

COHORT PROFILE

Cohort Profile: The English Longitudinal Study of Ageing

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The English Longitudinal Study of Ageing (ELSA) is a panel study of a representative cohort of men and women living in England aged ≥ 50 years. It was designed as a sister study to the Health and Retirement Study in the USA and is multidisciplinary in orientation, involving the collection of economic, social, psychological, cognitive, health, biological and genetic data. The study commenced in 2002, and the sample has been followed up every 2 years. Data are collected using computer-assisted personal interviews and self-completion questionnaires, with additional nurse visits for the assessment of biomarkers every 4 years. The original sample consisted of 11 391 members ranging in age from 50 to 100 years. ELSA is harmonized with ageing studies in other countries to facilitate international comparisons, and is linked to financial and health registry data. The data set is openly available to researchers and analysts soon after collection (<http://www.esds.ac.uk/longitudinal/access/elsa/l5050.asp>).

Keywords Ageing, cohort, longitudinal, UK

How did the study come about?

The increased longevity of the population is one of the greatest achievements of the modern age, but is also the source of some concern from the perspectives of economic, health and social policy. Around 15% of the population in England were aged ≥ 65 years in 2008, and this is expected to increase to nearly 25% during the next 2 decades, with the fastest growing sector of the population being people aged >75 years. The English Longitudinal Study of Ageing (ELSA) was developed as a companion study to the Health and Retirement Study (HRS) in the USA and was set up to document the experience of growing old in England in the 21st century. It provides high quality longitudinal data that can be used to investigate changes in economic circumstances, social status, physical and mental health, social relationships,

cognitive function and biology, as people prepare for and move into retirement and old age.

ELSA has a particular focus on the relationships between different aspects of the ageing process and on data that are relevant to policies about ageing. Accordingly, it was set up as a collaboration between institutions and research groups with complementary expertise. The data are designed and collected by a collaborating team of researchers from the Department of Epidemiology and Public Health at University College London, the Institute for Fiscal Studies, the University of Manchester and the National Centre for Social Research, with additional support from researchers at the Universities of Cambridge, East Anglia, Nottingham, Exeter and Oxford on specific aspects such as cognitive function and health care utilization.

ELSA is designed to provide directly comparable data to that collected in the HRS to facilitate opportunities for cross-national analyses while being attentive to the needs of UK policy makers for longitudinal data on older people. Even though it is based in England, around half the funding has come from the National Institute on Aging. The remaining support has come from UK Government Departments, coordinated by the Office for National Statistics. When ELSA started, support was provided by the Departments of Education and Skills, Environment, Food and Rural Affairs, Health, Trade and Industry, Work and Pensions, Her Majesty's Treasury, Inland Revenue, the Office of the Deputy Prime Minister and Office for National Statistics. Other departments have contributed to the funding of subsequent waves of ELSA. Initial funding was agreed in 2000 with Professor Sir Michael Marmot as Principal Investigator, and the first wave of data collection took place in 2002. ELSA is administered by a management committee of co-Principal Investigators drawn from the participating institutions, supported by a team of International Consultants and an Advisory Panel. Ethical consent has been obtained for all waves and components of ELSA, according to the ethical approval system in operation at the time.

What does the study cover, and how has this changed?

The intention has always been to release data into the public domain as quickly as possible, and to encourage use by the academic community and policy analysts. The broad research areas and questions motivating the design of the study were those surrounding the following: health trajectories, disability and healthy life expectancy; the nature and determinants of economic position and resources in old age; the timing of retirement and post-retirement labour market activity; the nature of social networks, social support and social participation at older ages; household and family structure and the transfer of resources; and most importantly, the linked dynamic relationships between all of the above.

Examples of specific topics within these areas that were considered in designing the study included the following: what are the most appropriate measures of socio-economic circumstances and social status at older ages? How are social and cultural activities linked with health and disability as we age? What are the demographic, economic and health drivers of social exclusion among the old? Are there differences in health and well-being between older people in comparable socio-economic positions in England and the USA? How do expectations of future pension provision and health mould the decisions of people in their 50s and 60s? What factors in the physical and social environment, including housing, public

transport and social capital, contribute to well-being and social engagement in the older population? New topics have entered the study in later waves as the policy context has evolved, including issues such as experienced well-being, the quality of primary health care, intergenerational transfers and social care provision. Other new measures have stemmed from scientific and technical developments in related fields, such as the application of behavioural economic methods, the use of accelerometers to assess physical activity and the inclusion of a genome-wide association study to increase the value of genetic data. There is a dynamic exchange between ELSA and HRS in terms of methodological innovations and topics of investigation. The two studies are also models for the development of longitudinal studies in many other countries, including the Study of Health, Ageing and Retirement in Europe, the Irish Longitudinal Study of Ageing¹ and studies in China, India, Korea and Brazil.

Who is in the cohort?

An overview of the sample studied in waves 1 to 5 is provided in Figure 1. The sample was drawn from participants in the Health Survey for England (HSE), an annual cross-sectional survey that is designed to monitor the health of the general population.² For wave 1, participants were recruited from the HSE in 1998, 1999 and 2001. Eligibility criteria were as follows: membership of a participating household from HSE in which at least one person had agreed to follow-up, born before 1 March 1952 and living in a private household in England at the time of the first wave of fieldwork. In addition to the target sample, partners who were aged <50 years and those who had joined the household since HSE were invited for interview. The initial sample size was selected to give an adequate number of men and women in 5-year age bands. The household response rate was 70%, with an individual response rate of 67%.³ The total sample of 12 099 consisted of 11 391 core members, 636 partners aged <50 years and 72 new partners aged ≥50 years. The mean age of the core sample was 65 years, ranging from 50 to 100. Comparisons of the socio-demographic characteristics of participants against results from the national census indicate that the sample was broadly representative of the English population.

The sample was refreshed at wave 3 to maintain the representation of people aged 50–53 years. A further refreshment sample of individuals aged 50–75 years was added at wave 4 to boost the scope for fine-grained analyses, and refreshment of people aged 50–55 years is taking place in wave 6. Apart from the range for year of birth, the eligibility criteria for the refreshment samples remain the same as those for wave 1.

In many instances, both members of a couple have participated in ELSA. Interviewing both partners

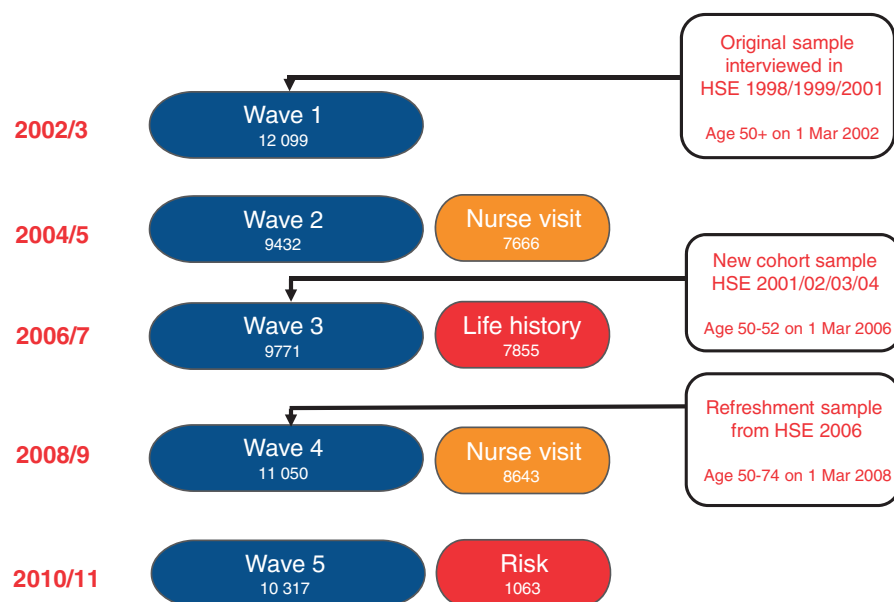


Figure 1 Overview of data collection in ELSA Waves 1 to 5. Sample sizes are for the complete study

enables financial information to be collected at benefit unit level when couples keep their finances together ('benefit unit' relates to the family definition of 'a single adult or couple living as married and any dependent children'). This is considered more suitable for understanding economic circumstances than indicators based on the individual. It also allows analyses of the intra-couple dynamics with respect to health, employment, retirement expectations and outcomes and quality of life. There is provision for collection of a reduced set of information by proxy where a sample member is unable to take part through poor health, or through physical or cognitive disability.

How often have they been followed up?

The aim has been to interview individuals at ~2-yearly intervals. On every occasion, a computer-assisted personal interview is completed together with tests of cognitive function and walking speed, plus a self-completion questionnaire. On alternate waves, a nurse visit is carried out to collect biomarkers and more detailed measures of function. Additional one-off assessments have also been made, as detailed later in the text.

Details of the number of core participants in the first five waves of ELSA are shown in Table 1. The analysis of response rates and attrition from ELSA is complicated because of variations in responses to different elements of the study, deaths and differences between core and refreshment cohorts. Some participants may fail to respond to one wave but take part in later waves, and there is the additional issue of

whether non-response to the original HSE survey from which the sample was drawn should be taken into account.⁴ The cross-sectional response rate for each wave can be defined as the total respondents divided by the number of individuals eligible for the wave, where eligibility means membership of the core sample and not known to have died or to have moved outside the UK. Rates were 82% in wave 2, 73% in wave 3, 74% in wave 4 and 80% in wave 5.^{3,5-7} Conditional response rates have also been computed; 82% of wave 1 respondents participated in wave 2, 73% in wave 3, 74% in wave 4 and 78% in wave 5. As the study progresses, ELSA methodology is evolving to address the issue of attrition.

As in many other panel studies, attrition in ELSA is socio-economically graded and more severe in less affluent sectors of the sample. This is illustrated in Table 2, in which wave 1 (2002–03) core individuals who did and did not participate in wave 5 (2010–11) are compared. It can be seen that people lost to follow-up tended to be older, less wealthy and less educated than those who took part in wave 5. They were also more likely to come from a non-managerial occupation and suffer from a limiting long-standing illness.

Both cross-sectional and longitudinal weights are available. In wave 1, a weight was calculated both to adjust for differential non-response and to calibrate back to 2001 Census population distributions for sex and age. The wave 2 weights further adjusted for differential non-response between waves 1 and 2 at the individual level through statistical modelling of a range of household and individual-level information collected from both HSE and ELSA wave 1. Additionally, there are weights for interview completion, self-completion, having a nurse visit and giving

Table 1 ELSA achieved sample numbers^a and response rates^b

Wave	1 2002–03	2 2004–05	3 2006–07	4 2008–09	5 2010–11
Wave 1 sample, number interviewed	11 391	8780	7536	6623	6242
Wave 3 refreshment sample, number interviewed	n/a	n/a	1275	972	936
Wave 4 refreshment sample, number interviewed	n/a	n/a	n/a	2290	1912
Wave 1 sample members interviewed who participated in all preceding waves	11 391	8780	7198	6019	5316
Wave 1 sample members who have died (cumulative)	n/a	504	1164	1620	2158
Wave 1 sample members field response rates (based on issued cases) ^b	67%	82%	73%	74%	78%

^aBased on core members only. The totals for productive interviews include those in care homes/institutions.

^bThose in care homes/institutions are excluded from the response rate calculations.

Table 2 Participation by ELSA core sample (wave 1) in wave 5

	Participants in wave 5 (<i>n</i> = 6242) ^a	Lost to follow-up (<i>n</i> = 3071) ^b	<i>P</i> difference
Gender			
Men	66.7%	33.3%	0.63
Women	67.2%	32.8%	
Age (years)			
50–59	67.9%	32.1%	<0.001
60–69	68.5%	31.5%	
70–79	65.6%	34.4%	
80+	56.3%	43.7%	
Wealth quintile			
1 (lowest)	56.5%	43.5%	<0.001
2	63.5%	36.5%	
3	67.1%	32.9%	
4	71.3%	28.7%	
5 (highest)	74.0%	26.0%	
Education			
No qualifications	59.7%	40.3%	<0.001
Intermediate or foreign	68.6%	31.4%	
Higher education	77.1%	22.9%	
Social class based on occupation			
Managerial	74.6%	25.4%	<0.001
Intermediate	70.6%	29.4%	
Routine	60.5%	39.4%	
Limiting long-standing illness			
Yes	63.9%	36.1%	<0.001
No	68.4%	31.6%	

^aWave 1 characteristics of individual who did and did not participate in wave 5.

^bExcludes individuals who died before the end of wave 5 data collection.

a blood sample. Similar methods have been used for later waves. Detailed descriptions can be found in the technical reports available at www.ifs.org.uk/elsa.

What has been measured?

The measures obtained in ELSA are summarized in Table 3. A broad range of topics related to family and work, economic issues, physical and mental health, social and psychological factors, behaviour, cognition and biology have been included. Details of the exact measures and their distribution across the CAPI, self-completion questionnaire and nurse visit can be found at www.ifs.org.uk/elsa. To allow for new questions to be added, not all the measures listed in Table 3 have been collected in every wave.

Some features of the data collected in ELSA deserve to be highlighted. The study includes detailed measures of individual and family finances and was the first study in England to collect full information on income (by source, including employment income, private and state pension income, other benefit income and asset income), all elements of financial wealth and debts, physical wealth (businesses, land, works of art, jewellery, etc.), pensions arrangements and contributions (from which accrued pension wealth is subsequently estimated) and housing wealth. Non-response to these elements of the interview was minimized through a system of 'unfolding brackets', allowing respondents to make range-restricted estimates when they did not have exact information. These bracketed values are then used as a range for subsequent imputation. The effect of this design on item non-response (at wave 1) was documented in the first ELSA report.³ Although it varies by asset type, typically >95% of individuals did not use the bracketed questions and were willing to report precise values. Those who did not were willing to use bracketed responses. Hence, of the 75 separate elements of wealth and income that are collected, there are only two elements where >3% of the sample have missing data and no elements with >5.5% missing data.

Table 3 Summary of data collected in ELSA**Demographic data**

Household membership
 Living relatives
 Marital status
 Ethnic group
 Country of birth
 Education
 Occupation of main carer when respondent was aged 14 years

Income and assets

Earnings
 Sources of income
 Pensions
 Financial and physical assets
 Housing wealth and mortgage debt
 Business wealth
 Debt
 Life insurance

Employment

Employment situation
 Job details
 Pension arrangements and contributions
 Retirement and reasons for retirement

Consumption

Housing
 Vehicle and durables ownership
 Household outgoings/expenditures
 Transfers (incl. charitable giving and Child Trust Funds) (2,4 to 6)

Expectations

Mortality
 Employment
 Housing situation
 Finance and future income

Physical health

Self-rated health
 Mobility
 Sensory function
 Dental health (3,5)
 Physician diagnosed conditions
 Falls/balance
 Pain
 Diagnostic symptom assessments: Rose Angina, MRC
 Respiratory questionnaire, Edinburgh claudication questionnaires
 Disability, mobility and activities of daily living

(continued)

Table 3 Continued

Incontinence
 Menopause (4,5,6)
 Sexual functioning and attitudes (6)
 Cancer screening (5,6)
 Polypharmacy (6)
 Health and disability vignettes (3)

Behavioural health

Smoking/smoking history
 Alcohol consumption
 Physical activity
 Level of physical activity at work
 Consumption of fruit and vegetables (3 to 6)
 Sleep duration and sleep disturbance (4,6)

Mental health

Psychiatric and emotional problems
 General Health Questionnaire (GHQ-12) (1,3)
 CES-D depression scale

Social and civic participation

Informal caregiving
 Volunteering/unpaid help
 Accessing local amenities and services
 Social and cultural participation
 TV watching (4 to 6)
 Social networks/support
 Social isolation/loneliness (2 to 6)
 Transport
 Social capital (1,3)
 Perceived discrimination (5)
 Religiosity (5)

Psychosocial factors

Control and demand
 Effort-reward balance (2 to 6)
 Subjective social status
 Relative deprivation and perceived financial difficulties (2 to 6)
 Age at which middle age ends and old age begins (1,3)
 Self-perceived and desired ages (2,4)
 Experience and perceptions of ageing (4)
 Altruism (4)
 Sense of collectiveness (4)
 Pet ownership (5)

Psychological and social well-being

Quality of life (CASP-19)
 Satisfaction With Life Scale (2 to 6)

(continued)

Table 3 Continued

Ryff well-being scales (2, subsample)
Positive affect (5,6)
Personality (5)
Cognitive function
Memory
Executive function (1 to 5)
Numerical ability (1,4,6)
Literacy (2,5,6)
Fluid intelligence (6)
Proxy interview of cognitive functioning (2 to 6)
Physical examination and performance
Height and weight; waist and hip circumference (2,4,6)
Blood pressure (2,4,6)
Lung function (2,4,6)
Chair stands; balance; grip strength (2,4,6)
Walking speed
Blood assays
DNA extraction and storage (2,4,6)
Total and HDL cholesterol, triglycerides (2,4,6)
C-reactive protein, fibrinogen (2,4,6)
Glucose, glycated haemoglobin (2,4,6)
Haemoglobin, ferritin (2,4,6)
White blood cell count (4,6)
IGF-1, DHEAS (4)
Vitamin D (6)

Note: Unless otherwise indicated, the measure was administered in every wave or updated if circumstances change. For measures not administered in every wave, the numbers in parentheses indicate the waves of data collection on which the measure was assessed. CES-D; Center for Epidemiologic Studies Depression scale.

Where possible, measures of psychosocial factors, social participation, mental health, physical symptoms and health behaviour have used established assessments and questionnaires. Measures of cognitive function have included assessments of time orientation, immediate and delayed recall, prospective memory, verbal fluency (word finding), letter cancellation (a test of attention, visual search and mental speed), numerical ability and health literacy. Most of the physical examination and performance measures are taken during the nurse visits. Blood samples have been obtained under fasting conditions from the majority of participants. DNA extraction was carried out in waves 2 and 4.

Field work in ELSA is conducted by NatCen using experienced interviewers and nurses distributed round the country. A robust system of quality control is in place, and many of the interviewers have met the same respondents over several waves of

data collection. Proxy interviews are carried out when the respondent is not able to participate in person, but inevitably involves a more limited set of measures.

Supplementary modules have been included at various points during the history of ELSA to address additional topics. At wave 3, the majority of participants completed a life history interview that captured information about children and fertility, partnerships, education, employment, migration, accommodation, key health events, childhood circumstances and adverse life events. An event history calendar was used to help respondents recall timing by anchoring events in terms of major personal and public events.⁸ When a participant in ELSA has died, we have carried out an end-of-life interview with a designated proxy, when one has been available. This involves collecting information about health, physical and cognitive function during the 2 years before death, the location and circumstances of the death, inheritances and the financial consequences of the death. In wave 5, a module focusing on risk preferences was carried out by a subsample of participants. This involved performance of study lotteries with the opportunity to win cash, together with assessments of willingness to postpone reward. Wave 6 includes collection of hair samples for the analysis of cortisol and the objective assessment of physical activity using accelerometry in a subsample. A genome-wide association study on the complete sample is also underway.

Linkage to administrative records has been an important component of data collection strategy since the inception of the ELSA study. Respondents have been asked for permission to link to official records of National Insurance contributions, welfare and benefit receipt, details of any tax credits they may be claiming, Hospital Episode Statistics and NHS Central Register (mortality) and cancer registration data.

What has been found?

There have been >130 peer-reviewed articles published using ELSA data, covering a wide range of issues (see www.ifs.org.uk/ELSA). The ELSA genetic data have contributed to a number of collaborative analyses across cohorts.^{9,10} Here, we outline a selection of findings that illustrate some of the ways in which the study can be exploited.

Inequalities in later life

ELSA includes a broad range of socio-economic measures, and marked inequalities are evident. For example the wealth distribution is heavily skewed, with those making up the top 10% of the wealth distribution having an average net non-housing wealth of £500 000, compared with a mean of £110 000, a median of only £22 500, and ~20% of the population having very little wealth.⁷ Such inequalities extend to cultural, social and civic activities. Over three-quarters

of the managerial and professional classes are members of an organisation compared with just over a half of routine and manual classes, and almost three quarters of those in the managerial and professional class visit museums and art galleries compared with just over a third of those in routine and manual classes.³ These socio-economic factors are paralleled by health inequalities. Over the first 5-year period of the study, 5% of men in the richest quintile of the original wealth distribution had died compared with 18% of men in the poorest wealth quintile, with equivalent figures of 3.3% and 15.6% for women.⁷ The breadth of the socio-economic measure in ELSA allows an exploration of both economic and psychosocial pathways in relation to these inequalities,¹¹ and the comprehensive follow-up of the sample allows for an examination of the effects of selective mortality.¹²

International comparisons

ELSA formed the basis of an important comparison with HRS showing that the US population in later middle age is less healthy than the equivalent British population.¹³ Differences were apparent not only in the prevalence of major chronic diseases but also in biomarkers, and were evident across the socio-economic spectrum. The comparison was made possible by the harmonized data in ELSA and HRS and stimulated a number of follow-up analyses,^{14–17} together with a National Academy of Sciences enquiry into the divergent levels of longevity in high-income countries.¹⁸

Quality of primary care

The quality of care for people with serious health conditions is variable, and the Quality Outcomes Framework was established in England to monitor quality indicators and pay general practices on the basis of their performance. Typically, quality of care has been assessed for single conditions, but ELSA has documented the quality of care received by older people for a broad range of health conditions. In wave 2, it was found that quality of care varied widely across conditions, with a high proportion of quality indicators achieved for ischaemic heart disease, hearing problems and pain management, but lower levels for conditions that are particularly characteristic of older age such as osteoarthritis, falls and urinary incontinence. Conditional on the need for care, however, the quality of care did not vary particularly strongly across the wealth distribution.¹⁹

Economic decision making and cognitive function

An illustration of the cross-disciplinary research that can be carried out with ELSA is a study of cognitive function in relation to financial decisions in retirement.^{20,21} It was found that independently of education and other objectively assessed cognitive factors,

numeracy was associated with greater accumulated wealth at older ages and with the specific types of investment and retirement wealth that were held. Numeracy is also related to respondents' understanding of pension arrangements, suggesting that retirement planning support might usefully be targeted at certain vulnerable sectors of the population.

Positive psychological well-being and mortality

ELSA can be used to investigate prospective relationships between socio-economic position, psychosocial and biomedical factors and future mortality and morbidity. An instance of innovative analysis was the first large scale study of experienced positive well-being and mortality. Affective well-being is typically assessed using retrospective questionnaires asking about people's mood during the past week or month. Such measures suffer from recall biases and the impact of salient memory heuristics, and repeated momentary sampling is regarded as the gold standard for measuring experienced affect.²² In ELSA, momentary assessments of positive affect were collected on a sizable sample in wave 2. Follow-up during a 5-year period showed reduced risk of death in those experiencing higher positive affect over the day, independently of demographic and socio-economic factors, health indicators, depression and health behaviours.²³ Such studies do not establish causality, but do suggest that improving the well-being of people at older ages is not only a valuable goal in itself but may also be associated with favourable health outcomes.

What are the main strengths and weaknesses?

ELSA is the first representative longitudinal study of older people in England to have a well-integrated multidisciplinary approach that is equally strong in measuring economic, health and social aspects of people's lives, and arguably the first in the world with such a strong joint emphasis on detailed economic processes and the assessment of all elements of health processes including symptoms, subjective assessments, diagnoses and biomarkers. Innovative techniques for estimating income and wealth have greatly strengthened the scope for obtaining comprehensive data on financial circumstances in a phase of life that is difficult to quantify in terms of simple indices of income. The harmonization of ELSA with other national studies of ageing has facilitated international comparisons, while linkage to administrative data adds great analytic power to the study. The age distribution of the cohort means that disability, disease and mortality emerge at a substantial rate, facilitating longitudinal analyses of health outcomes, and these are strengthened by the inclusion of objective markers of health, physical and cognitive performance

and biology. The detailed psychosocial and economic phenotyping presents opportunities for geneoconomics. The rapid availability of data to the general research community overcomes the time delays present for many cohort studies and ensures that up to date information can be analysed.

ELSA shares the weakness with many other general purpose panel studies that the level of detail on any particular health outcome or psychosocial process is not as great as in focused or hypothesis-driven investigations. There are very few ethnic minority participants, as establishing representative oversamples of ethnic minority groups was prohibitively expensive. Attrition is an ongoing issue, and efforts are being made to redress this problem. Since the study started when participants were aged 50 years (although data are available from the HSE year from which the sample was selected), information about earlier life was collected retrospectively. It is necessary to refresh the sample to maintain an appropriate proportion of participants in their early 50s and facilitate cross-cohort comparison. By its very nature, the study is confined to England, though efforts are underway to establish parallel studies in other parts of the UK.

Can I get hold of the data? Where can I find out more?

The data and documentation are deposited with the Economic and Social Data Service, and are available to researchers and analysts who fulfil eligibility criteria (<http://www.esds.ac.uk/longitudinal/access/elsa/15050>).

asp). The data set is deposited as soon as cleaning and checking are completed, typically within 6 months of the end of data collection. Some data of a sensitive nature are not available in the Archive, but can be accessed through application to the Data Sharing Committee of NatCen. Permission to use the genetic data requires application to the ELSA DNA Repository. Extensive work has also been done on the harmonization of measures in ELSA with parallel measures in other ageing studies. ELSA is one of the founding studies included in the RAND Survey Meta Data Repository (<https://mmicdata.rand.org/megametadadata/index.php>), where a data set harmonized with HRS, the Study of Health, Ageing and Retirement in Europe and the Korean Longitudinal Study of Aging is available. The academic team involved with ELSA hold regular User Days in conjunction with the Economic and Social Data Service to advise researchers and analysts about the use of the data. The ELSA team welcomes the fullest possible use of the data both in the UK and internationally.

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KEY MESSAGES

- The combination of detailed economic, psychosocial, health and genetic measures in ELSA makes it uniquely placed for the multidisciplinary analysis of the ageing process in England.
- The harmonization of measures with studies in the USA, mainland Europe and middle-income countries such as China and Brazil provides scope for detailed cross-national comparisons.
- The deposition of data into accessible archives within months of collection allows other researchers to carry out analyses without the need for collaborative agreements with the study team.

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