Attrition in longitudinal studies: who do you lose?

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Abstract

Objective: To describe the risk factors for various types of attrition in three age cohorts of women in a longitudinal study and to discuss strategies to minimise attrition.

Methods: Analysis of survey data from the Australian Longitudinal Study on Women's Health, collected by mailed questionnaire. In 1996, the study recruited and surveyed a national random sample of 'younger' (18-23 years, n=14,247), 'mid-age' (45-50 years, n=13,716), and 'older' women (70-75 years, n=12,432), and began a staggered cycle of mailed follow-up questionnaires: 1998 (mid-age), 1999 (older), 2000 (younger) and so on. Demographic, health and social risk factors for attrition were examined using multivariate analysis.

Results: Attrition at survey 2 was highest among younger women (32%), mainly because of participants not being contactable (21%), and lower among the older (16%) and mid-age women (10%). At survey 1, the survey 2 non-respondents were more likely to report having less education, being born in a non-English-speaking country and being a current smoker, in all cohorts, and had poorer health (mid-age and older cohort) and more difficulty managing on their income (younger and mid-age).

Conclusion: Although the magnitude of different types of attrition was found to differ by age, there were several risk factors for attrition that remained consistent. These findings are important to inform future studies on ways to lessen or prevent systematic loss of participants.

Implications: Recruitment and follow-up methods in longitudinal studies should be tailored to maximise retention of participants at higher risk of dropout.

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Longitudinal research is an important way to examine causal relationships and is critical to understanding issues associated with ageing.[1] One of the difficulties associated with conducting longitudinal studies is attrition (the loss of study participants). Attrition can occur through death or frailty, discontinued participation (withdrawal), lack of success in recontacting the participant for a follow-up survey (no contact) or by non-return of a survey by a participant (non-return).

Information on the types and possible correlates of attrition is important for a proper interpretation of the results of longitudinal analysis.[2-4] In their review of longitudinal studies, Chatfield et al. found that many studies did not report details of their attrition and of those that did, many did not explore multivariate methods of analysis of predictors of attrition[5] and few studies examined age-specific attrition patterns.[6] Furthermore, studies that reported on characteristics of their lost-to-follow-up group tended to ignore social factors and concentrated on the basic demographic factors such as education, income and marital status.[5]

Attrition not only causes loss of power because of diminishing numbers of participants, but the loss may be selective, which may reduce the internal and external validity of the findings.[2-4,7-9] Theoretically, some types of attrition such as withdrawal, no contact and non-return could be reduced by knowing the risk factors for these types of attrition.[5,10] Investigators who plan and evaluate studies would then be able to decide how to allocate resources to minimise loss.[11] For example, a profile of the characteristics of participants who have successfully been contacted and yet fail to complete a follow-up survey may suggest ways to improve the study methods and lower refusal rates.[10]

Data from three age cohorts of the Australian Longitudinal Study on Women's Health (ALSWH) provide an opportunity for comparisons across age of the magnitude and correlates of several different types of attrition among a large sample of women. The diverse range of variables collected in the questionnaires and participant tracking process allows the relationship between attrition and social factors as well as health and demographic factors to be investigated.

Methods

Sample

This research was conducted as part of the ALSWH, which has been approved by the University of Newcastle Human Research Ethics Committee. The ALSWH participants were a nationally representative sample of women aged 18-23 years (younger cohort), 45-50 years (mid-age cohort) and 70-75 years (older cohort) when the study began in 1996. The women were randomly selected from the national health insurance database (Medicare), which includes all permanent residents of Australia, with over-representation of women living in rural and remote areas.[12] Response rates to the first mailed survey (survey 1) cannot be exactly specified as some women selected in the

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sample may not have received the invitation (e.g. if they had died or had changed their address without notifying Medicare). An estimated 41-42% of the younger women, 53-56% of the mid-age women and 37-40% of the older women agreed to participate in the longitudinal study.[13] Confidentiality restrictions meant that names and contact details for the selected women were not available until they responded to the survey, so some of the usual methods of encouraging participation were not possible.[12] However, comparison with the 1996 Australian Census indicated the respondents were broadly representative of women in the same age groups with some over-representation of married and more highly educated women.[13]

Survey 2, the first follow-up, was staggered over three successive years: 1998 (mid-age cohort), 1999 (older cohort) and 2000 (younger cohort). Questionnaires were not sent to women who could not be traced or had withdrawn from the study, nor when the study had been notified that a woman was unable to complete the survey (e.g. dementia, stroke, trauma, travelling) or had died. Details of women in the older cohort were matched to the National Death Index early in 1999 before sending out survey 2 so that women who had died were removed from the mailing list.[14] Questionnaires were completed by proxy (family members, friends or carers) for a small proportion (2.5%) of older women. Thus respondents include all women who completed survey 2, including those questionnaires completed by proxy. If a completed questionnaire had not been returned within one month, a second mailed reminder was sent and then up to eight attempts were made to contact the woman by telephone, including leaving voice mail messages. Details of the strategies used to try to trace participants and a discussion about which strategies were more successful have already been published.[15] After all these efforts, some women could still not be contacted either by mail or telephone.

Measures

Types of attrition

From survey 1 to survey 2, five types of attrition were defined: death; too ill to complete further surveys (e.g. dementia, stroke); withdrawn; lack of success in contacting the respondent ('no contact') and 'non-return' of survey 2 where the participant was known to have received the questionnaire but did not return it. The first two categories comprise women who were ineligible for future surveys and the last three categories together comprise the 'non-respondent' group. Reasons for withdrawal from the study were recorded whenever possible. These reasons included having too many other commitments, concerns about confidentiality or privacy, moving overseas indefinitely, or no longer being interested in the study. When a request to withdraw from the study was received by mail, there was often no reason given. Hence misclassification between 'withdrawn' and 'too ill to complete' was possible, as some women may have withdrawn without providing a reason when they were, in fact, too ill to continue their participation. Attrition because of non-return may be a temporary state when, for example, a woman was caring for a sick or dying husband or was in the throes of a divorce. Similarly, attrition through no contact can be reversed in future waves if the participant is successfully tracked. Women who were prepared to complete the survey while travelling were encouraged to do so. Many questionnaires were sent to and returned from overseas addresses, particularly among the younger women.

Explanatory variables

All explanatory variables used in this analysis were from survey 1 in 1996. The choice of explanatory variables was based on previous findings of predictors of attrition, as well as a range of social factors.

Demographic variables

Country of birth was classified as Australia, another English-speaking country or non-English-speaking country. Marital status consisted of three categories for the younger and mid-age women: married/de facto; separated/divorced/widowed; and not married. Few younger and mid-age women were widowed (0% and 2% respectively), but widows among the older women are shown separately as a fourth category because of the large numbers. Education was classified as: did not finish high school; completed high school; or post-high school qualifications. The women were asked how they managed on their available income and responses were categorised as "not too bad/easy", "difficult some of the time", or "difficult all of the time/impossible".

Health and health behaviour

The MOS Short-Form Health Survey (SF-36) was included to measure perceived general health and well-being.[16] The SF-36 contains 36 items that are scored as eight multi-item scales and two overall summary scores: the Physical Component Summary score (PCS) and the Mental Component Summary score (MCS), which are each standardised to have a mean of 50 and standard deviation of 10.[17] Higher PCS and MCS scores reflect better health. Although no definitive guidelines for clinical significance exist as yet, normative data from the 1995 Australian National Health Survey show that the presence of one serious physical condition (e.g. cancer, heart disease, diabetes, hypertension, asthma, arthritis) results in decreases of physical and mental component scores of 3.3 and 2.1 respectively.[18] Current smokers were defined as women who responded that they now smoke occasionally or regularly.

Social factors

Women were asked whether they regularly provided care or assistance (e.g. personal care, transport) to any other person because of their long-term illness, disability or frailty (yes/no). Satisfaction with life achievements in the areas of work/career/study, family and closest relationships, friendships and social activities was measured on a Likert-type scale with four response options ranging from one for 'very dissatisfied' to four for 'very satisfied'. Responses to the five items were averaged to derive a mean score for life satisfaction, with a higher score indicating greater life satisfaction. Three questions were used to measure social support: "Does it seem that your family and friends

Table 1: Survey 2 response status by cohort (ages in 1996).

Status at survey 2	Younger 18-23 years		Mid-age 45-50 years		Older 70-75 years	
	n	%	n	%	n	%
Respondents						
Completed survey 2	9,688	68.0	12,338	90.0	10,434	83.9
Non-respondents						
Contacted but did not return survey 2 (non-return)	1,332	9.4	253	1.8	486	3.9
Unable to contact participant (no contact)	2,968	20.8	857	6.2	309	2.5
Withdrawn	234	1.6	211	1.5	583	4.7
Ineligible						
Deceased between survey 1 and survey 2	22	0.2	50	0.4	518	4.2
Too ill to complete further surveys (e.g. stroke, dementia)	3	0.0	7	0.1	102	0.8
Total	**14,247**	**100.0**	**13,716**	**100.0**	**12,432**	**100.0**

Table 2: The prevalence of different demographic, health and social characteristics at survey 1 for respondents (Resp) and non-respondents (Non-resp) at survey 2. Mid-age and younger non-respondents exclude those who were deceased or unable to complete survey 2.

	Younger		Mid-age		Older	
	Resp n=9,688 %	Non-resp n=4,534 %	Resp n=12,338 %	Non-resp n=1,321 %	Resp n=10,434 %	Non-resp n=1,378 %
Country of birth						
Australian born	91.2	86.2	71.2	59.0	75.0	62.6
Other English speaking background	4.0	4.8	15.7	14.6	13.8	12.0
Non-English-speaking background	4.7	9.0	13.1	26.4	11.2	25.3
Marital status						
Married/de facto	19.5	22.1	81.9	71.5	56.5	51.2
Separated/divorced	}	}			6.1	7.3
Widowed	0.5	1.6	14.4	23.8	34.2	38.6
Not married	80.0	76.3	3.7	4.7	3.2	2.9
Education						
Did not finish high school	11.9	20.6	45.3	55.6	69.7	76.7
Completed high school	57.7	50.5	17.5	17.4	13.6	11.5
Post-high school qualifications	30.4	28.9	37.2	27.0	16.7	11.9
Difficulty managing on income						
Not too bad/easy	51.6	44.3	59.2	47.7	74.9	66.4
Difficult some of the time	32.0	34.3	27.4	29.5	18.8	23.4
Difficult all of the time/impossible	16.4	21.4	13.4	22.8	6.3	10.3
Current smoker	29.0	38.3	17.0	27.0	7.2	10.4
Self-rated health	Mean (95% CI)		Mean (95% CI)		Mean (95% CI)	
Physical component score	50.5 (50.3-50.7)	49.3 (49.0-49.6)	50.3 (50.1-50.4)	48.5 (47.8-49.1)	50.5 (50.4-50.7)	48.4 (47.8-49.0)
Mental component score	50.2 (50.0-50.4)	49.6 (49.3-49.9)	50.4 (50.2-50.5)	48.1 (47.5-48.7)	50.7 (50.5-50.9)	47.8 (47.1-48.4)
Social factors						
Regularly provide care for someone	7.3	8.3	20.1	20.4	18.1	15.2
	Mean (95% CI)		Mean (95% CI)		Mean (95% CI)	
Life satisfaction	3.12 (3.11-3.13)	3.07 (3.06-3.09)	3.14 (3.13-3.14)	3.02 (2.99-3.05)	3.40 (3.39-3.41)	3.36 (3.34-3.39)
Social support	7.31 (7.28-7.34)	7.19 (7.15-7.26)	7.46 (7.43-7.48)	7.21 (7.13-7.30)	8.04 (8.02-8.06)	7.86 (7.79-7.93)
Life events	0.17 (0.16-0.17)	0.17 (0.17-0.18)	0.12 (0.11-0.12)	0.14 (0.13-0.14)	0.07 (0.07-0.07)	0.08 (0.07-0.08)

Notes:
All differences between respondents and non-respondents were adjusted for area of residence and were statistically significant with the exception of providing care in the mid-age cohort.
Numbers vary due to small amounts of missing data for different items: 0-4% in the younger cohort, 1-6% in the mid-age cohort and 2-9% in the older cohort.

understand you?", "Can you talk about your deepest problems with at least some of your family and friends?" and "Other than members of your family, how many persons in your local area do you feel you can depend on or feel very close to?". The mean of the three items, each scored 1-3, was calculated, with a higher score indicating better social support. Women reported the number of stressful life events they had experienced over the past 12 months from a list of 32 events for the younger, 25 for the mid-age and 21 for the older women.[19] A higher mean score indicates having experienced more stressful life events.

Statistical analysis

Women who had died between survey 1 and survey 2 or were too ill to complete survey 2 (see Table 1) were omitted from further analyses. Logistic regression models were used to compare demographic, health and social characteristics of women at survey 1, first according to their respondent status and then in more detail by the type of attrition within each age group.[20] These models estimate the odds ratios for the explanatory variables for each group relative to an odds ratio of one for the respondents. All models were adjusted for area of residence and age, to adjust for the over-sampling of rural and remote residents, and for the six-year age range within each cohort.

Results

A total of 68% of the 14,247 younger, 90% of the 13,716 mid-age and 84% of the 12,432 older women in the longitudinal study completed survey 2 (see Table 1). Loss because of the various types of attrition differed markedly across the three age cohorts. The main reason for loss among younger women was 'no contact' (21%), whereas only 6% of the mid-age and 2% of the older women could not be contacted. It is perhaps not surprising that 'no contact' was the largest type of attrition in the younger cohort as almost half (48%) of the younger respondents who completed survey 2 replied that they had moved house at least twice and 26% had moved once in the three years before survey 2. Between 1997 and 2000, ALSWH recorded 10,661 changes of address for women in the younger cohort. The main reasons for loss among older women were withdrawal (5%), non-return (4%) and death (4%).

There were statistically significant differences between respondents and non-respondents for all demographic, health and social variables shown in Table 2. In multivariate models, most of the demographic and health variables remained significant. Some social factors differed between respondents and non-respondents, namely that non-respondent mid-age women were more likely to have experienced stressful life events in the past year and to

Table 3: Adjusted odds[a] of being a non-respondent compared with a respondent at survey 2 (reference category) for different demographic, health and social characteristics at survey 1. Odds ratios in bold are significantly different to reference group.

	Younger n=14,222 OR (95% CI)	Mid-age n=13,659 OR (95% CI)	Older n=11,812 OR (95% CI)
Country of birth			
Australian born		reference group	
Other English speaking background	**1.33 (1.09-1.61)**	1.18 (0.98-1.43)	1.14 (0.91-1.41)
Non-English-speaking background	**2.26 (1.90-2.68)**	**2.27 (1.89-2.72)**	**2.28 (1.86-2.80)**
Marital status			
Married/de facto		reference group	
Separated/divorced	}	}	1.00 (0.73-1.37)
Widowed	**1.87 (1.28-2.74)**	**1.63 (1.38-1.94)**	1.12 (0.96-1.30)
Not married	0.91 (0.83-1.01)	**1.72 (1.25-2.36)**	0.91 (0.55-1.51)
Education			
Did not finish high school		reference group	
Completed high school	**0.58 (0.52-0.64)**	**0.75 (0.63-0.90)**	**0.69 (0.55-0.87)**
Post high school qualifications	**0.67 (0.60-0.76)**	**0.56 (0.48-0.65)**	**0.62 (0.49-0.77)**
Difficulty managing on income			
Not too bad/easy		reference group	
Difficult some of the time	**1.22 (1.11-1.33)**	**1.21 (1.04-1.41)**	1.17 (0.98-1.39)
Difficult all of the time/impossible	**1.39 (1.25-1.55)**	**1.35 (1.12-1.63)**	**1.32 (1.01-1.73)**
Current smoker	**1.43 (1.31-1.55)**	**1.46 (1.26-1.70)**	**1.41 (1.10-1.81)**
Self-rated health			
Physical component score	0.996 (0.993-1.000)	**0.993 (0.987-0.999)**	**0.981 (0.974-0.988)**
Mental component score	1.003 (0.998-1.007)	**0.990 (0.983-0.997)**	**0.979 (0.972-0.986)**
Social factors			
Regularly provide care for someone	1.04 (0.90-1.20)	**1.42 (1.01-2.00)**	0.91 (0.75-1.10)
Life satisfaction	0.99 (0.90-1.09)	0.96 (0.82-1.11)	**1.20 (1.01-1.43)**
Social support	0.99 (0.96-1.02)	0.98 (0.94-1.03)	0.97 (0.90-1.03)
Life events	1.14 (0.75-1.73)	**3.12 (1.61-6.02)**	1.56 (0.66-3.67)

Notes:
(a) Adjusted for area of residence, age and all other variables in the table.

be caring for someone and non-respondent older women were more likely to be satisfied with their life achievements (see Table 3). Non-respondents in all three age cohorts had higher odds of being born in a country of non-English-speaking background and of being a current smoker and lower odds of having completed high school or post-school qualifications. Younger and mid-age non-respondents had higher odds of being separated, divorced or widowed and of having difficulty managing on their available income. Mid-age and older women who did not respond tended to have poorer physical and mental health than respondents, suggesting a healthy survivor effect for these cohorts.

The characteristics of younger non-respondents compared with respondents, according to the three types of attrition, are shown in Table 4. The profile of 'non-returns' and 'no contacts' was consistent with that for the total group of younger non-respondents, with the exception of marital status, providing care and stressful life events. Women who received but did not return survey 2 were more likely to be single, to be regularly providing care for someone and less likely to have experienced stressful life events than respondents. Younger women who could not be contacted were less likely to be single, more likely to have experienced stressful life events and have poorer physical health than respondents. Younger women who withdrew from the study were more likely to be single and to have less education and lower social support than respondents but did not differ significantly on other variables.

Among the mid-age women, the correlates of the different types of attrition were similar (see Table 5), although those who could not be contacted were the group more likely to have experienced stressful life events, difficulty managing on their incomes, poorer self-rated mental health and less likely to be married or living in a de facto relationship. Women who withdrew were more likely to have poorer physical health and be caring for someone and less likely to have experienced stressful life events.

Table 6 shows that older women who could not be contacted at survey 2 were more likely to be widows at survey 1 and have more difficulty managing on their available income than respondents. Hence women of all ages who could not be contacted for the second survey differed from those who did not return the survey: they were more likely to be having difficulty managing on their income and they were more likely to be separated or divorced (younger and mid-age women) or widowed (older women).

Table 4: Survey 1 demographic, health and social characteristics of younger women (18-23 years). Logistic regression models of the adjusted odds[a] of being a non-respondent compared with a respondent at survey 2 (reference category) for different characteristics at survey 1. Odds ratios in bold are significantly different to respondent category.

	Non-respondents		
	Non-return n=1,332 OR (95% CI)	**No contact n=2,968 OR (95% CI)**	**Withdrawn n=234 OR (95% CI)**
Country of birth			
Australian born		reference category	
Other English speaking background	0.99 (0.70-1.40)	**1.49 (1.20-1.85)**	1.09 (0.53-2.24)
Non-English-speaking background	**2.23 (1.72-2.89)**	**2.34 (1.92-2.85)**	1.51 (0.82-2.79)
Marital status			
Married/de facto		reference category	
Separated/divorced/widowed	1.54 (0.74-3.18)	**1.85 (1.24-2.77)**	2.03 (0.47-8.79)
Not married	**1.37 (1.16-1.63)**	**0.75 (0.67-0.83)**	**1.65 (1.12-2.44)**
Education			
Did not finish high school		reference category	
Completed high school	**0.68 (0.57-0.82)**	**0.55 (0.49-0.62)**	**0.47 (0.32-0.69)**
Post-high school qualifications	**0.76 (0.62-0.92)**	**0.64 (0.56-0.74)**	0.71 (0.47-1.06)
Difficulty managing on income			
Not too bad/easy		reference category	
Difficult some of the time	**1.16 (1.01-1.34)**	**1.29 (1.17-1.44)**	0.77 (0.55-1.07)
Difficult all of the time/impossible	1.20 (1.00-1.44)	**1.53 (1.34-1.73)**	0.96 (0.64-1.44)
Current smoker	**1.37 (1.20-1.56)**	**1.48 (1.34-1.63)**	0.99 (0.73-1.36)
Self-rated health			
Physical component score	0.999 (0.992-1.005)	**0.995 (0.990-0.999)**	1.002 (0.987-1.017)
Mental component score	1.002 (0.995-1.010)	1.002 (0.997-1.007)	1.012 (0.995-1.029)
Social factors			
Regularly provide care for someone	**1.25 (1.01-1.56)**	0.94 (0.79-1.11)	0.94 (0.79-1.11)
Life satisfaction	1.08 (0.92-1.26)	0.94 (0.84-1.05)	1.14 (0.81-1.61)
Social support	0.99 (0.95-1.04)	1.00 (0.97-1.04)	**0.88 (0.80-0.98)**
Life events	**0.32 (0.16-0.66)**	**1.95 (1.21-3.16)**	0.80 (0.17-3.81)

Note:
(a) Adjusted for area of residence, age and all other variables in the table.

These women apparently changed their contact details (address, telephone number or surname) without contacting the study office and proved impossible to trace and/or contact at survey 2 using electronic telephone directories and electoral rolls.

Discussion

This paper reports detailed analysis of attrition at survey 2 in a longitudinal study of women. The results show that the magnitude of attrition differs in important ways according to the age of participants and the type of attrition. Response rates to survey 2 ranged from 68% among younger women, 84% among older women to 90% among the mid-age women. The primary reason for the low response rate in the younger cohort was the inability of the research team to contact 20% of the women.

Non-respondents differed from respondents across all age groups in their demographic circumstances (non-English-speaking background, less education) and this finding is consistent with previous studies.[21,22] It has been suggested that better education and, perhaps, English literacy enables participants to have a better understanding of the importance of the research and more interest in the study.[8] In agreement with other studies, we found that women in all age cohorts who were current smokers were more likely to become non-respondents.[23,24] Social factors were found to add little once the demographic and health variables had been considered.

This study has found a healthy survivor effect for the mid-age and older cohorts, with respondents at survey 2 having been in better health at survey 1 than non-respondents. This finding has implications for the generalisability of prevalence estimates from cross-sectional studies of mid-age and older women. In later phases of this longitudinal study it may be possible to determine the stage at which the healthy survivor effect becomes evident as the younger women age.

Within age groups the correlates of the different types of attrition were remarkably consistent. Most differences occurred among younger women where women who received but did not return a completed questionnaire were more likely to be unmarried and less likely to have experienced stressful life events. These women chose not to withdraw from the study but at the same time were not committed enough to return the questionnaire. Younger women who could not be contacted differed from respondents,

Table 5: Survey 1 demographic, health and social characteristics of mid-age women (45-50 years). Logistic regression models of the adjusted odds[a] of being a non-respondent compared with a respondent at survey 2 (reference category) for different characteristics at survey 1. Odds ratios in bold are significantly different to respondent category.

	Non-respondents		
	Non-return n=253 OR (95% CI)	No contact n=857 OR (95% CI)	Withdrawn n=211 OR (95% CI)
Country of birth			
Australian born		reference category	
Other English speaking background	0.72 (0.44-1.18)	**1.38 (1.10-1.72)**	0.98 (0.60-1.61)
Non-English-speaking background	**2.78 (1.95-3.96)**	**1.93 (1.53-2.45)**	**2.78 (1.89-4.07)**
Marital status			
Married/de facto		reference category	
Separated/divorced/widowed	1.36 (0.93-1.99)	**1.85 (1.51-2.26)**	1.13 (0.71-1.80)
Not married	1.36 (0.66-2.82)	**1.86 (1.26-2.74)**	1.70 (0.85-3.43)
Education			
Did not finish high school		reference category	
Completed high school	0.87 (0.60-1.26)	**0.78 (0.63-0.97)**	**0.52 (0.33-0.83)**
Post-high school qualifications	**0.62 (0.44-0.86)**	**0.56 (0.46-0.68)**	**0.51 (0.36-0.73)**
Difficulty managing on income			
Not too bad/easy		reference category	
Difficult some of the time	1.28 (0.93-1.75)	**1.38 (1.15-1.67)**	0.73 (0.50-1.06)
Difficult all of the time/impossible	1.16 (0.76-1.78)	**1.58 (1.26-1.98)**	0.91 (0.57-1.45)
Current smoker	**1.64 (1.20-2.25)**	**1.54 (1.29-1.84)**	0.94 (0.63-1.40)
Self-rated health			
Physical component score	1.001 (0.987-1.015)	0.993 (0.986-1.001)	**0.982 (0.968-0.996)**
Mental component score	0.996 (0.981-1.011)	**0.990 (0.982-0.999)**	0.984 (0.968-1.000)
Social factors			
Regularly provide care for someone	0.90 (0.63-1.28)	0.81 (0.66-1.00)	**1.42 (1.01-2.00)**
Life satisfaction	0.86 (0.62-1.20)	1.00 (0.83-1.21)	0.93 (0.65-1.33)
Social support	1.03 (0.92-1.14)	0.95 (0.90-1.01)	1.05 (0.93-1.18)
Life events	0.95 (0.20-4.61)	**7.50 (3.55-15.83)**	**0.12 (0.02-0.85)**

Note:
(a) Adjusted for area of residence, age and all other variables in the table.

particularly with regard to marital status. The reasons for loss of contact may include relocation because of changes in employment (for themselves and/or their partner), financial circumstances or opportunities for travel. The present study covered a large geographical area and although considerable resources were devoted to keeping in contact with participants, the more mobile section of the population proved to be difficult to track. The proportion of younger women who could not be contacted at survey 2 was more than three and six times the proportion of mid-age and older women respectively. Data were not collected on mobility at survey 1, but the large number of changes of address and the high mobility reported by most of the younger survey 2 respondents might partly explain these differences. Furthermore, frequent moves have been associated with disadvantage, being most prevalent among the unemployed or those in low-paid, casual work and unstable relationships.[25] The higher prevalence of difficulty managing on their income, and separation, divorce and widowhood among the women who could not be contacted is consistent with these findings.

The strengths of this study include the use of a large, geographically diverse sample of community-dwelling women in three distinct age cohorts. Previous studies of attrition have been dependent on smaller samples, selected geographic areas or patient populations. The use of the same sampling strategies, methodologies and follow-up protocols, despite different follow-up times, allows valid comparisons across age cohorts. Further, the multivariable analysis allows in-depth comparison of the unique contribution of a range of demographic, health and social variables. Unfortunately, data are unavailable to determine whether these findings are consistent for men in Australia, as the longitudinal study was commissioned to explore factors contributing to healthy ageing among women.

A limitation of the present study is that the time gap between survey 1 and survey 2 differed for each age cohort. Although the longer time gap between surveys for the younger cohort (four years) may have increased non-response, it is unlikely to be the sole cause as other research has demonstrated the difficulties in contacting and tracking young adults.[9,21,22,26,27] Similarly, the two-year gap between survey 1 and survey 2 for mid-age women may have enhanced response rates but, again, the mid-age women seem

Table 6: Survey 1 demographic, health and social characteristics of older women (70-75 years). Logistic regression models of the adjusted odds[a] of being a non-respondent compared with a respondent at survey 2 (reference category) for different characteristics at survey 1. Odds ratios in bold are significantly different to respondent category.

	Non-respondents		
	Non-return n=486 OR (95% CI)	**No contact n=309 OR (95% CI)**	**Withdrawn n=583 OR (95% CI)**
Country of birth			
Australian born		reference category	
Other English speaking background	1.27 (0.90-1.80)	1.28 (0.84-1.95)	0.96 (0.68-1.34)
Non-English-speaking background	**2.79 (2.03-3.83)**	**2.11 (1.43-3.12)**	**2.03 (1.49-2.78)**
Marital status			
Married/de facto		reference category	
Separated/divorced	0.94 (0.57-1.55)	1.21 (0.67-2.17)	0.91 (0.55-1.51)
Widowed	0.94 (0.73-1.21)	**1.65 (1.21-2.25)**	1.05 (0.84-1.32)
Not married	0.79 (0.32-1.96)	1.02 (0.36-2.84)	0.97 (0.47-2.00)
Education			
Did not finish high school		reference category	
Completed high school	0.73 (0.50-1.05)	0.83 (0.53-1.29)	**0.57 (0.40-0.82)**
Post-high school qualifications	**0.54 (0.37-0.80)**	0.96 (0.64-1.43)	0.52 (0.37-0.74)
Difficulty managing on income			
Not too bad/easy		reference category	
Difficult some of the time	**1.33 (1.01-1.76)**	**1.60 (1.13-2.26)**	0.89 (0.68-1.17)
Difficult all of the time/impossible	**1.57 (1.04-2.37)**	**2.43 (1.54-3.83)**	0.67 (0.41-1.11)
Current smoker	**1.55 (1.05-2.28)**	1.09 (0.65-1.83)	**1.46 (1.01-2.10)**
Self-rated health			
Physical component score	**0.969 (0.958-0.980)**	**0.985 (0.970;0.999)**	**0.989 (0.978-0.999)**
Mental component score	**0.978 (0.967-0.990)**	**0.975 (0.962;0.990)**	**0.981 (0.970-0.992)**
Social factors			
Regularly provide care for someone	0.86 (0.62-1.19)	0.92 (0.62-1.38)	0.95 (0.72-1.26)
Life satisfaction	1.17 (0.88-1.55)	0.96 (0.68-1.35)	**1.38 (1.06-1.80)**
Social support	1.03 (0.92-1.15)	0.95 (0.84-1.08)	0.92 (0.83-1.02)
Life events	1.75 (0.46-6.68)	0.54 (0.08-3.65)	2.20 (0.65-7.48)

Note:
(a) Adjusted for area of residence, age and all other variables in the table.

to be more stable and thus easier to trace than younger women. These findings are consistent with those from the HILDA survey, where, after adjusting for deaths and movements out of scope, levels of attrition were found to be twice as high for participants in their twenties (23%) compared with mid-age and older participants (11%).[28]

One reason for identifying correlates of attrition is to identify persons at baseline who are at higher risk of attrition and make additional efforts to keep them in the study.[7] However, the use of special strategies and incentives to increase participation among mid-age and older people with health problems may raise ethical concerns over respondent burden.[7] Few previous studies have investigated the characteristics of participants who could not be contacted as a separate category of non-response, even though the loss of this subgroup may introduce more systematic bias than participants who are contacted but do not return questionnaires.[29] This group is of particular interest as it may be most amenable to change if strategies to maintain contact with the women are improved. In Australia, there is no single identification number associated with individuals, and changes of name through marriage or by choice are not routinely available to researchers. After survey 1, several methods were introduced in an attempt to overcome the no contact problem.[15] Each year participants are sent a newsletter providing feedback on the study's findings and reminding the participants to let the study office know when they change their address, either by using the pre-paid change of contact details form or by calling the study freecall number. Since 1998, the contact details form has included email addresses and mobile phone numbers, which are becoming more stable as users choose to keep their mobile number even if they change service providers. At survey 2, participants were asked to provide details of at least one secondary contact such as a family member or work colleague, "someone who will always know where you are if the study loses track of you".[15] This process has improved the tracking capability of the study and should be instituted routinely in future longitudinal studies. The Electoral Roll has also been useful, particularly when the woman being tracked has an unusual combination of given names. Hence it is important to collect middle name, as women are likely to change surname during the course of the study.

As longitudinal studies may risk becoming increasingly based on "faithful, committed respondents",[30] several techniques have been employed within ALSWH to encourage ongoing participation. For example, in all correspondence to participants we emphasise the point that they are important and cannot be replaced and that their contribution is vital in making the study findings relevant for future generations of women. Financial incentives have not been used to encourage participation in this study, although some studies of mobile younger populations have found that financial incentives contribute to better retention rates.[29,31]

Reporting the extent and sources of loss in longitudinal epidemiological studies enables potential problems with attrition in future studies to be scrutinised and minimised. This paper makes a contribution to the literature about how respondents differ from non-respondents, according to age and type of attrition, in a longitudinal study. There are clear differences in types of attrition by age and some important differences in the correlates of types of attrition. The follow-up methods for subpopulations at higher risk of dropout, such as women with lower education and those who smoke, may need to be more intensive and different interventions may be appropriate to minimise different types of attrition. Future follow-ups will allow the factors associated with resumption of participation and ongoing commitment to the longitudinal study to be explored.

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