2) In a sale, a shop is selling all items at half price. Before the sale a sofa costs £300. How much will it cost in the sale?

q3) If the chance of getting a disease is 10 per cent, how many people out of 1,000 would be expect to get the disease?

q4) A second hand car dealer is selling a car for £6,000. This is two-thirds of what it cost new. How much did the car cost new?

q5) If 5 people all have the winning numbers in the lottery and the prize is £2 million, how much will each of them get?

q6) Let's say you have £200 in a savings account. The account earns ten per cent interest per year. How much will you have in the account at the end of two years?

Box 1b. Construction of broad cognitive function categories

Classification	Response to questions	Proportion of sample
<i>Group I</i>	Either: q2, q3, q4 all incorrect Or: q2 correct; q3, q4, q5 all incorrect	16.24%
<i>Group II</i>	At least one of q2, q3, q4, q5 incorrect; q6 incorrect	46.46%
<i>Group III</i>	Either: q2, q3, q4, q5 correct; q6 incorrect Or: At least one of q2, q3, q4 correct; q5 q6 correct	26.08%
<i>Group IV</i>	q2, q3, q4, q5, q6 correct	11.22%