


Exploring Survey Nonresponse in the UK: The Census-Survey Nonresponse Link Study


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Abstract

Like other survey organisations, the UK Office for National Statistics (ONS) has seen a decline in response rates on major government surveys during the last few decades. In order to investigate the factors that affect nonresponse, ONS has carried out research on survey nonresponse following the last four decennial Censuses of the population in Britain (1971, 1981, 1991 and 2001).

Of the ONS census-linked nonresponse studies, the one set up after the 2001 Census was the most ambitious. Addresses sampled for surveys taking place around the time of the Census were linked with census records at both the household and the individual respondent level. In addition, and for the first time, observations made by the interviewer at the time of the interview, interviewer attitudes, area characteristics and survey design features have also been linked. Thus, a large number of variables are available to investigate the factors that affect both contact and co-operation. This work builds on previous research and extends the work of Groves and Couper (1998) by including individual respondent-level information.

This paper presents an overview of the study and the methods used by ONS to investigate the relative contribution of different factors affecting nonresponse. We will provide an overview of the various data sources, the data linking process, the analysis strategy, and we will present the first results from our analysis.

Keywords: Nonresponse, nonresponse bias, improving process quality, survey design, nonresponse weighting.

1. Introduction

In the UK (as in most other countries), all government household surveys rely on the voluntary participation of respondents and, as a result, all household surveys have a certain level of nonresponse. The levels of nonresponse on government household surveys have been fairly stable for many years but the UK has seen a decline in response rates in the last decade. This decline is not limited to government surveys in the UK nor is it limited to the UK (Martin and Matheson, 1999; De Leeuw and De Heer, 2003).

Nonresponse is a problem because it can lead to bias in survey results. And although nonresponse bias is relatively difficult to measure, most survey organisations assume that the occurrence of nonresponse on a survey will lead to some bias in the survey results². As a result, survey organisations have traditionally made efforts to try to avoid nonresponse bias.

The efforts of most survey organisations in dealing with nonresponse bias have been concentrated in two areas. First, most survey organisations will try to *avoid* high levels of nonresponse because more nonresponse means a higher risk of nonresponse bias. In order to avoid high levels of nonresponse, organisations put lots of efforts into maximising response through improvements in the survey design or in the operational management of a survey. They also take steps to find out about the causes of nonresponse so they can attempt to minimise its occurrence. Examples of this are the use of incentives to pay respondents for their efforts, or the use of specific interviewer training initiatives to try to avoid respondent refusals. The second approach organisations use to address nonresponse bias is to admit that even though they make efforts to maximise response, a certain level of nonresponse is inevitable. As a result, they will try to *correct* for nonresponse by using statistical procedures to measure nonresponse bias and to compensate for the bias by carrying out nonresponse weighting or imputation.

The two methods of handling nonresponse described above come from very different research traditions. The approach that looks into the causes of nonresponse and attempts to improve response rates mainly operates within a behavioural science framework whereas the work aimed at correcting for nonresponse operates within a statistical and mathematical framework. These two viewpoints are very different and thus far too few attempts have been made to integrate these approaches (Groves, 1989:4; Dillman et al., 2003:25).

In 1999, the UK Office for National Statistics (ONS) started work on the design of the 2001 study with the aim of using the two approaches described above. This project

² The occurrence of a certain level of nonresponse as such is not a sufficient condition for nonresponse bias. In order for nonresponse bias to occur on a given survey estimate there needs to be a systematic difference between the people who respond to a survey and those who don't (on characteristics which are related to that survey estimate). Because surveys – by definition – do not have much information on people who don't respond this difference is often difficult to establish. Most survey organisations will therefore assume there will be a difference which will lead to bias. See Biemer and Lyberg (2003:80-115) for an overview of this issue.

makes use of a data source based on the 2001 Census which has been especially constructed for the research programme. The ONS has a lot of experience in carrying out this type of study. It has conducted a census-linked nonresponse study, in one form or another, after every decennial Census since 1971. This paper outlines the design of the 2001 census-linked non-response study and describes the progress made to date.

2. Study Design

2.1. History³

All the census-linked nonresponse studies ONS has carried out were based on a common design. Addresses sampled for surveys taking place around the time of the censuses were linked with individual census records for the same addresses. Since all the Census variables are available for both responding and nonresponding addresses, this provides a very powerful means of investigating the characteristics of nonrespondents and measuring nonresponse bias. Although there has been a tradition in the UK in conducting these studies, they are not unique to the UK; Groves and Couper (1998) have carried out a similar study using the 1990 US Census.

For the studies carried out after the 1971 and 1981 Censuses the record-level matched datasets were not available for nonresponse analysis. Researchers could analyse specified aggregate tables only and this limited the analysis to descriptive comparisons of the characteristics of respondents and nonrespondents and measurement of bias in terms of census characteristics. In 1991, record-level matched records were made available, under strict confidentiality arrangements, and this allowed much more detailed statistical modelling to be undertaken to investigate the interrelationship between variables which relate to nonresponse bias and to assess different methods of re-weighting data to compensate for the bias. Five surveys were included in the study in 1991, allowing comparison of results for surveys with very different designs. Key results are presented in Foster (1998).

The common aim of most of the ONS census-linked studies was to investigate response bias and how to correct for it. For the 2001 Census-linked study, a much more ambitious design was adopted. The design not only enables researchers to study nonresponse bias and devise adjustment, it also provides information about the different causes of nonresponse.

³ Based on White et al., 2001.

2.2. The 2001 Study⁴

For the 2001 census-linked study efforts have been made to enhance the census-survey linked data with other data which could help explain nonresponse. Apart from the traditional aim of investigating nonresponse bias and its correction, the design of the 2001 study combines the census-survey linked data with other data to investigate the factors that affect nonresponse. As mentioned earlier, researchers in other countries and organisations have also carried out studies into nonresponse and these and the ONS projects have led to the development of a coherent approach to investigating the causes of survey nonresponse. The most notable recent research is the work of Robert Groves and Mick Couper (1998). ONS had taken account of developments in recent research when it designed the 2001 census-linked nonresponse study and the study is underpinned by the strong theoretical framework developed by Groves and Couper.

Broadly speaking, Groves and Couper recognise five categories of influence on survey nonresponse:

1. household characteristics
2. survey design features
3. area characteristics
4. interviewer characteristics and behaviour
5. the social context

Each of these categories of factors affects the likelihood of an interviewer making contact with and / or gaining co-operation from a sampled household. However, the precise factors affecting contact and co-operation are not the same and the two stages have to be distinguished and examined separately in the analysis.

The design of the study recognises the two distinct aims of the study, namely:

- the development of survey specific estimates of nonresponse bias and approaches to correct for the bias and
- the development of cross-survey research to examine the factors that affect nonresponse.

To accommodate the two aims, the study is divided into two sub-projects. The sub-project relating to the assessment of nonresponse bias is designed to provide survey specific results for the twelve surveys participating in the study⁵ while the cross-cutting theoretical research has concentrated on the following six surveys:

- Labour Force Survey (LFS)
- Expenditure and Food Survey (EFS)
- Family Resources Survey (FRS)
- General Household Survey (GHS)
- National Travel Survey (NTS)
- Omnibus Survey (OMN)

⁴ For an elaborate description of the study design, see White et al, 2001.

⁵ The list of surveys can be found in Appendix A.

Funding for the two sub-projects was also different. Funds for the work on survey-specific estimates of nonresponse bias is provided by the clients of the surveys included in the study. The cross-cutting research is funded by the Methodology Group of ONS.

2.3. Data sources

In order to investigate/correct for nonresponse bias and to construct analytical models to explore the causes of nonresponse, various data sources were combined to construct a single comprehensive dataset.

2.3.1. Census-survey linked data

As in the previous studies, the core dataset was constructed by linking survey-based data of survey respondents and non-respondents with their corresponding census record.

The sample of linked records has to include a sufficient sample of survey respondents and non-respondents because one of the purposes of the study is to compare the characteristics of non-responding and responding households from both groups. It is also desirable that the cases should have been sampled as close as possible to the date of the Census (29 April 2001) in order to minimise the number of cases in which the occupants had moved between the Census day and the date of the survey interview. This was carried out in the sampling process by including addresses selected for survey interviews in the months just following the census night rather than the full survey year. An extra check on moving households identified a number of cases where the household had moved so these were excluded from the analysis.

Detailed information about the survey outcome was available for each record in the census – survey linked datafile. This enables the study to distinguish between nonresponse caused by the interviewer's failure to contact the household (noncontacts) and the interviewer's failure to gain co-operation from the household (refusals).

As in the previous census-linked studies, the census and survey records were linked at household level. However, for the 2001 study, the survey records for individuals within the households were also linked to their corresponding record in the census household. These individual-level data give us the opportunity to learn more about the factors that affect individual response rather than household-level response.

The data contained in the core data set are sufficient to carry out all the analysis required to assess and correct for nonresponse bias. However, more data are needed for the cross-cutting analysis on factors that affect nonresponse because this part of the project aims to measure the factors described in the Groves and Couper framework. As a lot of resources are required to incorporate the additional data required for the Groves and Couper framework, these additional data are attached to the six surveys listed in section 2.2. The additional data needed are described in the following sections.

2.3.2. Interviewer characteristics

It is essential that interviewers' effect on nonresponse is assessed because interviewers play a crucial part in securing response. In order to obtain more information about the interviewers working on ONS household surveys, we conducted a survey of interviewer characteristics. Both interviewer's socio-demographic background and their attitudes towards making contact and getting co-operation were measured. The survey was carried out around the time of the Census (April 2001) and the response rate to the survey was 84% (Freeth et al. 2002). The survey was a repeat of a survey ONS carried out in 1998 (Beerten, 1999) as part of an international project (Hox and De Leeuw, 2003:103).

2.3.3. Address observations

Around the time of the Census, ONS interviewers were asked to record details about the address they visited and the outcome of each call they made to the address. The information collected included: the time of the call, the outcome of the call, general information about the area, the quality of housing, the presence of physical barriers to entry to the address, and whether the interviewer spoke to anyone at the address. Variables derived from this type of observation data are associated with response and so this type of data are now often collected and used to broaden the range of information available about non-responding (and responding) households in surveys (eg. Campanelli et al, 1997; Groves and Couper, 1998)

2.3.4. Area characteristics

A fourth component of the census-linked data set is a collection of aggregate characteristics which describe the area in which sampled addresses were located. These aggregate area statistics are based on outputs of the 2001 Census and include characteristics such as population density, urbanicity, unemployment in the area etc.

2.3.5. Survey design features

Although we have included only six surveys in the cross-cutting analysis, it is our aim to try to include some assessment of the effect of survey design features on nonresponse. Most of the six surveys have at least one distinctive design feature. For example, the NTS asks respondents to keep a travel diary. The EFS not only asks respondents to complete diaries but also pays respondents a small financial incentive. The Omnibus is different from the other surveys in that it is a multi-topic survey which only asks information from one member in the household (the other surveys collect information about the whole household). The distinctive design features are recorded in the data set and will be used to assess the effect of survey design features on response.

2.4. Data linking

The data sources described above were linked on the six surveys separately. As each of the data sources had to be linked at different levels, the linking process was very time-consuming and complicated. The matching strategy is summarised below.

- Linkage began with the address observation data for each survey because they contain basic information for each address and have information about the outcome of each call (including the final outcome – co-operating household, refusal, or non-contact).
- The next step was to match on the variables describing interviewer characteristics. Each address observation has the ID number of the interviewer who completed the observation form and this number was used to link on the appropriate interviewer's details.
- The third step was to link in the census-survey linked data. This was carried out using the survey serial number which was recorded on both the address observation forms and the census-survey linked file.
- The final stage of the linking was to add the area-level characteristics. These are available at the postcode-sector level and the linking was carried out with the postcode sector code as the linking variable.

As each data source contains missing records, we expected a certain percentage of attrition throughout the linking process. A number of quality checks were carried out after data linkage to see whether this attrition was at random and these checks confirmed that data attrition was indeed random and would not lead to systematic bias. The distribution of key variables in the fully linked dataset was not significantly different from the distribution of those variables in the component datasets.

3. Analysis plan

As mentioned earlier, the study has two aims. The first aim is to examine the difference between responding and non-responding households, assess nonresponse bias and to construct factors that can correct for the bias. The second aim is to investigate the factors that affect nonresponse, using the theoretical model by Groves and Couper (1998). An analysis strategy was developed to address each of the aims.

3.1. Basic analysis of nonresponse

The analysis designed to detect and correct for nonresponse bias covered twelve surveys. The analysis has concentrated on addressing three questions:

- (a) What were the differences in Census characteristics between the households which responded and those which did not respond?
- (b) What correction factors need to be applied to correct for under-representation (or over-representation) of households with certain characteristics?

- (c) How did household characteristics affect contact and co-operation rates on each survey?

3.2. Cross-survey analysis of factors that affect non-response

The cross-cutting analysis is divided into several stages, namely:

- (a) The construction of a theoretical framework that describes the relationship between factors that affect contact / co-operation;
- (b) the selection of variables based on the expectations from the theoretical framework and the calculation of actual contact and co-operation rates;
- (c) basic analysis of the variables that are expected to affect contact and co-operation, including exploratory analysis and scale constructions;
- (d) bivariate analysis of the factors that are expected to influence contact and co-operation rates;
- (e) multivariate analysis – logistic regressions and multi-level analysis.

The cross-cutting analysis is first carried out on each survey separately. The data from the six surveys will then be pooled together and the pooled data set will be used to develop cross-cutting models.

4. Analysis results

Due to delays in linking the data, not all the analysis has been completed yet, so full results from the cross-cutting analysis are not available at the time of writing. Some work has been carried out on the preliminary analysis of the various data sources and the results of the full analysis will be presented at a later stage.

The results we present here relate to the first part of the project and concentrate on using the census-survey linked data to analyse the census characteristics of responding and nonresponding households. A wide range of analyses have been carried out and what is presented here is only a small selection of them. Also, for simplicity, the results presented here are for only one survey (the General Household Survey - GHS).

The GHS is a multi-purpose sample survey interviewing approximately 9,000 households and about 16,000 adults aged 16 years and over. Data are collected on a range of core topics, comprising: demographic information about household members, accommodation, consumer durables, housing tenure, migration, employment, pensions, education, health, smoking, drinking in the last seven days, family information and income. Other areas such as leisure, old people, and usual alcohol consumption in the last twelve months are covered periodically.

The GHS interview consists of a household component, to be answered by the Household Reference Person or spouse, and an individual component to be completed by all adults aged 16 years and over resident in the household. A report of the results is published annually (Walker et al, 2002).

4.1. Differences in characteristics of responding and non-responding households

Table 1 (Appendix B) gives an overview of the distribution of Census household characteristics by whether the household responded or not. The table presents characteristics which relate to household composition only; similar tables are available for other characteristics from the Census forms (eg, housing characteristics, accommodation, etc).

From the table we can see that household characteristics were related to response and non-response. Non-responding households tended to contain one adult only or to have no dependent children. On the other hand, responding households tended to have two adults in employment or to have dependent children aged under five years.

Multivariate analysis of the data showed that non-response on the GHS was related to:

- Government Office Region;
- the size of the household;
- whether the household contains children or not;
- type of accommodation occupied by the household;
- the household's length of residence at the address and
- the qualifications of the Household Reference Person.

4.2. Under-representation of households with certain characteristics⁶

Another way of analysing the data is to identify the groups that are over- or under-represented in the survey sample. In order to give an indication of the direction and size of non-response bias, a correction factor was calculated for each category by dividing the percentage of such households in the GHS-census matched sample by the corresponding percentage in the responding sample. The correction factors show the adjustment, or 'weight', that would need to be applied to the responding sample in order to achieve the same distribution as for the total set sample. However, the 'weights' are used here to illustrate the effect of non-response. It is unlikely that factors based on single variables would actually be used in weighting to adjust for non-response. The more a correction factor departs from 1.0, the greater the effect of non-response.

⁶ This analysis is only the first step of a much more detailed multivariate analysis which will lead to the construction of nonresponse weights.

Categories which are over-represented in the responding sample have factors of less than 1.0. In assessing nonresponse bias, most emphasis is usually placed on sub-groups, which are substantially under-represented. These groups have high correction factors (1.10 or above) and tend to have significantly low response rates. Sub-groups with correction factors of 1.10 and above include households:

- located in London (1.12);
- whose accommodation was a converted or shared house or flat (1.17);
- in accommodation with between one and three rooms (1.10);
- in accommodation with no central heating (1.16) and
- where the Household Reference Person was unemployed (1.10).

Correction factors of between 1.05 and 1.09 were more common. They were seen for households in the West Midlands (1.08), single person households (1.07); households containing one adult only (1.05), three or more adults in employment (1.06), no families (1.05), a couple with no dependent children (1.06), households living in privately rented accommodation (1.05) or in a purpose-built flat (1.07), households that did not own a car or van (1.05) or households whose HRP was aged 75 years or over (1.05), widowed (1.05), with no academic qualification (1.05), from Chinese or other origin (1.09), self-employed (1.05) or a student, permanently sick or disabled (1.07).

At all persons level, the following sub-groups had correction factors of between 1.05 and 1.09: people who were separated, had no academic qualifications or of Black, Chinese or 'other' origin.

Correction factors of less than 0.9, indicating sub-groups which were over-represented in the responding sample, were not common. The only group shown to be over-represented on the GHS were households with three or more dependent children (0.88).

4.3. Effect of household characteristics on contact and co-operation

A third type of analysis produced results which show the effect of household and individual Census characteristics on the two components of nonresponse: refusals and noncontacts. Table 2 (Appendix B) shows the results, this time for census characteristics which relate to the accommodation of the household.

From this table we can see that non-contact rates were higher among households living in purpose-built or converted houses or flats (6.0%) compared with households who lived in a house (3.2% or less).

Households occupying between one and three rooms had the highest rates of non-response; 6.4% non-contact, 23.2% refusal. These rates diminished with the increase in the number of rooms, so that households occupying seven or more rooms had the lowest non-contact (1.8%) and refusal (17.2%) rates.

Households without central heating were more likely to refuse to take part in the survey, at 28.3%, compared with 18.8% for households with central heating. There was no clear association between non-response and the availability of a bathroom in households.

There is a relationship between the number of cars owned by a household and non-response. Households without a car were more difficult to contact (4.0% compared with 1.9% amongst households with two cars). Households with no car were also more likely to refuse (22.6% compared with around 18% for households with at least one car).

Households that had not moved in the year before Census night had higher refusal rates (20.4% compared with 13.7 % for moving households).

5. Future work

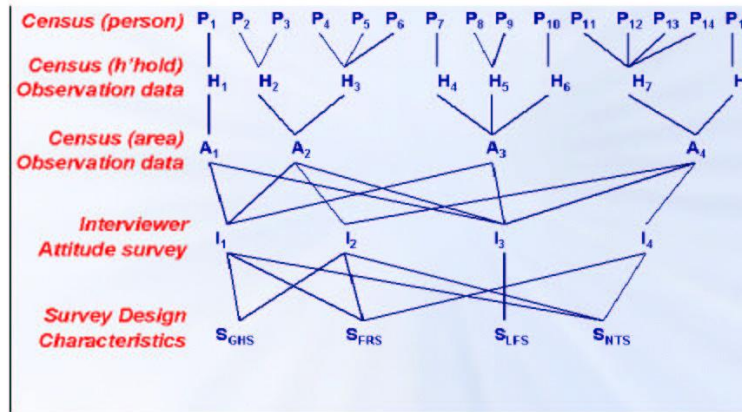
As previously mentioned the cross-cutting analysis has not progressed as far as expected. The main reasons for the delays are the complexity of the data linking process, and delays in the delivery of some of the information that is needed to construct a full data set which contains all the building blocks required to explore the theoretical model.

In the next few months, the analysis will concentrate on constructing multivariate models which take into account explanatory variables from the different data sources described earlier. This analysis will be done separately for contacts / noncontacts and co-operation/refusals, but will be done across the six surveys included in this part of the study.

One of the main challenges of the analysis will be to construct multivariate models in a multi-level context. From an analytical perspective the data have a clear hierarchy. Essentially there are different levels at which we can analyse non-contacts and refusals. Figure 1 displays a possible multi-level structure where the individual household members are nested within their households and households are nested within the area from which they were sampled. The areas are cross-classified with interviewers at the next level (because more than one interviewer can work in the same area) There is also cross-classification between interviewers and the surveys they work on (interviewers typically work on more than one survey). This complex structure poses significant challenges from a statistical modelling perspective. To arrive at suitable models for the full data set, we intend to explore some of the analytical and theoretical issues first by carrying out analyses on sub-sets of the various levels. When these exploratory have been completed, we will develop models using the full data set.

The final aim of the analysis is to build explanatory models which explain the variance in noncontacts and refusals for each of the levels. For example, what proportion of the variation in refusals can be attributed to households rather than interviewers? And how can characteristics of households and interviewers explain this variance?

Figure 1. Hierarchical structure of the fully linked data



6. Conclusion

The work presented here is very much a work in progress. We have presented some analysis of the core census-survey linked data, but much more information is available to enrich this analysis and to explore some of the factors that may give us an insight into the nonresponse problem.

In this respect the 2001 study is an improvement on the previous census-survey linked studies carried out in the UK. Together with the availability of person-level data, we have a very rich and powerful data source to explore the nonresponse phenomenon. However, this improvement also means there are more complex issues to resolve, especially in data linking and analysis. This has taken a lot of time and effort but we have gained a lot of experience which can be applied to similar studies in the future.

As discussed in the beginning of this paper, the final aim of this study is twofold. Firstly, it wants to understand nonresponse bias on specific surveys in the UK and to try to correct for this bias by constructing nonresponse weights. But the study also wants to validate and add to previous research on the factors that influence the different types of nonresponse. In this respect it hopes to contribute new findings and hypotheses to help us enhance our understanding of the nonresponse problem and to lead us to develop improved strategies to combat nonresponse.

APPENDIX A - Surveys included in the basic analysis

BCS	British Crime Survey
EFS	Expenditure and Food Survey
FRS	Family Resources Survey
GHS	General Household Survey
HSE	Health Survey for England
LFS	Labour Force Survey
NDNS	National Diet and Nutrition Survey
NTS	National Travel Survey
Omnibus	Omnibus Survey
SEH	Survey of English Housing
SHS	Scottish Household Survey
TUS	Time Use Survey

APPENDIX B - Tables

Table 1. Census household composition by GHS response

Characteristics of household	Full and partial response (%)	Non-response (%)	All households
Number of people in household *			
One	28.5	36.9	30.4
Two	35.6	33.0	35.0
Three	15.6	14.7	15.4
Four	14.1	10.8	13.3
Five or more	6.3	4.7	5.9
Base (=100%)	3910	1139	5049
Adults in employment *			
None	36.9	40.1	37.7
One	28.0	29.5	28.4
Two	28.8	22.6	27.4
Three or more	6.2	7.8	6.6
Base (=100%)	3910	1139	5049
Number of dependent children *			
None	71.1	77.9	72.6
One	11.2	10.6	11.1
Two	12.7	9.1	11.9
Three or more	5.0	2.5	4.4
Base (=100%)	3910	1139	5049
Age of youngest dependent child *			
No dependent children	71.1	77.9	72.6
Youngest aged 0-4	10.6	7.0	9.8
Youngest aged 5-9	7.8	5.7	7.3
Youngest aged 10-15	10.5	9.4	10.2
Base (=100%)	3910	1139	5049
Significance of chi-square ratio: *p<0.05; NS p>0.05			

Table 2. GHS household response rates by census household characteristics

Characteristics of household	Response (%)	Non-contact (%)	Refusal (%)	Base =100%
All households	77.4	3.0	19.6	5,049
Housing Tenure *				
Buying with mortgage	78.7	2.6	18.6	2,002
Owned outright	77.3	2.3	20.4	1,561
Local authority rented	77.7	3.9	18.3	698
Rent from Registered Social Landlord or Housing Association	75.1	3.9	21.1	284
Privately rented	74.1	5.7	20.2	336
Other (a)	72.7	27.4		168
Type of Building *				
Detached house	78.7	2.5	18.8	1,185
Semi-detached house	79.2	1.6	19.1	1,698
Terraced house	77.8	3.2	19.0	1,260
Purpose-built flat, maisonette, converted or shared house / flat	71.4	6.0	22.6	867
Other (b)	84.7	-	15.4	39
Number of rooms *				
One to three	70.4	6.4	23.2	578
Four	76.1	3.2	20.6	993
Five	77.3	2.7	20.1	1,393
Six	79.3	2.4	18.3	1,078
Seven or more	81.0	1.8	17.2	1,007
Central heating *				
Yes, in some or all rooms	78.4	2.8	18.8	4,649
No	66.6	5.3	28.3	400
Number of cars *				
No car	73.5	4.0	22.6	1,383
One	79.0	2.8	18.2	2,203
Two	80.0	1.9	18.0	1,169
Three or more	74.4	3.7	21.8	294
Lived at address a year ago *				
The whole household was at the address a year ago	76.8	2.8	20.4	4,444
Some or the whole of the household was at a different address a year ago	82.3	4.0	13.7	605

Significance of chi-square ratio: *p<0.05; NS p>0.05 (a) 'Other' consists of shared ownership, owned by the employer of a household member, owned by a relative of friend of a household member, accommodation supplied rent free, other. Total non-response rate is shown to comply with Census disclosure control rules. (b) 'Other' consists of commercial buildings, and caravans or other mobile or temporary structures.

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