Cohort Profile: The Australian Longitudinal Study of Ageing (ALSA)

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Word count:

Summary: 155

Key messages: 130

Main: 2702 (includes references to Tables and Figures)

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Summary

In response to the expressed need for more sophisticated and multidisciplinary data concerning aging of the Australian population, the Australian Longitudinal Study of Ageing (ALSA) was established some two decades ago in Adelaide, South Australia. At Baseline in 1992, 2087 participants living in the community or in residential care (ranging in age from 65 to 103 years) were interviewed in their place of residence (1031 or 49% women), including 565 couples. By 2013, 12 Waves had been completed; both face-to-face and telephone personal interviews were conducted. Data collected included self-reports of demographic details, health, depression, morbid conditions, hospitalization, gross mobility, physical performance, activities of daily living, lifestyle activities, social resources, exercise, education and income. Objective performance data for physical and cognitive function were also collected. The ALSA data are held at the Flinders Centre for Ageing Studies, Flinders University. Procedures for data access, information on collaborations, publications, and other details can be found at http://flinders.edu.au/sabs/fcas/.

Keywords: Australia, Cognition, Depression, Executive Function, Longitudinal Studies, Morale, Self Report, Spouses, Visual Acuity, Widowhood

Key Messages

- The population-based ALSA is one of the longest running cohort studies of older people in the world. The frequency of data collection, spanning some 12 waves over 22 years, has allowed insights about ageing rarely possible from other longitudinal studies of ageing.

- While the majority of participants at every wave appear to be experiencing aging as a positive process, with preservation of cognitive, affective and functional health, wide inter-individual differences, including in intra-individual change, were also observed.
- Many of the identified factors that promote longevity and quality of life are aspects of lifestyle that are amenable to change. Early screening could identify risk factors. Intervention strategies that encourage regular exercise, support social networks and engender a positive state of mind may help promote survival and a good quality of life.

Why was the ALSA cohort set up?

The proportion of Australians over 65 years old is projected to increase from 14% in 2012 to 27.1% by 2101, with South Australia having the second oldest population in Australia.[1]

In response to the need for more sophisticated data concerning aging of the Australian population, the Australian Longitudinal Study of Ageing (ALSA) was established two decades ago in Adelaide, capital of South Australia. The ALSA is multi-disciplinary and designed to improve understanding of how a broad range of individual and structural factors are associated with age-related changes in health and well-being. Following an extensive pilot study[2] in 1988, ALSA Wave 1 (Baseline) commenced in 1992.

Needs for comprehensive information on aging still exist, and a strength of the study is that the surviving ALSA cohort are now aged 85 years or older: the most rapidly growing portion of the older population.

What does ALSA cover?

The overarching aim was to investigate how social, biomedical, behavioural, economic, and environmental factors affect ageing. Specific objectives of ALSA were to:

i) Determine health and functional status and track changes in these characteristics over time;

ii) Identify risk factors for major chronic conditions and normative age-related changes;

iii) Assess effects of disease processes and lifestyle choices on functional status, and the demand for acute and longer-term aged care services; and

iv) Examine mortality outcomes.

Who is in the cohort?

The ALSA is a population-based cohort of older men and women who resided in the Adelaide Statistical Division and aged 70 years or more on 31 December 1992. Both community-dwelling and people living in residential care were eligible, and randomly selected from the South Australian Electoral Roll. The primary sample was stratified by age groups (70-74, 75-79, 80-84 and ≥ 85 years), gender, and local government area.

Letters of introduction and invitation were sent to 3,263 people; 560 were not eligible (210 were deceased, 88 had no translator available, 189 could not be contacted at the address, 37 were out of the geographical scope, and 36 were ineligible for other reasons, e.g., for incorrect date of birth). Of the 2,703 eligible persons, 1,477 consented and completed an interview (response fraction 54.6%).

In addition to the primary sample, spouses and other household members of eligible persons were invited to take part. The age requirement for spouses was relaxed to age 65 years. An additional 597 spouses and 13 household members were recruited. In total, 2,087 people took part in a Wave 1 interview, including 565 couples. Key Baseline characteristics are presented in Table 1.

After consenting, arrangements were made for the structured personal interview to be conducted at the participant's usual place of residence. Then participants were invited to take part in a detailed clinical assessment and complete self-administered questionnaires. To minimize participant attrition, at each wave members of the cohort were asked to provide contact details of three people who could provide information about their whereabouts should their residential location change.

Birthday and Christmas cards, and periodic newsletters, were sent to participants between waves.

(Table 1 about here)

To assess the representativeness of the Baseline sample, we compared them on a range of health-related markers to the overall over-70 population in South Australia.[3] Weights were applied to the data to adjust for age and sex stratification, and the probability of selection of respondents within each local government area sampled. The percentages for the weighted and unweighted values showed high correspondence on activities of daily living, self-ratings of health, and number of health professionals consulted and hospital stays in the previous year. At Baseline, 14% of participants used formal services, comparing favourably to 12% of the over-70 population.

Attrition was examined at Wave 3 in relation to partaking in the clinical assessment.[4] Those who did not complete the clinical assessment at Wave 3 had had poorer health and cognitive function at Wave 1, independent of age and gender. Rates of possible dementia were also higher in participants who did not undertake Wave 3 clinical assessment, compared with both those who did so and population data. Possible sample selectivity was also assessed by Luszcz et al.[5] using Baseline data to explain age-related differences in memory. We compared the target community-dwelling sample who met inclusion criteria to all community-dwellers who completed the structured interview. Table 2 shows a high degree of similarity between the groups; differences were in all cases a small fraction of the standard deviation. The target sample was slightly younger, healthier, and more cognitively able. More generally, missing data resulting from attrition have been analysed using maximum

likelihood estimation, e.g., growth curve modelling,[6] which produces estimates based on all available data under missing-at-random assumptions.[7]

(Table 2 about here)

How often have they been followed up?

There have been 12 waves of data collection. Wave 1 took place from September 1992 to March 1993. The next three waves took place 1, 2, or 3 years thereafter. Subsequent waves were approximately 6, 8, 11, 13, 15, 16, 18 and 21 years after baseline, with funding secured for a 22-year follow-up. Unequal intervals reflect funding availability for follow-up.

There were two key modalities of data collection: in person and telephone. Waves 1, 3, 6, 7, 9, 11 and 12 involved multiple components including structured interviews, clinical assessment (each of these components took 1.5 to 2 hours), and self-administered questionnaires (an additional 30 - 60 minutes). Waves 2, 4, 5, and 8 were shorter telephone interviews that focused on major life events since the previous wave. To accommodate increasing sensory frailty of the surviving participants, Wave 10 was conducted in-person. Figure 1 presents a schema of timing and response fractions.

(Figure 1 about here)

What has been measured?

Measures included in each wave are detailed in Table 3.

(Table 3 about here)

Structured interviews

The interview content was informed by other international longitudinal studies of ageing.[8-14]

Domains included demographic details, health, depression, morbid conditions, hospitalisation, cognition, gross mobility and physical performance, activities of daily living, lifestyle activities, social factors, exercise, education and income.

Clinical assessments

These assessments objectively measured physical and cognitive functioning. The physical examination included blood pressure, anthropometry, visual acuity, audiometry, grip strength, balance and gait. The cognitive assessment included memory, information processing efficiency, verbal ability and executive function. All clinical assessments were conducted by graduates trained in standard administration.

Self – administered questionnaires

Self-administered questionnaires, to be mailed back to the study co-ordinating centre or collected at the clinical assessment, encompassed nutrition, dental health, sexual activity and psychological measures of self-esteem, morale, control beliefs, and metamemory.

Biochemical analysis

Fasting blood samples (Waves 1, 3 and 9) and urine specimens (Wave 1) were collected on the morning following the clinical assessment. Basic haematology measures, 20 channel biochemical analysis, and lipid profiles have been conducted for blood, and standard assays for the urine samples. At Wave 1, selected hormone assays were carried out.

Qualitative interviews

The study incorporated qualitative sub-studies, on sleep[15] and widowhood.[16] In 2013 qualitative interviews were conducted with 20 Wave 12 participants aged 90 and older, to

gain a unique perspective on lived experiences that may be indicative of resilient aging.

Data linkage

Information about use of community services in the preceding year was collected at Wave 1 from participants' personal physicians and three community nursing and personal care services. Supplementary administrative data spanning Waves 6 through 8 were gathered from the Australian Health Insurance Commission (HIC), the federal government entity that manages and delivers publicly funded medical and pharmaceutical services. HIC data captured the use, nature, timing, charge and benefit paid for medical services and included prescriptions funded through the Australian Pharmaceutical Benefits Scheme. Deaths have been monitored systematically each year through the state-based Registry of Births, Deaths and Marriages and from relatives or other informants on deaths between reports. If participants could not be located, informants were contacted and they supplied date of death if a participant died outside of South Australia.[17] At January 2014, 1,806 (86%) of the original participants had died.

What has the ALSA found? Key findings and publications

As of 31 December 2013, 114 peer-reviewed papers, 1 book, and 6 book chapters have been published, with a listing available at the ALSA website [http://www.flinders.edu.au/sabs/fcas/alsa/bibliography.cfm]. The range of publication outlets encompasses biomedicine, epidemiology, gerontology and psychology, highlighting the inter-disciplinary nature of the findings.

Successful aging

Using MacArthur criteria developed in the U.S.[18], Andrews et al.[19] identified three distinct

groups of ALSA participants who were aging with varying degrees of success at Baseline. Groups were compared on functioning across a range of psychological, physical, and social domains, and mortality. Results showed risk and protective effects for successful aging from physical functioning and performance, lifestyle, cognition, affect and personality. Eight-year mortality was highest in the group aging with least success. Baseline inter-individual differences showed that those aging most successfully not only live longer, but also experience a better quality of life.

Psychological functioning

Seeking to understand factors, other than age, that contribute to cognitive functioning has been a major focus of our work.[5] We examined the *common cause* hypothesis of cognitive aging, according to which decline in cognition and sensory functioning go hand in hand due to shared neurophysiological underpinnings associated with brain aging. Unlike initial work showing a strong relationship between cognitive and sensory (hearing and vision) functioning[20], we found evidence for both specific and common factors underlying changes in them.[21] This was confirmed in a study showing neither processing efficiency, nor sensory abilities, entirely explained cognitive change over the first eight years in ALSA.[22] Relatedly, we examined de-differentiation of cognitive functions with aging[23], with results suggesting that common factors play a smaller role than previously thought in explaining age-related changes in cognitive and sensory performance.[24]

We have used some of the cognitive data, e.g., naming of simple line-drawings[25] and the National Adult Reading Test[26], to provide norms against which cognitive performance can be compared to distinguish individuals' normal patterns of cognitive aging from those with possible cognitive impairment. The contribution of cognitive functioning to health and

functional outcomes has also been demonstrated in, for example, studies of mortality[17], driving cessation[27] and self-esteem.[6]

The Mini Mental Status Examination (MMSE[28]) was included in all major ALSA waves. Graham et al.[29] used Bayesian hierarchical modelling with a joint tobit distribution to examine serial measurements of MMSE and informative dropout or death. Results suggested that higher levels of physical activity, more education and higher income were associated with higher MMSE at baseline, and a slower rate of decline.

Other psychological research has considered aspects of affective functioning, encompassing mood and emotional well-being, and subjective perceptions of aging. A particular focus has been on depressive symptoms, as outcomes, mediators, or explanatory variables. We have provided prevalence figures for depression in both community-dwellers (14%) and persons living in residential aged care (32%).[30] Extending our work concerning falls[31,32], depressive symptoms, along with cognitive functioning, are linked to driving cessation.[27,33] Following driving cessation, the stronger an individual's perceived control, the less likely they are to experience depressive symptoms[33]. Another investigation[34] showed that depressive symptoms predict declining cognitive processing, rather than the converse.

A recent study[6] examined trajectories of change in self-esteem over chronological age and time-to-death, indicating remarkable stability until very late in life when minor declines emerged. Poorer perceived control was associated with poorer self-esteem, as was poorer cognition, which also related to steeper age-related and mortality-related declines. Another psychological construct, self-perceptions of one's own aging, appears to play a powerful role in predicting health[35] and survival.[36] It is plausible that those with better perceptions of aging

are more likely to engage in positive health behaviours.

Physical functioning

The average number of chronic health conditions at Wave 1 was 5.3 (SD = 3.0), with 6% reporting ≥ 10. The majority of older adults have multiple chronic condition (64% had ≥ 2 chronic conditions, 40% reporting ≥ 3[37]). Arthritis was the most common condition experienced in conjunction with another condition: arthritis and cardiovascular disease (21%), hypertension (19%), gastrointestinal disease (18%) and mental health problems (17%) were most prevalent. Over a 14-year period, participants with 3 or 4 chronic conditions at Wave 1 had a 25% increased risk of mortality compared to those with no chronic disease, while those with ≥ 5 chronic diseases had an 80% increased risk of mortality, after adjusting for age, sex and place of residence.[38]

Physical functioning has been variously considered as both an exposure and outcome in analyses using ALSA data. Sargent-Cox et al.[39] established that self-perceptions of aging predicted 16-year change in physical functioning over lags of 1 year. However, the converse did not hold: changes in physical functioning did not predict changes in self-perceptions of aging. A range of studies has also examined vision and hearing.[40,41]

Social functioning

Different aspects of ALSA participants' social milieu have been demonstrated to contribute across a range of health and well-being outcomes. Larger overall social networks were associated with reduced residential care admission, risk of disability, and 10-year mortality[42-44], as well as memory decline.[45] Specifically, larger friends social networks were of benefit for survival across a decade[43] and for memory preservation across 15 years.[45]

After widowhood, trajectories of social engagement across 15 years increased, and frequency of phone contact with children and participation in social activities were higher for widowed than married ALSA participants.[16] Baseline data showed that informal and formal social support jointly buffered the effects of disability on depressive symptoms in later life.

A distinguishing feature of ALSA is the inclusion of couples. We have examined the dynamic relationships between spouses over time in cognition, and subjective well-being. Figure 2 shows spousal interdependencies in trajectories of cognition and well-being. Spousal interrelations in level and change of cognitive functioning across 11 years showed that perceptual speed, a robust marker of cognitive functioning, of husbands predicted subsequent perceptual speed decline for wives (time lags of 1 year)[47], but the opposite unidirectional effect (i.e., wives scores predicting husbands' decline) did not hold. In analyses of subjective well-being (morale) across 11 years, wives' changes in morale were shown to predict subsequent changes among husbands, but not the reverse. Husbands whose wives reported higher initial subjective well-being showed a relatively shallower decline over time relative to husbands whose wives reported lower initial subjective well-being, which had little effect on husbands.[48] Adopting a different approach, the interdependence of spousal social activity trajectories over the same span was examined. Joint spousal activities depend not only on individual resources, but also on spousal cognitive, physical, and affective resources at baseline.[49] Wives performed more social activities and displayed different associations between depression and social activity than did husbands. Stronger within-couple associations were more evident in social activities than in cognition. Together, these studies suggest that the impact of one spouse on the other varies depending on the domain of inquiry.

(Figure 2 about here)

What are the main strengths and weaknesses of the study?

The main strengths of ALSA are the population-based sample, frequent data collections and the duration of the study. ALSA was unprecedented in the Southern Hemisphere at the time of its establishment. There has been a low rate of experimental attrition across the two decades of follow-up. The range and multi-disciplinary nature of the domains included in the ALSA means it has been pivotal in informing practice and policy on healthy aging and establishing collaborations[50]. Using measures common to international studies (e.g., [10,11]) has assisted in undertaking comparative studies.

The main limitations pertain to the varying intervals between data collection and the use of a single panel, with no replenishment. Attrition from wave to wave contributes to positive selection effects inherent in most longitudinal studies of older adults. The breadth of the study, while an overall strength, also means that interrogation in many areas is somewhat limited. Financial constraints and vagaries of the availability of external funding dictated the frequency of study occasions and prohibited inclusion of non-English speakers in the sample.

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

Inquiries regarding the use of collected data are welcome. All proposals for specific analyses are reviewed by a scientific committee. The ALSA data are held at the Flinders Centre for Ageing Studies, Flinders University. Procedures for data access, information on collaborations and other details can be found at http://flinders.edu.au/sabs/fcas/.

Funding

The first four ALSA waves were funded by the US National Institute on Aging (AG 08523-02). Other funding sources have included the Australian Research Council (DP0879152 and DP130100428; LP 0669272; LP 100200413; Future Fellowship FT100100228 to TDW), and the National Health and Medical Research Council (Project Grants 179839; 229922; Early Career Fellowships 987100 to KJA and 627033 to LCG).

Acknowledgements

All of the participants and the ALSA team of collaborators, research assistants, graduate, and post-graduate students are thanked for their involvement in the project. The late Gary Andrews and the late George Myers began the study, and the late Michael Clark was one of the founding study Chief Investigators. They helped to build a dedicated team of researchers, in addition to the authors. We wish to acknowledge the ongoing commitment and involvement at various points during the project of Lynne Cobiac, Debbie Faulkner, Denis Gerstorf, Andy Gilbert, James Harrison, Christiane Hoppmann, Konrad Pseudovs, and Linnett Sanchez.

Conflict of interest

None declared.

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Table 1: Key characteristics of the ALSA participants at Baseline

Characteristic	Summary
Gender *n = 2,087 (%)*	
Male	1056 (51)
Female	1031 (49)
Age *(mean, SD)*	78.3 (6.7)
Age in 5-year bands *n = 2,087 (%)*	
65 - 69	140 (7)
70 - 74	562 (27)
75 - 79	524 (25)
80 - 84	429 (21)
≥ 85	432 (21)
Marital Status, *n = 2,086 (%)*	
Married / Defacto	1367 (65.0)
Widowed	594 (28.6)
Never Married	76 (3.6)
Divorced / Separated	49 (2.4)
Self-Rated Health, *n = 2,081 (%)*	
Excellent / Very good,	790 (38)
Good	633 (30.4)
Fair / Poor	658 (31.6)
Education: Age left School, *n = 2,061 (%)*	
≤ 14 years	1155 (55.3)
> 15 years	906 (43.4)
Annual Income, *n = 1,930 (%)*	
$AUD < $12,000	686 (35.5)
$AUD $12,000 – < $30,000	1083 (56.1)
$AUD $30,000 - < $50,000	136 (7.1)
$AUD ≥ $50,000	25 (1.3)

Table 2: Summary of Sub-Sample Characteristics and Differences Compared to Full Sample Residing in Community

Variable	Sub-Sample			Difference[a]	
	%	*M*	*SD*	%	*M*
Age		77.6	5.5		−0.65
Gender (n)					
Male	54.2	515		+0.1	
Female	45.8	436		−0.1	
Married	70			+3.5	
School (left ≥ 16)	29			+4.2	
Illnesses		5.5	2.8		−0.18
Medications		2.6	1.9		+0.02
Self-rated health (≥good)	74			+5.0	
Activities of daily living (≥1)	11			−5.0	
Instrumental Activities of daily living (≥1)	32			−3.0	
Depressive Symptoms		7.4	6.7		−0.53
Adelaide Activities Profile[b]					
Home Maintenance		52.5	18.7		+2.5
Domestic		52.2	18.5		+2.2
Social		51.3	19.8		+1.3
Service to Others		52.3	20.3		+2.3
NART errors		22.2	8.4		−0.27
IQ estimate[c]		102.0	9.5		+0.32
Processing accuracy		0.97	0.07		0.00
Processing speed		29.9	10.9		+0.68
Picture naming		13.7	1.6		+0.18
Recall					
Address		8.60	1.6		+0.20
Symbol		6.28	2.0		+0.06
Picture		5.62	2.3		+0.17

Note. Statistics extracted from Luszcz, et al.[5]

[a] Raw score difference relative to all community residents.

[b] Clark and Bond (1995)[51] standardized these scales to $M = 50$ ($SD = 20$).

[c] IQ estimate is based on NART errors. NART: National Adult Reading Test.

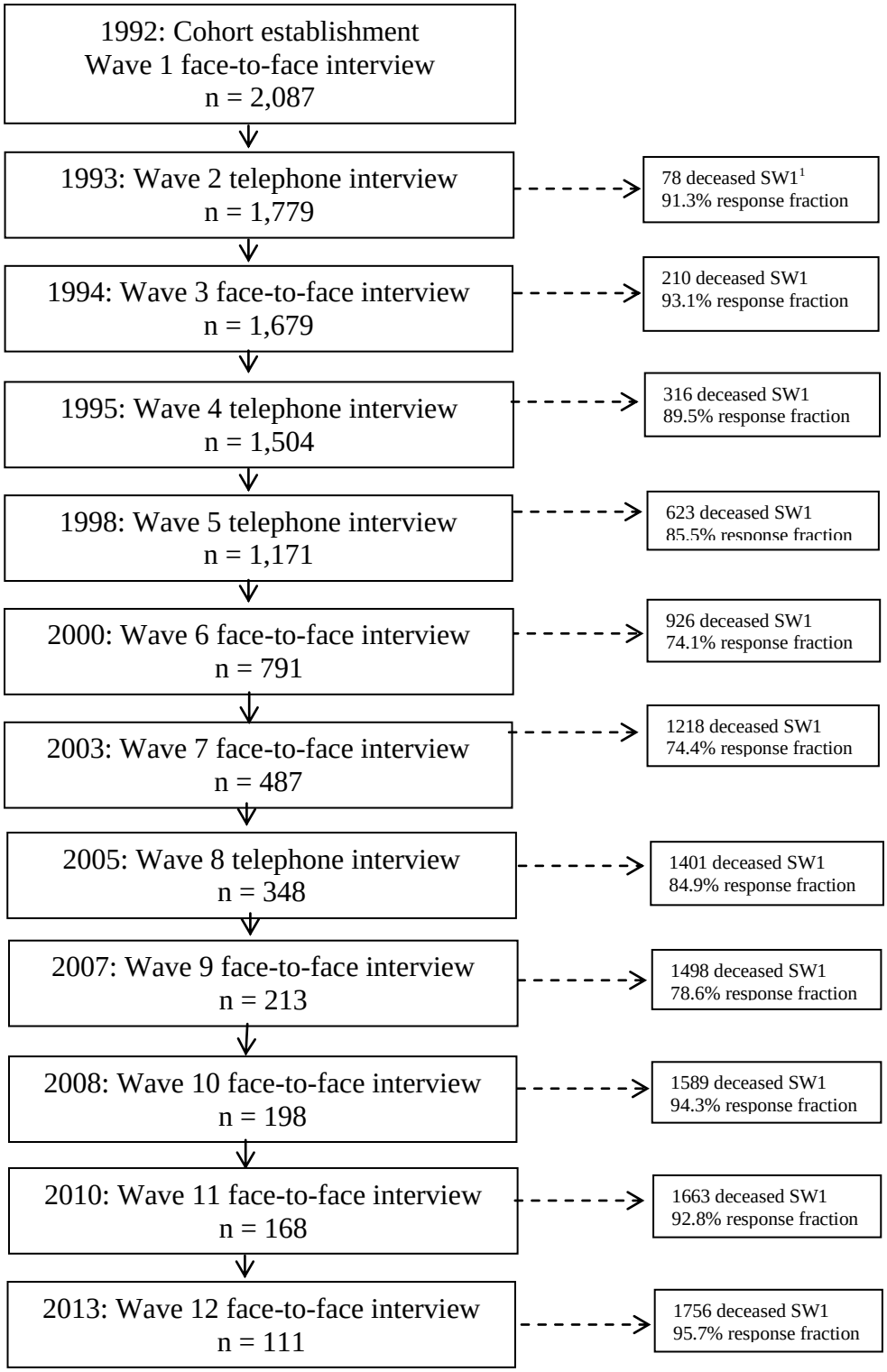
Table 3: Summary of ALSA Domains, Waves 1 through 12

	Study wave											
QUESTIONNAIRE DOMAINS	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
Residence and household structure	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Socio-demographic Information	✓		✓					✓		✓		
Family composition	✓		✓			✓	✓		✓		✓	✓
Health status of spouse	✓	✓	✓					✓		✓	✓	✓
Carer role		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
Self-Rated health	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Depression	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓
Chronic conditions and symptoms	✓		✓			✓	✓		✓		✓	✓
Medications	✓		✓			✓	✓		✓		✓	✓
Falls/injuries	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fractures/surgery	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Hearing and vision	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Continence	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Health Service Utilisation	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Dental health	✓	✓	✓	✓	✓	✓		✓	✓	✓		
Quality of life				✓							✓	✓
Weight history	✓	✓	✓	✓		✓	✓		✓			
Personal Growth			✓									
Purpose in Life					✓			✓		✓	✓	✓
Reproductive History (Females)	✓											
Cognitive Status	✓		✓			✓	✓	✓	✓	✓	✓	✓
Sleep	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Memory Impairment Screen/Executive Function			✓			✓	✓		✓		✓	✓
ADL Physical Performance and Physical Aids	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
IADL Physical Performance and Physical Aids	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Gross Mobility		✓		✓	✓	✓	✓	✓	✓	✓	✓	✓
Social Support and Interaction	✓		✓			✓	✓		✓			
General Life Satisfaction	✓					✓	✓		✓	✓	✓	✓
Significant Life Events	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Tobacco and Alcohol Consumption	✓		✓			✓	✓		✓		✓	✓
Exercise and Activity Levels	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓
Social Activities and Religion	✓		✓			✓	✓		✓		✓	✓
Adelaide Activities Profile	✓		✓				✓		✓		✓	✓
Driving	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
CLINICAL ASSESSMENT DOMAINS												
Boston Naming Task	✓		✓			✓	✓		✓		✓	✓
Digit Symbol Subtest (of the WAIS-R)	✓		✓			✓	✓		✓		✓	✓
Digit Symbol Recall	✓		✓			✓	✓		✓		✓	✓
National Adult Reading Test (NART)	✓		✓			✓						

Initial Letter Fluency Task (FAS)			✓			✓	✓		✓		✓	✓
Flinders Fluency Task			✓			✓	✓		✓			
Uses for Common Objects			✓			✓	✓		✓			
Quality of Life (Hopes and Fears for the Future)	✓		✓				✓		✓		✓	✓
Audiometry	✓		✓			✓	✓		✓		✓	✓
Visual Acuity	✓		✓			✓	✓		✓		✓	✓
Sitting, Standing Blood Pressure	✓		✓			✓	✓		✓		✓	✓
Weight and Height	✓		✓			✓	✓		✓		✓	✓
Girths	✓		✓			✓	✓		✓		✓	✓
Skin Fold Thickness	✓		✓			✓	✓		✓		✓	✓
Lower Leg Length	✓		✓			✓	✓		✓			
Arm Span (Demispan)	✓		✘			✓	✓		✓		✓	✓
Functional Reach	✓		✓			✓	✓		✓		✓	✓
Grip Strength	✓		✓			✓	✓		✓		✓	✓
Physical Signs, Ecchymoses, Pitting Oedema	✓		✓			✓	✓		✓		✓	✓
Physical Performance Evaluation (EPESE)	✓		✓			✓	✓		✓		✓	✓
Abnormalities Of Gait And Posture	✓		✓			✓	✓		✓		✓	✓
SELF - COMPLETE QUESTIONNAIRES DOMAINS												
Nutrition - You and Your Diet (2 Versions)	✓					✓			✓		✓	✓
Nutrition			✓									
Dental - Oral Health Impact Profile	✓		✓				✓					
Psychological - Attitudes and Views (Control, Morale, Self-esteem, Metamemory)[1]	✓		✓			✓	✓		✓		✓	✓
Emotional Health Questionnaire			✓									
Sexual Activity	✓		✓			✓	✓		✓		✓	
ANCILLARY CLINICAL STUDIES DOMAINS												
Bone Densitometry	✓		✓						✓			✓
Nerve Conduction Studies	✓		✓									
Spirometry	✓											
LABORATORY STUDIES DOMAINS												
Haematology - Fasting Blood	✓		✓						✓			✓
Biochemistry - Fasting Blood	✓		✓						✓			✓
Blood Sample - Blotted onto FTA GeneCard						✓	✓					

1 Some of these instruments appeared in the Household Interview at later waves.

Figure 1: Mode of interview and number of participants over time in the ALSA study



[1]SW1 = Since Wave 1

Figure 2 Caption:

Top Panel A represents model-implied sample (of average age and education) means on wives' cognition (perceptual speed) from a bivariate Dual Change Score Model (Full Dynamics) for the hypothetical case that the initial sample means for husbands' cognition were varied by half a standard deviation (i.e., 5 T-score units). Under the assumption of comparable wives' cognition at T1, wives with cognitively fit husbands ($husbands_{T1}$ +0.5 *SD*) showed relatively shallow perceptual speed decline, whereas those with cognitively less fit husbands ($husbands_{T1}$ –0.5 *SD*) showed relatively steeper perceptual speed decline. In contrast, the lines in *Top Panel B* indicate that husbands' cognitive trajectories of change over time were minimally changed as a function of different initial levels of wives' perceptual speed.

Bottom Panel B shows model-implied change in subjective well-being (SWB: morale) for participants (of average age and education, adjusted also for health constraints, length of marriage, and number of children) assuming that all husbands reported similar morale at T1, but their wives differed in initial morale. On average, morale declined for husbands; but husbands whose wives reported low SWB ($wives_{T1}$ –0.5 *SD*) showed relatively stronger SWB decline, whereas those husbands whose wives reported high SWB ($husbands_{T1}$ +0.5 *SD*) showed relatively shallow decline. In contrast, *Bottom Panel A* shows wives' decline was altered modestly as a result of varying initial husbands' SWB.

Figure 2: Illustration of the differential magnitude of dynamic partner effects between wives' and husbands' perceptual speed[47] (Top Panel) and subjective well-being[48] (Bottom Panel).