

# Selective attrition in life satisfaction among elderly people: the harmonisation of longitudinal data

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**Abstract.**Methodological research of the determinants of attrition makes it possible to identify which predictors of elderly people are most likely to be lost to follow-up in longitudinal studies. The aim of the study is to explore and compare the attrition in longitudinal aging population studies in the UK and Taiwan. Data draw from the *Nottingham Longitudinal Study of Activity and Aging* (NLSAA) and the *Survey of Health and Living Status of the Elderly in Taiwan* (SHLSET). Results from bivariate analyses indicate that no statistically significant association was found from logistic regression analyses between attrition and other factors in the second (1989) and third (1993) wave of the NLSAA survey. However, logistic regression did reveal an association between attrition and having lived with someone else at baseline in the SHLSET. Thus, living with others has effect on attrition and is related to re-interview in follow-up study.

## 1 Introduction

This research is a cross-national comparison of longitudinal studies, designed to compare the attrition, to identify the physical, mental, social, environmental factors contributing to attrition in old age.

Attrition refers to the loss of respondents from a survey [1]. According to Matthews et al. (2004, p. 2), “Attrition can be defined as the loss of relevant individuals occurring after definition of the population to be included in a study. [2]” There are two major types of subject attrition. One is selective attrition, which is described as the tendency of certain individuals in a study to be more likely to drop out of a study than others, because of some inherent characteristic; e.g., they choose no longer to participate because they do not have the disease of interest, and therefore are less interested in the study; or they move, because they are among the healthy people in the study and are still employed. The other major form of attrition is non-selective attrition, which is when people cannot participate because of some relatively random event, or some event deemed unrelated to the study outcomes of interest, like death in a car accident. In general, selective attrition is non-random and introduces statistical bias because the sample is no longer representative of the population and can detract from the internal and external validity of longitudinal study [3-5]. Non-selective attrition occurs randomly in a sample and in the population. Among the two types of attrition, mortality is considered to be non-selective attrition, and is unavoidable among older participants in longitudinal studies [6].

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Subject attrition is an important issue in longitudinal studies, because altering the composition of the initial randomly selected sample may introduce biases and adversely affect how representative the sample is of the population of interest. This is particularly a problem in gerontology, as older people may die, or become unable to participate in ongoing surveys due to a variety of age-related diseases and disabilities, e.g., Alzheimer's disease or cardiovascular disease or cerebral vascular disease [7]. Therefore, the longitudinal patterns of non-response were quite complex among older people.

Factors associated with attrition in longitudinal surveys have been investigated in a number of studies [7, 8]. For example, Slymen et al. showed that attrition is associated with older age, lower income, and poorer health. However, much less attention has been paid to examining the impact of attrition on specific research outcomes [2]. It raises the question as to whether the results from responses gathered from participants who are re-interviewed in follow-up surveys, after a certain amount of attrition, can be generalized to the initial population of older people from which the study sample originally was drawn (in this instance, in the UK and Taiwan), and how serious a problem this is. Therefore, the aim of this study examines the effect of selective attrition from baseline to follow-up on the outcomes among the older people' studies, provides a better understanding on how the occurrence and characteristics of attrition may affect life satisfaction assessments in older people, and compared attrition among older people in the UK and Taiwan.

## **2 Methods**

### **2.1 Participants and ethics**

Data were derived from the *Nottingham Longitudinal Study of Activity and Aging* (NLSAA) [9] and the *Survey of Health and Living Status of the Elderly in Taiwan* (SHLSET) [10].

The NLSAA was based on a 1985 survey that had 1,042 participants aged 65 years and over (i.e., born before 30<sup>th</sup> September, 1920). Follow-up surveys were conducted on those who still were alive and living in Nottingham in 1989 and 1993. In 1989, 690 subjects were re-interviewed (response rate= 88%). In 1993, 410 took part in the interviews, to yield a response rate of 72% [9].

Data were extracted from SHLSET and provided by the Bureau of Health Promotion, Department of Health, Taiwan. This project was conducted jointly by the Taiwan Provincial Institute of Family Planning, in Taichung, and the Population Studies Centre (PSC) and Institute of Gerontology at the University of Michigan, and founded by the US National Institute on Aging (NIA), in 1989, 1993, 1996, and 1999 [10]. SHLSET involved a nationally representative cohort of 4,049 older people, initially 60 years old and older (i.e., born before 31<sup>st</sup> December 1928) during a baseline survey conducted in 1989. Of this number, 3,155 subjects were re-interviewed in 1993 with a response rate of 91%.

The participants in the NLSAA were born in or before 1920, and the subjects in SHLSET born in or before 1928. Therefore, the sample for comparative study contained all participants born before 1920 who were interviewed in 1989/1993. To identify individuals born before 30 April 1920, an algorithm was used to calculate and create an exact age, and those participants born before 15<sup>th</sup> April 1920 for the Taiwan-based sample who were interviewed in 1989 and 1993. The 15<sup>th</sup> April date was used because the exact date of birth was not recorded in SHLSET. The final sample contained 1,438 subjects (35.5%, n=4,049) in 1989 and 1,003 (31.8%, n=3,155) in 1993. An additional 410 participants (10.1%, n=4,049) in 1989 and 299 participants (9.5%, n=3,155) in 1993 were dropped due to missing data relating to date of birth and reported age.

### **2.2 Instruments**

The data collection instrument for the NLSAA was a structured interview questionnaire, composed of 161 questions (including 314 items of data) the addressed demographics, mobility, physical health,

psychological health (cognitive status, depression, and morale), social functioning, use of health and personal social services, customary physical activity, and physical measurements [9, 11].

The SHLSET questionnaire was composed of eight sections including marital history and other background characteristics; household schedule, social economic exchanges; health, health care utilization and behaviours; occupational history; activities and general attitudes; residence history; economics/financial well-being; and emotional and instrumental support [10].

The NLSAA and the SHLSET both used shortened versions of the Life Satisfaction Index, a commonly-used measure of well-being and morale in studies of older people [12], adapted for local use, such that the NLSAA used the 13-item LSI-Z scale [13] and the SHLSET used the 10-item LSI scale [14]. For comparative purposes, a common scoring system for each response category and question across the two studies was adopted and the scores for the two scales were standardised to a 100-point scale.

Other variables from the two studies were compared and variables with similar questions and response categories were harmonised using established methods [13, 15] to create new variables covering demographics and socioeconomics, physical and mental health and social activity: further details of which are available elsewhere [16].

### **2.3 Data analyses**

To understand as clearly as possible the differences between participants who continued to accept being interviewed and those who did not, it was imperative to distinguish between the different types of attrition. To assess attrition effects, Goodman and Blum [17] suggested using multiple logistic regression to determine whether attrition influences the sample based upon one or more variables. This is because logistic regression models generally deal with binomial dependent variables, assigning a value of '0' to one outcome (e.g., not re-interviewed) and a value of '1' to the other (e.g., re-interviewed). In this study, Mann-Whitney U tests and chi-square analysis was used as a first step to compare those who were re-interviewed versus those who were not re-interviewed with respect to a variety of continuous variables. Then, as a second step, chi-squared tests were used to compare those who were re-interviewed versus those who were not re-interviewed among categorical variables in the NLSAA and the SHLSET data sets. Finally, logistic regression analysis was performed to assess the relative contributions of, and hence the likelihood of bias caused by, variables deemed different between the two groups (re-interviewed versus not) on selective attrition as it existed at four-year and eight-year follow-up for the NLSAA study (1989 versus 1985; and 1993 versus 1985), and four-year follow-up for the SHLSET study (1993 versus 1989).

## **3 Results**

The mean age of the NLSAA sample was 78 (SD=5.78), ranging from 69 to 98 in 1989 and 81 (SD=5.17), ranging from 73 to 101 in 1993. The majority of participants were female (62.3% in 1989, 66.1% in 1993). Almost half (47.4% in 1989, 50.6% in 1993) were widowed, and 42.7% (1989) and 39.8% (1993) were married. The majority of participants reported in good health (41.5% in 1989, 38.6% in 1993) and average (19.4% in 1989, 21.7% in 1993).

The sample in SHLSET, the mean age was 76 (SD=5.42), ranging from 69 to 98 in 1989 and 79 (SD=4.96), ranging from 73 to 99 in 1993. Over half of the participants were male (53.4% in 1989 and 52.9% in 1993). The majority of the participants were married (51.3% in 1989, 56.1% in 1993) and about half of sample was widowed (42.6% in 1989 but 38.9% in 1993). About half of the sample reported in average health (40.7% in 1989, 36% in 1993) and approximately 20% said they were in fair and good health in 1989 and 1993.

### 3.1 Exploded from Mann-Whitney U tests for continuous variables

Table 1 shows the results of Mann-Whitney U tests to determine whether there were significant differences in 1985 between those who were alive and re-interviewed in 1989 and those who were alive but not re-interviewed in 1989 in the NLSAA study. There was no significant difference in the mean rank for age ( $Z$  statistic=-0.511;  $p=0.609$ ), standardised SAD score ( $Z$  statistic=-1.58;  $p=0.113$ ), standardised LSI score ( $Z$  statistic=-0.905;  $p=0.366$ ), or number of people living in the household ( $Z$  statistic=-0.737;  $p=0.461$ ) in 1985 between survivors interviewed versus survivors not re-interviewed in 1989.

There were significant differences in 1985 between those who were alive and re-interviewed in 1993 and those who were alive but not re-interviewed in 1993 in the NLSAA study. There was an association between whether 1993 survivors were interviewed or not and age ( $Z=-2.692$ ;  $p=0.007$ ) and standardised LSI score ( $Z=-2.488$ ;  $p=0.013$ ) in 1985. Older survivors were less likely to be re-interviewed, as were those with a lower baseline standardised LSI score (Table 1).

**Table 1.** Mann-Whitney U tests comparing attrition in continuous variables in the NLSAA.

Variable	Alive not interviewed Mean Rank (N)	Alive interviewed Mean Rank (N)	Z statistic	p value
From 1985 to 1989				
Age	364.78 (65)	379.25 (690)	-0.511	0.609
Standardised SAD score	406.01 (62)	363.40 (671)	-1.585	0.113
Standardised LSI score	345.65 (62)	371.15 (675)	-0.905	0.366
Number of people living in household	359.04 (65)	377.61 (686)	-0.737	0.461
From 1985 to 1993				
Age	306.29 (139)	264.39 (410)	-2.692	0.007
Standardised SAD score	278.35 (129)	264.04 (405)	-0.962	0.336
Standardised LSI score	240.04 (130)	278.89 (408)	-2.488	0.013
Number of people living in household	253.96 (137)	280.70 (410)	-1.934	0.053

Table 2 presents the mean rank for the continuous variables and the results of the Mann-Whitney U tests for the SHLSET data in 1989. The only statistically significant difference between 1993 survivors interviewed and those not interviewed related to the number of people living in the household in 1989 ( $Z=-6.033$ ;  $p<0.001$ ) in 1989. People in 1989 who had more people living in the household were more likely to be re-interviewed in 1993.

**Table 2.** Mann-Whitney U tests comparing attrition in continuous variables in SHLSET, 1989-1993.

Variable	Alive not interviewed Mean Rank (N)	Alive interviewed Mean Rank (N)	Z statistic	p value
Age	516.23 (99)	553.89 (1001)	-1.125	0.260
Standardised SAD score	538.37 (92)	526.46 (962)	-0.360	0.719
Standardised LSI score	486.02 (93)	536.41 (970)	-1.526	0.127
Number of people living in household	367.72 (99)	568.05 (1000)	-6.033	<0.001

### 3.2 Exploded from Chi-square tests for categorical variables

Separate Chi-square tests were used to test each null hypothesis that there was no association between participants who were alive and not interviewed and participants who were alive and interviewed from the baseline interviewing date.

Table 3 showed that Chi-square tests compared baseline (1985) categorical variables between people alive and re-interviewed in 1989 versus those alive but not re-interviewed in the NLSAA study. There was an association between whether 1989 survivors were re-interviewed or not and self-rated

health ( $\chi^2=4.967$ ;  $p=0.026$ ) in 1985. Survivors in 1989 who were re-interviewed were more likely than their non-re-interviewed counterparts to have reported good (49.6%,  $n=335$ ) or excellent (16.7%,  $n=113$ ) health in 1985, and less likely to have rated their health as poor (11.1%,  $n=7$ ), fair (12.7%,  $n=8$ ), or average (22.2%,  $n=14$ ).

**Table 3.** Prediction of attrition among elderly people in the NLSAA study.

Study	Variable (reference category)	Category	Odds ratio	95% CI	p value
NLSAA 1985-1989	Self-rated health (Excellent)	Poor	0.221	0.071–0.687	0.043
		Fair	0.759	0.266–2.168	0.606
		Average	0.460	0.179–1.185	0.108
		Good	0.769	0.326–1.813	0.548
NLSAA 1985-1993	Age		0.972	0.934–1.010	0.150
	Marital status (Married)	Single	0.724	0.258–2.037	0.541
		Widowed	0.904	0.413–1.978	0.801
		Separated/Divorced	0.872	0.245–3.106	0.832
	Living status (Live alone)	Live with someone	1.427	0.659–3.090	0.367
	Comparison with peer group health (More healthy)				0.219
		Less healthy	0.564	0.265–1.202	0.138
		About as healthy	0.796	0.395–1.604	0.523
	Reading newspaper or journals (No)	Yes	1.613	0.723–3.600	0.243
	Attending religious group (No)	Yes	1.630	0.989–2.688	0.055
	Attending clubs (No)	Yes	1.378	0.879–2.162	0.162
Standardized LSI score			1.008	0.968–1.050	0.685

The results of Chi-square tests comparing baseline categorical variables between people who were alive and re-interviewed in 1993 and people who were alive but not re-interviewed in 1993 in the NLSAA study. There was a statistical association between being re-interviewed among 1993 survivors, versus not, and the following 1985 variables: marital status ( $\chi^2=5.040$ ;  $p=0.025$ ), living status ( $\chi^2=4.070$ ;  $p=0.044$ ), comparison with peer group health ( $\chi^2=5.842$ ;  $p=0.016$ ), read newspapers or journals ( $\chi^2=4.980$ ;  $p=0.026$ ), attending religious group ( $\chi^2=4.618$ ;  $p=0.032$ ), and participation in a club or organization ( $\chi^2=3.975$ ;  $p=0.046$ ) in the NLSAA study, although one or more of these differences may have been the result of Type I error (detecting a difference that does not truly exist) because of the large number of tests done. However, to err on the side of caution all these variables were included in the regression model.

Survivors in 1993 who were re-interviewed were more likely to have been married in 1985 than those not re-interviewed. Those living with someone else in 1985 were more likely to be interviewed in 1993 than those living alone in 1985. Those who reported being about as healthy as their peers in 1985 were more likely to be interviewed in 1993 than people who felt more or less healthy than their peers in 1985. Participants who were reading newspapers and/or journals, and attending a religious group, and/or other club or organization were more likely to be re-interviewed in 1993 than those not re-interviewed.

The results of chi-square tests comparing baseline (1989) categorical variables between people who were alive and re-interviewed in 1993 and those who were alive but not re-interviewed in the SHLSET study. Significant differences were apparent for marital status ( $\chi^2=7.542$ ;  $p=0.006$ ), socioeconomic class ( $\chi^2=6.884$ ;  $p=0.009$ ), comparison with peer group health ( $\chi^2=4.791$ ;  $p=0.029$ ), and reading a newspaper or journal ( $\chi^2=9.796$ ;  $p=0.002$ ).

Those re-interviewed in 1993 were more likely to have been married, be semiskilled/unskilled /others, and read newspapers or journals than survivors who were not re-interviewed in 1993. People

who reported in 1989 that they felt about as healthy as their peers were more likely to participate in the 1993 re-interview than those who felt they were more and less healthy. Those who read a newspaper or journal in 1989 were more likely to be re-interviewed in 1993 than people who were not reading newspaper or journals.

Table 4 shows the results of the logistic regression models for baseline (1989) SHLSET variables to determine if any baseline variables predicted whether survivors were re-interviewed in 1993 or not. In the SHLSET study, the overall model ( $\chi^2=36.518$ ;  $df=9$ ;  $p<0.001$ ) with all independent variables entered, was significant. There was a significant association between 1993 re-interview and the number of people living in the household in 1989 ( $p<0.001$ ), in that those who lived with others in 1989 were more likely to be re-interviewed in 1993 (OR=1.232; 95% CI=1.108–1.370). In brief, living with someone else in 1989–1993 was a significant predictor of a 1993 re-interview.

**Table 4.** Prediction of attrition among elderly people in the SHLSET study.

Study	Variable (reference category)	Category	Odds ratio	95% CI	<i>p</i> value
SHLSET 1989- 1993	Marital status (Married)	Single	1.165	0.241–5.642	0.849
		Widowed	0.481	0.278–0.834	0.009
		Separated/Divorced	0.798	0.210–3.035	0.740
	No. of people living in household		1.232	1.108–1.370	<0.001
	Socioeconomic class (Professional/intermediate)	Skilled/manual & non-manual	1.575	0.717–3.460	0.074
		Semiskilled/unskilled/others	2.309	1.121–4.757	0.023
	Comparison with peer group health (More healthy)	Less healthy	1.579	0.718–3.473	0.256
		About as healthy	1.013	0.583–1.759	0.963
	Reading newspaper or journals (No)	Yes	0.787	0.426–1.456	0.446

## 4 Discussion

In any analysis of longitudinally-collected data, it is crucial to look for sources of bias that might result from subject attrition, and it is important to discriminate between mortality and non-mortality-related attrition, such as non-response or moving away. A major challenge in studies of older people is that death is a common source of attrition. In this study, there was substantial mortality-related attrition from 1985 to 1989 and from 1985 to 1993 in the NLSAA sample; and from 1989 to 1993 in the SHLSET sample. However, mortality-related attrition occurred in both samples, as well as in the population from which the samples came, and seems unlikely to have led to significant bias.

Attrition is always a concern in any longitudinal study, as it was in both of the studies included in the present research. That attrition occurred was never a question, it occurs in all large longitudinal studies. Rather, the question was, does attrition significantly affect the comparison between the UK and Taiwanese studies examined here? Mann-Whitney U tests showed that there were no significant differences between those who survived and were re-interviewed and those who survived but were not re-interviewed in the NLSAA study follow-up survey that transpired in 1989. However, age and level of life satisfaction were different between those who were re-interviewed and not re-interviewed in the 1993 NLSAA follow-up survey; and in the SHLSET study, older people who lived with someone in 1989 were more likely to be re-interviewed in 1993 than those who had lived alone.

Chi-square analysis yielded somewhat different results, in that significant differences were evident in the proportion rating their health as good relative to peers between those who were re-interviewed and those who were not in the 1989 NLSAA survey. Even more baseline differences were found in terms of being re-interviewed for NLSAA in 1993, with a statistically significant effect of attrition on marital status, living with others, reporting oneself as healthy relative to peers, reading newspapers or journals, and attending religious groups, clubs or organisations.

No statistically significant association was found from logistic regression analyses between attrition and other factors in the second (1989) and third (1993) wave of the NLSAA survey. However, logistic regression did reveal an association between attrition and having lived with someone else at baseline in the SHLSET. The attrition showed its effect on 'living with some people' among older people in Taiwan. It may reflect the outcome of an individual's living status to affect whether participant accepts an interview or not. Older people live with someone that may be willing to accept interview because someone else could help and answer the questions for them. Older Taiwanese might accept an interview by proxy due to health problems, lower levels of education or other reasons. Thus, the use of a proxy in ageing research is a challenge for future research.

With regard to non-mortality-related attrition, refusal can be problematic, if those who refuse to participate further in a study are systematically different from those who continue to participate; and this is commonly the case. However, in these analyses of the effect of attrition, it seemed to have a relatively minor effect in terms of the overall difference between the British and Taiwanese samples.

The research in this paper had several limitations. First of all, a limitation was that the data were old, collected in 1985, 1989 and 1993, and the situation may have changed in both countries since that time. However, individuals 65 years and over comprise a more diverse group than those in any other age group. The reason for this variability derives from the variety of experiences older people have had over time, and their broad range of health status and/or functional ability. For example, an 85-year old might be frail and housebound because older people themselves as age their health changes, versus a 65-year old who might still being highly active, or even still working. However, these data still have their value, and can help us to understand the complex conditions or status of older people at the time the data were collected.

Another limitation, as with most research of this kind, is that it is likely that certain participant characteristics, related to both dependent and independent variables (so called 'confounders'), were not examined in this research. It must be kept in mind that the presence of such confounding variables - known or unknown - could explain at least part of the relationships detected in this research. For example, it was not possible to assess certain disease states. It is possible some disease states that were not examined (e.g., alcohol abuse) could be related to quality of life and a variety of other factors; and not examining these conditions may limit the extent to which these findings can be interpreted.

Finally, the selected predictors of attribution might not explain the causes of attrition. Given the lack of knowledge regarding which factors of attrition are most important, it is possible that potentially important components were missing in this research; for instance, social relationships, the environment, fear of crime, and so on. This research was designed to examine attrition among older people in the UK and Taiwan. As a result, the questions associated with attrition did not seem complete. Limitations arise because the studies might fail to recognize variations between countries in the importance of attrition. The lack of comparable data (e.g., diseases, social support), often restricts international research as it attempts to explain multifaceted of attrition.

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