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Longitudinal Study 1971–2001: Completeness of Census Linkage

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Longitudinal Study 1971- 2001: Completeness of Census linkage

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Longitudinal Study 1971- 2001: Completeness of Census linkage

Summary

Background

The Longitudinal Study (LS) links census and vital event information for 1 per cent of the population of England and Wales. This report provides a first assessment of the linkage of 2001 Census records to the existing study records, using provisional data obtained from the recently completed linkage. It compares success rates in linking 2001 Census records to those achieved in 1981 and 1991. It aims to address the following questions:

- How many individuals identified in the LS on previous occasions were not found in 2001?
- What were their characteristics?
- What might account for the loss to follow-up of these individuals?

In attempting to answer the last of these questions, information on some types of losses are readily available from the study (for example, records of deaths and emigration). However, a limitation of the study design is that individuals can be lost to follow-up when dates of birth or other corroborating information is inconsistently recorded on different occasions. Other individuals are lost to follow-up if they are not counted in every census. The LS cannot provide definitive answers to the question of how specific individuals were lost to follow-up. However, this report sets out to systematically bring together whatever information is available to shed light on possible explanations.

The report contains:

- Descriptions of numbers traced and linked at each Census after 1971 and of differences between the demographic profiles of those 'found' and 'not found' on each occasion (1981, 1991 and 2001).
- Details of the characteristics of those not found in 2001, separately considering those present in the 1991 Census, births and immigrants in the 1990s.
- An assessment of how much of the cumulative losses in the study can be explained by repetition, in subsequent decades, of those that occurred in the first decade of the study and how much can be explained by what is known about census undercounts in 1991 and 2001.

Numbers traced and linked at each Census after 1971

Since the study started, 927,242 people have been included in the sample at some point. The total number identified in the 2001 Census was 539,665 and the records of 99.3 per cent of these were traced at NHSCR. This success at tracing compares with 98.8 per cent in 1981 and 98.4 per cent in 1991. In the provisional database used to create this report, there were 5,959 multiply enumerated LS members (for whom only one record was used in the analysis). Subsequent analysis of multiple enumerations found 5,756, of whom 3,690 were students. Excluding students, multiple enumerations represent 0.38 per cent of LS members. This

compares to net over-counting in England and Wales in 1981 of 0.39 per cent of the population.

Among those not found in 2001, the number known to have died was 190,733 and 16,923 were recorded at NHSCR as having emigrated. Among the 701,060 LS members who entered the study before the 2001 Census and were not known to have died or embarked, 74.3 per cent were found in the 2001 Census. The comparable figures for 1981 and 1991 were 88.4 per cent and 82.5 per cent, respectively. If those who were not traced are excluded from this calculation, these figures rise to 89.6 per cent in 1981, 83.9 per cent in 1991 and 76.1 per cent in 2001.

To some extent, this reflects the accumulation of losses as the duration of the study increases. However, the proportion lost between each Census has also increased. Among LS members found in the 1991 Census and not recorded as having died or embarked before the 2001 Census, 12.2 per cent were not found in 2001. Figures for comparable groups not found in 1981 and 1991 were 8.7 and 10.2 per cent, respectively. Similarly, for births recorded between censuses that were not recorded as having died or embarked before the following census, 7.2 per cent were not found in 1981, 8.7 per cent were not found in 1991 and 14.3 per cent were not found in 2001. For immigrants recorded at NHSCR between censuses, the comparable figures for those not found were 47.5 per cent in 1981, 61.8 per cent in 1991 and 66 per cent in 2001.

Between the 1980s and 1990s, the number of immigrants recorded in the LS increased from 22,957 in the 1980s to 45,908 in the 1990s. In the 1970s, the figure was 31,255. As a result of the larger number in the 1990s and higher proportion not found, immigrants comprised 29.7 per cent of all those not found in 2001, compared to 23.1 per cent in 1981 and 19.6 in 1991. In most years between 1971 and 2000, the LS captured more immigrants than the International Passenger Survey or, in the 1990s, the adjusted Total International Migration figures. However, the excess was smaller in the 1980s than in the 1970s or 1990s.

Characteristics of LS members found in 1991 and not accounted for in 2001

Among adults found in 1991, males were less likely to be found in 2001 than females. Those who were not found were concentrated in the younger age groups (15-49 years), although the proportion not found also rose at ages 75 years and over. Among those found in 1991, for men, the proportion not found in 2001 was greatest at ages 25-29 (24.1 per cent not found) and, for women, it was greatest at ages 20-24 (16.5 per cent).

There was wide variation in linkage failure rates by area of residence in 1991. LS members in Greater London in 1991 were least likely to be found (20.4 per cent not found compared to 12.2 per cent for England and Wales as a whole). The second highest failure rate was for Merseyside (14.6 per cent). Within Greater London, linkage failure was highest for those in Inner London in 1991. The highest rate was for Westminster (35.6 per cent).

There was an association between family circumstances and linkage failure rates. LS members who were not currently married in 1991 were less likely to be found in 2001 than those who were (15.2 and 8.8 per cent not found, respectively). Married LS members living with dependent children in 1991 were most likely to be found in 2001, with 7.5 per cent not found. Dependent children living with two parents in 1991 were more likely to found in 2001 than those living with single parents (13.3 per cent and 22.7 per cent not found, respectively). Linkage failure also varied by housing tenure, with 9.9 per cent of owner-occupiers in 1991 not found in 2001 compared to 16.3 per cent of those in social housing, 22.2 per cent of those in privately rented accommodation and 29.3 per cent of residents in communal establishments.

In terms of country of birth, those born in England and Wales were the most likely to be found in 2001 (10.8 per cent not found compared to 21.7 for other parts of the British Isles, 25.7 for the Commonwealth and 28.8 for the rest of the world). Ethnic variations were also apparent. LS members who described themselves as 'White' in 1991 were more likely to be found in 2001 (11.1 per cent not found) than non-white people (27.0 per cent not found). Black Africans were least likely to be found (40.6 per cent not found). Within each ethnic group women were more likely to be found in 2001 than men.

Linkage rates also varied according to education levels and employment. LS members with diploma level qualifications in 1991 were most likely to be found in 2001 and those with higher degrees least likely to be found (8.5 and 13.3 per cent, respectively). In terms of economic activity, women in part-time employment were most likely to be found (6.4 per cent not found). Among men, the retired were most likely to be found (8.8 per cent not found). Linkage failure was higher among the unemployed (24.8 per cent for males and 16.6 per cent for females), those waiting to start jobs (25.8 and 17.8 per cent) and students (25.8 and 18.6 per cent) in 1991. There was some association between social class and linkage. Among men, linkage failure was highest among the unskilled (16.6 per cent) while for women it was highest among professionals (11.6 per cent).

Patterns of high linkage failure among those found in London in 1991 but not found in 2001

Greater London contained more groups in 1991at high risk of not being found in 2001 than other areas: young people, ethnic minorities, adults living alone. There were 11 London boroughs with linkage failure rates of over 25 per cent. In these boroughs, 33.1 per cent of LS members were adults living alone in 1991, compared to 21.6 per cent in England and Wales, and 7.0 per cent were dependent children with single parents in 1991, compared to 3.9 per cent in England and Wales.

Additionally, most socio-demographic groups in these 11 London boroughs were less likely to be found than their counterparts in England and Wales as a whole. For example, linkage failure in these 11 London boroughs was:

- twice that for England and Wales as whole for LS males aged 35-39 (33.9 per cent in London compared to 16.5 per cent in England and Wales as a whole)
- three times higher for LS females aged 65-69 (21.0 per cent compared to 6.8 per cent)

- twice as high for LS adults living alone (30.6 per cent compared to 15.5 per cent)
- three times higher for married LS members with no children (22.4 per cent compared to 7.5 per cent)
- twice as high for dependent LS children living with two parents (28.4 per cent compared to 13.3 per cent)
- twice as high for white LS males (28.2 per cent compared to 12.6 per cent)

Characteristics of LS members born in the 1990s and not accounted for in 2001

There were wide geographic variations in linkage failure in 2001 among births included in the LS in the 1990s. As with LS members found in 1991, Greater London had the highest linkage failure rates for births in the 1990s (24 per cent not found). Greater Manchester had the second highest rate, with 16.7 per cent not found. Within Greater London, Westminster had the highest percentage (51.4 per cent) followed by Kensington and Chelsea (44.2 per cent).

Linkage rates varied according to parental characteristics. For example, children whose mothers were aged under 20 when they were born were least likely to be found in 2001 (21.7 per cent not found). They were most likely to be found if their mothers were aged 30-34 at their birth (11.5 per cent not found). Children registered to married parents were more likely to be found (12.5 per cent not found), compared to those registered by cohabiting parents (15.0 per cent not found), parents with different addresses (19.1 per cent not found) and by the mother alone (22.7 per cent).

Among children whose birth was registered by the mother alone, linkage failure varied little by mother's age. However, where parents were married or the birth was jointly registered, mother's age was strongly associated with being found in the 2001 Census. In particular, among children born to mothers aged under 20, those registered to married parents were as likely not to be found in 2001 as those solely registered.

Children born in the 1990s whose parents were also born in England and Wales were more likely to be found in 2001 than those with parents born elsewhere (for example, 11.6 per cent of those with mothers born in England and Wales were not found compared to 25.5 per cent for the rest of the British Isles and 30.1 per cent for countries outside the British Isles).

Characteristics of LS immigrants in the 1990s not accounted for in 2001

The percentage of immigrants not found at Census increased with age. Linkage rates decline as the time between entry and Census increased. However, even among those entering in 2000, 58.6 per cent were not found (compared to 73.6 per cent who entered in 1991).

Accounting for shortfalls in the 1991 and 2001 LS samples

To assess whether the reduction in coverage in the LS over time can readily be explained, adjustments were made to the numbers lost to follow-up for reasons other than recorded

migration and death. These adjustments took account of both losses to follow-up that might be expected in any longitudinal study and recognised levels of under-enumeration in recent censuses.

Adjustments for under-enumeration in 1991 and 2001 were made to LS linkage failure rates. Adjusting 2001 LS figures using One Number Census imputation rates reduced residual linkage failure among 50-79 year-olds and teenagers to levels similar to those in 1981 and 1991. These adjustments over-corrected in some older age groups and under-corrected among younger adults (particularly males aged 25-34 and females 25-29).

When compared to 1981, adjustments made for under-enumeration in 1991 over-correct percentages not found in the LS for females of all ages (particularly at ages 25-34) and males at all ages except 35-39 and 45-49 years. Over-correction of 1991 figures was greatest at ages 25-29 for males.

To focus on those LS members for whom linkage was not as problematic as it was for immigrants, the same adjustments were made to LS sample numbers after excluding immigrants and re-entrants. With these excluded, ONC adjustments over-corrected for non-linkage of females in all age groups in 2001, as compared to 1981 Census figures, and for males in most age groups except those aged 25-34 years. Similarly, the 1991 adjustments over-corrected for females in all age groups and males in most age groups, except 45-54 year-olds.

The only sub-national analyses possible were to compare ONC imputation levels in 2001 to the percentages not accounted for in the LS in 2001 among those in London Family Health Service Authorities in the 1990s. With the exception of Croydon, the ratio of LS percentages not found to ONC imputation rates was greater in Outer London than Inner London.

A further set of adjustments aimed to account for losses from the LS in 1991 and 2001, in a way that reflected similar types of loss to that which occurred in the 1970s as a result of unrecorded migration and mismatched census records. Based on this adjustment alone, there was some unexplained linkage failure. This was highest among men and women in their twenties.

When both sets of adjustments were applied to LS linkage failure rates the only unexplained losses in 2001were among males aged 25-34 (4 per cent were not accounted for). Discrepancies at ages 65 and over are likely to have reflected LS processing problems in 1981.

When both adjustments were applied to 1991 linkage failure rates using contemporary population estimates for 1991, the adjustments overcompensated for males aged 20-29 (by 3 per cent) and males and females aged over 80 years. However, when the calculations were repeated using 1991 population estimates that had been rebased using 2001 Census results,

this fully accounted for linkage failure at each age. In particular, there was no over-compensation when the rebased population estimates were used.

Conclusions

Tracing of LS records in 2001 was extremely successful. Provisional estimates are that 99.3 per cent of records identified from the 2001 Census were traced at NHSCR and 96.6 per cent were linked to a previous record. For the traced sample in 2001, linkage was 97.2 per cent. Among existing members of the study - those where some record had been identified for inclusion in the study between 1971 and Census 2001- 74.3 per cent were linked to a 2001 Census record (after excluding those who were known to have died or emigrated). This figure was 76.1 per cent for the traced sample.

A number of factors affecting non-linkage in the LS in 2001 have been identified. These include:

- Being young and male
- Being an immigrant
- Living in London, particularly Inner London
- Being single, divorced, cohabiting or living in a lone-parent household
- Being born outside of England and Wales
- Among children, having parents who were born outside of England and Wales
- Being in a minority ethnic group
- Living in private rented accommodation or social housing
- Being unemployed or a student, or on a Government scheme
- Serving or having parents who serve in the armed forces
- Being born in the 1990s to a young mother
- Being a sole registered birth in the 1990s

While these often identify the same people, the factors do to some degree act independently (for example, elderly women were more likely not to be linked in London).

LS linkage failure rates were adjusted to assess whether the reduction in coverage in the LS over time can be explained by losses to follow-up that might be expected in any longitudinal study, and recognised levels of under-enumeration in recent censuses. Adjustments for under-enumeration in 1991 and 2001 were made. A further set of adjustments were undertaken to account for losses from the LS in 1991 and 2001, in a way that might have reflected similar types of losses to those that occurred in the 1970s as a result of unrecorded migration and mismatched census records.

When both sets of adjustments were applied to LS linkage failure rates the only unexplained losses in 2001were among males aged 25-34 (4 per cent not accounted for). Adjustments to 1991 linkage failure rates, using contemporary population estimates for 1991, over-compensated for males aged 20-29 and both sexes at ages over 80 years. However, when rebased 1991 population estimates were used there was no over-compensation.

Thus, the reduction in coverage in the LS over time could almost completely be explained by cumulative losses, estimated at 1971-1981 levels, and census under-enumeration.

Longitudinal Study 1971- 2001: Completeness of Census linkage

1. Introduction

The Longitudinal Study (LS) links census and vital event information for 1 per cent of the population of England and Wales from 1971. Following the first successful linkage between the 1971 and 1981 Censuses, a detailed report was produced on the quality of linkage and changes in individual circumstances over the intercensal period (OPCS,1988). Information from the LS has also been used to validate information collected at census (OPCS,1983) as well as for substantive analyses of intercensal change and prospective analysis of fertility, migration and mortality (the LS publications list can be viewed at http://www.celsius.lshtm.ac.uk/publications.html). The extent to which linkage is successfully achieved at each census is crucial to these uses.

This report provides a first assessment of the linkage of 2001 Census records to the existing study records, using provisional data obtained from the recently completed linkage. It compares success rates in matching 2001 Census records to those achieved in 1981 and 1991. It aims to address the following questions:

- How many individuals identified in the LS on previous occasions were not found in 2001?
- What were their characteristics?
- What might account for the loss to follow-up of these individuals?

In attempting to answer the last of these questions, information on some types of losses is readily available from the study (e.g. records of deaths and emigration). However, a limitation of the study design is that individuals can be lost to follow-up when dates of birth or other corroborating information are inconsistently recorded on different occasions. Other individuals are lost to follow-up if they are not counted in every Census. The LS cannot provide definitive answers to the question of how specific individuals were lost to follow-up. However, this report sets out to systematically bring together whatever information is available to shed light on possible explanations

The next section provides background information on the LS and the preliminary database that has been created to address these questions quickly. This includes a brief description of quality shortfalls and how they have been addressed to make this analysis possible. The report then contains descriptions of numbers traced and linked at each Census after 1971 and of differences between the demographic profiles of those 'found' and 'not found' on each occasion (1981, 1991 and 2001). The next part of the report describes in more detail the characteristics of those not found in 2001, considering in turn those present in the 1991 Census, births and immigrants in the 1990s. The aim is to describe, as far as the data and the scope of this report allow, the people who were not found in 2001. In the final section we look at how much of the cumulative losses in the study can be explained by repetition, in subsequent decades, of those that occurred in the first decade of the study and how much can be explained by what is known about Census undercounts in 1991 and 2001.

2. Data and methods

2.1 The Longitudinal Study sample 1971-2001

The LS sample originally included the 1971 Census of Population information for people born on one of four selected dates of birth, thus approximating to a one per cent sample. The sample was updated at the 1981, 1991 and 2001 Censuses, by taking people with the same four dates of birth in each year and linking them individually across the censuses, using the National Health Service Central Register (NHSCR) to trace and match the records. To these data vital event information is added, including births and immigration of people with the four dates of birth (entry events) and deaths and emigrations (exit events). Significantly for the study of populations, the LS includes those present in communal establishments in 1971-91, and residents in communal establishments in 2001. For those in households, at each census point, other people in the household of the LS member are included.

2.2 Provisional 2001 data

The process of incorporating 2001 Census data is not yet finished. Tracing of the 2001 LS/Census sample, which involves finding each LS member's entry on the NHSCR, is complete. However, the resulting data have yet to be cleaned of multiple census records, imputed data need to be flagged and the dataset needs to be tested and merged with the other LS data. The final database is planned for launch to analysts in August 2004. A provisional database has been set up that includes pre-2001 LS data, preliminary 2001 events data (births, deaths, migration) and basic 2001 Census information. This was created to shed more light on important Census coverage questions. It includes the following from the 2001 Census:

- An indicator showing if an LS member was present at the 2001 Census
- An indicator showing if an LS member present at the 2001 Census was traced at NHSCR
- A multiple enumeration indicator
- Sex
- Age

This file has not been subjected to the full consistency checking and quality assurance planned for the final 2001 LS database by 2004. As a result, it suffers from some quality shortfalls, which we have addressed as indicated below:

Shortfall	Database adjustment
The provisional data used for this report were produced before multiple enumerations were examined. Since then, these have been analysed (see Addendum), and the number of LS members found in 2001 has been revised. However, for the purpose of this report, tracing at NHSCR had identified 11,979 census records relating to 5,959 NHSCR records. Some of these are easy to resolve: students who have been enumerated at the family home and at their term-time address, for example (applies to 3,500 NHSCR records, 7,000 Census records). The term-time address indicator will be used to select the primary record. Others, however, are not so straightforward, for example, young adults enumerated in the family home and elsewhere. The latter required examination of census forms.	The findings summarised in the Addendum are being used in the creation of the final database. However, for this investigation, a single record was used for each LS member, which was flagged to indicate if they were multiply enumerated in the 2001 Census. This is not problematic where we are describing LS members in terms of their pre-2001 characteristics, in which case we take, for example, sex and age from the LS core file. These historical data are not available for new members appearing at 2001 Census for the first time. The age and sex information on multiple census records was examined for inconsistencies. Of the 5,959 cases, 360 had conflicting data on age and 85 on sex. For this analysis age and sex are treated as missing where multiple records disagree.
Deaths occurring in the first quarter of 2001 have not yet been added to the LS (currently 2,310). This means that exit information is incomplete, which will particularly affect older cohorts. The effect would also be to deflate linkage rates, since LS members who had died would, without death records, be classed as 'not found' in 2001.	These death records have been added to the preliminary database from the LS (work in) progress file, with the exception of 22 deaths that have not completed NHSCR data validation processes.
Some pre-Census births have not yet been added to the LS database and they therefore currently appear to enter the LS for the first time in 2001 (estimated at 1,720). These will ultimately be recoded as new birth entries (as opposed to Census entries).	Any LS members enumerated at census with a 2001 year of birth have been coded as new births (1,459) if traced at NHSCR and new entrants (4) if untraced. 1,722 new births have been captured through the vital event processing system in the first quarter of 2001. Tables have therefore been adjusted to show an additional 263 third decade new births not enumerated at 2001.

The LS sample comprises people with one of the four LS birth dates either joining the study in any one of the four censuses since 1971, being born or being immigrants recorded at NHSCR. Immigrants are only noted as such at NHSCR when they register with a doctor and are entered onto the system. This may, of course, be some time after they have entered the country. Some LS members have only an entry record, having entered the study because of an erroneous date of birth. These members are usually never seen again in the LS. The entire sample up to and including Census day 2001 amounts to 927,242 LS members.

In this report LS members found and not found in 2001 are described with reference to their LS histories. Those who were found at the 1991 Census and those entering the LS through a birth or NHSCR immigration over the 1990s are each considered separately. Adopting a comparative approach, findings for 2001 are compared with those for 1991 and 1981.

The findings that follow are summarised in Tables 2.1-2.3, which describe the LS with particular reference to the 2001, 1991 and 1981 Censuses, respectively. The columns in Table 2.1 represent different 2001 statuses: traced LS members who were found in the 2001 Census, not found in the 2001 Census, having died before Census and embarked since 1991 with no record of re-entry into NHSCR before Census day 2001. The rows describe different LS histories, allowing comparisons between traced LS members found in 1991 and LS members entering as births or immigrants in the decade up to 2001. We also show LS members who appeared for the first time in 2001. In addition, we show LS members not expected from the 1991 Census. The latter include pre-1991 deaths and embarkations (with no pre-2001 re-entry) and LS members not accounted for in 1991. All 927,242 LS members are represented in Tables 2.1 to 2.3. All tables after and including Table 3.1 and all figures refer to traced LS members only.

When the Tables refer to the 1970s, 1980s and 1990s we mean the inter-censal decade, for example 1970s means between 1971(after midnight on Census day) and 1981 (Census day).

Analysis of the LS sample, in terms of tracing and linking in 2001, shown in Table 2.1, indicates that:

- 539,665 LS members were identified in the 2001 Census
- Of those identified in 2001, 536, 008 LS members were traced (99.3 per cent of the total)
- 18,526 LS members entered the study in the 2001 Census, of whom 14, 954 (80.7 per cent) were traced
- Among 701,060 LS members who had entered the study before the 2001 Census and who were not known to have died or embarked, 521,139 (74.3) per cent were found in the 2001 Census
- Among 685,060 LS members who had entered the study before the 2001 Census and who were not known to have died or embarked and who had been traced, 521, 054 (76.1 per cent) were found in the 2001 Census

Analysis of the LS sample, in terms of tracing and linking in 1991, shown in Table 2.2, indicates that:

- 543,884 LS members were identified in the 1991 Census
- Of those identified in the 1991 Census, 535,021 LS members were traced (98.4 per cent of the total)
- 25,514 LS members entered the study in the 1991 Census, of whom 16,901 (66.2 per cent) were traced
- Among 628,545 LS members who had entered the study before the 1991 Census and who were not known to have died or embarked, 518,370 (82.5 per cent) were found in the 1991 Census
- Among 617,839 LS members who had entered the study before the 1991 Census and who were not known to have died or embarked and who had been traced, 518,120 (83.9 per cent) were found in the 1991 Census

Table 2.1 The LS sample in terms of tracing and linkage in 2001					
	2001 status				
	Expected in 2001		Not expected in 2001		Total
LS history	Found	Not found	Died before Census 2001	Embarked before Census 2001 (no re-entry prior to Census)[b]	
TRACED[a] SAMPLE					
LS members present in 1991 Census or entered/ re-entered in 1990s					
Found at 1991 Census	418,869	58,368	57,934	2,028	537,199
1990s births	59,833	9,953	461	301	70,548
1990s immigrants[c] (not present at 1991 Census)	14,895	28,966	212	1,835	45,908
1990s re-entrants (not present at 1991 Census)	533	406	40	44	1,023
New LS members					
LS members entering in 2001 with no previous LS history	14,954				14,954
LS members not expected from 1991 Census/ 1990s					
LS members not accounted for in 1991[d]	26,924	66,313	6,099	1,488	100,824
Deaths pre-1991			125,954		125,954
Embarkations[e] pre-1991 (with no re-entry before 1991)			33	11,227	11,260
UNTRACED SAMPLE					
LS members entering in 2001 with no previous LS history	3,572				3,572
Found in 1991 Census	72	6,613			6,685
LS members not accounted for in 1991[f]	13	9,302			9,315
Total[g]	539,665	179,921	190,733	16,923	927,242

Notes

a 'Traced' means the LS member's record has been found on CHRIS (the NHSCR computer system) before or during the 2001 Census Link.

b LS members who embarked in the 1990s but who re-appeared at Census or for whom we have a notification of death without, in either case, a re-entry notification have been re-assigned to the appropriate 'Found' or 'Died before Census' columns. In addition, 1,680 LS members embarked in the 1990s but returned prior to the 2001 Census.

c These are people with LS dates of birth entering the NHSCR for the first time, or re-entering the NHSCR with no previous LS record.

d These are people recorded at either the 1971 or 1981 Census and 1970s and 1980s births and immigrants who were not subsequently found at the 1991 Census.

e Embarkations are notifications to NHSCR that an LS member has gone abroad. As there is no statutory obligation to declare an embarkation, the data are particularly lacking (estimated at 50 per cent of the true figure).

f These are untraced LS members who entered at either the 1971 or 1981 Census who were not subsequently found at the 1991 Census.

g This is the total number of LS members up to and including Census day 2001.

Table 2.2 The LS sample in terms of tracing and linkage in 1991					
	1991 status				
	Expected in 1991		Not expected in 1991		Total
LS history	Found	Not found	Died before Census 1991	Embarked before Census 1991 (no re-entry prior to Census)[b]	
TRACED[a] SAMPLE					
LS members present in 1981 Census or entered/ re-entered in 1980s					
Found at 1981 Census	422,191	47,861	59,033	2,797	531,882
1980s births	65,701	6,288	703	313	73,005
1980s immigrants[c] (not present at 1981 Census)	8,243	13,331	122	1,261	22,957
1980s re-entrants (not present at 1981 Census)	904	422	26	53	1,405
New LS members					
LS members entering in 1991 with no previous LS history	16,901				16,901
LS members not expected from 1981 Census/ 1980s					
LS members not accounted for in 1981[d]	21,081	31,817	4,957	902	58,757
Deaths pre-1981			61,062		61,062
Embarkations[e] pre-1981 (with no re-entry before 1991)			37	7,135	7,172
UNTRACED SAMPLE					
LS members entering in 1991 with no previous LS history	8,613				8,613
Found in 1981 Census	213	4,046			4,259
LS members not accounted for in 1981[f]	37	6,410			6,447
Sub-total	543,884	110,175	125,940	12,461	792,460
Not entered the LS by Census 1991					134,782
Total[g]					927,242

Notes

a 'Traced' in this table means the LS member's record has been found on CHRIS (the NHSCR computer system) before or during the 1991 Census Link.

b LS members who embarked in the 1980s but who re-appeared at Census or for whom we have a notification of death without, in either case, a re-entry notification have been re-assigned to the appropriate 'Found' or 'Died before Census' columns. In addition, 1,992 LS members embarked in the 1990s but returned prior to the 2001 Census.

c These are people with LS dates of birth entering the NHSCR for the first time, or re-entering the NHSCR with no previous LS record.

d These are people recorded at either the 1971 Census or 1970s births and immigrants who were not subsequently found at the 1981 Census.

e Embarkations are notifications at NHSCR that an LS member has left the study area of England and Wales.

f These are untraced LS members who entered at the 1971 Census who were not subsequently found at the 1981 Census.

g This is the total number of LS members up to and including Census day 2001.

Table 2.3 The LS sample in terms of tracing and linkage in 1981					
	1981 status				
	Expected in 1981		Not expected in 1981		Total
LS history	Found	Not found	Died before Census 1981	Embarked before Census 1981 (no re-entry prior to Census)[b]	
TRACED[a] SAMPLE					
LS members present in 1971 Census or entered/ re-entered in 1970s					
Found at 1971 Census	417,032	39,853	59,669	5,282	521,836
1970s births	64,927	5,075	1,189	696	71,887
1970s immigrants[c] (not present at 1971 Census)	14,857	13,466	198	2,734	31,255
New LS members					
LS members entering in 1981 with no previous LS history	33,125				33,125
UNTRACED SAMPLE					
LS members entering in 1981 with no previous LS history	4,955				4,955
LS members found in 1971	1,245	6,821			8,066
Sub total	536,141	65,215	61,056	8,712	671,124
Not entered the LS by Census 1981					256,118
Total[d]					927,242

Notes

a 'Traced' in this table means the LS member's record has been found on CHRIS (the NHSCR computer system) before or during the 1981 Census Link.

b LS members who embarked in the 1970s but who re-appeared at Census or for whom we have a notification of death without, in either case, a re-entry notification have been re-assigned to the appropriate 'Found' or 'Died before Census' columns. In addition, 3,551 LS members embarked in the 1990s but returned prior to the 2001 Census.

c These are people with LS dates of birth entering the NHSCR for the first time, or re-entering the NHSCR with no previous LS record.

d This is the total number of LS members up to and including Census day 2001.

Analysis of the LS sample, in terms of tracing and linking in 1981, shown in Table 2.3, indicates that:

- 536,141 LS members were identified in the 1981 Census
- Of those identified in 1981, 529,941 LS members were traced (98.8 per cent of the total)
- 38,080 LS members entered the study in the 1981 Census, of whom 33,125 (87.0 per cent) were traced
- Among 563,276 LS members who had entered the study before the 1981 Census and who were not known to have died or embarked, 498,061 (88.4 per cent) were found in the 1981 Census
- Among 562,031 LS members who had entered the study before the 1981 Census and who were not known to have died or embarked and who had been traced, 503,637 (89.6 per cent) were found in the 1981 Census

3. Accounting for individuals in the LS sample at each Census

3.1 Tracing and linkage outcomes 1981, 1991 and 2001

Census to census linkage rates for traced LS members are reported after each LS-Census Link exercise, providing an indicator of both LS data tracing quality and census enumeration. Tracing rates achieved in the 2001 Census-LS link were higher than before, at 99.3 per cent, compared to 98.4 per cent in 1991, 98.8 per cent in 1981 and 96.8 per cent in 1971. There are several reasons for the high tracing rates achieved in the 2001 Census-LS Link. The use of the NHSCR's database CHRIS (the Central Health Register Inquiry System) allowed automatic record matching to take place. For those records that were not automatically matched, there was more census information available for query resolution, including access to census form images. In addition, the project benefited from the high level of expertise of tracing staff at NHSCR. The quality of data tracing and linkage in 2001 will be informed by analysis of the results, of which this is the first, and by a qualitative examination of the data, which forms part of the post-Link data quality assessment. High tracing levels do not necessarily imply high linkage because 2001 tracing levels relate solely to 2001 Census records. They do not imply anything about records not found in the 2001 Census.

Table 3.1 synthesises the information in Tables 2.1-2.3 to show how many traced LS members either found in the previous census or from the last decade's births, immigrations or re-entries were not found in 2001, 1991 and 1981.

The overall percentage not found in 2001, at 16.5 per cent, is higher than at previous censuses (significant at the 5 per cent level). For each type of LS history, a higher percentage was not found in 2001 compared to 1991 or 1981. The percentage of those found in the 1991 Census but not accounted for in 2001, at 12.2 per cent, is up from 10.2 per cent in 1991 and 8.7 per cent in 1981. We show below that linkage failure in 2001 is higher for males and concentrated in the younger age groups.

Comparing the percentages of different types of LS members not found in 2001 and 1991, births in particular were less likely to have been found in 2001. Among 1990s births, 14.3 per cent were not found in 2001 compared to 8.7 per cent of 1980s births not found in 1991. Linkage failure for 1990s births in 2001 is almost twice as high as for 1970s births in 1981 (14.3 per cent compared to 7.2 per cent).

Two-thirds (66 per cent) of 1990s immigrants were not found in 2001. This high level of linkage failure represents a significant but relatively small increase over 1991 (at 61.8 per cent). However, the impact on overall linkage rates for 2001 is compounded by the substantial increase in immigration to NHSCR in the 1990s compared to the 1980s, at 43,861 and 21,574 respectively. While the proportion of immigrants not found in 1991 was much higher than in 1981, at 61.8 per cent compared to 47.5 per cent, this did not impact heavily on overall linkage failure rates in 1991 because of the 1970s/1980s fall in the number of immigrants, from 28,323 down to 21,574.

Table 3.1 Number and percentage of traced[a] LS members found in the previous decade who were not accounted for at census: 2001, 1991 and 1981

	Found in the previous decade and not recorded as having died or embarked	Not found at census and not recorded as having died or embarked	Percentage not found	95% confidence interval	
				Lower	Upper
Total found in the previous decade					
2001	591,823	97,693	16.5	16.4	16.6
1991	564,941	67,902	12.0	11.9	12.1
1981	555,210	58,394	10.5	10.4	10.6
Found in the previous census					
2001	477,237	58,368	12.2	12.1	12.3
1991	470,052	47,861	10.2	10.1	10.3
1981	456,885	39,853	8.7	8.6	8.8
From the previous decade's births					
1990s births expected in 2001	69,786	9,953	14.3	14.0	14.5
1980s births expected in 1991	71,989	6,288	8.7	8.5	8.9
1970s births expected in 1981	70,002	5,075	7.2	7.1	7.4
From the previous decade's immigrations					
1990s immigrations expected in 2001	43,861	28,966	66.0	65.6	66.5
1980s immigrations expected in 1991	21,574	13,331	61.8	61.1	62.5
1970s immigrations expected in 1981	28,323	13,466	47.5	47.0	48.1
From the previous decade's re-entries					
1990s re-entries expected in 2001	939	406	43.2	40.0	46.5
1980s re-entries expected in 1991	1,326	422	31.8	29.3	34.4
1970s re-entries expected in 1981	N/a	N/a	N/a	N/a	N/a

Notes

a 'Traced' means the LS member's record has been found on CHRIS (the NHSCR computer system) during or before the relevant Census-LS Link.

N/a = not applicable

Table 3.2 shows that the proportion of those not found at census who had entered the LS during the previous decade as immigrants rose to 29.7 per cent in 2001, up from 19.6 per cent in 1991 and 23.1 per cent in 1981. The previous decade's births also accounted for a larger proportion of LS members not accounted for in 2001 (10.2 per cent compared to 9.3 per cent and 8.7 per cent in 1991 and 1981 respectively). LS members found at the previous census represent a smaller proportion of traced LS members not accounted for in 2001 (59.7 per cent) than in 1991 or 1981 (70.5 and 68.2 per cent). This was despite higher non-linkage rates for this group in 2001, at 12.2 per cent (shown in Table 3.1), than in 1991 or 1981 (10.2 per cent and 8.7 per cent respectively).

Table 3.1 shows that the percentage of re-entrants to the LS who were not found in 2001, at 43.2 per cent, was also higher than in 1991 (31.8 per cent). There is no 1981 comparison since all LS members entering in the 1980s are classed as migrants to NHSCR (and therefore to the LS) in the absence of any pre-1971 LS history for them (LS records start from 1971).

Table 3.2 Number and percentage of traced[a] LS members not accounted for at census according to where first identified during the previous decade : 2001, 1991 and 1981

	Not found at 2001		Not found at 1991		Not found at 1981	
	Number	%	Number	%	Number	%
Found in the previous census and not recorded as having died or embarked	58,368	59.7	47,861	70.5	39,853	68.2
From the previous decade's births and not recorded as having died or embarked	9,953	10.2	6,288	9.3	5,075	8.7
From the previous decade's immigrations[b] and not recorded as having died or embarked	28,966	29.7	13,331	19.6	13,466	23.1
From the previous decade's re-entries[c] and not recorded as having died or embarked	406	0.4	422	0.6	N/A	N/A
Total from the previous decade not recorded as having died or embarked	97,693	100	67,902	100	58,394	100

Notes

a 'Traced' means the LS member's record has been found on CHRIS (the NHSCR computer system) during or before the relevant Census-LS link.

b These are people with LS dates of birth entering the NHSCR for the first time or re-entering the NHSCR with no previous LS record.

c These are LS members who embarked before the previous census and re-entered in the following decade.

3.2 Demographic profiles of those found and not accounted for

Figure 3.1 shows the numbers of traced LS members from the 1991 Census or from 1990s births or migrants and re-entrants to NHSCR who were found and not found in 2001, by age and sex. Deaths and emigrations notified to NHSCR are excluded. Focusing first on LS members not found in 2001, more men than women were not found, and 20-44 year-olds of both sexes were particularly likely to have been missed. Immigrants and re-entrants entering in the 1990s account for a large proportion of those not found in 2001 (30.1 per cent over all ages). This is highest among females aged 25-29, among whom 57.3 per cent are immigrants or re-entrants, and males aged 25-29, 42.4 per cent of whom are immigrants or re-entrants. LS members not found in 2001 can be compared to 1991. Figure 3.2 shows the numbers of LS members found in 1981 and immigrating or born over the 1980s who were not found at the 1991 Census. Fewer were missing in 1991 than in 2001, though they had a similar age profile to those missing in 2001. A smaller proportion were immigrants or re-entrants: 19 per cent overall, rising to a highest level of 38.9 per cent among women aged 25-29 and 26.2 per cent among men aged 30-34. Figure 3.3 shows that 20-44 year-olds were also more likely to be missed in 1981 than other age groups. However, fewer were missing than in 1991 or 2001. Overall, 21 per cent of those missing in 1981 were immigrants or re-entrants. The highest proportions were among 25-29 year-olds, at 48.5 per cent for women and 35.8 per cent for men. When compared with Figures 3.2 and 3.3, the pyramid for those not found in 2001 (Figure 3.1) has a thicker base, suggesting that finding LS members under the age of ten at census has become more problematic, both in comparison to other age groups and in absolute terms.

Figures 3.1 to 3.3 also show the population pyramids for LS members found in 2001, 1991 and 1981. The shapes of these pyramids are typical for the population as a whole, showing increasing life expectancy, which is higher for females, and the demographic ageing of those born during the post-war baby boom. They contrast with the pyramids for those not found, which from 1981 onwards depart further from the demographics of those found, with increasing concentration among 20-44 year-olds and over-representation of males. Sections 4 to 6 consider separately LS members found in 1991, LS members entering the LS over the1990s as new births and those entering as immigrants and re-entrants to NHSCR.

Figure 3.1 **1990s traced LS members not recorded as having died or embarked by 2001 Census, by age**

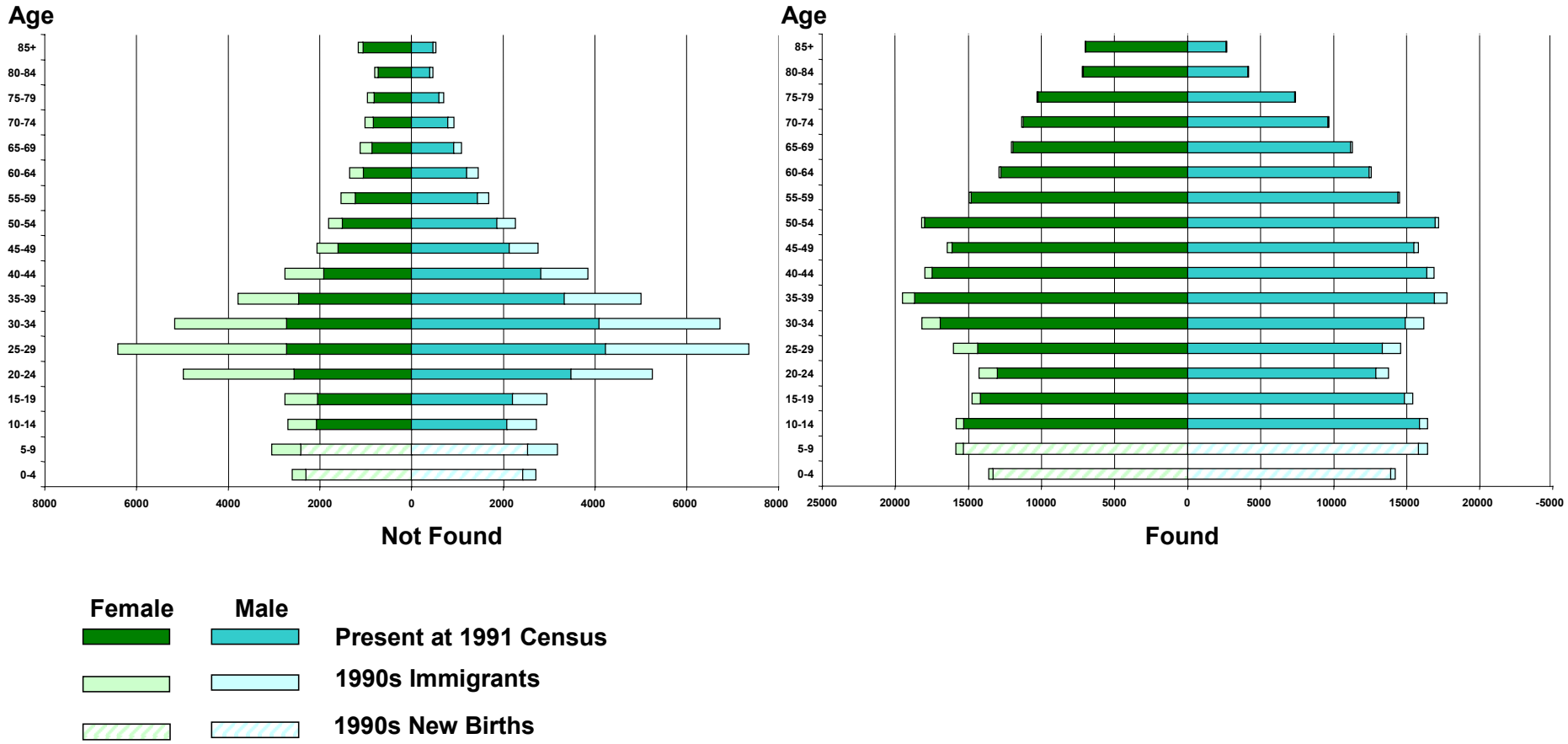


Figure 3.2 **1980s traced LS members not recorded as having died or embarked by 1991 Census, by age**

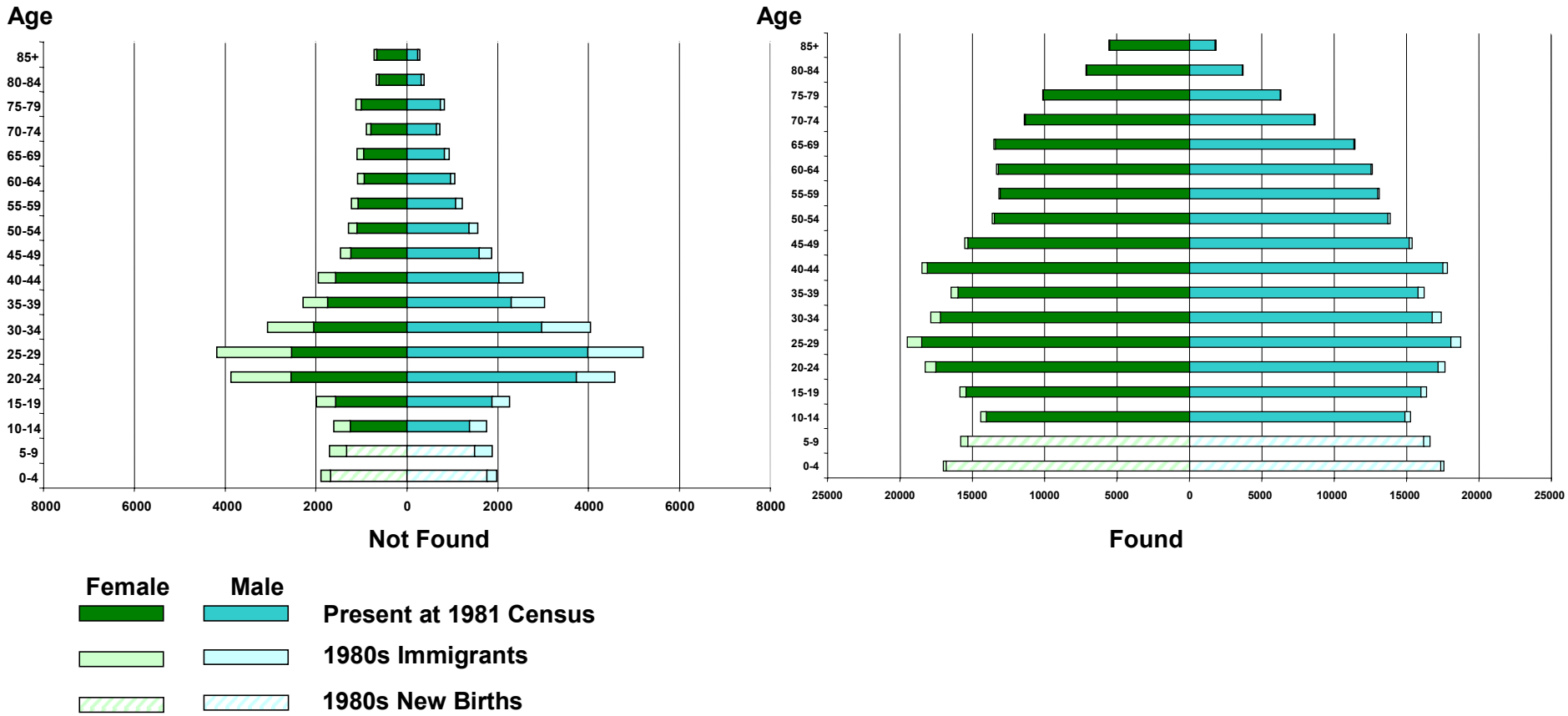
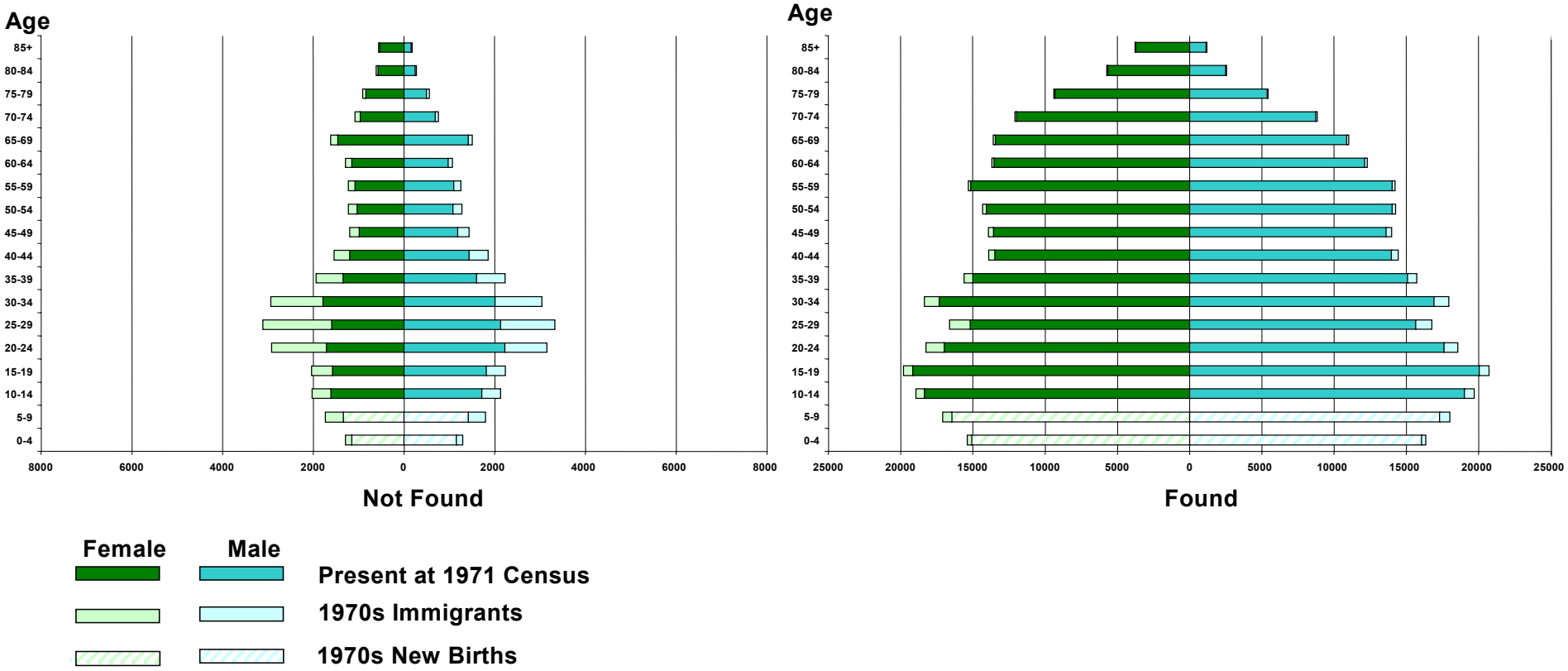


Figure 3.3 **1970s traced LS members not recorded as having died or embarked by 1981 Census, by age**



4. Individuals in the 1991 Census sample who could not be accounted for in the 2001 Census sample

4.1 Linkage of LS members who were found and traced in 1991

Table 3.1 showed that 12.2 per cent of traced LS members found in the 1991 Census and not recorded as having died or embarked were not found in 2001. Table 4.1 shows the age and sex breakdown of this group. Males were less likely to be found than females, with 13.8 and 10.7 per cent not found, respectively. For both sexes linkage failure was highest in the 20-39 years age groups and among the over-80s. At each census there has been a problem with elderly people not wanting to open their doors to enumerators from census. The number of women living alone has risen and there is increased fear of crime in some areas. However, a new problem introduced in the 2001 Census is that someone who was staying for a short time in an institution (particularly a short-stay residential unit or nursing home), who usually lives elsewhere, should have appeared only as a resident at their own home. However, if they lived alone or were omitted from the form for their home, they will not have appeared at the Census at all. At previous censuses they would have been enumerated as visitors to communal establishments. In the LS non-linkage of older age groups may also result from embarkations and possibly subsequent deaths that have not yet been added to the database. Among the younger age groups, non-linkage was highest among young males, exceeding 20 per cent in the 20-34 age groups. Almost a quarter (24.1 per cent) of males aged 25-29 were not found. For females linkage failure was highest among 20-24 year-olds, at 16.5 per cent.

Tables 4.2 and 4.3 show comparable non-linkage rates for 1991 and 1981. At both previous censuses, linkage failure was also concentrated among women and men aged 20-39 years, with high rates of non-linkage occurring among elders as well. Compared to 1981, the 1991 increase in linkage failure rates was particularly high among those aged under 40. In 2001 there were also substantial increases for those aged 40-49, which could reflect an age and cohort effect.

Tables 4.1, 4.2 and 4.3 are summarised in Figures 4.1 and 4.2, showing the percentages of traced males and females from the previous census not found in 2001, 1991 and 1981 and not recorded as having died or embarked. These graphs show how linkage failure has increased consistently for the under-50s since the 1981 Census. Males and females aged 65-69 in 1981 were less likely to be found than those in adjacent cohorts. This is also visible for the same cohort in 1991 when they were aged 75-79 and in 2001 at 85-89 years. Aside from this particular cohort effect, linkage failure for both males and females is lowest, at around 7 to 8 per cent, among 50 to 74 year-olds, after which age it rises, for the reasons outlined above.

Table 4.1 Traced[a] LS members found in 1991 but not accounted for in 2001, by age and sex

Age in 2001	Males		Females	
	Found in 1991, not recorded as having died or embarked by 2001	Not found in 2001 (%)	Found in 1991, not recorded as having died or embarked by 2001	Not found in 2001 (%)
10-14	17,955	11.6	17,424	12.0
15-19	17,043	12.9	16,261	12.7
20-24	16,390	21.2	15,608	16.5
25-29	17,556	24.1	17,107	16.0
30-34	18,989	21.5	19,711	13.9
35-39	20,230	16.5	21,173	11.7
40-44	19,192	14.7	19,418	9.9
45-49	17,613	12.1	17,759	9.1
50-54	18,820	9.9	19,523	7.8
55-59	15,823	9.1	16,068	7.7
60-64	13,653	8.8	13,874	7.7
65-69	12,082	7.5	12,843	6.8
70-74	10,399	7.6	12,122	6.9
75-79	7,939	7.4	11,075	7.5
80-84	4,534	8.8	7,904	9.4
85-89	2,284	14.4	5,215	13.3
90-94	687	16.3	2,179	11.5
95-99	119	16.0	569	18.5
100+	13	38.5	83	26.5
All ages	231,321	13.8	245,916	10.7

Note

a 'Traced' means the LS member's record has been found on CHRIS (the NHSCR computer system) during or before the 2001 Census-LS Link.

Table 4.2 Traced[a] LS members found in 1981 but not accounted for in 1991, by age and sex

Age in 1991	Males		Females	
	Found in 1981, not recorded as having died or embarked by 1991	Not found in 1991 (%)	Found in 1981, not recorded as having died or embarked by 1991	Not found in 1991 (%)
10-14	16,263	8.5	15,340	8.2
15-19	17,882	10.5	17,053	9.3
20-24	20,919	17.8	20,131	12.8
25-29	22,018	18.1	21,094	12.1
30-34	19,731	15.1	19,320	10.7
35-39	18,084	12.7	17,785	9.9
40-44	19,539	10.3	19,741	8.0
45-49	16,764	9.5	16,606	7.5
50-54	15,068	9.0	14,612	7.6
55-59	14,073	7.6	14,215	7.6
60-64	13,490	7.1	14,197	6.7
65-69	12,186	6.8	14,407	6.7
70-74	9,269	7.0	12,184	6.6
75-79	7,013	10.6	11,115	9.2
80-84	3,961	8.1	7,771	8.1
85-89	1,553	11.0	4,263	9.4
90-94	389	14.1	1,551	12.3
95-99	60	18.3	327	17.1
100+	20	15.0	58	36.2
All ages	228,282	11.4	241,770	9.0

Note

a 'Traced' means the LS member's record has been found on CHRIS (the NHSCR computer system) during or before the 1991 Census-LS Link.

Table 4.3 Traced[a] LS members found in 1971 but not accounted for in 1981, by age and sex

Age in 1981	Males		Females	
	Found in 1971, not recorded as having died or embarked by 1981	Not found in 1981 (%)	Found in 1971, not recorded as having died or embarked by 1981	Not found in 1981 (%)
10-14	20,744	8.3	19,991	8.1
15-19	21,862	8.3	20,787	7.6
20-24	19,808	11.2	18,716	9.2
25-29	17,775	12.0	16,806	9.5
30-34	18,925	10.6	19,154	9.4
35-39	16,705	9.6	16,381	8.3
40-44	15,394	9.3	14,717	8.2
45-49	14,778	8.0	14,577	6.8
50-54	15,099	7.2	15,139	6.9
55-59	15,112	7.3	16,252	6.7
60-64	13,088	7.4	14,723	7.8
65-69	12,283	11.5	14,953	9.9
70-74	9,425	7.3	12,972	7.5
75-79	5,869	8.5	10,214	8.3
80-84	2,750	9.0	6,273	9.3
85-89	996	11.5	3,029	11.3
90-94	265	13.6	1,035	14.5
95-99	46	17.4	202	16.3
100+	5	40.0	35	37.1
All ages	220,929	9.2	235,956	8.3

Note

a 'Traced' means the LS member's record has been found on CHRIS (the NHSCR computer system) during or before the 1981 Census-LS Link.

Figure 4.1 **Percentage of male LS members who were found at the previous census, but not accounted for in 2001,1991 and 1981**

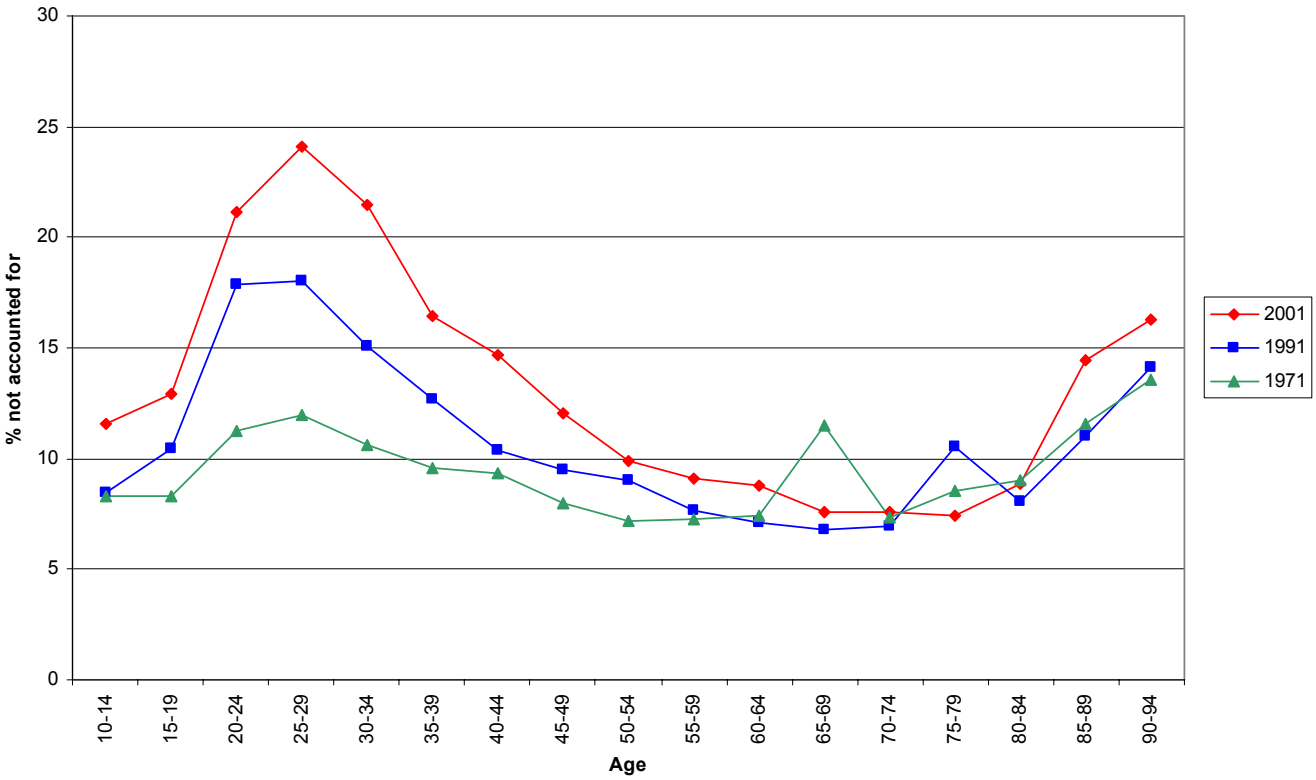
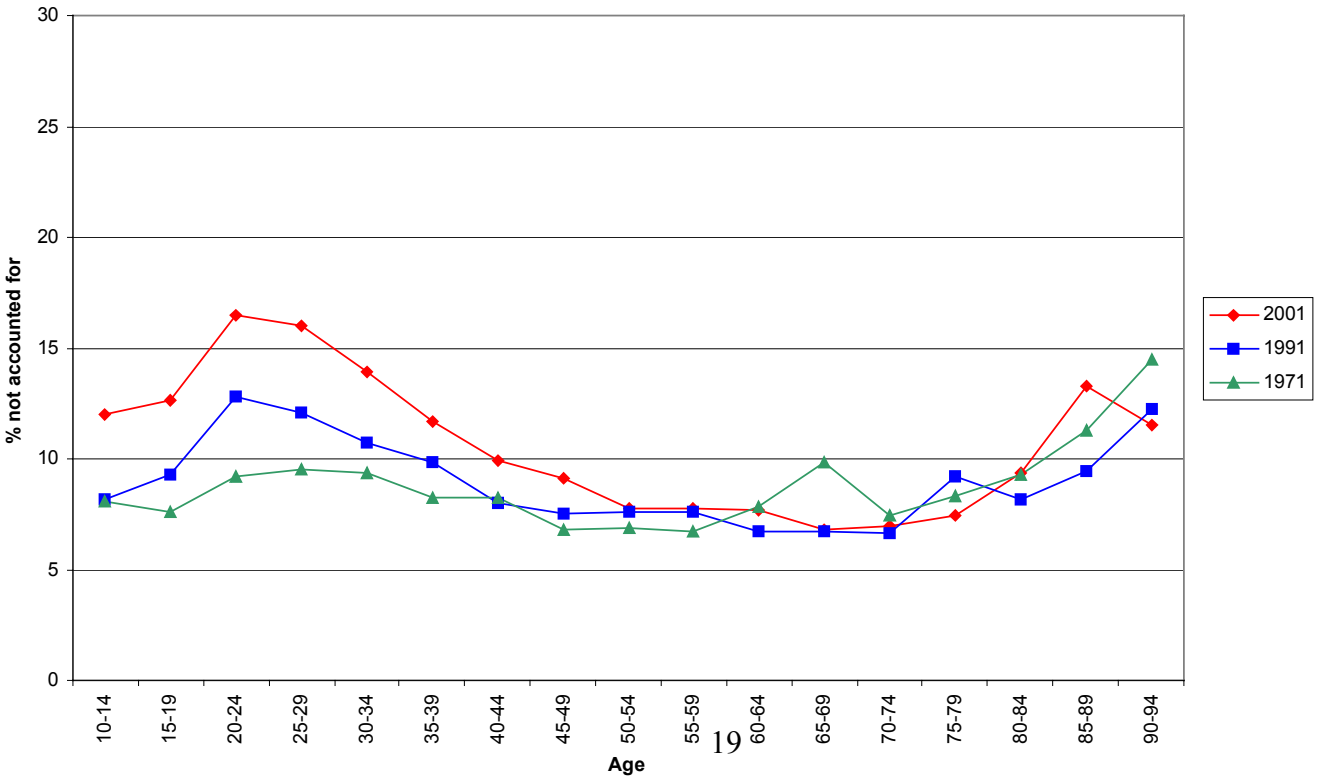


Figure 4.2 **Percentage of female LS members who were found at the previous census, but not accounted for in 2001,1991 and 1981**



4.2 Geographic variation in the percentages of LS members who were found in 1991 but not accounted for in 2001

There was wide geographic variation in 1991 to 2001 linkage rates. Since we do not know the whereabouts of those not found in 2001, they are analysed with reference to the address of their usual residence at the 1991 Census. Many more LS members living in the metropolitan areas in 1991 were missing in 2001 compared to those living in non-metropolitan areas.

Table 4.4 Percentage of traced[a] LS members found in 1991 but not accounted for in 2001, by the county of their usual residence in 1991

County	LS members found in 1991 and not recorded as having died or embarked by 2001	Percentage not found in 2001	County	LS members found in 1991 and not recorded as having died or embarked by 2001	Percentage not found in 2001
Greater London	63,498	20.4	Kent	14,521	10.5
Merseyside	13,138	14.6	Nottinghamshire	9,501	10.5
South Glamorgan	3,794	14.0	Dorset	6,083	10.3
Gwynedd	2,248	13.5	Northamptonshire	5,535	10.3
Greater Manchester	23,740	13.3	West Sussex	6,667	10.2
West Midlands	25,095	12.9	North Yorkshire	6,665	10.1
Buckinghamshire	6,345	12.6	Cheshire	9,182	10.1
West Yorkshire	19,543	12.5	Cornwall (and Isle of Scilly)	4,571	10.0
Berkshire	7,257	12.5	Essex	14,612	10.0
Bedfordshire	5,174	12.2	Wiltshire	5,498	9.9
East Sussex	6,093	12.0	Northumberland	2,901	9.9
Lancashire	13,123	11.9	Devon	9,458	9.5
Hertfordshire	9,504	11.7	Gloucestershire	4,971	9.4
Oxfordshire	5,248	11.6	Norfolk	6,992	9.3
Avon	8,881	11.6	South Yorkshire	12,082	9.3
Tyne and Wear	10,298	11.5	Powys	1,106	9.2
Surrey	9,812	11.4	Humberside	8,385	9.2
Clwyd	3,857	11.3	Shropshire	3,856	9.1
Isle of Wight	1,132	11.2	Hereford and Worcester	6,503	9.1
Cleveland	5,300	11.1	Durham	5,671	9.0
Cambridgeshire	6,027	11.1	Staffordshire	9,851	8.9
Dyfed	3,226	11.0	Suffolk	5,929	8.9
West Glamorgan	3,340	10.9	Cumbria	4,683	8.9
Mid-Glamorgan	5,041	10.8	Derbyshire	8,982	8.8
Leicestershire	8,492	10.6	Lincolnshire	5,442	8.7
Gwent	4,166	10.6	Warwickshire	4,837	8.7
Hampshire	14,940	10.6	Somerset	4,409	8.5
			Total	477,205	12.2

Notes

This table does not include 32 LS members' records for whom county of usual residence information is missing.

a 'Traced' means the LS member's record has been found on CHRIS (the NHSCR computer system) during or before the 2001 Census-LS Link.

Table 4.4 lists the 1991 counties of usual residence of traced LS members found in 1991 but not accounted for in 2001, showing:

- Greater London had, by a wide margin, the highest percentage of LS members not found, at 20.4 per cent.
- The second highest was Merseyside, with 14.6 per cent not found, followed by
- South Glamorgan (14.0 per cent);
- Gwynedd (13.5 per cent);
- Greater Manchester (13.3 per cent);
- West Midlands (12.9 per cent).

LS members were most likely to be found in 2001 if they lived in Somerset in 1991 (8.5 per cent not found). Within each of the counties there was also geographic variation. This is shown for Greater London in Table 4.5.

Table 4.5 Percentage of traced[a] LS members found in 1991 but not accounted for in 2001, by the London borough of their usual residence in 1991

London borough	LS members found in 1991 and not recorded as having died or embarked by 2001	Percentage not found in 2001	London borough	LS members found in 1991 and not recorded as having died or embarked by 2001	Percentage not found in 2001
Greater London	63,498	20.4			
London borough					
Westminster	1,371	35.6	Enfield	2,548	18.6
Kensington and Chelsea	1,026	35.1	Greenwich	1,979	18.4
Hackney	1,665	31.6	Waltham Forest	2,053	17.6
Islington	1,501	29.7	Croydon	3,074	16.1
Camden	1,486	28.5	Redbridge	2,235	16.1
Hammersmith and Fulham	1,344	28.0	Harrow	2,028	15.8
Brent	2,386	27.7	Richmond Upon Thames	1,500	15.7
Tower Hamlets	1,629	27.4	Merton	1,535	15.5
Lambeth	2,136	27.1	Kingston Upon Thames	1,237	15.2
Haringey	1,900	26.1	Barking and Dagenham	1,363	14.8
Southwark	1,941	25.2	City of London	27	14.8
Newham	2,121	23.5	Hillingdon	2,284	14.6
Wandsworth	2,340	23.1	Bromley	2,765	12.4
Lewisham	2,163	22.9	Bexley	2,159	12.0
Ealing	2,788	22.8	Sutton	1,701	10.4
Barnet	2,837	19.2	Havering	2,246	9.9
Hounslow	2,130	18.9			

Notes
This table does not include 32 LS members for whom London borough information is missing.
a 'Traced' means the LS member's record has been found on CHRIS (the NHSCR computer system) during or before the 2001 Census-LS Link.

Table 4.5 demonstrates that linkage failure in Westminster and Kensington and Chelsea is not just the result of non-linkage of 1990s immigrants. It also shows that:

- With the exception of Bexley, Sutton and Havering, all of the boroughs within Greater London had a higher percentage of LS members not found than the 12.2 per cent average for England and Wales.
- LS members were least likely to be found in 2001 if they lived in Westminster in 1991 (35.6 per cent not found in 2001).
- The second highest linkage failure rate was in Kensington and Chelsea (35.1 per cent not found).
- Linkage failure was higher among LS members living in the Inner London boroughs in 1991 and generally lower in Outer London.

Percentages of LS members resident in each of the county districts and local authorities in 1991 and not found in 2001 are shown in Appendix 1. To summarise, geographical analysis at this level of detail revealed that, outside Greater London, the 20 local authorities with the highest percentages of LS members that were not found in 2001 were:

- Manchester Metropolitan District (19.9 per cent not found);
- Oxford (18.5 per cent);
- Liverpool Metropolitan District (18.4 per cent);
- Knowsley (18.0 per cent);
- Slough (17.8 per cent);
- Berwick Upon Tweed (16.9 per cent);
- Luton (16.3 per cent);
- Watford (16.1 per cent);
- Birmingham (16.1 per cent);
- Preston (16.0 per cent);
- Dwyfor (15.8 per cent);
- Salford (15.7 per cent);
- South Bucks (15.5 per cent);
- Brighton (15.5 per cent);
- Nottingham (15.4 per cent);
- Forest Heath (15.2 per cent);
- Arfon (15.1 per cent);
- Oldham (15.0 per cent);
- Cardiff (14.9 per cent);
- Leicester (14.8 per cent).

Most of these areas have linkage failure rates that are similar to Outer London boroughs. Many include social groups with characteristics associated with high linkage failure. In Section 4.11 we focus on 11 London boroughs where linkage failure rates are over 25 per cent. For these boroughs we compare LS members' characteristics and the associated linkage failure rates with corresponding statistics for England and Wales as a whole. The aim is to assess the extent to which the high rate of linkage failure found in Inner London is explained by differences in its social composition.

4.3 The effect that 1991 marital status has on LS members' chances of being found in 2001

LS members who were in their first marriage or remarried in 1991 were more likely than either unmarried or divorced LS members to be found in 2001. Only 9.4 per cent of males and 8.1 per cent of females who were in their first marriage in 1991 were not found in 2001, compared to 10.4 per cent of remarried males and 8.5 per cent of remarried females. Table 4.6 also shows that 11.8 per cent of widowers and 10.0 per cent of widows were not found in 2001. People who were still single in 1991 were least likely to be found in 2001 (17.8 per cent of males and 14.0 per cent of females), followed by those who were divorced (16.2 per cent of males and 10.0 per cent of females not found).

Further analysis is required to assess the impact that name changes had on linkage rates, for example, among women who were single in 1991 and married in 2001. However, this is beyond the scope of this report.

Table 4.6 Percentage of traced[a] LS members found in 1991 but not accounted for in 2001, by 1991 marital status and sex

Marital status	Males			Females		
	LS members found in 1991 and not recorded as having died or embarked by 2001: numbers	LS members found in 1991 and not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001	LS members found in 1991 and not recorded as having died or embarked by 2001: numbers	LS members found in 1991 and not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001
Single	111,022	48.0	**17.8**	99,655	40.5	**14.0**
Married (first marriage)	94,919	41.0	**9.4**	102,589	41.7	**8.1**
Remarried	12,767	5.5	**10.4**	13,344	5.4	**8.5**
Divorced	9,587	4.1	**16.2**	13,965	5.7	**10.0**
Widow(er)ed	3,026	1.3	**11.8**	16,363	6.7	**10.0**
Total	231,321	100.0	**13.8**	245,916	100.0	**10.7**

Note
a 'Traced' means the LS member's record has been found on CHRIS (the NHSCR computer system) before or during the 2001 Census Link.

4.4 The effect of household circumstances in 1991 on LS members' chances of being found in 2001

In addition to marital status, LS members' household circumstances in 1991 impacted on their chances of being found in 2001. Table 4.7 shows that LS members living in communal establishments in 2001 were least likely to be found in 2001 (31.6 per cent of males and 26.5 per cent of females not found). However, these account for less than 1 per cent of LS members found in 1991 and not recorded as having died or embarked by 2001. Among visitors to either households or communal establishments in 1991, 22.3 per cent of males and 14.8 per cent of females were not found in 2001. Again, these represent a small minority (2.1 per cent) of LS members expected in 2001. Among children living with a single parent in 1991, 25.1 per cent of males and 20.3 per cent of females were not found in 2001. This is higher than among children who in 1991 lived with two parents: 14.0 per cent of males and

12.6 per cent of females were not found in 2001. LS members most likely to be found in 2001 were married and without children in 1991 (7.6 per cent of males and 7.4 per cent of females not found). LS members who were married and with dependent children in 1991 were the next group most likely to be found in 2001 (10.5 per cent of males and 8.3 per cent of females were not found). Cohabitees living with and without children in 1991 were less likely to be found in 2001 than their married counterparts. Among cohabitees, 14.8 per cent of males and 10.5 per cent of females without children were not found, and 20.2 per cent of males and 10.0 per cent of females with children were not found. Among LS members who were lone parents in 1991, 17.5 per cent of lone fathers and 13.0 per cent of lone mothers were not found in 2001. Among those living alone in 1991, 18.9 per cent of males and 12.2 per cent of females were not found in 2001. This aspect of non-linkage makes a substantial contribution to overall linkage failure, given that over a fifth of all LS members were living alone in 1991.

Table 4.7 Percentage of traced[a] LS members found in 1991 but not accounted for in 2001, by household circumstances in 1991 and sex

1991 household circumstances	Males			Females		
	LS members found in 1991 and not recorded as having died or embarked by 2001: numbers	LS members found in 1991 and not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001	LS members found in 1991 and not recorded as having died or embarked by 2001: numbers	LS members found in 1991 and not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001
Visitor to a household or communal establishment	5,191	2.2	**22.3**	4,928	2.0	**14.8**
Living in a communal establishment	2,002	0.9	**31.6**	1,621	0.7	**26.5**
Adult living alone[b]	51,272	22.2	**18.9**	51,759	21.0	**12.2**
Married couple, no children	54,674	23.6	**7.6**	60,980	24.8	**7.4**
Cohabiting couple, no children	7,365	3.2	**14.8**	7,277	3.0	**10.5**
Married adult living with spouse and dependent child(ren)	47,894	20.7	**10.5**	48,246	19.6	**8.3**
Cohabiting adult living with partner and child(ren)	3,630	1.6	**20.2**	3,756	1.5	**10.0**
Lone parent	1,045	0.5	**17.5**	10,894	4.4	**13.0**
Dependent child living with two parents	47,804	20.7	**14.0**	46,251	18.8	**12.6**
Dependent child living with a single parent	9,486	4.1	**25.1**	9,351	3.8	**20.3**
Total	231,321	100.0	**13.8**	245,916	100.0	**10.7**

Notes
This table does not include 1,811 LS members for whom we have missing information.
a 'Traced' means the LS member's record has been found on CHRIS (the NHSCR computer system) before or during the 2001 Census Link.
b Includes LS members who are not part of a family unit.

4.5 The effect of country of birth on the percentage of LS members who were found in 1991 but not accounted for in 2001

Table 4.8 Percentage of traced[a] LS members found in 1991 but not accounted for in 2001, by country of birth

Country of birth	LS members found in 1991 and not recorded as having died or embarked by 2001: numbers	LS members found in 1991 and not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001
United Kingdom	438,024	91.8	**10.9**
England	403,881	84.6	**10.8**
Wales	25,511	5.3	**10.8**
Scotland	6,754	1.4	**19.3**
Northern Ireland	1,851	0.4	**17.9**
United Kingdom (part not stated)	27	0.0	**37.0**
Rest of British Isles	5,196	1.1	**26.0**
Irish Republic and Ireland (not defined)	4,934	1.0	**26.5**
Channel Islands and Isle of Man	262	0.1	**16.0**
Old Commonwealth	1,425	0.3	**33.8**
New Commonwealth	21,169	4.4	**25.2**
Eastern Africa	2,486	0.5	**20.0**
Southern Africa	235	0.0	**26.8**
Western Africa	861	0.2	**36.9**
Caribbean	2,566	0.5	**29.1**
South Asia	11,785	2.5	**24.4**
South East Asia	1,487	0.3	**27.4**
Remainder of New Commonwealth	1,749	0.4	**24.4**
Rest of world	11,423	2.4	**28.8**
European Community	4,399	0.9	**24.8**
Remainder of Europe	1,569	0.3	**17.9**
Turkey	413	0.1	**38.5**
USSR	247	0.1	**14.6**
Africa (not included above)	1,334	0.3	**30.6**
America (not included above	1,183	0.2	**39.3**
Asia (not included above)			
Middle East	943	0.2	**37.1**
Remainder of Asia	1,316	0.3	**37.2**
Other	19	0.0	**26.3**
All places of birth	477,237	100.0	**12.2**

Note

a 'Traced' means the LS member's record has been found on CHRIS (the NHSCR computer system) before or during the 2001 Census Link.

LS members who were born in England and Wales were more likely to be found in 2001 than those born elsewhere. Table 4.8 shows the countries of birth of LS members found in 1991 but not accounted for in 2001. A tenth (10.1 per cent) of LS members who were found in

1991 and not recorded as having died or embarked by 2001 were born outside of England and Wales. A tenth of those born outside of England and Wales were from the Irish Republic, among whom over a quarter (26.5 per cent) were not found in 2001. We show in Section 5 below that linkage failure was higher still among children who were born to parents who themselves were born in the Irish Republic.

South Asians and people born in other EU countries represent 2.5 per cent and 0.9 per cent of all LS members, and these groups also have high linkage failure rates (24.4 per cent and 24.8 per cent, respectively). Linkage failure was also high among those born in the Old Commonwealth countries (Australia, Canada and New Zealand), among whom more than a third (33.8 per cent) were not found in 2001. Among those born in the New Commonwealth countries, 25.2 per cent were not found in 2001. Those from Western Africa in particular were likely to not be found in 2001 (36.9 per cent). LS members born in America were least likely to be found in 2001, but this group accounts for just 0.2 per cent of the entire number of LS members to be accounted for in 2001.

4.6 The effect of 1991 ethnic group on the percentage of LS members who were found in 1991 but not accounted for in 2001

Table 4.9 Percentage of traced[a] LS members found in 1991 but not accounted for in 2001, by ethnic group in 1991

1991 ethnic group	LS members found in 1991 and not recorded as having died or embarked by 2001: numbers	LS members found in 1991 and not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001	Not found in 2001: percentage distribution	Found in 2001: percentage distribution
White	**442,754**	**92.8**	**11.1**	**84.1**	**94.0**
Non-white	**34,483**	**7.2**	**27.0**	**15.9**	**6.0**
Black Caribbean	4,941	1.0	**30.9**	2.6	0.8
Black African	2,102	0.4	**40.6**	1.5	0.3
Black Other	1,714	0.4	**27.6**	0.8	0.3
Indian	10,841	2.3	**19.7**	3.7	2.1
Pakistani	5,999	1.3	**27.4**	2.8	1.0
Bangladeshi	2,378	0.5	**29.8**	1.2	0.4
Chinese	1,640	0.3	**30.7**	0.9	0.3
Other Asian	2,035	0.4	**33.3**	1.2	0.3
Other	2,833	0.6	**27.1**	1.3	0.5
All ethnic groups	**477,237**	**100.0**	**12.2**	**100.0**	**100.0**

The 1991 Census asked people to describe their ethnic group, and these answers are coded into ten ethnic groups for analysis. The percentages of LS members present in 1991 in each of the ethnic groups who were not found in 2001 are shown in Table 4.9. Linkage failure was higher among minority ethnic groups (27.0 per cent not found) than among white people (11.1 per cent not found). Black Africans in particular were least likely to be found in 2001 (40.6 per cent not found). This group was characterised as the most transient in 1991, largely comprising people coming to the UK for study (Peach, 1996). However, even among people

describing themselves as Black Other, which is considered to largely comprise British-born children of first-generation migrants, 27.6 per cent were not found in 2001. The non-white group most likely to be found in 2001 was Indian, with 19.7 per cent not found. Among LS members found in 2001, 6.0 per cent were in minority ethnic groups, compared to15.9 per cent of those not found.

In every ethnic group males were less likely to be found than females (Table 4.10). The sex difference is greatest among Black Caribbeans, among whom 35.5 per cent of males and 27.0 per cent of females were not found in 2001. The smallest difference was among Indian people, with 19.8 per cent of males and 19.7 per cent of females not found in 2001.

Table 4.10 Percentage of traced[a] LS members found in 1991 but not accounted for in 2001, by ethnic group and sex

Ethnic group in 1991	Males			Females			Sex ratio (M/F)
	LS members found in 1991 and not recorded as having died or embarked by 2001	LS members found in 1991 and not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001	LS members found in 1991 and not recorded as having died or embarked by 2001	LS members found in 1991 and not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001	
White	214,178	92.6	**12.6**	228,576	92.9	**9.6**	1.3
Non-white	17,143	7.4	**28.8**	17,340	7.1	**25.2**	1.1
Black Caribbean	2,300	1.0	**35.5**	2,641	1.1	**27.0**	1.3
Black African	1,041	0.5	**45.1**	1,061	0.4	**36.2**	1.2
Black Other	823	0.4	**30.1**	891	0.4	**25.3**	1.2
Indian	5,445	2.4	**19.8**	5,396	2.2	**19.7**	1.0
Pakistani	3,147	1.4	**29.0**	2,852	1.2	**25.6**	1.1
Bangladeshi	1,156	0.5	**32.7**	1,222	0.5	**27.0**	1.2
Chinese	836	0.4	**31.5**	804	0.3	**29.9**	1.1
Other Asian	980	0.4	**35.6**	1,055	0.4	**31.2**	1.1
Other	1,415	0.6	**29.3**	1,418	0.6	**24.8**	1.2
All ethnic groups	231,321	100.0	**13.8**	245,916	100.0	**10.7**	1.3

Note
a 'Traced' means the LS member's record has been found on CHRIS (the NHSCR computer system) before or during the 2001 Census Link.

4.7 The effect of tenure in 1991 on the percentage of LS members who were found in 1991 but not accounted for in 2001

Table 4.7 showed that more than a quarter (29.3 per cent) of LS members who were living in communal establishments in 1991 were not found in 2001. Table 4.11 repeats linkage rates for this group and for visitors, but also shows variations by tenure for those resident in households. Those who were renting privately in 1991 were least likely to be found in 2001

(22.2 per cent not found). Owner-occupiers were most likely to be found in 2001 (9.9 per cent not found), whilst 16.3 per cent of LS members living in social housing in 1991 were not found in 2001.

Table 4.11 Percentage of traced[a] LS members found in 1991 but not accounted for in 2001, by tenure in 1991

1991 tenure	LS members found in 1991 and not recorded as having died or embarked by 2001: numbers	LS members found in 1991 and not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001	Not found in 2001: percentage distribution	Found in 2001: percentage distribution
Visitor to a household or communal establishment	10,119	2.1	**18.6**	3.2	2.0
Living in a communal establishment	3,623	0.8	**29.3**	1.8	0.6
Owner occupier	338,659	71.0	**9.9**	57.6	72.8
Living in social housing	99,739	20.9	**16.3**	27.8	19.9
Renting privately	25,097	5.3	**22.2**	9.6	4.7
Total	477,237	100.0	**12.2**	100.0	100.0

Note
a 'Traced' means the LS member's record has been found on CHRIS (the NHSCR computer system) before or during the 2001 Census Link.

4.8 The effect of highest qualifications held in 1991 on the percentage of LS members who were found in 1991 but not accounted for in 2001

The 1991 Census asked about qualifications gained after the age of 18. Table 4.12 shows that qualifications obtained by 1991 had some impact on whether LS members found in 1991 were found again in 2001. Those with degrees and diplomas were more likely to be found in 2001 than those without (11.1 per cent, 8.5 per cent and 12.5 per cent not found, respectively). LS members with higher degrees were most likely not to be found (13.3 per cent). Plausibly the highly qualified have more opportunity for out-migration than those less qualified, and could appear as missing in the absence of embarkation notification from NHSCR. The quality of LS embarkations data is discussed more fully in Section 6 below.

Table 4.12 Percentage of traced[a] LS members found in 1991 but not accounted for in 2001, by highest qualifications in 1991					
1991 highest qualifications	LS members found in 1991 and not known to have having died or embarked by 2001: numbers	LS members found in 1991 and not known to have having died or embarked by 2001: percentage distribution	% not found in 2001	Not found in 2001: percentage distribution	Found in 2001: percentage distribution
No degrees, professional or vocational qualifications	427,600	89.6	**12.5**	91.4	89.3
Diploma-level qualification	22,876	4.8	**8.5**	3.3	5.0
Degree-level qualification	23,217	4.9	**11.1**	4.4	4.9
Higher degree	3,544	0.7	**13.3**	0.8	0.7
Total	477,237	100.0	**12.2**	100.0	100.0

Notes
This table refers only to qualifications gained after the age of 18.
a 'Traced' means the LS member's record has been found on CHRIS (the NHSCR computer system) before or during the 2001 Census Link.

4.9 The effect of economic position in 1991 on the percentage of LS members who were found in 1991 but not accounted for in 2001

LS members' economic position in 1991 influences their likelihood of being found in 2001, as illustrated by Table 4.13. LS members who were in employment or retired in 1991 were more likely to be found in 2001 than those in other economic positions. Among 1991 full-timers, 11.0 per cent of males and 9.7 per cent of females were not found in 2001. Female part-timers were more likely to be found than female full-timers (6.4 per cent not found compared to 9.7 per cent), while male part-timers were less likely to be found (14.0 per cent not found) than male full-timers (11.0 per cent).

Linkage failure was high among those waiting to start jobs (25.8 per cent of males and 17.8 per cent of females not found), the unemployed (24.8 per cent of males and 16.6 per cent of females not found) and LS members on government schemes (21.8 per cent of males and 14.4 per cent of females not found). All three statuses are transitory ones, leading to changed circumstances, which may help to explain the high linkage failure found in these groups. Their likelihood of embarkation relative to those in other economic positions is not known.

Among the economically inactive, people who were retired in 1991 were most likely to be found in 2001. Only 8.8 per cent of male retirees and 9.2 per cent of female retirees were not found. In contrast to female home-makers, among whom only 9.9 per cent were not found in 2001, male home-makers had high linkage failure rates (19.7 per cent not found). Students also had high linkage failure rates (25.8 per cent of males and 18.6 per cent of females not found).

Table 4.13 Percentage of traced[a] LS members found in 1991 but not accounted for in 2001, by economic position in 1991 and sex						
1991 economic position	Males			Females		
	LS members found in 1991 and not recorded as having died or embarked by 2001: numbers	LS members found in 1991 and not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001	LS members found in 1991 and not recorded as having died or embarked by 2001: numbers	LS members found in 1991 and not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001
Economically active						
Full-time employed	99,208	56.1	**11.0**	56,480	29.2	**9.7**
Part-time employed	3,230	1.8	**14.0**	35,484	18.3	**6.4**
Employer	7,336	4.1	**11.5**	2,463	1.3	**10.1**
Self-employed	15,312	8.7	**12.6**	4,441	2.3	**9.9**
On a government scheme	2,038	1.2	**21.8**	1,288	0.7	**14.4**
Waiting to start a job	430	0.2	**25.8**	360	0.2	**17.8**
Unemployed	15,026	8.5	**24.8**	6,827	3.5	**16.6**
Economically inactive						
Student	8,817	5.0	**25.8**	9,122	4.7	**18.6**
Sick	7,194	4.1	**12.7**	5,376	2.8	**11.8**
Retired	16,770	9.5	**8.8**	26,795	13.8	**9.2**
Home-maker	1,056	0.6	**19.7**	44,613	23.0	**9.9**
Other	433	0.2	**39.0**	349	0.2	**26.6**
All economic positions	176,850	100.0	**18.1**	193,598	100.0	**13.6**

Notes
This table does not include 54,471 males and 52,318 females who were under 16 or for whom we have missing information.
a 'Traced' means the LS member's record has been found on CHRIS (the NHSCR computer system) before or during the 2001 Census Link.

4.10 The effect of social class in 1991 on the percentage of LS members who were found in 1991 but not accounted for in 2001

There were contrasting patterns of linkage failure by social class for men and women (Table 4.14). For men, linkage failure is higher at the bottom of the social classification, with 16.6 per cent of males in unskilled occupations in 1991 not found in 2001. It is lowest among those in the managerial and technical class (10.3 per cent not found) and in the professional class (10.5 per cent not found). In contrast, linkage failure is at its highest among professional women, at 11.6 per cent. It is lowest among women in skilled non-manual occupations, at 8.0 per cent, but is also low among the unskilled, at 8.2 per cent.

Table 4.14 also shows that 21.8 per cent of males and 14.0 per cent of females in the armed forces in 1991 were not found in 2001, a pattern which is also found for 1990s births to parents in the armed forces. The nature of the work implies that many of these LS members could have been posted abroad but are not counted as emigrants in the LS without embarkation notifications from NHSCR, discussed more fully in Section 6 below.

Table 4.14 Percentage of traced[a] LS members found in 1991 but not accounted for in 2001, by social class in 1991 and sex						
1991 social class	Males			Females		
	LS members found in 1991 and not recorded as having died or embarked by 2001: numbers	LS members found in 1991 and not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001	LS members found in 1991 and not recorded as having died or embarked by 2001: numbers	LS members found in 1991 and not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001
I Professional	10,088	6.5	**10.5**	2,294	1.7	**11.6**
II Managerial & Technical	42,281	27.3	**10.3**	34,739	25.3	**9.5**
IIIN Skilled Non-manual	17,659	11.4	**11.7**	53,455	39.0	**8.0**
IIIM Skilled Manual	50,030	32.3	**12.1**	10,306	7.5	**9.3**
IV Partly-Skilled	24,879	16.0	**13.9**	25,121	18.3	**9.3**
V Unskilled	8,363	5.4	**16.6**	10,261	7.5	**8.2**
Armed Forces	1,759	1.1	**21.8**	1,033	0.8	**14.0**
All social classes	155,059	100.0	**12.3**	137,209	100.0	**8.9**

Notes
This table does not include 76,262 males and 109,564 females for whom we have missing or inadequately described information.
a 'Traced' means the LS member's record has been found on CHRIS (the NHSCR computer system) before or during the 2001 Census Link.

4.11 High linkage failure London boroughs: comparisons with the England and Wales average

Section 4.2 above found that there was wide geographical variation in linkage failure rates in 2001. This section compares some of the key characteristics of LS members in 11 London boroughs with linkage failure rates of over 25 per cent with those in England and Wales as a whole. The 11 London boroughs, which we group together for analysis, are: Westminster, Kensington and Chelsea, Hackney, Islington, Camden, Hammersmith and Fulham, Brent, Tower Hamlets, Lambeth, Haringey and Southwark.

4.11.1 Linkage rates by age and sex in England and Wales and in the 11 London boroughs with linkage failure rates of over 25 per cent

Table 4.15 shows the distributions of males and females in five-year age bands within England and Wales and within the 'high linkage failure' London boroughs. Comparing the percentage distributions in the London boroughs and in England and Wales reveals that LS members in the latter had different age distributions, particularly in the 'high risk' (of linkage failure) groups aged 20-45. LS members recorded as having died or embarked are not included in the table. Among males in the London boroughs in 1991, 32.1 per cent of those not found were aged 30-44 in 2001, compared to 25.3 per cent in England and Wales as a whole. Among females, 32.7 per cent of those not found were aged 30-44 in 2001, compared to 24.5 per cent in England and Wales as a whole. Among males in the London boroughs, 12.2 per cent of those not found were aged 20-29, compared to 14.7% in England and Wales. Among females, 11.1 per cent of those not found in the selected London boroughs were aged 20-29, compared to 13.3 per cent in England and Wales. The substantial differences between London and England and Wales can be interpreted in terms of all the explanatory factors that contribute to linkage failure converging in the London boroughs.

Table 4.15 Percentage of traced[a] LS members not accounted for in 2001 in England and Wales and in the London boroughs with linkage failure rates of over 25 per cent[b], by age and sex							
Sex	Age in 2001	England and Wales			Highest linkage failure London boroughs[b]		
		LS members found in 1991 and not recorded as having died or embarked by 2001: numbers	LS members found in 1991 and not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001	LS members found in 1991 and not recorded as having died or embarked by 2001: numbers	LS members found in 1991 and not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001
Male	10-14	17,955	7.8	**11.6**	686	7.8	**28.9**
	15-19	17,043	7.4	**12.9**	582	6.6	**28.0**
	20-24	16,390	7.1	**21.2**	533	6.1	**39.8**
	25-29	17,556	7.6	**24.1**	538	6.1	**42.8**
	30-34	18,989	8.2	**21.5**	850	9.7	**41.4**
	35-39	20,230	8.7	**16.5**	1,036	11.8	**33.9**
	40-44	19,192	8.3	**14.7**	930	10.6	**33.4**
	45-49	17,613	7.6	**12.1**	647	7.4	**27.7**
	50-54	18,820	8.1	**9.9**	560	6.4	**25.9**
	55-59	15,823	6.8	**9.1**	536	6.1	**25.7**
	60-64	13,653	5.9	**8.8**	504	5.7	**24.0**
	65-69	12,082	5.2	**7.5**	451	5.1	**23.1**
	70-74	10,399	4.5	**7.6**	377	4.3	**28.9**
	75-79	7,939	3.4	**7.4**	279	3.2	**22.2**
	80+	7,637	3.3	**5.2**	272	3.1	**12.1**
	All ages	231,321	100.0	**13.8**	8,781	100.0	**31.2**
Female	10-14	17,424	7.1	**12.0**	665	6.9	**29.3**
	15-19	16,261	6.6	**12.7**	589	6.1	**26.1**
	20-24	15,608	6.3	**16.5**	499	5.2	**34.1**
	25-29	17,107	7.0	**16.0**	571	5.9	**33.8**
	30-34	19,711	8.0	**13.9**	992	10.3	**35.3**
	35-39	21,173	8.6	**11.7**	1,230	12.8	**29.8**
	40-44	19,418	7.9	**9.9**	916	9.5	**25.9**
	45-49	17,759	7.2	**9.1**	662	6.9	**23.1**
	50-54	19,523	7.9	**7.8**	668	7.0	**21.3**
	55-59	16,068	6.5	**7.7**	570	5.9	**22.6**
	60-64	13,874	5.6	**7.7**	484	5.0	**24.0**
	65-69	12,843	5.2	**6.8**	443	4.6	**21.0**
	70-74	12,122	4.9	**6.9**	436	4.5	**16.7**
	75-79	11,075	4.5	**7.5**	347	3.6	**17.6**
	80+	15,950	6.5	**4.7**	532	5.5	**22.2**
	All ages	245,916	100.0	**10.7**	9,604	100.0	**26.6**

Notes

a 'Traced' means the LS member's record has been found on CHRIS (the NHSCR computer system) before or during the 2001 Census Link.

b These are the London boroughs of Westminster, Kensington and Chelsea, Hackney, Islington, Camden, Hammersmith and Fulham, Brent, Tower Hamlets, Lambeth, Haringey and Southwark.

Linkage failure rates across all age groups were substantially higher in the London boroughs than the England and Wales average, at 31.2 per cent compared to 13.8 per cent for males and 26.6 per cent compared to 10.7 per cent for females. Linkage failure rates are at their highest

level, of around 20 per cent, among 20-45 year olds in England and Wales. In the London boroughs described here, linkage failure typically exceeds 20 per cent in every age group except the over-80s. Linkage failure peaks in the 20-44 year age groups in the selected London boroughs, as in England and Wales as a whole, but at much higher levels. In these London boroughs 42.8 per cent of 25-29 year-old men and 35.3 per cent of 30-34 year-old women were not found. In the older age groups, linkage failure in the selected London boroughs is more than three times higher than the England and Wales average. For example, among 65-69 year-old men, 23.1 per cent were not found in the London boroughs compared to 7.5 per cent in England and Wales as a whole. Corresponding percentages for women were 21.0 per cent and 5.2 per cent, respectively.

4.11.2 Linkage rates by household circumstances in England and Wales and in the 11 London boroughs with linkage failure rates of over 25 per cent

Section 4.4 found that 1991 to 2001 linkage rates varied significantly depending on the LS member's household circumstances in 1991. These findings are repeated in Table 4.16 and compared with corresponding information for the selected London boroughs. The column percentages show that LS members living in these London boroughs tended in 1991 to have different household circumstances to the average for England and Wales. In the London boroughs, 33.1 per cent were adults living alone in 1991, compared to 21.6 per cent in England and Wales. There were fewer married couples without children (16.0 per cent compared to 24.3 per cent). There were fewer married adults living with their spouse and dependent child(ren) (15.0 per cent compared to 20.1 per cent). In the London boroughs, 14.4 per cent of LS members were dependent children living with two parents in 1991, compared to 19.7 per cent in England and Wales. In the London boroughs, 7.0 per cent of LS members were dependent children with lone parents, compared to 3.9 per cent in England and Wales as whole. Although relatively few LS members lived in communal establishments, in these London boroughs there were more than twice as many in 1991 as the average for England and Wales (2.0 per cent compared to 0.8 per cent).

Thus, London boroughs contained more LS members in those types of household circumstances that were typically associated with high rates of linkage failure nationally. This contributed to higher linkage failure in these areas. However, linkage failure for each of these groups was also substantially higher in the London boroughs than the England and Wales average. In the London boroughs, twice as many adults living alone in 1991 were not found in 2001 compared to the England and Wales average (30.6 per cent and 15.5 per cent, respectively). The percentage of married LS members with no children in 1991 who were not found in 2001 was three times higher in the London boroughs than in England and Wales (22.4 per cent compared to 7.5 per cent). Among cohabitees with no children, 31.8 per cent in the London boroughs were not found in 2001 compared to 12.6 per cent in England and Wales.

Among dependent children, living in London in 1991 had a substantial impact on their chances of being found in 2001, especially if they were living with both parents. In England and Wales, 13.3 per cent of dependent children living with both parents in 1991 were not found in 2001. In the London boroughs, this rises to 28.4 per cent. While the overall (England and Wales) linkage failure rate for children living with a single parent in 1991 was 22.7 per cent, in the London boroughs this rises to 37.7 per cent. Figure 4.3 illustrates the increase in linkage failure in the selected London boroughs.

Table 4.16 Percentage of traced[a] LS members not accounted for in 2001 in England and Wales and in the London boroughs with linkage failure rates of over 25 per cent[b], by household circumstances

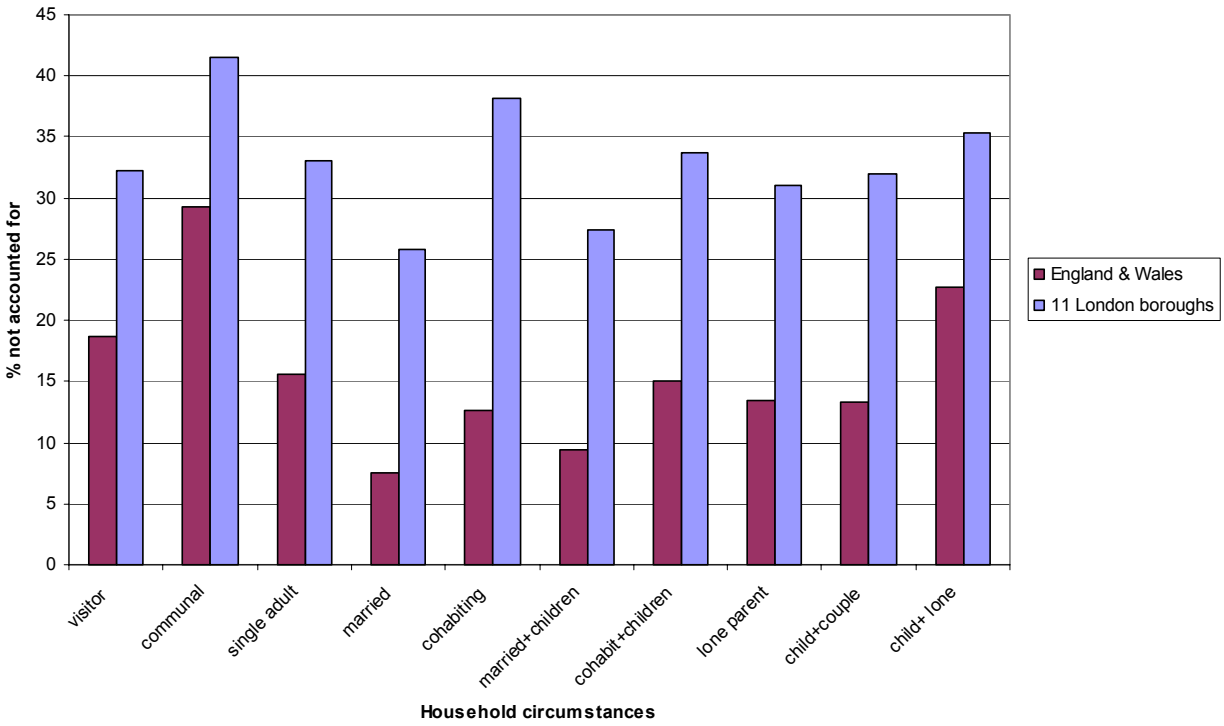
1991 household circumstances	England and Wales			Highest linkage failure London boroughs[b]		
	LS members found in 1991 and not recorded as having died or embarked by 2001: numbers	LS members found in 1991 and not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001	LS members found in 1991 and not recorded as having died or embarked by 2001: numbers	LS members found in 1991 and not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001
Visitor to a household or communal establishment	10,119	2.1	**18.6**	513	2.8	**29.8**
Living in a communal establishment	3,623	0.8	**29.3**	359	2.0	**43.5**
Adult living alone	103,031	21.6	**15.5**	6,044	33.1	**30.6**
Married couple, no children	115,654	24.3	**7.5**	2,912	16.0	**22.4**
Cohabiting couple, no children	14,642	3.1	**12.6**	710	3.9	**31.8**
Married adult living with spouse and dependent child(ren)	96,140	20.1	**9.4**	2,743	15.0	**24.0**
Cohabiting adult living with partner and child(ren)	7,386	1.5	**15.0**	266	1.5	**31.6**
Lone parent	11,939	2.5	**13.4**	795	4.4	**31.2**
Dependent child living with two parents	94,055	19.7	**13.3**	2,631	14.4	**28.4**
Dependent child living with a single parent	18,837	3.9	**22.7**	1,277	7.0	**37.7**
Total	475,426	100.0	**12.3**	18,250	100.0	**29.0**

Notes

a 'Traced' means the LS member's record has been found on CHRIS (the NHSCR computer system) before or during the 2001 Census Link.

b These are the London boroughs of Westminster, Kensington and Chelsea, Hackney, Islington, Camden, Hammersmith and Fulham, Brent, Tower Hamlets, Lambeth, Haringey and Southwark. This table does not include 135 LS members for whom we have no information on household circumstances.

Figure 4.3 Percentage of LS members found in 1991 but not accounted for in 2001, by household circumstances



4.11.3 Linkage rates by ethnic group in England and Wales and in the 11 London boroughs with linkage failure rates of over 25 per cent

Section 4.6 described how LS-2001 Census linkage rates varied by ethnic group. Table 4.17 compares the ethnic composition of England and Wales as a whole with that of the 11 selected London boroughs, also reporting respective linkage failure rates. In the London boroughs, 30.9 per cent of males and 31.9 per cent of females were in minority ethnic groups, compared to 7.4 per cent of males and 7.1 per cent of females in the whole of England and Wales. White LS members found in 1991 were much more likely to be found in 2001 than LS members in ethnic minorities. Overall, 12.6 per cent of white males and 9.6 per cent of white females were not found in 2001. This compares to failure rates for England and Wales of 28.8 per cent among ethnic minority males and 25.2 per cent among ethnic minority females. In the London boroughs, linkage failure for white people is much higher than the England and Wales average, at 28.2 per cent for males (compared to 12.6 per cent in England and Wales) and 23.9 per cent for white females (compared to 9.6 per cent in England and Wales). Linkage failure for ethnic minorities, already much higher than for whites at the national level, is higher still in the London boroughs, at 38.0 per cent for males and 32.3 for females (compared to 28.8 and 25.2 per cent for males and females, respectively, in England and Wales). Thus, the difference in linkage failure rates between whites and non-whites is much smaller in the London boroughs, where linkage failure appears to be universally high.

Linkage rates for non-whites combine ethnic variations. For example, while linkage failure was typically higher in the London boroughs than across England and Wales for women and men in all ethnic groups, for Bangladeshi males it was lower.

Table 4.17 Percentage of traced[a] LS members not accounted for in 2001 in England and Wales and in the London boroughs with linkage failure rates of over 25 per cent[b], by ethnic group and sex

Sex	1991 ethnic group	England and Wales			Highest linkage failure London boroughs[b]		
		LS members found in 1991 and not recorded as having died or embarked by 2001: numbers	LS members found in 1991 and not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001	LS members found in 1991 and not recorded as having died or embarked by 2001: numbers	LS members found in 1991 and not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001
Male	White	214,178	92.6	**12.6**	6,065	69.1	**28.2**
	Non-white	17,143	7.4	**28.8**	2,716	30.9	**38.0**
	Black Caribbean	2,300	1.0	**35.5**	602	6.9	**46.0**
	Black African	1,041	0.5	**45.1**	392	4.5	**45.7**
	Black Other	823	0.4	**30.1**	163	1.9	**35.6**
	Indian	5,445	2.4	**19.8**	451	5.1	**23.9**
	Pakistani	3,147	1.4	**29.0**	106	1.2	**37.7**
	Bangladeshi	1,156	0.5	**32.7**	421	4.8	**31.1**
	Chinese	836	0.4	**31.5**	143	1.6	**35.0**
	Other Asian	980	0.4	**35.6**	202	2.3	**41.6**
	Other	1,415	0.6	**29.3**	236	2.7	**44.1**
	All ethnic groups	231,321	100.0	**13.8**	8,781	100.0	**31.2**
Female	White	228,576	92.9	**9.6**	6,544	68.1	**23.9**
	Non-white	17,340	7.1	**25.2**	3,060	31.9	**32.3**
	Black Caribbean	2,641	1.1	**27.0**	788	8.2	**31.6**
	Black African	1,061	0.4	**36.2**	427	4.4	**38.9**
	Black Other	891	0.4	**25.3**	215	2.2	**36.3**
	Indian	5,396	2.2	**19.7**	453	4.7	**26.7**
	Pakistani	2,852	1.2	**25.6**	112	1.2	**30.4**
	Bangladeshi	1,222	0.5	**27.0**	459	4.8	**28.5**
	Chinese	804	0.3	**29.9**	115	1.2	**33.0**
	Other Asian	1,055	0.4	**31.2**	227	2.4	**34.8**
	Other	1,418	0.6	**24.8**	264	2.7	**34.8**
	All ethnic groups	245,916	100.0	**10.7**	9,604	100.0	**26.6**

Notes

a 'Traced' means the LS member's record has been found on CHRIS (the NHSCR computer system) before or during the 2001 Census Link.

b These are the London boroughs of Westminster, Kensington and Chelsea, Hackney, Islington, Camden, Hammersmith and Fulham, Brent, Tower Hamlets, Lambeth, Haringey and Southwark.

5. Children born in the 1990s who could not be accounted for in the 2001 Census sample

5.1 Linkage of LS members who were born over the 1990s

The LS is notified of all births occurring on LS dates and the quality of these data is known to be very good, with around 100 per cent of all births occurring on LS dates entering the study (see Tables 7.1a and 7.1b, p110 of Hattersley and Creeser, 1995). The percentage of the previous decade's new births that was not found in 2001 was higher than in previous censuses, at 14.3 per cent compared to 8.7 per cent and 7.2 per cent in 1991 and 1981, respectively (Table 3.1).

5.2 Geographic variation in the linkage of 1990s births

Table 5.1 Percentage of LS members born between the 1991 Census and up to the end of 1995 who were not accounted for in 2001, by their mother's county of usual residence at the time of the birth

County	LS members found in 1991 and not recorded as having died or embarked by 2001	Percentage not found in 2001	County	LS members found in 1991 and not recorded as having died or embarked by 2001	Percentage not found in 2001
Greater London	5,304	24.0	Clwyd	251	11.2
Greater Manchester	1,807	16.7	Surrey	656	11.1
South Glamorgan	311	16.1	Isle of Wight	72	11.1
Merseyside	969	15.9	Kent	979	11.0
Buckinghamshire	462	14.9	Warwickshire	311	10.9
Tyne and Wear	711	14.5	Gwynedd	130	10.8
West Midlands	1,969	14.0	Essex	1,037	10.7
East Sussex	426	13.6	Mid-Glamorgan	379	10.6
Bedfordshire	407	13.5	Dorset	363	10.5
West Sussex	407	13.5	West Glamorgan	214	10.3
West Yorkshire	1,443	13.3	Cornwall (and Isle of Scilly)	253	10.3
Suffolk	415	12.8	Northumberland	179	10.1
Lancashire	931	12.7	Norfolk	457	9.8
Leicestershire	571	12.6	Durham	376	9.8
Northamptonshire	387	12.4	Dyfed	205	9.8
Oxfordshire	396	12.4	Gwent	330	9.7
Powys	74	12.2	Staffordshire	667	9.4
Avon	681	12.0	Cleveland	357	9.2
Nottinghamshire	681	11.7	Humberside	570	8.6
South Yorkshire	882	11.7	Devon	595	8.6
Berkshire	542	11.6	Wiltshire	413	8.5
Shropshire	250	11.6	Cumbria	291	8.2
North Yorkshire	425	11.5	Lincolnshire	328	8.2
Derbyshire	590	11.5	Hampshire	1,030	8.1
Cambridgeshire	426	11.5	Gloucestershire	338	7.4
Hertfordshire	713	11.2	Somerset	306	5.9
Cheshire	617	11.2	Hereford and Worcester	435	5.7
			All counties	34,319	13.7

Note

This table does not include three LS members for whom we have missing or inadequately described county information. Only births between 1991 Census and the end of 1995 are included.

Linkage rates for new births, as for LS members found in 1991, vary geographically, as shown in Table 5.1. This Table only refers to post-1991 Census, pre-1996 births, after which date local government reorganisation led to discontinuities in geographical data. In Greater London the percentage of births not found in 2001 is much higher, at 24 per cent, than in the rest of England and Wales. The second highest county is Greater Manchester, where 16.7 per cent of pre-1996 births were not found in 2001.

Table 5.2 focuses on boroughs within Greater London. As for LS members found in 1991 but not in 2001, the borough with the highest percentage of pre-1996 births not found in 2001 was Westminster, at 51.4 per cent. Linkage failure rates are higher in Inner London, and only below the England and Wales average of 13.7 per cent (Table 5.1) in the outer London boroughs of Sutton, Richmond Upon Thames, Hillingdon, Bexley and Havering. A listing of linkage failure rates for pre-1996 LS births in each local authority in England and Wales is in Appendix 2.

Table 5.2 Percentage of LS members born between the 1991 Census and up to the end of 1995 who were not accounted for in 2001, by their mother's London borough of usual residence at the time of the birth

London borough	LS members found in 1991 and not recorded as having died or embarked by 2001	Percentage not found in 2001	London borough	LS members found in 1991 and not recorded as having died or embarked by 2001	Percentage not found in 2001
Greater London	5,304	24.0			
London borough					
Westminster	109	51.4	Newham	234	23.1
Kensington and Chelsea	77	44.2	Lewisham	206	22.8
Hammersmith and Fulham	118	38.1	Greenwich	178	22.5
Hackney	181	35.9	Barnet	204	22.1
Lambeth	191	33.0	Croydon	241	20.7
Haringey	187	32.1	Merton	134	19.4
Camden	121	30.6	Harrow	152	19.1
Tower Hamlets	185	29.7	Kingston Upon Thames	75	17.3
Brent	206	29.6	Redbridge	162	16.0
Barking and Dagenham	112	25.9	Bromley	185	15.1
Southwark	202	25.2	Sutton	125	13.6
Ealing	229	24.9	Richmond Upon Thames	110	12.7
Hounslow	170	24.7	Hillingdon	186	12.4
Waltham Forest	217	24.0	Bexley	144	10.4
Enfield	203	23.6	Havering	128	10.2
Wandsworth	197	23.4	City of London	*	*
Islington	133	23.3			

Notes

This table does not include three LS members for whom we have missing or inadequately described county information. Only births between 1991 Census and the end of 1995 are included.

* Small numbers, excluded from Table.

5.3 Variations in the linkage of 1990s births by parents' age at the birth

As with other LS members, non-linkage of births can occur for a number of reasons, including the possibility that the child is no longer in England and Wales. They will be 'missing' at Census if NHSCR has not been notified of an embarkation. However, further analysis revealed no consistent relationship between linkage rates and year of birth, nor was there any consistent difference in linkage rates between males and females. However, their chances of being found do depend on the age of their parents. Table 5.3 shows that babies born to mothers at both ends of the age range at the time of the child's birth were less likely to be found at census than those born to mothers aged 25-39. This table and those that follow only include births up to the end of 2000: at the time of extracting these data, 2001 births had not been added to the LS database so, although we know how many there were, we did not have the more detailed information required for this analysis. Linkage failure is highest for births where the mother is under 20, with 21.7 per cent not found at Census. The lowest linkage failure rate is for births to mothers in their thirties, after which age linkage failure rates rise again, to 14.1 per cent for mothers over 40 years.

Table 5.3 also shows the outcome of these different linkage rates. Columns 5 and 6 show the ages (at the baby's birth) of mothers whose children were found and not found in 2001. Children who were not found in 2001 were more likely to have been born to mothers aged under 24 (35.2 per cent) than those who were found (25.8 per cent).

Table 5.3 1990s births not accounted for in 2001, by mother's age

Mother's age at the child's birth	1990s births not recorded as having died or embarked by 2001: numbers	1990s births not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001	1990s births not found in 2001: percentage distribution	1990s births found in 2001: percentage distribution
Under 20	4,880	7.2	**21.7**	10.9	6.5
20-24	13,602	20.0	**17.3**	24.3	19.3
25-29	22,341	32.8	**13.7**	31.5	33.0
30-34	18,731	27.5	**11.5**	22.2	28.4
35-39	7,242	10.6	**12.4**	9.2	10.9
Over 40	1,268	1.9	**14.1**	1.8	1.9
All ages	68,064	100.0	**14.2**	100.0	100.0

Note
This table includes 1990s births up to the end of 2000: births occurring in 2001 before Census day are not included.

The same pattern is found between linkage failure for births and father's age (Table 5.4), except that children not found in 2001 were more likely to have been born to fathers under 29 or over 50 than those who were found. The overall non-linkage rate in Table 5.4, at 13.5 per cent, is lower than in Table 5.3, at 14.2 per cent. This is because Table 5.4 excludes births registered by the mother alone, since father's age information is taken from the birth registration process. Marital status, presence and co-residence of the child's father also emerged as important influences on linkage rates, as we now show.

Table 5.4 1990s births not accounted for in 2001, by father's age					
Father's age at the child's birth	1990s births not recorded as having died or embarked by 2001: numbers	1990s births not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001	1990s births not found in 2001: percentage distribution	1990s births found in 2001: percentage distribution
Under 20	1,178	1.9	**20.5**	2.8	1.7
20-24	7,556	12.0	**17.6**	15.6	11.5
25-29	17,897	28.5	**13.6**	28.6	28.4
30-34	19,899	31.7	**12.0**	28.1	32.2
35-39	10,731	17.1	**12.5**	15.7	17.3
40-44	3,819	6.1	**13.6**	6.1	6.1
45-49	1,180	1.9	**13.6**	1.9	1.9
Over 50	612	1.0	**15.8**	1.1	0.9
All ages	62,872	100.0	**13.5**	100.0	100.0

Notes
This table includes 1990s births up to the end of 2000: births occurring before Census day 2001 are not included
a 5,192 births registered by the mother alone during the 1990s are not included (as father's age is taken from the registration form).

5.4 Variations in the linkage of 1990s births by registration type

Table 5.5 1990s births not accounted for in 2001, by registration type					
Registration type	1990s births not recorded as having died or embarked by 2001: numbers	1990s births not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001	1990s births not found in 2001: percentage distribution	1990s births found in 2001: percentage distribution
Married parents	44,424	65.3	**12.5**	57.4	66.6
Joint registration, both parents at the same address	13,822	20.3	**15.0**	21.3	20.1
Joint registration, parents at different addresses	4,626	6.8	**19.1**	9.1	6.4
Sole registration	5,192	7.6	**22.7**	12.2	6.9
All statuses	68,064	100.0	**14.2**	100.0	100.0

Note
This table includes 1990s births up to the end of 2000: births occurring in 2001 before Census day are not included.

Sole registered births were least likely to be found in 2001 (22.7 per cent not found). Births registered to two parents living at different addresses were more likely to be found than sole registrations (19.1 per cent compared to 22.7 per cent not found). Among births registered to co-residing but unmarried parents, 15.0 per cent were not found at Census. Children

registered to married parents were most likely to have been found (12.5 per cent not found). Columns 5 and 6 of table 5.5 show that, among children born in the 1990s, both those found and not found in 2001 were most likely to have been registered to married parents. However, those not found were almost twice as likely as those found to have been sole registrations (12.2 compared to 6.9 per cent).

5.5 The combined effects of age and registration type on linkage rates

To some extent the high linkage failure of children registered to unmarried parents is explained by the age profile of their mothers: unmarried mothers are typically younger than married mothers, as shown in Table 5.6. Of babies registered to married parents, 15.6 per cent had mothers who were under 25, compared to 42.4 per cent of babies registered to cohabitees, 56 per cent of babies registered jointly but to parents at different addresses and 58 per cent of sole registered babies. As table 5.3 showed, linkage failure is highest for children born to young mothers. Table 5.7 shows the combined effects of the mother's age and whom the birth was registered to on the chances that a 1990s birth was not found in 2001. Linkage failure was as likely among births registered to a married couple if the mother was under 19 as it was among many of the births registered to a lone mother. Among babies registered to two parents, linkage rates rise with mother's age up to the age of 39, after which linkage failure increases. There is no similar pattern among sole registrations, which have the highest linkage failure rates in all age groups.

Table 5.6 1990s births not recorded as having died or embarked by 2001, by registration type and the mother's age

Mother's age at child's birth	Type of birth registration									
	Married parents:		Joint, same address		Joint, different addresses		Sole		Total	
	No.	Age distn	No.	Age distn	No.	Age distn	No.	Age distn	No.	Age distn
Under 20	627	*1.4*	1,656	*12.0*	1,215	*26.3*	1,382	*26.6*	4,880	*7.2*
20-24	6,296	*14.2*	4,181	*30.2*	1,494	*32.3*	1,631	*31.4*	13,602	*20.0*
25-29	16,112	*36.3*	4,033	*29.2*	1,037	*22.4*	1,159	*22.3*	22,341	*32.8*
30-34	14,922	*33.6*	2,577	*18.6*	548	*11.8*	684	*13.2*	18,731	*27.5*
35-39	5,560	*12.5*	1,133	*8.2*	278	*6.0*	271	*5.2*	7,242	*10.6*
Over 40	907	*2.0*	242	*1.8*	54	*1.2*	65	*1.3*	1,268	*1.9*
All ages	44,424	*100.0*	13,822	*100.0*	4,626	*100.0*	5,192	*100.0*	68,064	*100.0*

Note
This table includes 1990s births up to the end of 2000: births occurring in 2001 before Census day are not included.

Table 5.7 The effects of the mother's age and registration type on the percentage of 1990s births not accounted for in 2001					
Mother's age at child's birth	Type of birth registration				
	Married parents	Joint, same address	Joint, different addresses	Sole	All types
Under 20	**24.6**	**20.0**	**19.9**	**24.0**	**21.7**
20-24	**17.2**	**15.2**	**19.1**	**21.4**	**17.3**
25-29	12.2	**14.5**	**20.4**	**24.7**	13.7
30-34	10.7	12.8	**17.5**	**19.4**	11.5
35-39	11.7	13.0	11.9	**23.6**	12.4
Over 40	12.2	**16.1**	**25.9**	**23.1**	14.1
All ages	12.5	**15.0**	**19.1**	**22.7**	14.2

Notes
Bold percentages are greater than the Table average of 14.2 per cent not found.
This table includes 1990s births up to the end of 2000: births occurring in 2001 before Census day are not included.

5.6 Variations in the linkage of 1990s births by parents' social class

Table 5.8 shows how the child's father's social class when the birth was registered affected their chances of being found in 2001. Social class is based on the usual occupation stated at registration. Linkage failure is lowest where the father was in skilled non-manual work (11.7 per cent not found) at the time of the birth and highest where the father was unskilled (16.1 per cent). Over a fifth (21.9 per cent) of births to fathers in the armed forces were not found at census.

Table 5.8 1990s births not accounted for in 2001, by father's social class					
Father's social class at the child's birth	1990s births not recorded as having died or embarked by 2001: numbers	1990s births not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001	1990s births not found in 2001: percentage distribution	1990s births found in 2001: percentage distribution
I Professional	4,708	7.7	**12.3**	7.3	7.8
II Managerial & Technical	16,065	26.4	**12.1**	24.4	26.7
IIIN Skilled non-manual	6,187	10.2	**11.7**	9.1	10.3
IIIM Skilled manual	20,883	34.3	**13.0**	34.3	34.3
IV Semi-skilled	8,590	14.1	**14.1**	15.2	14.0
V Unskilled	3,372	5.5	**16.1**	6.8	5.3
Armed forces	1,008	1.7	**21.9**	2.8	1.5
All social classes	60,813	100.0	**15.9**	100.0	100.0

Notes
This table includes 1990s births up to the end of 2000: births occurring in 2001 before Census day are not included. We have not included 5,192 sole registrations, 1,694 records where the father's occupation was not stated or 365 records where the father's occupation was inadequately described.

Table 5.9 1990s births not accounted for in 2001, by mother's social class					
Mother's social class at the child's birth	1990s births not recorded as having died or embarked by 2001: numbers	1990s births not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001	1990s births not found in 2001: percentage distribution	1990s births found in 2001: percentage distribution
I Professional	1,737	4.5	**13.2**	5.3	4.4
II Managerial & Technical	12,932	33.3	**10.8**	32.7	33.4
IIIN Skilled non-manual	14,872	38.3	**10.1**	35.1	38.7
IIIM Skilled manual	3,533	9.1	**11.4**	9.4	9.1
IV Semi-skilled	4,968	12.8	**12.6**	14.6	12.6
V Unskilled	704	1.8	**14.1**	2.3	1.8
Armed forces	68	0.2	**32.4**	0.5	0.1
All social classes	38,814	100.0	**11.0**	100.0	100.0

Notes
This table includes 1990s births up to the end of 2000: births occurring in 2001 before Census day are not included. We have not included 28,917 records where the mother's occupation was not stated, or 333 records where the mother's occupation was inadequately described.

Linkage failure was higher still among babies with mothers in the armed forces, with 32.4 per cent not found in 2001. Linkage failure was also high at both ends of the social classification, with 13.2 per cent of babies with mothers in the professional class and 14.1 per cent with mothers in the unskilled class not found in 2001. Linkage rates were highest where the mother was in the skilled non-manual class, with 10.1 per cent not found.

Linkage failure in 2001 for all traced LS members with a 1991 social class (shown in Table 4.14) was 12.3 and 8.9 per cent for males and females, respectively. Parents of children born in the 1990s had higher linkage failure rates than these (15.9 per cent for fathers and 11.0 per cent for mothers, in Tables 5.8 and 5.9). To some extent this is because linkage failure rates were higher in the prime childbearing age range, falling to lower levels among males over 50 and females over 40 (Table 4.1).

5.7 Variations in the linkage of 1990s births by parents' country of birth

Where in the 1990s births were to parents who themselves were born outside of England and Wales, the children were less likely to be found in 2001. More than a third (39.2 per cent) of 1990s births to mothers from the Irish Republic were not found in 2001 (Table 5.10). Among births to mothers from outside of England and Wales, Scotland and Ireland, 30.1 per cent were not found in 2001. These comprised over a quarter (25.6 per cent) of 1990s births not found in 2001, but only 9.9 per cent of those that were found. Births to mothers born in Scotland or Northern Ireland were less likely to be found in 2001 than if the mothers were born in England and Wales (20.2, 17.8 and 11.6 per cent not found, respectively).

Table 5.10 1990s births not accounted for in 2001, by mother's country of birth					
Mother's country of birth	1990s births not recorded as having died or embarked by 2001: numbers	1990s births not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001	1990s births not found in 2001: percentage distribution	1990s births found in 2001: percentage distribution
England and Wales	58,031	85.3	**11.6**	69.7	87.8
Scotland	987	1.5	**20.2**	2.1	1.3
Northern Ireland	264	0.4	**17.8**	0.5	0.4
Irish Republic[a]	530	0.8	**39.2**	2.1	0.6
Elsewhere[b]	8,252	12.1	**30.1**	25.6	9.9
All countries	68,064	100.0	**14.2**	100.0	100.0

Notes
This table includes 1990s births up to the end of 2000: births occurring in 2001 before Census day are not included.
a This row includes people giving an undefined 'Ireland' country of birth.
b 'Elsewhere' includes the Isle of Man and the Channel Islands in this table.

Similar patterns are found between linkage rates and father's country of birth, although failure rates for fathers were lower overall because sole registered births, which have high non-linkage rates, are not included in the figures for fathers (Table 5.11).

Table 5.11 1990s births not accounted for in 2001, by father's country of birth					
Father's country of birth	1990s births not recorded as having died or embarked by 2001: numbers	1990s births not recorded as having died or embarked by 2001: percentage distribution	% not found in 2001	1990s births not found in 2001: percentage distribution	1990s births found in 2001: percentage distribution
England and Wales	52,629	83.7	**10.8**	67.1	86.3
Scotland	1,116	1.8	**17.0**	2.2	1.7
Northern Ireland	296	0.5	**14.9**	0.5	0.5
Irish Republic[a]	499	0.8	**36.5**	2.1	0.6
Elsewhere[b]	8,332	13.3	**28.6**	28.0	10.9
All countries	62,872	100.0	**15.4**	100.0	100.0

Notes
This table includes 1990s births up to the end of 2000: births occurring in 2001 before Census day are not included. We have not included 5,192 births that were registered by lone mother.
a This row includes people giving an undefined 'Ireland' country of birth.
b 'Elsewhere' includes the Isle of Man and the Channel Islands in this table.

6. Immigrants and re-entrants to NHSCR in the 1990s who could not be accounted for in the 2001 Census sample

In this section findings for immigrants and re-entrants to NHSCR are combined for simplicity. Table 3.1 showed that in 2001 these two groups were far less likely to be found than either LS members found at the previous census or new births: 43.2 per cent of re-entrants and 66.0 per cent of immigrants were not found, compared to 12.2 per cent of those found in 1991 and 14.3 per cent of 1990s births. The number of re-entrants is too small (for example, only 406 not found in 2001) for separate analysis.

While 66 per cent of the previous decade's immigrants were not found in the 2001 Census, 61.8 per cent were not found in 1991 and 47.5 per cent in 1981. Not only were linkage rates for immigrants lower in 2001 relative to previous censuses, but the impact on overall linkage of LS members is compounded by the sharp increase in the number of immigrants in the 1990s compared to the previous decades (up from 31,255 in the 1970s and 22,957 in the 1980s to 45,908 in the 1990s). To some extent, the sharp increase in LS immigrants in the 1990s may be due to under-recording of immigration in the LS as recorded at NHSCR in the 1980s (see comparison with the International Passenger Survey in Appendix 3).

6.1 The effect of year of entry to NHSCR on linkage failure rates

One reason why immigrants may not have been linked at census is that they had in fact left the country, but their record at NHSCR was not updated because no embarkation notification was received. There are well-documented gaps in LS coverage of embarkation (see Hattersley and Creeser, 1995, 7.2.2 p121). Embarkation information comes from two sources. If people emigrating return their NHS registration cards to their Health Authorities, NHSCR is notified. Additionally, NHSCR used to be notified if any benefit claimants left the UK. In April 2002 the Benefits Agency stopped the supply of this information, though this analysis should not be affected by the change. Very few emigrants notify their GP or Health Authority if they are leaving the country permanently.

We would expect linkage failure rates to vary by year of entry, assuming that those entering earlier in the decade are more likely to have left by the time of the Census than those entering later. Table 6.1 confirms this trend. Particularly among immigrants entering in each of the five years before census, not found rates go down[1]. However, non-linkage of immigrants registering in the year prior to Census, at 58.6 per cent for 2000, 56.4 per cent for 1990 and 38.2 per cent for 1980, is still high. This suggests that under-recording of embarkations is substantial but does not provide a complete explanation.

[1] Low linkage failure among immigrants entering in the early 1970s is probably an artefact of LS processing, which began in 1974.

Table 6.1 Immigrants not accounted for at census, by year of entry: 2001, 1991 and 1981 compared						
Year of entry to NHSCR for 1990s decade immigrants (1980s/1970s in brackets)	2001		1991		1981	
	1990s immigrants not recorded as having died or embarked by 2001	% not found	1980s immigrants not recorded as having died or embarked by 1991	% not found	1970s immigrants not recorded as having died or embarked by 1981	% not found
1991 *(1981/1971)*	2,600	**73.6**	996	**65.3**	1,811	**45.9**
1992 *(1982/1972)*	3,444	**70.1**	1,370	**66.9**	3,145	**47.7**
1993 *(1983/1973)*	3,525	**70.0**	1,600	**66.4**	3,067	**49.5**
1994 *(1984/1974)*	3,603	**70.4**	1,774	**61.7**	2,840	**52.7**
1995 *(1985/1975)*	3,919	**70.5**	1,993	**63.2**	3,069	**51.7**
1996 *(1986/1976)*	4,240	**67.5**	2,426	**63.9**	3,062	**49.8**
1997 *(1987/1977)*	4,336	**66.6**	2,354	**64.9**	2,732	**49.0**
1998 *(1988/1978)*	4,779	**64.3**	2,415	**60.6**	2,833	**48.0**
1999 *(1989/1979)*	5,302	**62.1**	2,499	**60.1**	2,679	**43.4**
2000 *(1990/1980)*	6,119	**58.6**	2,951	**56.4**	2,518	**38.2**
2001 *(1991/1981)*	1,994	**58.5**	1,196	**53.6**	567	**31.7**
Decade total	43,861	**66.0**	21,574	**61.8**	28,323	**47.5**

6.2 The effect of immigrants' age on 2001 linkage failure rates

Linkage failure rates increase with age, as illustrated by Tables 6.2-6.4. The majority of immigrants expected at each census are young. Of those expected in 2001, 62.4 per cent were aged 20-39 years. This is higher than at previous censuses: 57.0 per cent of those expected in 1991 were 20-39, 50.1 per cent in 1981. Linkage rates for immigrants were significantly lower at both the 1991 and 2001 censuses than in 1981. There is no additional information on the characteristics of immigrants not found. The information in Tables 6.2-6.4 is summarised in Figures 6.1 and 6.2.

Figure 6.1 **Percentage of male immigrants and re-entrants entering in the decade up to 2001, 1991 and 1981 who were not accounted for at census**

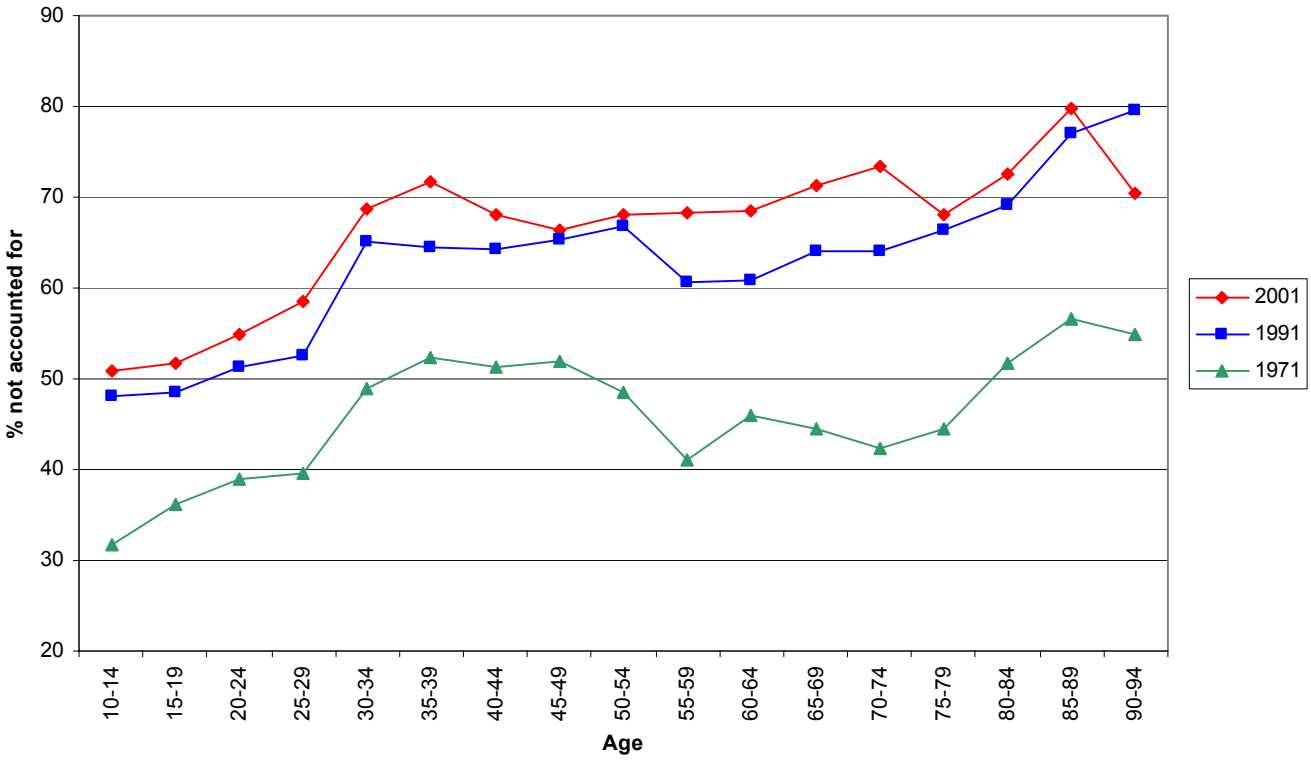


Figure 6.2 **Percentage of female immigrants and re-entrants entering in the decade up to 2001, 1991 and 1981 who were not accounted for at census**

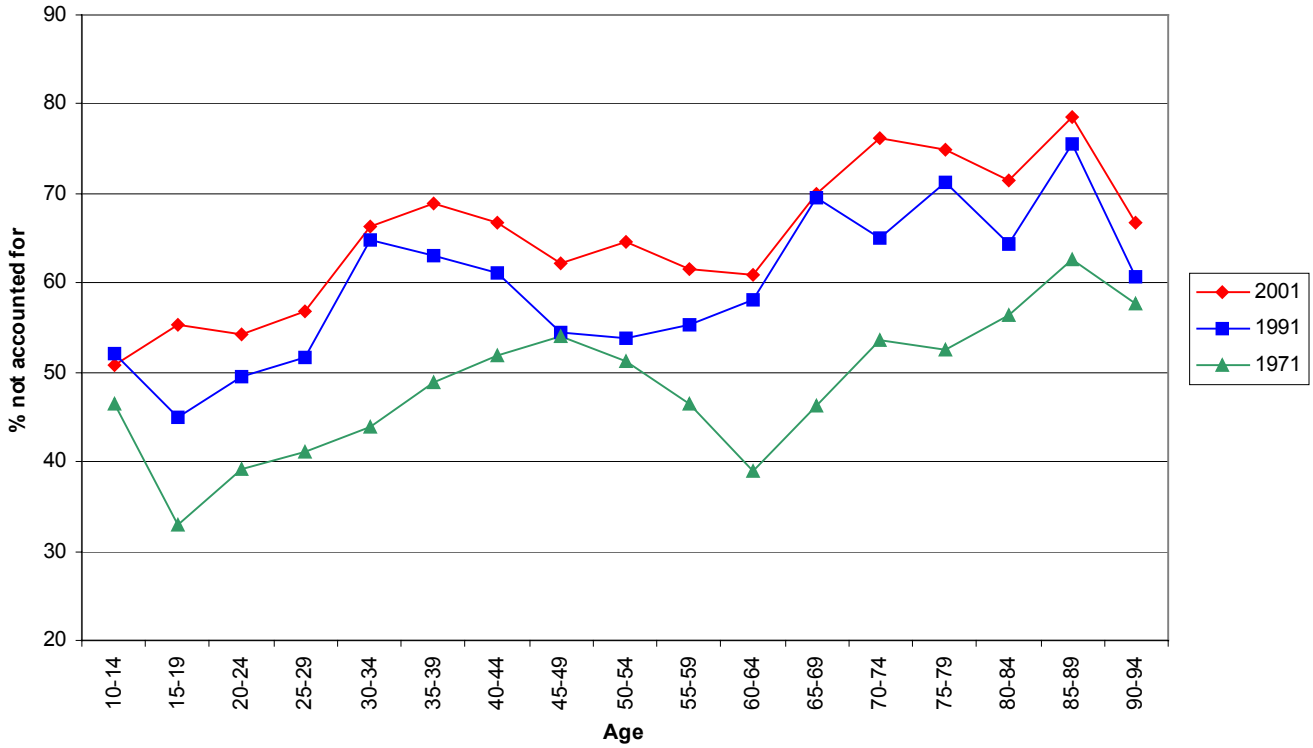


Table 6.2 1990s immigrants and re-entrants not accounted for in 2001, by sex and age						
2001 age	Males			Females		
	1990s immigrants not recorded as having died or embarked by 2001	% of all ages	% of 1990s immigrants not found	1990s immigrants not recorded as having died or embarked by 2001	% of all ages	% of 1990s immigrants not found
0-4	545	2.5	**50.8**	564	2.5	**50.7**
5-9	1,241	5.7	**51.7**	1,139	4.9	**55.3**
10-14	1,148	5.3	**55.0**	1,122	4.9	**54.3**
15-19	1,267	5.8	**58.4**	1,241	5.4	**56.9**
20-24	2,568	11.8	**68.8**	3,625	15.7	**66.3**
25-29	4,333	19.9	**71.8**	5,322	23.1	**69.0**
30-34	3,866	17.7	**68.0**	3,639	15.8	**66.7**
35-39	2,500	11.5	**66.3**	2,110	9.2	**62.1**
40-44	1,485	6.8	**68.1**	1,298	5.6	**64.5**
45-49	897	4.1	**68.3**	732	3.2	**61.5**
50-54	578	2.7	**68.5**	485	2.1	**60.8**
55-59	335	1.5	**71.3**	420	1.8	**70.0**
60-64	330	1.5	**73.3**	370	1.6	**76.2**
65-69	248	1.1	**68.1**	332	1.4	**75.0**
70-74	164	0.8	**72.6**	238	1.0	**71.4**
75-79	134	0.6	**79.9**	178	0.8	**78.7**
80-84	78	0.4	**70.5**	96	0.4	**66.7**
85+	64	0.3	**82.8**	108	0.5	**79.6**
All ages	21,781	100.0	**66.4**	23,019	100.0	**64.8**

Table 6.3 1980s immigrants and re-entrants not accounted for in 1991, by sex and age						
1991 age	Males			Females		
	1980s imigrants not recorded as having died or embarked by 2001	% of all ages	% of 1980s immigrants not found	1980s immigrants not recorded as having died or embarked by 2001	% of all ages	% of 1980s immigrants not found
0-4	425	4.0	**48.0**	372	3.0	**52.2**
5-9	769	7.2	**48.5**	786	6.4	**44.9**
10-14	717	6.7	**51.2**	707	5.8	**49.5**
15-19	697	6.5	**52.7**	780	6.4	**51.7**
20-24	1,263	11.8	**65.2**	2,015	16.5	**64.8**
25-29	1,870	17.5	**64.5**	2,576	21.1	**63.0**
30-34	1,642	15.4	**64.2**	1,640	13.4	**61.1**
35-39	1,094	10.2	**65.4**	963	7.9	**54.5**
40-44	767	7.2	**66.8**	698	5.7	**53.7**
45-49	436	4.1	**60.6**	380	3.1	**55.3**
50-54	294	2.8	**60.9**	308	2.5	**58.1**
55-59	198	1.9	**64.1**	187	1.5	**69.5**
60-64	139	1.3	**64.0**	197	1.6	**65.0**
65-69	122	1.1	**66.4**	191	1.6	**71.2**
70-74	97	0.9	**69.1**	135	1.1	**64.4**
75-79	83	0.8	**77.1**	131	1.1	**75.6**
80-84	49	0.5	**79.6**	66	0.5	**60.6**
85+	28	0.3	**75.0**	78	0.6	**75.6**
All ages	10,690	100.0	**61.3**	12,210	100.0	**59.0**

Table 6.4 1970s immigrants and re-entrants not accounted for in 1981, by sex and age						
1981 age	Males			Females		
	1970s immigrants not recorded as having died or embarked by 2001	% of all ages	% of 1970s immigrants not found	1970s immigrants not recorded as having died or embarked by 2001	% of all ages	% of 1970s immigrants not found
0-4	408	3.0	**31.6**	408	2.8	**32.8**
5-9	1,011	7.4	**36.1**	985	6.7	**39.2**
10-14	1,034	7.6	**38.9**	970	6.6	**41.1**
15-19	1,044	7.7	**39.7**	1,044	7.1	**44.0**
20-24	1,876	13.8	**49.0**	2,439	16.6	**48.9**
25-29	2,269	16.7	**52.3**	2,912	19.8	**51.9**
30-34	1,989	14.6	**51.3**	2,105	14.3	**54.0**
35-39	1,185	8.7	**52.0**	1,131	7.7	**51.3**
40-44	848	6.2	**48.6**	709	4.8	**46.4**
45-49	596	4.4	**41.1**	523	3.6	**39.0**
50-54	398	2.9	**46.0**	389	2.6	**46.3**
55-59	312	2.3	**44.6**	257	1.7	**53.7**
60-64	210	1.5	**42.4**	248	1.7	**52.4**
65-69	175	1.3	**44.6**	250	1.7	**56.4**
70-74	118	0.9	**51.7**	163	1.1	**62.6**
75-79	83	0.6	**56.6**	109	0.7	**57.8**
80-84	31	0.2	**54.8**	50	0.3	**56.0**
85+	16	0.1	**68.8**	28	0.2	**67.9**
All ages	13,603	100.0	**46.6**	14,720	100.0	**48.4**

7. Accounting for shortfalls in the 1991 and 2001 LS Census samples

In previous sections it was shown that, between the 1981 and 2001 Censuses, the numbers of LS members lost to follow-up, for reasons other than recorded migration and death, increased at each Census. The proportion of the sample lost varied by age and sex, with the largest proportion among young men in their twenties. In this section we examine adjustments to the figures that might account for these proportions. In doing this, our aim is to identify whether the reduction in coverage in the LS sample over time reflects well-understood processes, such as attrition in any follow-up study and recognised levels of under-enumeration in recent censuses. Alternatively, does it indicate some previously unquantified shortfalls?

Two adjustments have been made to the figures. First, an overall adjustment for under-enumeration at each age is presented in Section 7.1. For 2001, the adjustment was derived from One Number Census imputation figures. Separate adjustments were made to figures for males and females of different ages. For 1991, adjustment for under-enumeration was made using the 1991 Census-based mid-year population estimates for 1991.

The second set of adjustments are presented in Section 7.3. These were undertaken to account for those losses from the study, at each successive census, that simply reflected similar types of loss to that which occurred in the 1970s as a result of unrecorded migration and mismatching of Census records. In Section 7.4, the results of applying both sets of adjustments are presented, to show whether there is any linkage failure that is not accounted for by either attrition or under-enumeration.

This analysis was undertaken purely in terms of age, sex and cohort. It would be useful to know whether any of the factors discussed in previous sections were associated with linkage failure that could not be accounted for in this way. Unfortunately, no disaggregation of these figures using these other factors was possible because, by definition, no other characteristics of those not found on a particular occasion (e.g. 2001 Census) can be deduced from what was known about them when they last appeared in the sample (e.g. at an earlier census). In particular, geographic information quickly becomes out of date. For example, area of residence for those not found in 2001 cannot be deduced from address in 1991, because they will include LS members who moved address during the 1990s.

To partially overcome this limitation (and so shed some light on geographic variations), LS linkage failure rates in 2001, according to area of residence in the 1990s, were compared with ONC imputation rates for these areas in 2001. However, this was only possible for areas in which no unitary authorities were created and coding of migrant records remained constant over the 1990s. This necessarily restricted the analysis to Family Health Service Authorities (FHSAs) within Greater London. This analysis is presented in Section 7.2. It was not possible to apply the adjustment process described in Section 7.3 to these sub-national figures as this would have required an additional, unmeasured element – the association between internal migration and linkage failure.

Finally, the 2001 ONC figures have been used by ONS as a basis for revising previously published population estimates for 1982 to 2000. It is of considerable interest to know whether, by using the ONC-based population estimates for 1991 (rather than the 1991 Census-based estimates), the adjustment for under-enumeration in 1991 improves or worsens the explanation given for linkage failure, both in Section 7.1 and 7.3. The results of using rebased 1991 estimates in the adjustments are presented in Section 7.5

7.1 Linkage failure in 1991 and 2001, after adjusting for under-enumeration

This section examines the effect of under-enumeration in 1991 and 2001 on linkage rates in the LS.

7.1.1 Linkage failure by age and sex in 1991 and 2001, after adjusting for under-enumeration

Figures 7.1 and 7.2 show the percentages of male and female LS members not accounted for in 1981, 1991 and 2001. The figures include LS members found at the previous census, births in the previous decade, immigrants and re-entrants, for whom there are no death or embarkation notifications. For 1991 and 2001 the percentages not found in the LS after applying Census imputation factors to adjust for under-enumeration are also shown. With the exception of rates for those aged over 80[2], LS non-linkage in 2001 and ONC imputation rates had the same age profiles, although the percentages of LS members not found were generally higher than the ONC imputation rates. LS members not found in 2001 were concentrated in the 15-50 year age range for both sexes, as were the most substantial ONC adjustments for under-enumeration. The 1991 adjustments use final 1991 Census based mid-year estimates for 1991, adjusted back to Census day (by allowing for birth, death and migration between 21 April and 30 June 1991)[3]. Births occurring in 2001 were not included[4]. These figures show that:

- Adjusting 2001 LS figures using ONC imputation rates reduced residual linkage failure among 50-79 year-olds and teenagers to levels similar to those in 1991 and 1981.
- ONC adjustments brought the 2001 LS figures closer to 1981 figures for females than for males.
- The adjustments over-correct percentages not found in the LS 2001 to below 1981 levels for males aged 65-84 and females aged 55-84.
- The adjustments under-correct among males aged 20-44 years, particularly at ages 25-34, and among females aged 20-34 (particularly those aged 25-29).
- When compared to 1981, adjustments made for under-enumeration in 1991 over-correct percentages not found in the LS for females of all ages (particularly at ages 25-34) and males at all ages except 35-39 and 45-49. Over-correction was greatest at ages 25-29 for males.
- The high non-linkage rates for young people, particularly males, in their 20s, are not fully compensated for in 2001, but were over-compensated in 1991 in comparison to 1981. Adjusted percentages for male 25-29 year-olds not found were 24.1 in 2001 and 11.4 in 1991, compared to 16.5 in 1981 (unadjusted). For females of the same age, adjusted percentages not found were 20.5 in 2001 and 12.9 in 1991, compared to 15.8 in 1981 (unadjusted).

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[2] High non-linkage for older LS members may be due to incomplete data, as discussed in Section 3.2.
[3] See OPCS Monitor PPI 93/1, 24 June 1993.
[4] This is because they have not yet been added to the LS database. Thus we only know how many there are and the number appearing at Census, but not the sex of those not found.

Figures 7.3 and 7.4 were calculated in the same way as Figures 7.1 and 7.2, but immigrants and re-entrants have not been included. The aim is to focus on those LS members for whom linkage was not as problematic as it was for immigrants. These figures show that:

- When immigrants are excluded, ONC adjustment over-corrects for non-linkage of females in all age groups in 2001, as compared to 1981 Census figures.
- Among males (excluding immigrants) not found in 2001, ONC imputation over-corrects in most age groups, except among 25-34 year-olds.
- The 1991 adjustments for under-enumeration also over-correct for non-linkage of females in all age groups.
- Among men, the 1991 adjustments over-correct in most age groups, except among 45-54 year-olds[5].

For females in most age groups the adjusted percentages for 1991 are closer to the 1981 percentages not found than the 2001 adjusted percentages are. There was no consistent pattern for males.

[5] Higher non-linkage of 75-79 year-olds in 1991 is possibly a cohort-specific artefact arising from pre-computerised linkage of embarkations at or soon after retirement age.

Figure 7.1 **Percentage of LS males not accounted for in 1981, 1991 and 2001, adjusted for census under-enumeration in 1991 and 2001 (using contemporary estimates), by age**

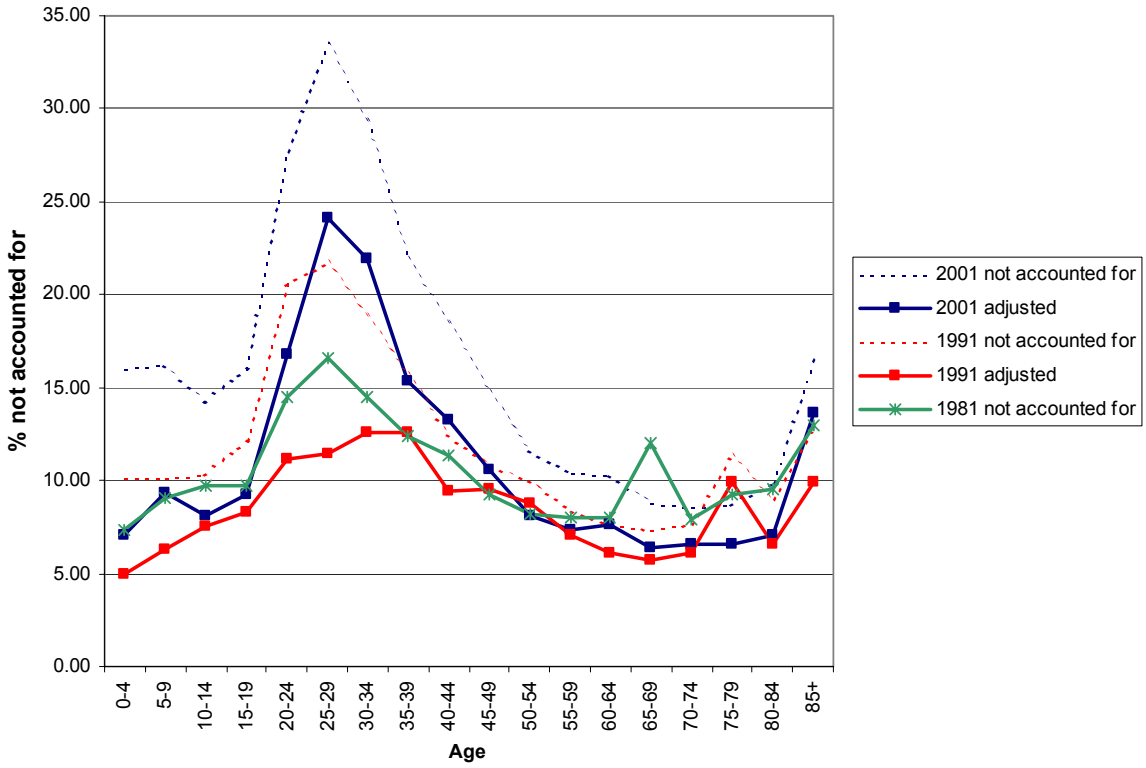


Figure 7.2 **Percentage of LS females not accounted for in 1981, 1991 and 2001, adjusted for census under-enumeration in 1991 and 2001 (using contemporary estimates), by age**

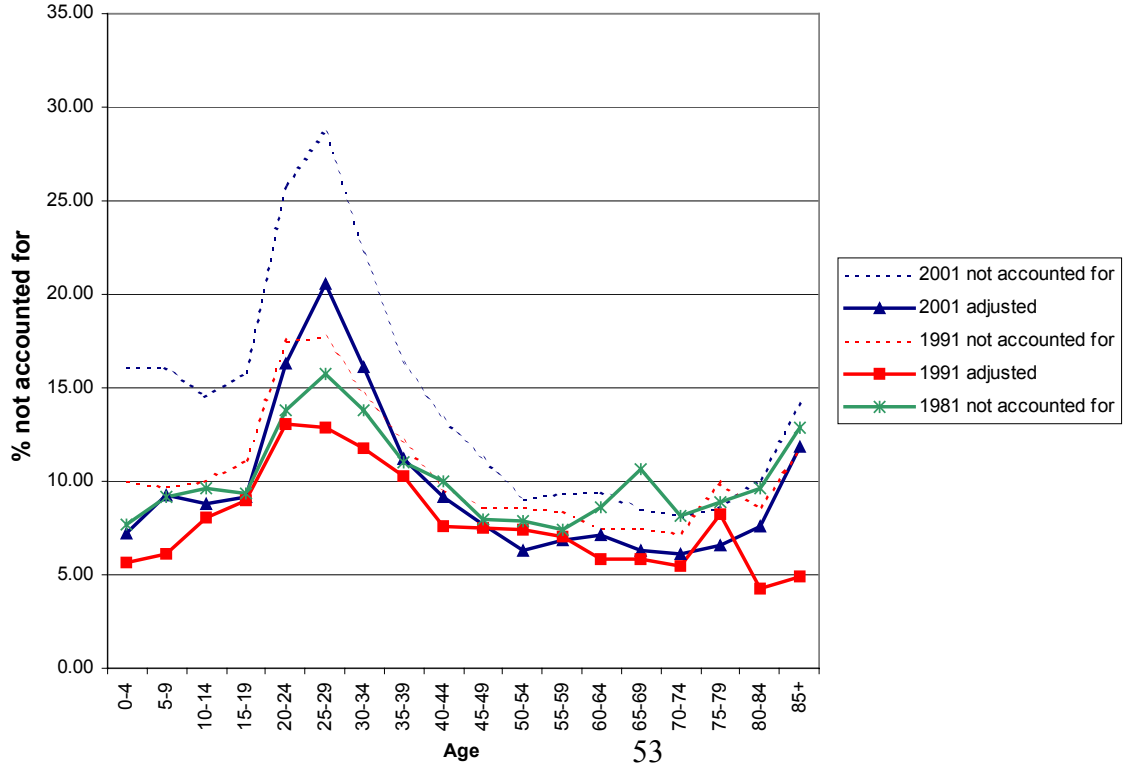


Figure 7.3 **Percentage of LS males, excluding immigrants, not accounted for in 1981, 1991 and 2001, adjusted for census under-enumeration in 1991 and 2001 (using contemporary estimates), by age**

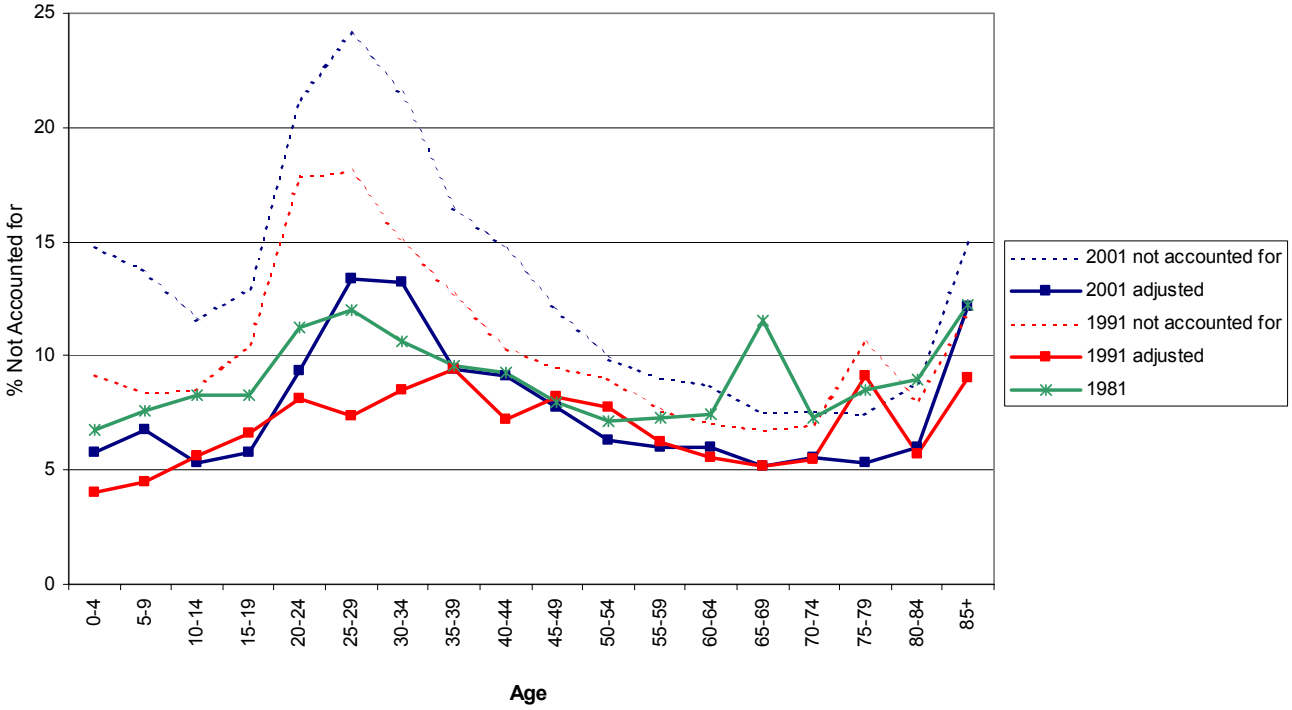
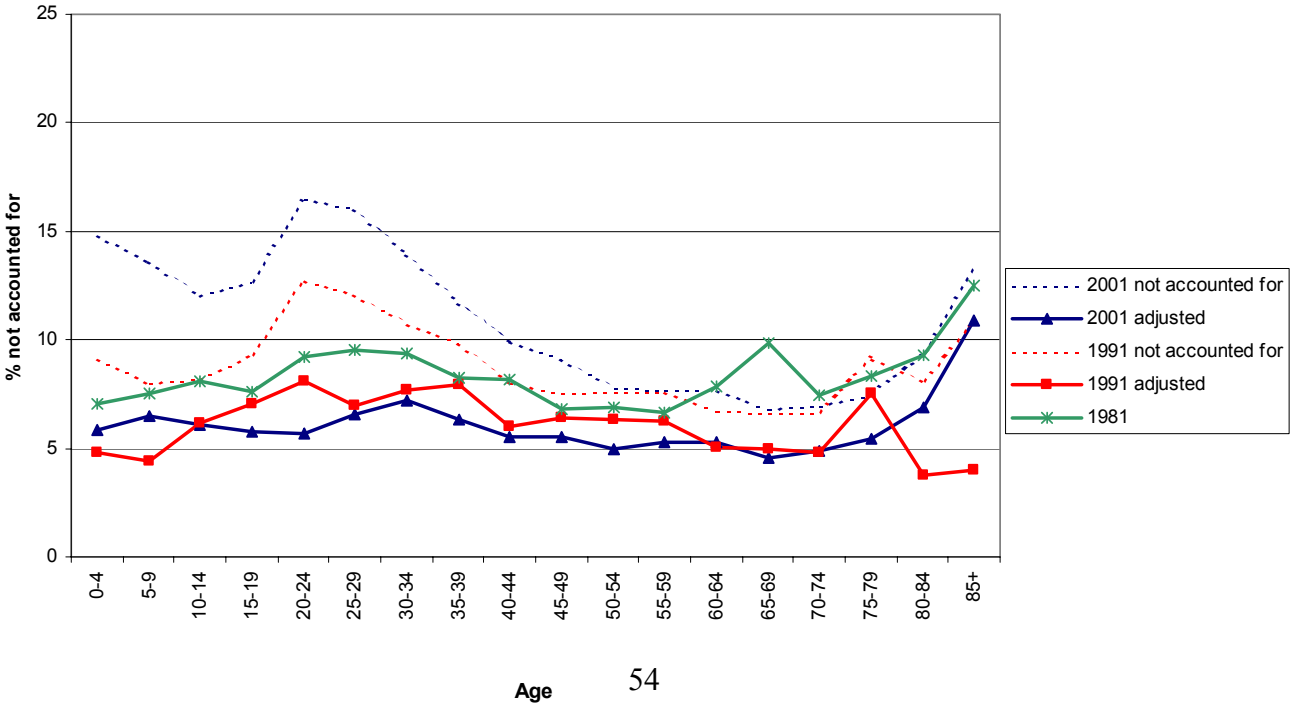


Figure 7.4 **Percentage of LS females, excluding immigrants, not accounted for in 1981, 1991 and 2001, adjusted for census under-enumeration in 1991 and 2001 (using contemporary estimates), by age**



7.1.2 Differences between LS linkage failure and ONC imputation rates in the Greater London area

We now extend the analysis of under-enumeration in 2001 to sub-national areas, comparing 2001 Census adjustments for under-enumeration, used to create the 'One Number Census', with observed losses from the LS in 2001. However, changes to local authority areas in the 1990s, particularly the creation of Unitary Authorities that began in 1995, preclude analysis of geographical variation in areas affected. For immigrants in the 1990s, the only geographic identifiers available in the LS prior to the 2001 Census were the codes at NHSCR for the Family Health Service Authority (FHSA) in which they registered with a general practitioner. The figures in this section are therefore restricted to FHSAs. As these FHSA codes changed during the 1990s for many areas, it was only practical to present figures for areas where there was continuity and coterminosity throughout the 1990s. All of these limitations effectively restricted the analysis to FHSAs in London (Table 7.1). Within London, FHSAs were coterminous with the areas covered by one or more London boroughs throughout the 1990s.

In Table 7.1, non-linkage rates are shown for LS members found in 1991 (column 2), then revised to include new births not found (column 3) and finally revised for 1990s immigrants (column 4). Comparing columns 3-4 demonstrates the impact that immigrants have on non-linkage rates, particularly in the Inner London areas. In Kensington and Chelsea and Westminster, for example, the linkage failure rate of 37.0 per cent rises to 53.8 per cent when 1990s immigrants are included. This compares with Bromley, with the lowest overall linkage failure rate, at 12.6 and 15.3 per cent before and after immigrants are included.

There is less than a twofold difference in LS non-linkage and ONC imputation rates in the following FHSAs:

- Kensington Chelsea Westminster
- Camden Islington
- City & East London
- Lambeth Lewisham Southwark
- Croydon

With the exception of Croydon, the ratio of LS percentages not found and ONC imputation is greater in Outer London, and at its highest in Kingston and Richmond, at 3.1.

Table 7.1 Comparison between ONC imputation and percentage of LS members not accounted for in the London Family Health Service Authorities[a]

FHSA London borough	% of LS members present in 1991 and not accounted for in 2001	% of LS members present in 1991 and 1990s births not accounted for in 2001	% of LS members present in 1991, 1990s births and immigrants not accounted for in 2001	ONC imputat -ion	Ratio LS/ ONC
Greater London Total	**20.4**	**21.2**	**31.5**	**14.9**	**2.1**
Kensington Chelsea Westminster	**35.4**	**37.0**	**53.8**	**30.5**	**1.8**
Kensington and Chelsea	35.1	36.7		35.6	
Westminster LB	35.6	37.1		26.0	
Camden Islington	**29.1**	**29.7**	**43.3**	**22.8**	**1.9**
Camden	28.5	29.4		23.4	
Islington	29.7	29.9		22.1	
City & East London	**27.1**	**28.1**	**39.5**	**24.0**	**1.7**
City of London	14.8	16.1		26.1	
Hackney	31.6	32.0		27.9	
Newham	23.5	25.0		20.3	
Tower Hamlets	27.4	28.4		24.4	
Lambeth Lewisham Southwark	**25.1**	**25.5**	**37.8**	**21.2**	**1.8**
Lambeth	27.1	27.3		21.2	
Lewisham	22.9	23.0		19.2	
Southwark	25.2	26.2		23.2	
Ealing Hammersmith Fulham Hounslow	**22.6**	**23.4**	**34.9**	**15.3**	**2.3**
Ealing	22.8	23.1		14.8	
Hammersmith and Fulham	28.0	29.0		23.8	
Hounslow	18.9	20.1		9.3	
Brent Harrow	**22.3**	**23.0**	**34.2**	**15.1**	**2.3**
Brent	27.8	28.7		20.6	
Harrow	15.8	16.2		8.2	
Enfield Haringey	**21.8**	**22.6**	**33.0**	**13.3**	**2.5**
Enfield	18.6	19.2		10.6	
Haringey	26.1	27.1		16.6	
Barnet (Barnet LB)	**19.2**	**19.5**	**30.3**	**10.4**	**2.9**
Merton Sutton Wandsworth	**17.1**	**17.7**	**25.5**	**9.8**	**2.6**
Merton	15.5	16.0		12.1	
Sutton	10.4	11.0		5.8	
Wandsworth	23.1	23.4		11.0	
Redbridge Waltham Forest	**16.8**	**17.7**	**25.2**	**12.6**	**2.0**
Redbridge	16.1	16.6		13.0	
Waltham Forest	17.6	18.8		12.2	
KingstonRichmond	**15.5**	**15.4**	**24.1**	**7.8**	**3.1**
Kingston Upon Thames	15.2	15.0		8.5	
Richmond Upon Thames	15.7	15.6		7.1	
Croydon (Croydon LB)	**16.1**	**17.0**	**22.3**	**12.9**	**1.7**
Hillingdon (Hillingdon LB)	**14.6**	**14.5**	**20.7**	**7.3**	**2.8**
Bexley Greenwich	**15.1**	**15.6**	**20.2**	**9.2**	**2.2**
Bexley	12.0	11.9		4.1	
Greenwich	18.4	19.6		14.4	
Barking and Dagenham Havering	**11.8**	**12.3**	**15.8**	**7.8**	**2.0**
Barking and Dagenham	14.8	16.1		13.7	
Havering	9.9	9.8		3.4	
Bromley (Bromley LB)	**12.4**	**12.6**	**15.3**	**6.1**	**2.5**

Notes a LS percentages not found combine LS members found in 1991 and 1990s births, for whom we know the borough of usual residence, and 1990s immigrants, for whom we have Family Health Service Authority data. Census boroughs are nested within FHSAs. Discrepancies can exist between FHSA and usual residence. ONC estimates for borough of usual residence were aggregated and weighted to produce FHSA estimates.

7.2 Linkage failure in 1991 and 2001, after adjusting for cumulative losses from the LS, estimated at levels observed between 1971 and 1981

Linkage failure in the LS can arise from:

- Existing LS members who were no longer resident in England and Wales but their embarkation was not notified to NHSCR
- Existing LS members resident in England and Wales who were not enumerated at census
- Existing LS members resident in England and Wales who were enumerated at census but not matched to their existing LS record

The shortfall in LS embarkation data was discussed in Section 6.1. and the effects of under-enumeration in Sections 7.1.1 and 7.1.2. Linkage failure, as a result of failure to match records, can occur through discrepancies in recording key matching information (e.g. date of birth) or processing errors (in data input, computer programmes or clerical matching). Date of birth errors, for example, draw LS members into the sample who are unlikely to be found again (discussed in Section 2.1) and, conversely, results in not finding LS members present on previous occasions.

In this section, adjustment has been made for rates of loss between recent censuses, using figures for the loss rates that would have occurred had non-linkage between 1981 and 1991 and between 1991 and 2001 been similar to that between1971 and 1981. To do this, loss rates experienced between 1971 and 1981 were applied to the samples present in1981 and 1991, respectively, after allowing for sample replenishment in the following decade (immigration, births and LS members found for the first time at census) and known losses (recorded deaths and embarkations).

Specifically, the adjustment between 1981 and 1991 was made by applying loss rates (by 1981) for those found in 1971 who were not recorded as having died or embarked to the numbers found in 1981 who were not known to have died or embarked by 1991. A comparable adjustment was made to figures for births and immigrants in the 1980s who were not recorded as dying or embarking by 1991. Loss rates for births and immigrants in the 1970s were used to make this adjustment.

To adjust the 2001 figures for cumulative losses at the levels observed between 1971 and 1981, the loss rates for the 1970s, described above, were applied to the adjusted numbers in 1991, calculated using the method described above. For births and immigrants in the 1990s who were not recorded as dying or embarking by 2001, the same adjustment was made as that described above for births and immigrants in the previous decade. The approach is described more fully in Appendix 4.

Figures 7.5 and 7.6 show the LS linkage failure rates for males and females in 1981, 1991 and 2001 and the 1991 and 2001 losses after adjusting for 1971/81 levels of linkage failure. High rates of linkage failure among those aged 65-69 in 1981 were discussed in Sections 4.1, attributed to the pre-computerised processing of embarkations at and around retirement. This processing artefact is reflected in the age-specific adjustment for cumulative loss, creating a corresponding over-adjustment for this age group in 1991 and 2001. This cohort effect and small numbers in older age groups make it difficult to draw firm conclusions about those aged over 65.

Figure 7.5 **Percentage of LS males not accounted for in 1981, 1991 and 2001, adjusted for cumulative loss from the LS in 1991 and 2001, by age**

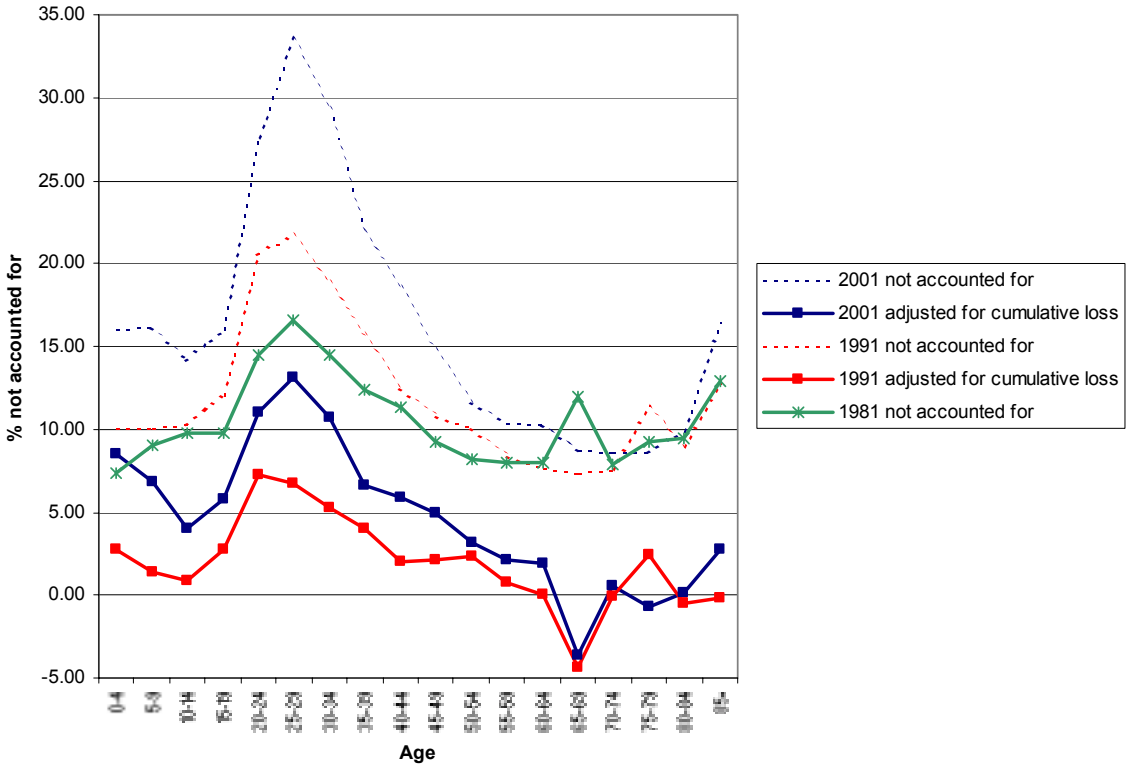
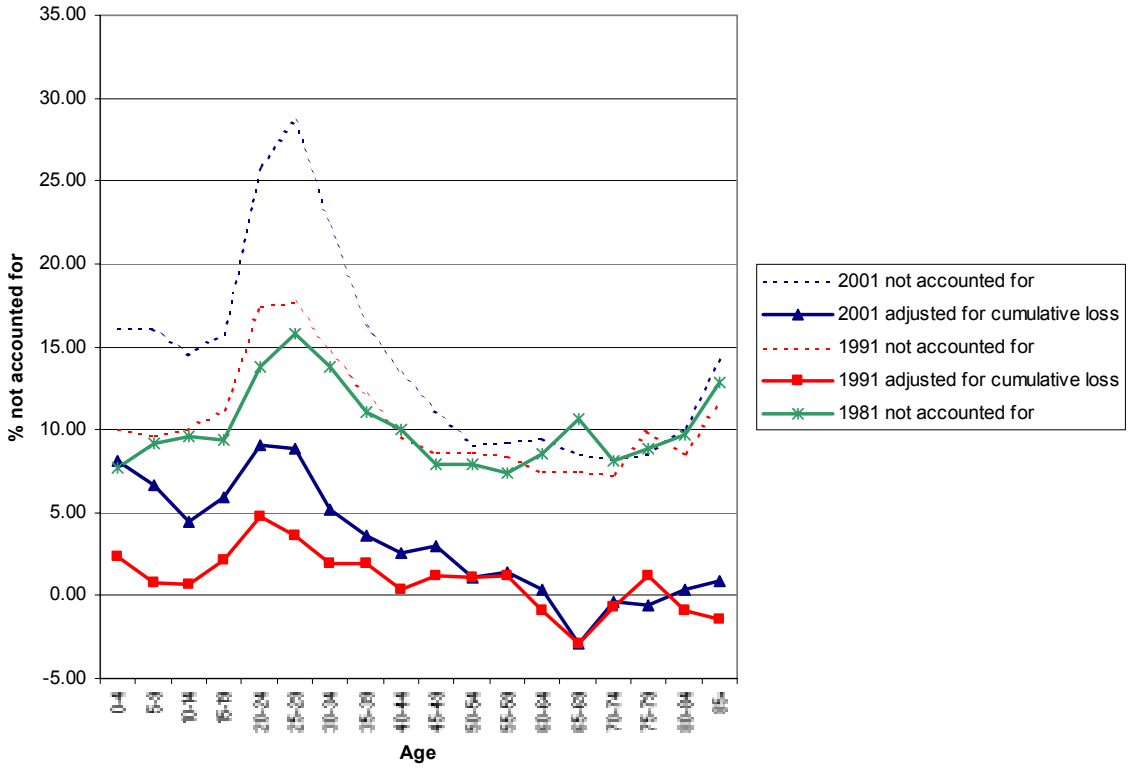


Figure 7.6 **Percentage of LS females not accounted for in 1981, 1991 and 2001, adjusted for cumulative loss from the LS in 1991 and 2001, by age**



7.3 LS linkage failure, after adjusting both for cumulative losses from the LS and Census under-enumeration

This section examines the extent to which LS linkage failure in 1991 and 2001 can be explained by repetition, in subsequent decades, of the losses that occurred in the first decade of the study and how much can be explained by what is known about Census undercounts in 1991 and 2001.

Figures 7.7 and 7.8 show, for males and females, LS linkage failure rates in 1981, 1991 and 2001. They also show LS linkage failure rates in 1991 and 2001 after adjusting for cumulative losses at 1971/81 levels and the net 1991 and 2001 loss rates after adjusting for census under-enumeration. For the latter, positive values suggest unexplained losses and negative values imply over-compensation.

Aside from the over-65s, the series of adjustments made have almost exactly accounted for the substantial proportions of male and female LS members not found in 1991 and 2001, with the exception of:

- male LS members in 2001, aged 25-34, among whom around 4 per cent are not accounted for
- over-compensation for male LS members in 1991, aged 20-29, at around 3 per cent.

7.4 LS linkage failure in 1991, adjusted for cumulative losses from the LS and by estimating under-enumeration in 1991, using 2001 Census rebased population estimates for 1991

So far this report has used 1991 mid-year estimates, based on the 1991 Census and adjusted back to Census day 1991, to estimate net LS linkage failure in 1991. This section compares net linkage failure rates based on these estimates with the 2001 Census rebased estimates. Thus, Figures 7.9 and 7.10 compare, for males and females, percentages of LS members expected but not found in 1991, adjusted for cumulative losses from the LS and imputation to correct for census under-enumeration, based on the 1991 and 2001 Censuses, respectively. The comparison suggests that the revisions following the 2001 Census correct for over-compensation in the original estimates for:

- Males aged under 30 and
- Males and females aged over 80.

Figures 7.11 and 7.12 show linkage failure rates in 1981, 1991 and 2001, as presented in Figures 7.7 and 7.8 but applying the rebased imputation factors to the 1991 adjustments.

Figure 7.7 **Percentage of LS males not accounted for in 1981, 1991 and 2001, adjusted for cumulative loss from the LS in 1991 and 2001 and census under-enumeration, by age**

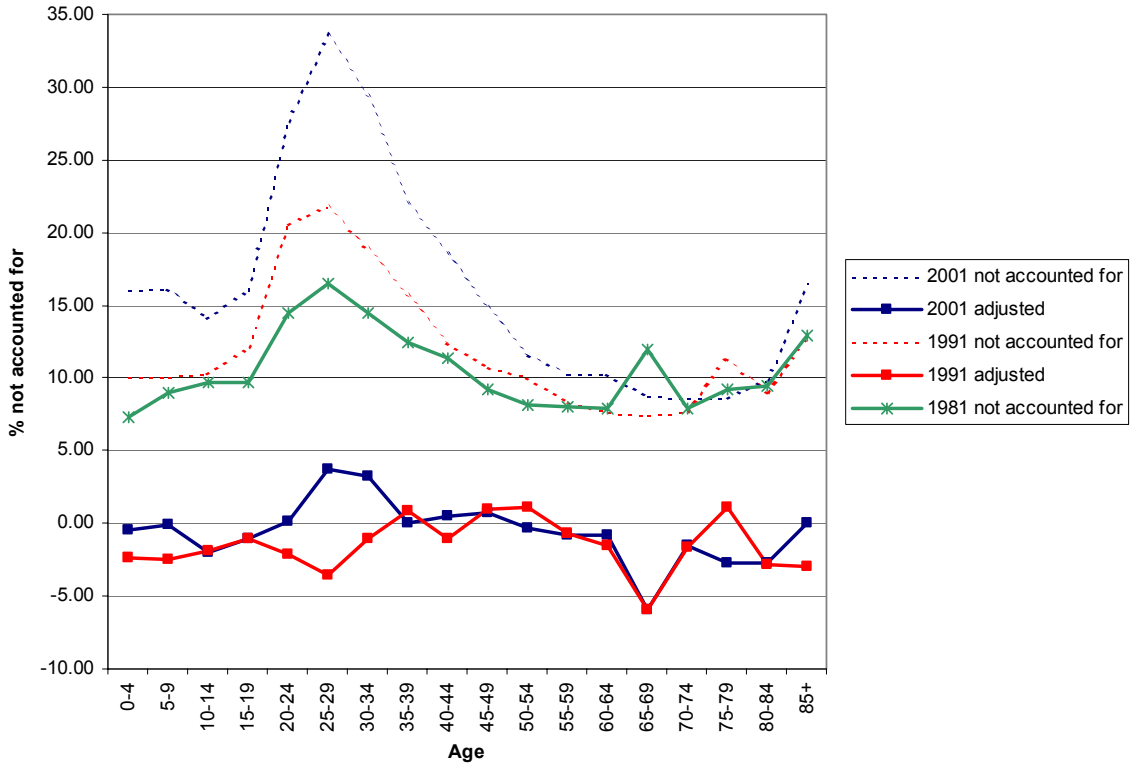


Figure 7.8 **Percentage of LS females not accounted for in 1981, 1991 and 2001, adjusted for cumulative loss from the LS in 1991 and 2001 and census-under enumeration, by age**

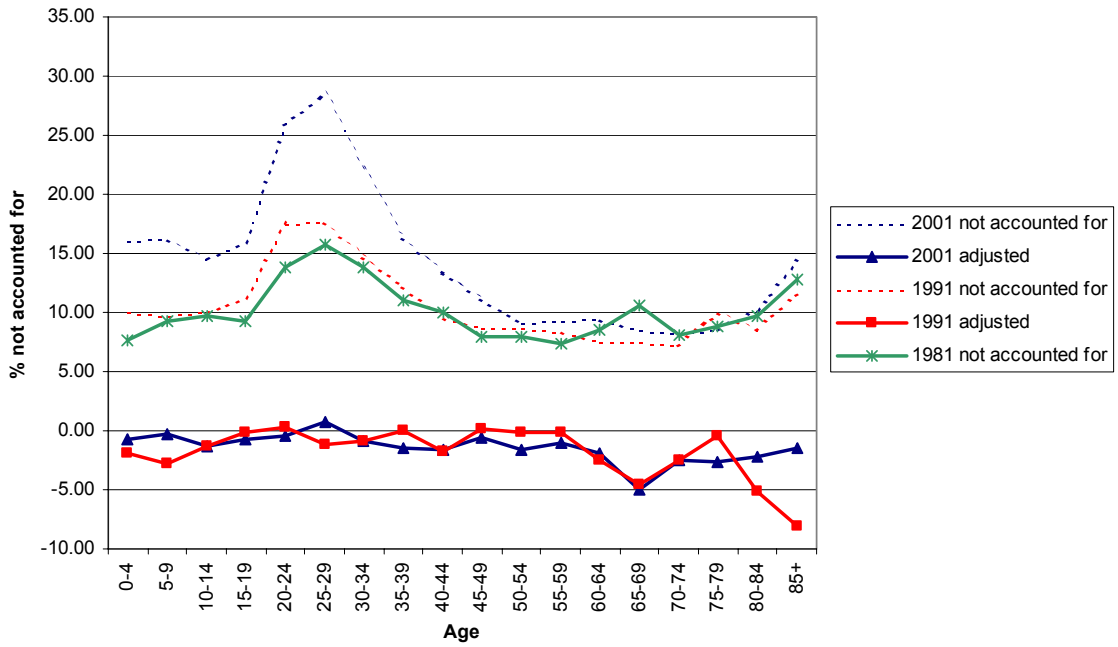


Figure 7.9 **Percentage of LS males not accounted for in 1991, adjusted for cumulative loss from the LS and census under-enumeration, using 1991 population estimates based on 1991 and 2001 Censuses**

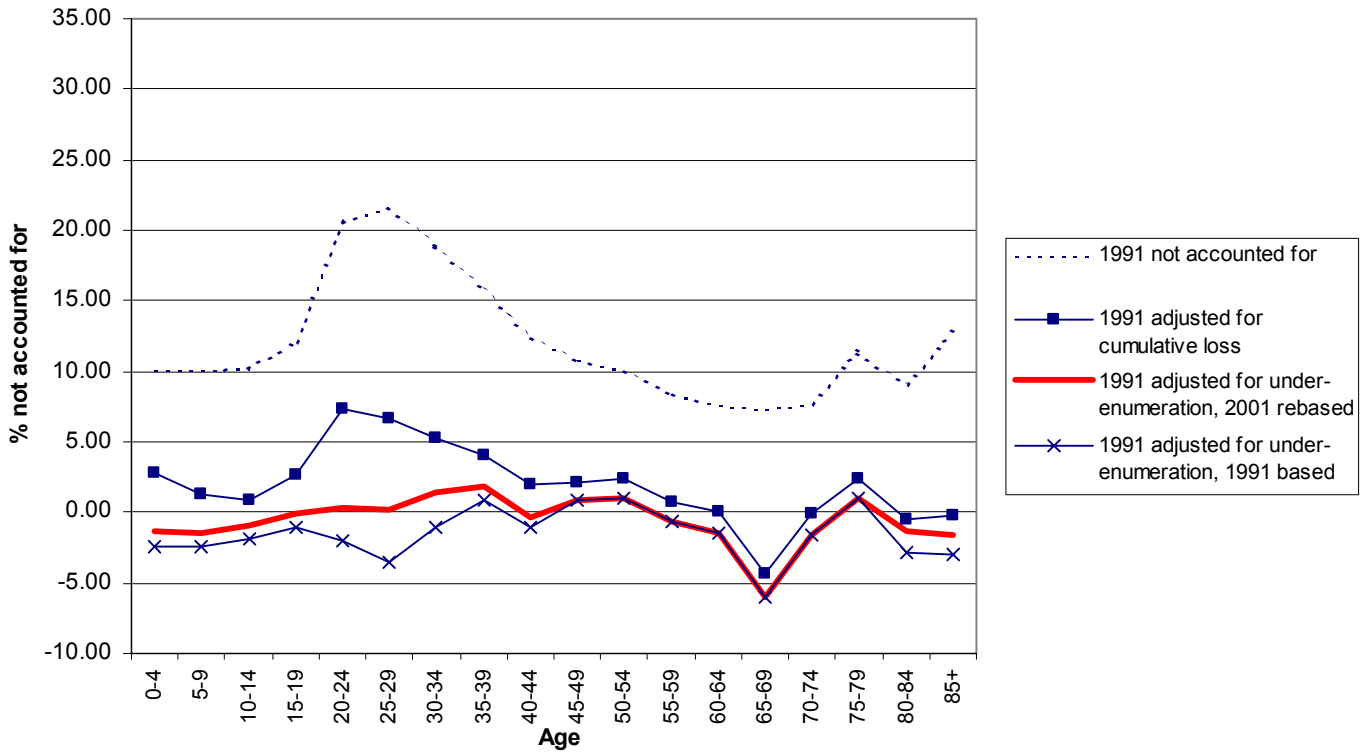


Figure 7.10 **Percentage of LS females not accounted for in 1991, adjusted for cumulative loss from the LS and census under-enumeration, using 1991 population estimates based on 1991 and 2001 Censuses**

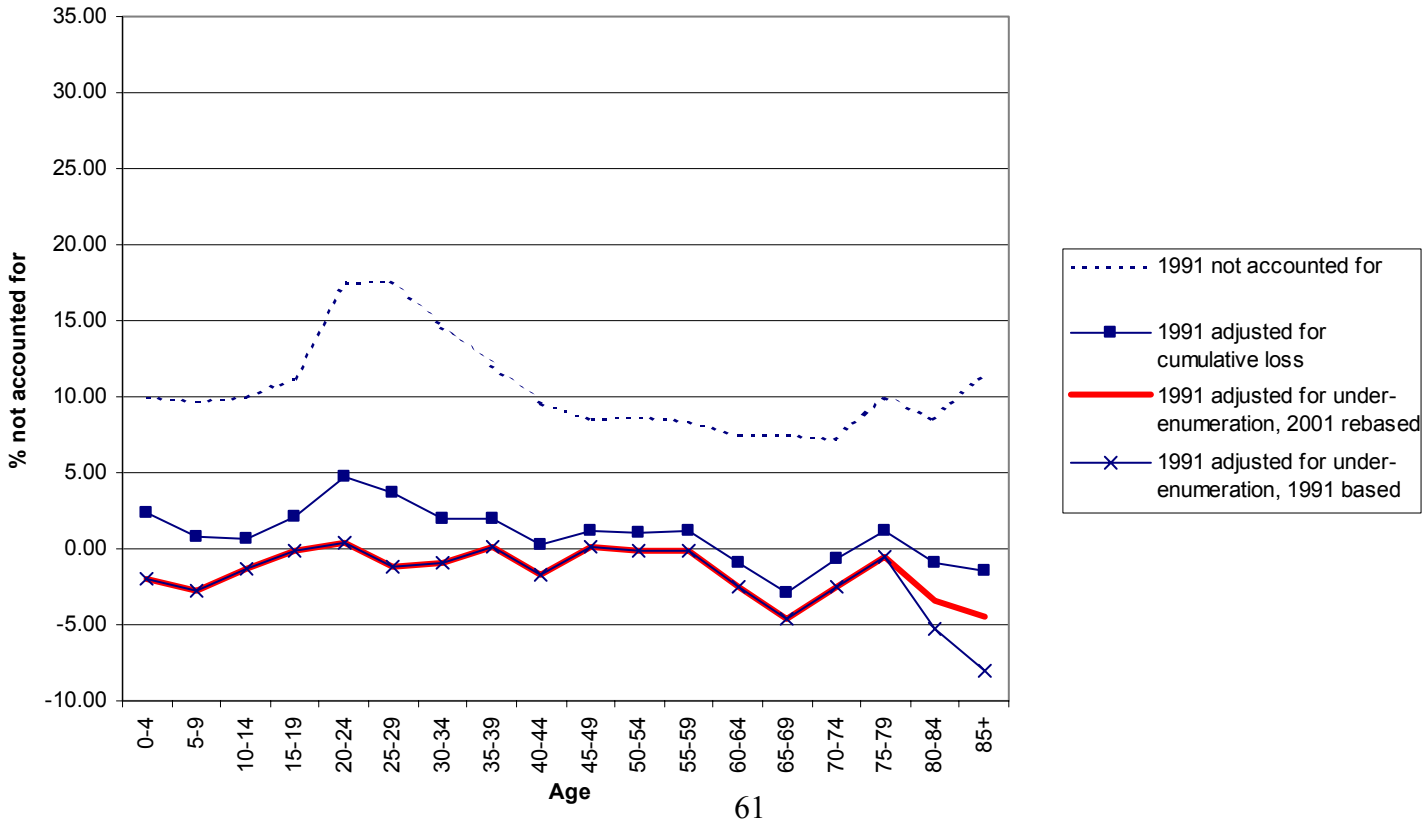
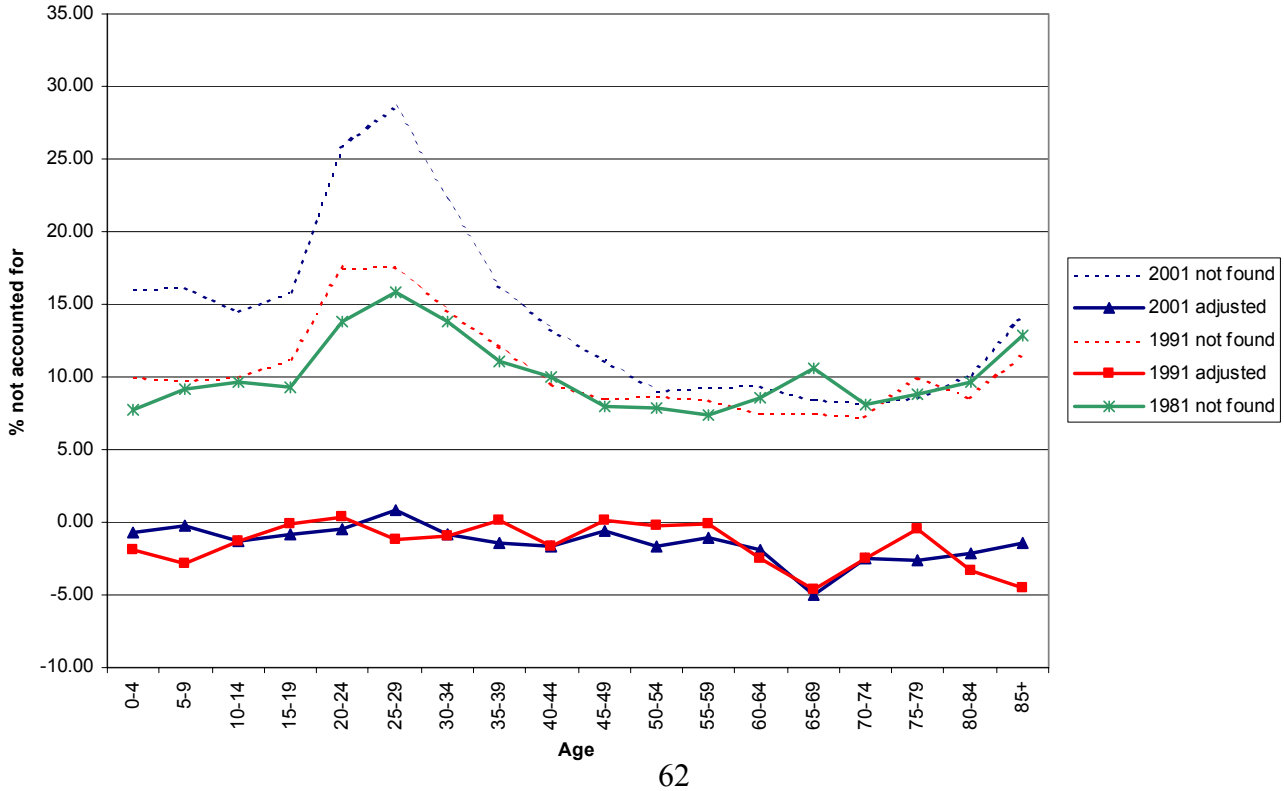


Figure 7.11 **Percentage of LS males not accounted for in 1981, 1991 and 2001, adjusted in 1991 and 2001 for cumulative loss from the LS and census under- enumeration, using 1991 population estimates based on the 2001 Census**

Figure 7.12 **Percentage of LS females not accounted for in 1981, 1991 and 2001, adjusted in 1991 and 2001 for cumulative loss from the LS and census under- enumeration, using 1991 population estimates based on the 2001 Census**



7.5 Summary

The purpose of adjusting LS linkage failure rates in this section was to assess whether the reduction in coverage in the LS over time can be explained by losses to follow-up that might be expected in any longitudinal study, and recognised levels of under-enumeration in recent censuses. In Section 7.1.1 adjustments for under-enumeration in 1991 and 2001 were made to LS linkage failure rates. As a result, issues relating to different age groups were identified. A further set of adjustments, described in Section 7.2, aimed to account for losses from the LS in 1991 and 2001, in a way that reflected similar types of loss to that which occurred in the 1970s as a result of unrecorded migration and mismatched census records. Based on this adjustment alone, there was some unexplained linkage failure. This was highest among men and women in their twenties. When both sets of adjustments were applied to LS linkage failure rates (in Section 7.3), the only unexplained losses in 2001were among males aged 25-34. At these ages, 4 per cent were not accounted for. Discrepancies at ages 65 and over are likely to reflect LS processing problems in 1981.

When both adjustments were applied to 1991 linkage failure rates using contemporary population estimates for 1991, the adjustments overcompensated for males aged 20-29 (by 3 per cent) and males and females aged over 80 years. However, when the calculations were repeated using 1991 population estimates that had been rebased using 2001 Census results, this fully accounted for linkage failure at each age. In particular, there was no over-compensation when the rebased population estimates were used.

Thus the reduction in coverage in the LS over time could almost completely be explained by cumulative losses, estimated at 1971-1981 levels, and census under-enumeration. The only exception was in 2001, when 4 per cent of males aged 25-34 were not accounted for.

8. Conclusions

Tracing of LS records in 2001 was extremely successful. Provisional estimates are that 99.3 per cent of records identified from the 2001 Census were traced at NHSCR and 96.6 per cent were linked to a previous record. For the traced sample in 2001, linkage was 97.2 per cent. Among existing members of the study - those where some record had been identified for inclusion in the study between 1971 and Census 2001- 74.3 per cent were linked to a 2001 Census record (after excluding those who were known to have died or emigrated). This figure was 76.1 per cent for the traced sample.

A number of factors affecting non-linkage in the LS in 2001 have been identified. These include:

- Being young and male
- Being an immigrant
- Living in London, particularly Inner London
- Being single, divorced, cohabiting or living in a lone-parent household
- Being born outside of England and Wales
- Among children, having parents who were born outside of England and Wales
- Being in a minority ethnic group
- Living in private rented accommodation or social housing
- Being unemployed or a student or on a Government scheme
- Serving or having parents who serve in the armed forces
- Being born in the 1990s to a young mother
- Being a sole registered birth in the 1990s

While these often identify the same people, the factors do to some degree act independently (for example, elderly women were more likely not to be linked in London).

LS linkage failure rates were adjusted to assess whether the reduction in coverage in the LS over time can be explained by losses to follow-up that might be expected in any longitudinal study, and recognised levels of under-enumeration in recent censuses. Adjustments for under-enumeration in 1991 and 2001 were made. A further set of adjustments were undertaken to account for losses from the LS in 1991 and 2001, in a way that might have reflected similar types of losses to those that occurred in the 1970s as a result of unrecorded migration and mismatched census records. When both sets of adjustments were applied to LS linkage failure rates the only unexplained losses in 2001were among males aged 25-34.

When both adjustments were applied to 1991 linkage failure rates using contemporary population estimates for 1991, the adjustments overcompensated for males aged 20-29 (by 3 per cent) and males and females aged over 80 years. However, when the calculations were repeated using 1991 population estimates that had been rebased using 2001 Census results, this fully accounted for linkage failure at each age. In particular, there was no over-compensation when the rebased population estimates were used.

Thus, the reduction in coverage in the LS over time could almost completely be explained by cumulative losses, estimated at 1971-1981 levels, and census under-enumeration.

References

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Appendix 1 LS members found in 1991 and not recorded as having died or embarked by 2001, by county and local authority

County/ local authority	LS members found in 1991 and not recorded as having died or embarked by 2001	% not found in 2001
England and Wales	477,237	12.2
1 Greater London	63,498	20.4
Westminster LB	1,371	35.6
Kensington and Chelsea LB	1,026	35.1
Hackney LB	1,665	31.6
Islington LB	1,501	29.7
Camden LB	1,486	28.5
Hammersmith and Fulham LB	1,344	28.0
Brent LB	2,386	27.7
Tower Hamlets LB	1,629	27.4
Lambeth LB	2,136	27.1
Haringey LB	1,900	26.1
Southwark LB	1,941	25.2
Newham LB	2,121	23.5
Wandsworth LB	2,340	23.1
Lewisham LB	2,163	22.9
Ealing LB	2,788	22.8
Barnet LB	2,837	19.2
Hounslow LB	2,130	18.9
Enfield LB	2,548	18.6
Greenwich LB	1,979	18.4
Waltham Forest LB	2,053	17.6
Croydon LB	3,074	16.1
Redbridge LB	2,235	16.1
Harrow LB	2,028	15.8
Richmond Upon Thames LB	1,500	15.7
Merton LB	1,535	15.5
Kingston Upon Thames LB	1,237	15.2
Barking and Dagenham LB	1,363	14.8
City of London LB	27	14.8
Hillingdon LB	2,284	14.6
Bromley LB	2,765	12.4
Bexley LB	2,159	12.0
Sutton LB	1,701	10.4
Havering LB	2,246	9.9
2 Greater Manchester	23,740	13.3
Bolton MD	2,436	11.6
Bury MD	1,651	11.8
Manchester MD	3,759	19.9
Oldham MD	2,054	15.0
Rochdale MD	2,019	14.7
Salford MD	1,976	15.7
Stockport MD	2,772	10.3
Tameside MD	2,060	10.5

Trafford MD	2,028	12.2
Wigan MD	2,985	9.3
3 Merseyside	13,138	14.6
Knowsley MD	1,452	18.0
Liverpool MD	4,253	18.4
St Helens MD	1,684	9.3
Sefton MD	2,751	12.7
Wirral MD	2,998	12.3
4 South Yorkshire	12,082	9.3
Barnsley MD	2,073	8.3
Doncaster MD	2,807	10.0
Rotherham MD	2,491	9.4
Sheffield MD	4,711	9.2
5 Tyne and Wear	10,298	11.5
Gateshead MD	1,835	11.7
Newcastle upon Tyne MD	2,458	14.4
North Tyneside MD	1,804	11.4
South Tyneside MD	1,459	9.6
Sunderland MD	2,742	9.8
6 West Midlands	25,095	12.9
Birmingham MD	9,421	16.1
Coventry MD	2,918	14.4
Dudley MD	3,039	7.7
Sandwell MD	2,831	12.0
Solihull MD	1,961	9.2
Walsall MD	2,492	10.2
Wolverhampton MD	2,433	11.6
7 West Yorkshire	19,543	12.5
Bradford MD	4,597	13.9
Calderdale MD	1,801	13.2
Kirklees MD	3,662	11.4
Leeds MD	6,472	13.1
Wakefield MD	3,011	9.7
8 Avon	8,881	11.6
Bath CD	706	12.5
Bristol CD	3,558	14.0
Kingswood CD	862	7.7
Northavon CD	1,272	10.0
Wansdyke CD	787	10.0
Woodspring CD	1,696	10.1
9 Bedfordshire	5,174	12.2
Luton CD	1,727	16.3
Mid Befordshire CD	1,145	8.9
North Bedfordshire CD	1,278	12.1
South Bedfordshire CD	1,024	9.0
10 Berkshire	7,257	12.5
Bracknell Forest CD	943	10.6
Newbury CD	1,397	9.9
Reading CD	1,221	13.8

Slough CD	1,097	17.8
Windsor and Maidenhead CD	1,224	13.2
Wokingham CD	1,375	10.3
11 Buckinghamshire	6,345	12.6
Aylesbury Vale CD	1,480	10.8
Chiltern CD	895	11.4
Milton Keynes CD	1,831	13.5
South Bucks CD	606	15.5
Wycombe CD	1,533	12.9
12 Cambridgeshire	6,027	11.1
Cambridge CD	838	13.7
East Cambridgeshire CD	537	7.6
Fenland CD	738	10.7
Huntingdonshire CD	1,318	10.2
Peterborough CD	1,411	12.3
South Cambridgeshire CD	1,185	10.3
13 Cheshire	9,182	10.1
Chester CD	1,091	10.9
Congleton CD	851	8.5
Crewe and Nantwich CD	992	8.3
Ellesmere Port and Neston CD	735	10.9
Halton CD	1,209	12.3
Macclesfield CD	1,433	9.6
Vale Royal CD	1,055	10.4
Warrington CD	1,816	9.8
14 Cleveland	5,300	11.1
Hartlepool CD	853	11.6
Langbaurgh-on-Tees CD	1,352	10.5
Middlesbrough CD	1,354	13.2
Stockton-on-Tees CD	1,741	9.6
15 Cornwall (and Isle of Scilly)	4,571	10.0
Caradon CD	772	9.1
Carrick CD	790	11.5
Kerrier CD	865	9.0
North Cornwall CD	745	11.0
Penwith CD	549	9.8
Restormel CD	832	9.5
Scilly, Isle of CD	18	22.2
16 Cumbria	4,683	8.9
Allerdale CD	962	8.9
Barrow-in-Furness CD	720	10.6
Carlisle CD	924	8.8
Copeland CD	672	7.0
Eden CD	450	11.1
South Lakeland CD	955	7.9
17 Derbyshire	8,982	8.8
Amber Valley CD	1,059	5.1
Bolsover CD	653	8.4
Chesterfield CD	874	8.9
Derby CD	2,190	11.5

Derbyshire Dales CD	672	7.3
Erewash CD	964	6.8
High Peak CD	835	11.0
North East Derbyshire CD	1,012	7.4
South Derbyshire CD	723	9.1
18 Devon	9,458	9.5
East Devon CD	1,099	8.0
Exeter CD	962	11.5
Mid Devon CD	615	8.3
North Devon CD	784	9.6
Plymouth CD	2,271	10.3
South Hams CD	680	9.4
Teignbridge CD	986	8.4
Torbay CD	1,061	9.6
Torridge CD	554	7.2
West Devon CD	446	10.8
19 Dorset	6,083	10.3
Bournemouth CD	1,400	11.7
Christchurch CD	361	7.2
East Dorset CD	750	10.0
North Dorset CD	513	11.9
Poole CD	1,264	10.8
Purbeck CD	431	11.6
West Dorset CD	796	7.9
Weymouth and Portland CD	568	8.8
20 Durham	5,671	9.0
Chester-le-Street CD	497	9.9
Darlington CD	922	10.6
Derwentside CD	788	7.7
Durham CD	782	11.3
Easington CD	971	7.8
Sedgefield CD	850	7.8
Teesdale CD	258	6.2
Wear Valley CD	603	9.8
21 East Sussex	6,093	12.0
Brighton CD	1,261	15.5
Eastbourne CD	717	11.9
Hastings CD	720	10.4
Hove CD	729	14.7
Lewes CD	764	9.8
Rother CD	732	9.6
Wealdon CD	1,170	10.7
22 Essex	14,612	10.0
Basildon CD	1,588	11.2
Braintree CD	1,051	8.3
Brentwood CD	713	9.0
Castle Point CD	830	9.0
Chelmsford CD	1,510	9.4
Colchester CD	1,374	11.0
Epping Forest CD	1,134	10.3
Harlow CD	753	10.8
Maldon CD	475	7.4

Rochford CD	755	9.9
Southend-on-Sea CD	1,417	11.1
Tendring CD	1,167	9.3
Thurrock CD	1,232	11.5
Uttlesford CD	613	7.0
23 Gloucestershire	4,971	9.4
Cheltenham CD	961	12.0
Cotswold CD	707	9.6
Forest of Dean CD	686	9.2
Gloucester CD	938	9.7
Stroud CD	1,014	8.2
Tewkesbury CD	665	7.2
24 Hampshire	14,940	10.6
Basingstoke and Deane CD	1,408	9.9
East Hampshire CD	968	10.6
Eastleigh CD	1,063	8.7
Fareham CD	1,001	9.0
Gosport CD	738	11.2
Hart CD	780	9.4
Havant CD	1,180	10.4
New Forest CD	1,525	9.6
Portsmouth CD	1,664	11.9
Rushmoor CD	837	11.7
Southampton CD	1,870	11.9
Test Valley CD	995	9.4
Winchester CD	911	12.7
25 Hereford and Worcester	6,503	9.1
Bromsgrove CD	887	8.2
Hereford CD	488	10.7
Leominster CD	392	7.7
Malvern Hills CD	826	9.4
Redditch CD	786	9.0
South Herefordshire CD	471	11.3
Worcester CD	759	10.5
Wychavon CD	994	8.0
Wyre Forest CD	900	8.2
26 Hertfordshire	9,504	11.7
Broxbourne CD	822	13.6
Dacorum CD	1,291	10.5
East Hertfordshire CD	1,095	9.5
Hertsmere CD	828	12.0
North Hertfordshire CD	1,125	10.2
St Albans CD	1,235	11.8
Stevenage CD	765	9.9
Three Rivers CD	781	14.5
Watford CD	682	16.1
Welwyn Hatfield CD	880	11.5
27 Humberside	8,385	9.2
Boothferry CD	642	8.9
Cleethorpes CD	693	9.5
East Yorkshire CD	837	7.9
E.Yorks Boro of Beverley CD	1,081	7.0

Glanford CD	715	8.4
Great Grimsby CD	860	8.6
Holderness CD	499	6.8
Kingston upon Hull CD	2,434	11.4
Scunthorpe CD	624	9.8
28 Isle of Wight	1,132	11.2
Medina CD	657	12.0
South Wight CD	475	10.1
29 Kent	14,521	10.5
Ashford CD	924	11.7
Canterbury CD	1,146	9.8
Dartford CD	820	10.0
Dover CD	1,012	10.4
Gillingham CD	972	10.2
Gravesham CD	902	11.3
Maidstone CD	1,250	10.4
Rochester upon Medway CD	1,482	10.9
Sevenoaks CD	1,019	9.9
Shepway CD	810	12.1
Swale CD	1,156	10.4
Thanet CD	1,089	11.4
Tonbridge and Malling CD	978	8.8
Tunbridge Wells CD	961	10.5
30 Lancashire	13,123	11.9
Blackburn CD	1,346	14.7
Blackpool CD	1,327	13.0
Burnley CD	844	12.6
Chorley CD	922	8.4
Fylde CD	676	11.7
Hyndburn CD	750	13.5
Lancaster CD	1,155	11.8
Pendle CD	822	14.6
Preston CD	1,213	16.0
Ribble Valley CD	476	5.3
Rossendale CD	646	11.5
South Ribble CD	1,032	8.2
West Lancashire CD	1,014	9.9
Wyre CD	900	11.1
31 Leicestershire	8,492	10.6
Blaby CD	787	7.4
Charnwood CD	1,448	9.4
Harborough CD	653	9.5
Hinckley and Bosworth CD	943	8.4
Leicester CD	2,703	14.8
Melton CD	448	8.7
North West Leicestershire CD	710	8.2
Oadby and Wigston CD	497	8.0
Rutland CD	303	10.2
32 Lincolnshire	5,442	8.7
Boston CD	526	6.7
East Lindsey CD	1,018	11.0
Lincoln CD	790	10.0

North Kesteven CD	764	8.6
South Holland CD	624	7.1
South Kesteven CD	1,023	7.7
West Lindsey CD	697	8.6
33 Norfolk	6,992	9.3
Breckland CD	1,013	8.4
Broadland CD	1,059	7.6
Great Yarmouth CD	827	10.0
Kings Lynn and West Norfolk CD	1,163	9.7
North Norfolk CD	824	9.1
Norwich CD	1,130	11.6
South Norfolk CD	976	8.6
34 Northamptonshire	5,535	10.3
Corby CD	522	13.2
Daventry CD	599	8.3
East Northamptonshire CD	713	7.7
Kettering CD	702	9.1
Northampton CD	1,694	12.1
South Northamptonshire CD	658	10.6
Wellingborough CD	647	8.7
35 Northumberland	2,901	9.9
Alnwick CD	313	8.0
Berwick-upon-Tweed CD	255	16.9
Blyth Valley CD	781	8.6
Castle Morpeth CD	479	8.8
Tynedale CD	530	9.4
Wansbeck CD	543	11.2
36 North Yorkshire	6,665	10.1
Craven CD	522	7.1
Hambleton CD	767	9.6
Harrogate CD	1,340	11.4
Richmondshire CD	432	14.4
Ryedale CD	883	9.4
Scarborough CD	1,000	10.1
Selby CD	843	8.7
York CD	878	10.3
37 Nottinghamshire	9,501	10.5
Ashfield CD	1,033	7.4
Bassetlaw CD	1,002	9.7
Broxtowe CD	1,053	10.2
Gedling CD	1,055	10.3
Mansfield CD	939	7.3
Newark and Sherwood CD	1,009	8.5
Nottingham CD	2,467	15.4
Rushcliffe CD	943	8.2
38 Oxfordshire	5,248	11.6
Cherwell CD	1,068	12.4
Oxford CD	1,034	18.5
South Oxfordshire CD	1,190	9.2
Vale of White Horse CD	1,084	9.7

West Oxfordshire CD	872	8.1
39 Shropshire	3,856	9.1
Bridgnorth CD	475	7.2
North Shropshire CD	481	9.8
Oswestry CD	312	9.9
Shrewsbury and Atcham CD	897	7.9
South Shropshire CD	336	8.6
The Wrekin CD	1,355	10.3
40 Somerset	4,409	8.5
Mendip CD	935	9.4
Sedgemoor CD	918	8.2
South Somerset CD	1,374	8.1
Taunton Deane CD	894	7.8
West Somerset CD	288	11.1
41 Staffordshire	9,851	8.9
Cannock Chase CD	878	6.7
East Staffordshire CD	891	9.3
Lichfield CD	863	7.1
Newcastle-under-Lyme CD	1,134	7.9
South Staffordshire CD	1,038	7.2
Stafford CD	1,108	10.0
Staffordshire Moorlands CD	850	7.6
Stoke-on-Trent CD	2,376	11.5
Tamworth CD	713	8.6
42 Suffolk	5,929	8.9
Babergh CD	799	7.4
Forest Heath CD	435	15.2
Ipswich CD	1,095	9.4
Mid Suffolk CD	756	7.1
St Edmundsbury CD	872	8.5
Suffolk Coastal CD	967	8.8
Waveney CD	1,005	8.7
43 Surrey	9,812	11.4
Elmbridge CD	1,083	12.7
Epsom and Ewell CD	633	10.3
Guildford CD	1,161	9.5
Mole Valley CD	777	13.5
Reigate & Banstead CD	1,132	10.7
Runnymeade CD	717	12.6
Spelthorne CD	854	9.1
Surrey Heath CD	821	11.1
Tandridge CD	737	11.9
Waverley CD	1,075	12.2
Woking CD	822	12.7
44 Warwickshire	4,837	8.7
North Warwickshire CD	602	8.3
Nuneaton and Bedworth CD	1,176	9.3
Rugby CD	870	8.4
Stratford-on-Avon CD	1,019	7.1
Warwick CD	1,170	10.1

45 West Sussex	6,667	10.2
Adur CD	577	9.0
Arun CD	1,157	10.9
Chichester CD	971	10.3
Crawley CD	858	11.9
Horsham CD	1,098	10.0
Mid Sussex CD	1,173	9.5
Worthing CD	833	9.6
46 Wiltshire	5,498	9.9
Kennet CD	676	11.8
North Wiltshire CD	1,139	10.2
Salisbury CD	1,002	10.2
Thamesdown CD	1,665	10.1
West Wiltshire CD	1,016	8.0
56 Clwyd	3,857	11.3
Alyn and Deeside CD	722	10.7
Colwyn CD	491	14.1
Delyn CD	629	9.7
Glyndwr CD	400	9.8
Rhuddlan CD	483	14.3
Wrexham Maelor CD	1,132	10.7
57 Dyfed	3,226	11.0
Carmarthen CD	517	9.1
Ceredigion CD	615	11.9
Dinefwr CD	343	9.3
Llanelli CD	695	10.5
Preseli Pembrokeshire CD	652	11.2
South Pembrokeshire CD	404	14.1
58 Gwent	4,166	10.6
Blaenau Gwent CD	694	9.2
Islwyn CD	646	9.8
Monmouth CD	747	9.4
Newport CD	1,251	13.2
Torfaen CD	828	9.8
59 Gwynedd	2,248	13.5
Aberconwy CD	477	11.7
Arfon CD	511	15.1
Dwyfor CD	233	15.9
Meirionnydd CD	319	11.9
Ynys Mon - Isle of Anglesey CD	708	13.6
60 Mid-Glamorgan	5,041	10.8
Cynon Valley CD	603	11.4
Merthyr Tydfil CD	555	11.0
Ogwr CD	1,271	11.4
Rhondda CD	714	10.6
Rhymney Valley CD	1,016	9.6
Taff-Ely CD	882	11.0
61 Powys	1,106	9.2
Brecknock CD	387	9.8
Montgomeryshire CD	498	8.8

Radnorshire CD	221	9.0
62 South Glamorgan	3,794	14.0
Cardiff CD	2,669	14.9
Vale of Glamorgan CD	1,125	11.9
63 West Glamorgan		
Lliw Valley CD	603	11.8
Neath CD	623	9.5
Port Talbot CD	452	8.8
Swansea CD	1,662	11.7

Appendix 2 LS members born between the 1991 Census and up to the end of 1995 who were not accounted for in 2001, by county and local authority

County/ local authority	LS members found in 1991 and not recorded as having died or embarked by 2001	% not found in 2001
England and Wales 1990s total[a]	69,786	14.3
1 Greater London	5,304	24.0
Westminister LB	109	51.4
Kensington and Chelsea LB	77	44.2
Hammersmith and Fulham LB	118	38.1
Hackney LB	181	35.9
Lambeth LB	191	33.0
Haringey LB	187	32.1
Camden LB	121	30.6
Tower Hamlets LB	185	29.7
Brent LB	206	29.6
Barking and Dagenham LB	112	25.9
Southwark LB	202	25.2
Ealing LB	229	24.9
Hounslow LB	170	24.7
Waltham Forest LB	217	24.0
Enfield LB	203	23.6
Wandsworth LB	197	23.4
Islington LB	133	23.3
Newham LB	234	23.1
Lewisham LB	206	22.8
Greenwich LB	178	22.5
Barnet LB	204	22.1
Croydon LB	241	20.7
Merton LB	134	19.4
Harrow LB	152	19.1
Kingston Upon Thames LB	75	17.3
Redbridge LB	162	16.0
Bromley LB	185	15.1
Sutton LB	125	13.6
Richmond Upon Thames LB	110	12.7
Hillingdon LB	186	12.4
Bexley LB	144	10.4
Havering LB	128	10.2
City of London LB	*	*
2 Greater Manchester	1,807	16.7
Bolton MD	216	16.2
Bury MD	106	17.0
Manchester MD	346	25.1
Oldham MD	160	21.3
Rochdale MD	154	12.3
Salford MD	171	18.1
Stockport MD	168	12.5
Tameside MD	158	9.5
Trafford MD	120	16.7
Wigan MD	208	10.6

3 Merseyside	969	15.9
Knowsley MD	144	17.4
Liverpool MD	321	21.8
St Helens MD	103	9.7
Sefton MD	184	12.0
Wirral MD	217	12.4
4 South Yorkshire	882	11.7
Barnsley MD	133	7.5
Doncaster MD	205	15.1
Rotherham MD	184	10.3
Sheffield MD	360	11.9
5 Tyne and Wear	711	14.5
Gateshead MD	119	16.8
Newcastle upon Tyne MD	184	17.4
North Tyneside MD	114	15.8
South Tyneside MD	118	11.0
Sunderland MD	176	11.4
6 West Midlands	1,969	14.0
Birmingham MD	813	16.9
Coventry MD	213	15.5
Dudley MD	204	3.9
Sandwell MD	243	17.7
Solihull MD	115	13.0
Walsall MD	200	8.5
Wolverhampton MD	181	12.7
7 West Yorkshire	1,443	13.3
Bradford MD	390	12.8
Calderdale MD	123	13.0
Kirklees MD	293	15.0
Leeds MD	435	14.0
Wakefield MD	202	10.4
8 Avon	681	12.0
Bath CD	46	15.2
Bristol CD	290	14.8
Kingswood CD	67	9.0
Northavon CD	111	11.7
Wansdyke CD	50	8.0
Woodspring CD	117	7.7
9 Bedfordshire	407	13.5
Luton CD	154	18.8
Mid Befordshire CD	72	13.9
North Bedfordshire CD	100	8.0
South Bedfordshire CD	81	9.9
10 Berkshire	542	11.6
Bracknell Forest CD	83	6.0
Newbury CD	104	7.7
Reading CD	107	13.1
Slough CD	82	22.0
Windsor and Maidenhead CD	72	15.3
Wokingham CD	94	7.4

11 Buckinghamshire	462	14.9
Aylesbury Vale CD	105	10.5
Chiltern CD	57	17.5
Milton Keynes CD	147	13.6
South Bucks CD	44	20.5
Wycombe CD	109	17.4
12 Cambridgeshire	426	11.5
Cambridge CD	43	11.6
East Cambridgeshire CD	44	6.8
Fenland CD	53	5.7
Huntingdonshire CD	98	5.1
Peterborough CD	121	21.5
South Cambridgeshire CD	67	10.4
13 Cheshire	617	11.2
Chester CD	88	15.9
Congleton CD	52	5.8
Crewe and Nantwich CD	63	11.1
Ellesmere Port and Neston CD	42	7.1
Halton CD	78	16.7
Macclesfield CD	91	7.7
Vale Royal CD	70	15.7
Warrington CD	133	8.3
14 Cleveland	357	9.2
Hartlepool CD	60	3.3
Langbaurgh-on-Tees CD	100	6.0
Middlesbrough CD	99	16.2
Stockton-on-Tees CD	98	9.2
15 Cornwall (and Isle of Scilly)	253	10.3
Caradon CD	41	4.9
Carrick CD	42	2.4
Kerrier CD	44	11.4
North Cornwall CD	39	12.8
Penwith CD	31	19.4
Restormel CD	55	12.7
Scilly, Isle of CD	*	*
16 Cumbria	291	8.2
Allerdale CD	53	9.4
Barrow-in-Furness CD	53	11.3
Carlisle CD	64	7.8
Copeland CD	37	5.4
Eden CD	27	7.4
South Lakeland CD	57	7.0
17 Derbyshire	590	11.5
Amber Valley CD	59	10.2
Bolsover CD	38	7.9
Chesterfield CD	68	8.8
Derby CD	166	15.7
Derbyshire Dales CD	33	6.1
Erewash CD	67	10.4
High Peak CD	47	17.0

North East Derbyshire CD	66	6.1
South Derbyshire CD	46	13.0
18 Devon	595	8.6
East Devon CD	56	3.6
Exeter CD	68	4.4
Mid Devon CD	37	0.0
North Devon CD	52	9.6
Plymouth CD	164	10.4
South Hams CD	48	8.3
Teignbridge CD	66	10.6
Torbay CD	56	8.9
Torridge CD	23	0.0
West Devon CD	25	32.0
19 Dorset	363	10.5
Bournemouth CD	88	11.4
Christchurch CD	23	4.3
East Dorset CD	33	0.0
North Dorset CD	29	3.4
Poole CD	91	16.5
Purbeck CD	37	13.5
West Dorset CD	30	6.7
Weymouth and Portland CD	32	12.5
20 Durham	376	9.8
Chester-le-Street CD	31	6.5
Darlington CD	70	15.7
Derwentside CD	44	4.5
Durham CD	55	7.3
Easington CD	67	13.4
Sedgefield CD	53	7.5
Teesdale CD	18	11.1
Wear Valley CD	38	7.9
21 East Sussex	426	13.6
Brighton CD	104	24.0
Eastbourne CD	47	4.3
Hastings CD	54	14.8
Hove CD	63	6.3
Lewes CD	42	14.3
Rother CD	51	9.8
Wealdon CD	65	12.3
22 Essex	1,037	10.7
Basildon CD	133	10.5
Braintree CD	79	6.3
Brentwood CD	52	11.5
Castle Point CD	43	7.0
Chelmsford CD	100	12.0
Colchester CD	96	8.3
Epping Forest CD	54	11.1
Harlow CD	52	1.9
Maldon CD	43	14.0
Rochford CD	41	9.8
Southend-on-Sea CD	121	14.9
Tendring CD	71	9.9

Thurrock CD	113	14.2
Uttlesford CD	39	12.8
23 Gloucestershire	338	7.4
Cheltenham CD	52	9.6
Cotswold CD	45	13.3
Forest of Dean CD	39	2.6
Gloucester CD	97	8.2
Stroud CD	56	8.9
Tewkesbury CD	49	0.0
24 Hampshire	1,030	8.1
Basingstoke and Deane CD	103	5.8
East Hampshire CD	59	6.8
Eastleigh CD	81	11.1
Fareham CD	45	15.6
Gosport CD	66	4.5
Hart CD	46	4.3
Havant CD	71	5.6
New Forest CD	95	5.3
Portsmouth CD	135	7.4
Rushmoor CD	85	5.9
Southampton CD	130	10.0
Test Valley CD	71	9.9
Winchester CD	43	18.6
25 Hereford and Worcester	435	5.7
Bromsgrove CD	54	1.9
Hereford CD	45	8.9
Leominster CD	20	15.0
Malvern Hills CD	34	5.9
Redditch CD	66	7.6
South Herefordshire CD	33	3.0
Worcester CD	65	4.6
Wychavon CD	63	6.3
Wyre Forest CD	55	3.6
26 Hertfordshire	713	11.2
Broxbourne CD	59	8.5
Dacorum CD	94	17.0
East Hertfordshire CD	87	10.3
Hertsmere CD	60	8.3
North Hertfordshire CD	97	11.3
St Albans CD	95	9.5
Stevenage CD	63	11.1
Three Rivers CD	49	14.3
Watford CD	42	11.9
Welwyn Hatfield CD	67	9.0
27 Humberside	570	8.6
Boothferry CD	48	6.3
Cleethorpes CD	43	7.0
East Yorkshire CD	45	8.9
E.Yorks Boro of Beverley CD	51	7.8
Glanford CD	47	4.3
Great Grimsby CD	60	11.7
Holderness CD	23	0.0

Kingston upon Hull CD	199	11.6
Scunthorpe CD	54	5.6
28 Isle of Wight	72	11.1
Unitary Authority	*	*
Medina CD	38	10.5
South Wight CD	21	14.3
29 Kent	979	11.0
Ashford CD	59	13.6
Canterbury CD	68	10.3
Dartford CD	64	14.1
Dover CD	74	8.1
Gillingham CD	68	11.8
Gravesham CD	53	1.9
Maidstone CD	84	14.3
Rochester upon Medway CD	108	9.3
Sevenoaks CD	71	9.9
Shepway CD	43	27.9
Swale CD	77	10.4
Thanet CD	84	11.9
Tonbridge and Malling CD	76	11.8
Tunbridge Wells CD	50	2.0
30 Lancashire	931	12.7
Blackburn CD	112	12.5
Blackpool CD	80	11.3
Burnley CD	67	23.9
Chorley CD	63	14.3
Fylde CD	37	10.8
Hyndburn CD	62	14.5
Lancaster CD	87	10.3
Pendle CD	65	15.4
Preston CD	108	13.0
Ribble Valley CD	30	3.3
Rossendale CD	42	14.3
South Ribble CD	66	12.1
West Lancashire CD	65	3.1
Wyre CD	47	14.9
31 Leicestershire	571	12.6
Blaby CD	51	5.9
Charnwood CD	86	7.0
Harborough CD	53	15.1
Hinckley and Bosworth CD	44	13.6
Leicester CD	217	19.4
Melton CD	24	8.3
North West Leicestershire CD	52	7.7
Oadby and Wigston CD	29	0.0
Rutland CD	*	*
32 Lincolnshire	328	8.2
Boston CD	26	15.4
East Lindsey CD	57	3.5
Lincoln CD	54	7.4
North Kesteven CD	42	7.1
South Holland CD	32	9.4

South Kesteven CD	65	7.7
West Lindsey CD	52	11.5
33 Norfolk	457	9.8
Breckland CD	64	9.4
Broadland CD	89	6.7
Great Yarmouth CD	63	17.5
Kings Lynn and West Norfolk CD	72	9.7
North Norfolk CD	39	15.4
Norwich CD	82	7.3
South Norfolk CD	48	6.3
34 Northamptonshire	387	12.4
Corby CD	40	10.0
Daventry CD	40	12.5
East Northamptonshire CD	38	2.6
Kettering CD	38	10.5
Northampton CD	147	17.0
South Northamptonshire CD	38	13.2
Wellingborough CD	46	8.7
35 Northumberland	179	10.1
Alnwick CD	10	0.0
Berwick-upon-Tweed CD	11	0.0
Blyth Valley CD	53	9.4
Castle Morpeth CD	26	7.7
Tynedale CD	31	9.7
Wansbeck CD	48	16.7
36 North Yorkshire	425	11.5
Craven CD	26	7.7
Hambleton CD	43	7.0
Harrogate CD	95	15.8
Richmondshire CD	32	18.8
Ryedale CD	50	4.0
Scarborough CD	65	15.4
Selby CD	61	11.5
York CD	53	7.5
37 Nottinghamshire	681	11.7
Ashfield CD	80	7.5
Bassetlaw CD	81	12.3
Broxtowe CD	67	9.0
Gedling CD	61	4.9
Mansfield CD	54	7.4
Newark and Sherwood CD	53	7.5
Nottingham CD	234	19.2
Rushcliffe CD	51	3.9
38 Oxfordshire	396	12.4
Cherwell CD	96	12.5
Oxford CD	95	20.0
South Oxfordshire CD	68	10.3
Vale of White Horse CD	69	10.1
West Oxfordshire CD	68	5.9

39 Shropshire	250	11.6
Bridgnorth CD	27	18.5
North Shropshire CD	33	24.2
Oswestry CD	*	*
Shrewsbury and Atcham CD	44	4.5
South Shropshire CD	23	0.0
The Wrekin CD	110	10.9
40 Somerset	306	5.9
Mendip CD	62	3.2
Sedgemoor CD	71	4.2
South Somerset CD	86	9.3
Taunton Deane CD	70	5.7
West Somerset CD	17	5.9
41 Staffordshire	667	9.4
Cannock Chase CD	59	8.5
East Staffordshire CD	66	6.1
Lichfield CD	56	8.9
Newcastle-under-Lyme CD	75	10.7
South Staffordshire CD	63	4.8
Stafford CD	71	15.5
Staffordshire Moorlands CD	52	9.6
Stoke-on-Trent CD	170	8.2
Tamworth CD	55	14.5
42 Suffolk	415	12.8
Babergh CD	44	15.9
Forest Heath CD	57	42.1
Ipswich CD	89	3.4
Mid Suffolk CD	48	6.3
St Edmundsbury CD	53	11.3
Suffolk Coastal CD	51	5.9
Waveney CD	73	9.6
43 Surrey	656	11.1
Elmbridge CD	75	14.7
Epsom and Ewell CD	39	5.1
Guildford CD	80	13.8
Mole Valley CD	40	2.5
Reigate & Banstead CD	75	10.7
Runnymeade CD	47	23.4
Spelthorne CD	69	8.7
Surrey Heath CD	55	10.9
Tandridge CD	43	16.3
Waverley CD	71	8.5
Woking CD	62	6.5
44 Warwickshire	311	10.9
North Warwickshire CD	35	5.7
Nuneaton and Bedworth CD	91	12.1
Rugby CD	54	13.0
Stratford-on-Avon CD	60	10.0
Warwick CD	71	11.3
45 West Sussex	407	13.5
Adur CD	32	6.3

Arun CD	68	16.2
Chichester CD	49	10.2
Crawley CD	65	29.2
Horsham CD	69	8.7
Mid Sussex CD	76	6.6
Worthing CD	48	14.6
46 Wiltshire	413	8.5
Kennet CD	52	13.5
North Wiltshire CD	102	7.8
Salisbury CD	61	4.9
Thamesdown CD	136	8.8
West Wiltshire CD	62	8.1
56 Clwyd	251	11.2
Alyn and Deeside CD	45	15.6
Colwyn CD	34	2.9
Delyn CD	41	4.9
Glyndwr CD	26	11.5
Rhuddlan CD	36	8.3
Wrexham Maelor CD	69	17.4
57 Dyfed	205	9.8
Carmarthen CD	26	7.7
Ceredigion CD	39	5.1
Dinefwr CD	22	9.1
Llanelli CD	39	12.8
Preseli Pembrokeshire CD	45	8.9
South Pembrokeshire CD	34	14.7
58 Gwent	330	9.7
Blaenau Gwent CD	52	9.6
Islwyn CD	53	11.3
Monmouth CD	45	6.7
Newport CD	117	10.3
Torfaen CD	63	9.5
59 Gwynedd	130	10.8
Aberconwy CD	38	5.3
Arfon CD	31	19.4
Dwyfor CD	15	0.0
Meirionnydd CD	13	0.0
Ynys Mon - Isle of Anglesey CD	33	18.2
60 Mid-Glamorgan	379	10.6
Cynon Valley CD	38	10.5
Merthyr Tydfil CD	36	22.2
Ogwr CD	99	8.1
Rhondda CD	62	11.3
Rhymney Valley CD	82	6.1
Taff-Ely CD	62	12.9
61 Powys	74	12.2
Brecknock CD	22	9.1
Montgomeryshire CD	43	9.3
Radnorshire CD	*	*

62 South Glamorgan	311	16.1
Cardiff CD	218	16.1
Vale of Glamorgan CD	93	16.1
63 West Glamorgan	214	10.3
Lliw Valley CD	36	16.7
Neath CD	30	10.0
Port Talbot CD	28	7.1
Swansea CD	120	9.2

Notes

* Small numbers, not included.

This table does not include three LS members for whom we have missing or inadequately described county information. Only births between 1991 Census and the end of 1995 are included.

a The England and Wales total represents all 1991-2001 births.

Appendix 3 LS immigration, the International Passenger Survey and Total International Migration compared

It is important to know whether the completeness of immigration recording in the LS has changed over time. There is some value in comparing immigration to the LS with in-flows to England and Wales derived from the International Passenger Survey (IPS). However, there are limitations on the conclusions that can be drawn from this because:

- The IPS only samples from international arrivals and departures, so domestic flights (including those from the Irish Republic) or via ferry routes across the Irish Sea are not included
- LS 'immigrants' are only recorded as such when they register with a GP
- IPS immigrants are those who declare an intention to remain for a year or longer, at the point of entry

Table A3.1 LS immigrants and International Passenger Survey in-flows to England and Wales compared, 1971-2000

	Male			Female			All		
Year of entry	LS immi-grants	IPS immi-grants	Ratio LS: IPS	LS immi-grants	IPS immi-grants	Ratio LS: IPS	LS immi-grants	IPS immi-grants	Ratio LS: IPS
1971 (part)	1,055	67,048	**1.57**	1083	61959	**1.75**	2,138	129,007	**1.66**
1972	1,825	108,300	**1.69**	1,853	100,800	**1.84**	3,678	209,000	**1.76**
1973	1,757	97,800	**1.80**	1,778	84,700	**2.10**	3,535	182,500	**1.94**
1974	1,541	94,300	**1.63**	1,656	71,900	**2.30**	3,197	166,200	**1.92**
1975	1,539	94,100	**1.64**	1,879	86,700	**2.17**	3,418	180,800	**1.89**
1976	1,646	92,900	**1.77**	1,719	85,100	**2.02**	3,365	178,000	**1.89**
1977	1,328	79,900	**1.66**	1,676	68,900	**2.43**	3,004	148,800	**2.02**
1978	1,452	89,500	**1.62**	1,604	86,100	**1.86**	3,056	175,600	**1.74**
1979	1,387	95,700	**1.45**	1,435	85,300	**1.68**	2,822	181,000	**1.56**
1980	1,231	86,100	**1.43**	1,330	77,200	**1.72**	2,561	163,300	**1.57**
1981	960	75,700	**1.27**	1,095	64,900	**1.69**	2,055	140,600	**1.46**
1982	788	96,000	**0.82**	889	93,500	**0.95**	1,677	189,500	**0.88**
1983	849	97,400	**0.87**	999	88,300	**1.13**	1,848	185,800	**0.99**
1984	923	93,400	**0.99**	1,061	93,300	**1.14**	1,984	186,700	**1.06**
1985	976	92,100	**1.06**	1,192	124,500	**0.96**	2,168	216,600	**1.00**
1986	1,208	113,500	**1.06**	1,398	118,300	**1.18**	2,606	231,800	**1.12**
1987	1,177	97,700	**1.20**	1,363	102,300	**1.33**	2,540	200,000	**1.27**
1988	1,196	101,900	**1.17**	1,350	100,100	**1.35**	2,546	201,900	**1.26**
1989	1,249	101,400	**1.23**	1,359	129,700	**1.05**	2,608	231,100	**1.13**
1990	1,346	124,700	**1.08**	1,623	126,100	**1.29**	2,969	250,800	**1.18**
1991	2,193	108,500	**2.02**	2,397	132,100	**1.81**	4,590	240,600	**1.91**
1992	1,927	89,700	**2.15**	2,018	109,200	**1.85**	3,945	198,900	**1.98**
1993	1,864	90,800	**2.05**	2,048	106,300	**1.93**	3,912	197,100	**1.98**
1994	1,932	109,800	**1.76**	2,030	119,800	**1.69**	3,962	229,600	**1.73**
1995	2,026	123,000	**1.65**	2,171	109,300	**1.99**	4,197	232,200	**1.81**
1996	2,221	119,400	**1.86**	2,307	133,000	**1.73**	4,528	252,400	**1.79**
1997	2,126	136,400	**1.56**	2,439	131,400	**1.86**	4,565	267,800	**1.70**
1998	2,377	154,200	**1.54**	2,594	156,800	**1.65**	4,971	311,000	**1.60**
1999	2,588	169,500	**1.53**	2,842	162,300	**1.75**	5,430	331,700	**1.64**
2000	3,070	176,200	**1.74**	3,092	165,000	**1.87**	6,162	341,100	**1.81**

Table A3.1 shows LS immigrants, numbers of immigrants to England and Wales derived from the IPS, and ratios of LS immigrants to IPS estimates for the years 1971-2000. This updates Tables 7.5a and 7.5b in Hattersley and Creeser, 1995.

Ratios of LS to IPS immigrants for the 1970s and 1990s are higher than in the 1980s, when the volume of LS immigration was much lower than in the 1970s and 1990s. However, this decline in the number of LS immigrants in the 1980s was not matched in the IPS, as shown in Figure A3.1. This requires further investigation.

Comparisons with Total International Migration (TIM) estimates in the 1990s are shown in Table A3.2. The TIM estimates make the following allowances for immigration not covered by the IPS:

- asylum seekers and their dependants estimated not to have been covered by the IPS
- visitor switchers: those who arrive as visitors but change their intentions and become migrants (i.e. stay for a year or more)
- migrant switchers: those who arrive with the intention of being a migrant, but subsequently change their mind and stay for less than one year
- immigrants from the Irish Republic

In addition, an adjustment has been made in the TIM figures for 1991 to 1998 for weighting methodology changes that were made in 1999. These adjustments are not included in the IPS comparison. The methodology used to create these estimates is described at: http://www.statistics.gov.uk/downloads/theme_population/Methodology%20for_Revised_International_migration_Estimates.doc

The TIM estimates are uniformly higher than the IPS, so that ratios of numbers of LS immigrants to the adjusted TIM figures are lower than those based on comparison with the IPS alone. Nevertheless, they remain higher than the proportion of the enumerated census population identified as LS members, which was around 1.09 in each census between 1971 and 2001.

Table A3.2 LS immigrants, International Passenger Survey and adjusted Total International Migration in-flows to England and Wales compared, 1991-2000					
Year of entry	LS immigrants	IPS	Ratio LS: IPS	Adjusted TIM	Ratio LS: adjusted TIM
Males					
1991	2,193	108,500	**2.02**	144,100	**1.52**
1992	1,927	89,700	**2.15**	120,600	**1.60**
1993	1,864	90,800	**2.05**	119,800	**1.56**
1994	1,932	109,800	**1.76**	146,000	**1.32**
1995	2,026	123,000	**1.65**	163,000	**1.24**
1996	2,221	119,400	**1.86**	147,000	**1.51**
1997	2,126	136,400	**1.56**	163,100	**1.30**
1998	2,377	154,200	**1.54**	193,600	**1.23**
1999	2,588	169,500	**1.53**	237,700	**1.09**
2000	3,070	176,200	**1.74**	258,800	**1.19**
Females					
1991	2,397	132,100	**1.81**	159,800	**1.50**
1992	2,018	109,200	**1.85**	131,100	**1.54**
1993	2,048	106,300	**1.93**	129,000	**1.59**
1994	2,030	119,800	**1.69**	145,900	**1.39**
1995	2,171	109,300	**1.99**	135,900	**1.60**
1996	2,307	133,000	**1.73**	152,200	**1.52**
1997	2,439	131,400	**1.86**	147,400	**1.65**
1998	2,594	156,800	**1.65**	175,400	**1.48**
1999	2,842	162,300	**1.75**	192,900	**1.47**
2000	3,092	165,000	**1.87**	200,100	**1.55**
All LS Members					
1991	4,590	240,600	**1.91**	303,900	**1.51**
1992	3,945	198,900	**1.98**	251,700	**1.57**
1993	3,912	197,100	**1.98**	248,900	**1.57**
1994	3,962	229,600	**1.73**	291,900	**1.36**
1995	4,197	232,200	**1.81**	298,900	**1.40**
1996	4,528	252,400	**1.79**	299,200	**1.51**
1997	4,565	267,800	**1.70**	310,600	**1.47**
1998	4,971	311,000	**1.60**	369,000	**1.35**
1999	5,430	331,700	**1.64**	430,600	**1.26**
2000	6,162	341,100	**1.81**	458,900	**1.34**

Figure A 3.1 LS immigrants and International Passenger Survey inflows to England and Wales 1971-2000

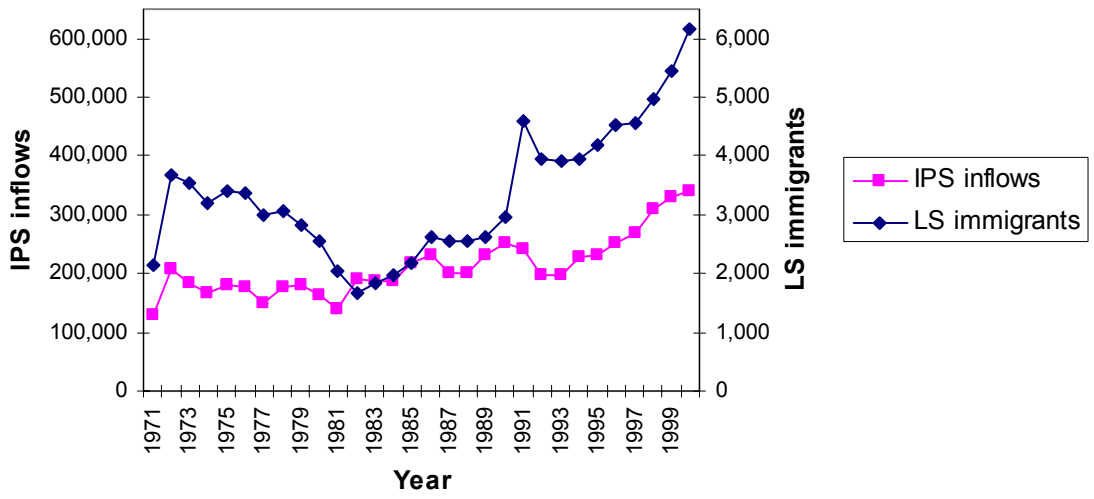
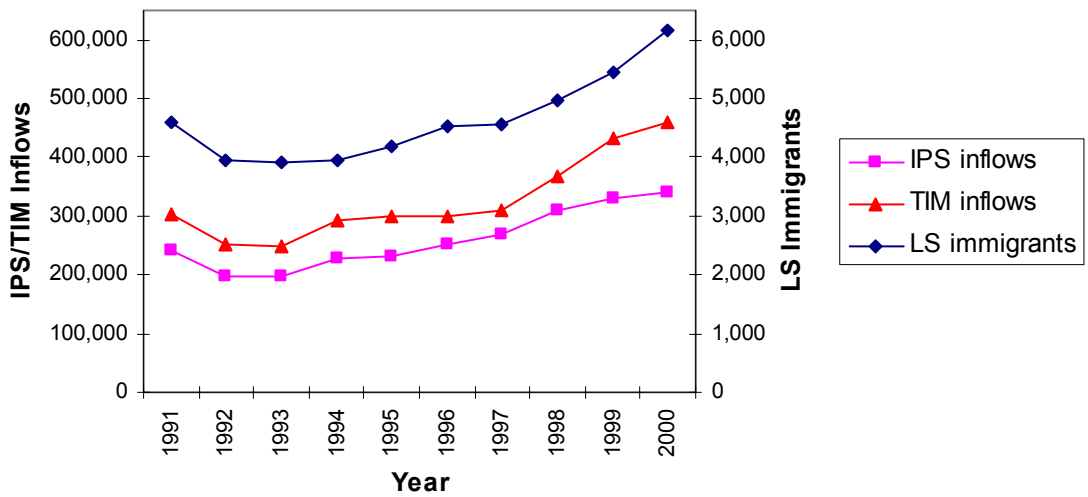


Figure A 3.2 LS immigrants, International Passenger Survey and adjusted Total International Migration inflows to England and Wales 1991-2000



Appendix 4 Modelling LS attrition at 1971/81 attrition rates

The approach can be understood incrementally, considering attrition at different censuses:

Time period	t
1971 Census	0
1981 and preceding decade (after 1971 Census)	1
1991 and preceding decade (after 1981 Census)	2
2001 and preceding decade (after 1991 Census)	3

<u>1971/81 attrition</u>

Observed attrition in 1981 has three components:
$Att_1 = r_1 + h_1 + n_1$

Where r_1 = number of traced LS members found in 1971 but not in 1981,
h_1 = number of LS members entering as NHSCR immigrants in the 1970s but not found in 1981
n_1 = number of LS members born in the 1970s but not found in 1981.

The 71/81 census-to-census attrition rate for traced LS members found in the 1971 Census but not accounted for in 1981 can be represented as:

$$\frac{r_1}{N_0 - s_1}$$

Where N_0= number of LS members found and traced in 1971,
s_1= number of traced LS members found in 1971 but either died or embarked (exits) before 1981.

The 1971/81 immigrants attrition rate for LS members who entered as NHSCR immigrants in the 1970s but were not found in 1981 can be represented as:

$$\frac{h_1}{I_1 - k_1}$$

Where I_1 = number of LS members entering as NHSCR immigrants in the 1970s,
k_1= number of LS members entering as NHSCR immigrants in the 1970s but having died or embarked by 1981.

The 1971/81attrition rate for new births is

$$\frac{n_1}{B_1 - l_1}$$

Where B_1= number of LS members born in the 1970s
l_1= number of LS members born in the 1970s but having died or embarked by 1981.

<u>1981/91 attrition</u>

The 1971/81 attrition rates are used to estimate LS attrition for 1981/1991, now with four components:

$Attr_2 = r_2 + h_2 + n_2 + m_2$

r_2 = attrition by 1991 of LS members found in 1981, at 71/81 census-to-census attrition rates:

$$r_2 = \frac{r_1}{N_0 - s_1}\left(N_0 - s_1 - r_1 + I_1 - k_1 - h_1 + B_1 - l_1 - n_1 - s_2\right)$$

s_2= number of observed 1980s deaths and embarkations for LS members found in 1981.

In addition, attrition by 1991 of LS members entering as NHSCR immigrants over the 1980s but not found in 1991, at 1970s immigrants attrition rates:

$$h_2 = \frac{h_1}{I_1 - k_1}\left(I_2 - k_2\right)$$

Where I_2 = number of LS members entering as NHSCR immigrants in the 1980s
k_2 = number of LS members entering as NHSCR immigrants in the 1980s but having died or embarked by 1991.

Attrition by 1991 of LS members born in the 1980s but not found in 1991, at 1970s new births attrition rates, is represented as:

$$n_2 = \frac{n_1}{B_1 - l_1}\left(B_2 - l_2\right)$$

Where B_2 = number of LS members born in the 1980s
l_2 = number of LS members born in the 1980s but having died or embarked by 1991, and
n_2 = number of LS members born in the 1980s but not found in 1991.

For 1991, there is also attrition of traced LS members found at the 1981 Census for the first time.

Let M_1 = number of LS members entering and traced in 1981.

The attrition rate for this group is assumed to be the same as for other LS members found at the 1981 Census. Then attrition by 1991 is represented as

$$m_2 = \frac{r_1}{N_0 - s_1}(M_1 - d_2)$$

Where d_2 = number of observed 1980s deaths and embarkations for LS members entering and traced in 1981.

Taken together, 1981/91 attrition is:

$$\frac{r_1}{N_0 - s_1}(N_0 - s_1 - r_1 + I_1 - k_1 - h_1 + B_1 - l_1 - n_1 - s_2) + \frac{h_1}{I_1 - k_1}(I_2 - k_2) + \frac{n_1}{B_1 - l_1}(B_2 - l_2) + \frac{r_1}{N_0 - s_1}(M_1 - d_2)$$

<u>1991/01 attrition</u>

Attrition for 1991/ 2001 also has four components:

$Attr_3 = r_3 + h_3 + n_3 + m_3$

Here r_3 represents attrition by 2001 of traced LS members found in 1981 and entering in the 70s and 80s whom we predict would have been found in 1991, had 71/81 attrition rates prevailed through the 1980s and 1990s:

$r_3 =$

$$\frac{r_1}{N_0 - s_1}(N_0 - s_1 - r_1 + I_1 - k_1 - h_1 + B_1 - l_1 - n_1 - s_2 - r_2 + I_2 - h_2 - k_2 + B_2 - n_2 - l_2 + M_1 - d_2 - m_2 - s_3)$$

s_3= number of observed 1990s deaths and embarkations for LS members found in 1991.

In addition, attrition by 2001 of LS members entering as NHSCR immigrants over the 1990s but not found in 2001, at 1970s immigrants attrition rates:

$$h_3 = \frac{h_1}{I_1 - k_1}(I_3 - k_3)$$

Where I_3 = number of LS members entering as NHSCR immigrants in the 1990s
k_3 = number of LS members entering as NHSCR immigrants in the 1980s but having died or embarked by 2001.

Attrition by 2001 of LS members born in the 1990s but not found in 2001, at 1970s new births attrition rates, is represented as:

$$n_3 = \frac{n_1}{B_1 - l_1}(B_3 - l_3)$$

Where B_3 = number of LS members born in the 1990s
l_3 = number of LS members born in the 1990s but having died or embarked by 2001, and
n_3 = number of LS members born in the 1990s but not found in 2001.

For 2001, there is also attrition of traced LS members found at the 1991 Census for the first time.

Let M_2 = number of LS members entering and traced in 1991

Attrition by 2001 is represented as

$$\frac{r_1}{N_0 - s_1}(M_2 - d_3)$$

Where d_3 = number of observed 1990s deaths and embarkations for LS members entering and traced in 1991.

Thus, 1991/01 attrition is:

$$\frac{r_1}{N_0 - s_1}(N_0 - s_1 - r_1 + I_1 - k_1 - h_1 + B_1 - l_1 - n_1 - s_2 - r_2 + I_2 - h_2 - k_2 + B_2 - n_2 - l_2 + M_1 - d_2 - m_2 - s_3)$$

$$+\frac{h_1}{I_1 - k_1}(I_3 - k_3) + \frac{n_1}{B_1 - l_1}(B_3 - l_3) + \frac{r_1}{N_0 - s_1}(M_2 - d_3)$$

Link	Attrition component
	Based on those present in 1971, adjusted for inter-censal entries and exits
71/81 t=1	r_1
81/91 t=2	$\frac{r_1}{N_0 - s_1}(N_0 - s_1 - r_1 + I_1 - k_1 - h_1 + B_1 - l_1 - n_1 - s_2)$
91/01 t=3	$\frac{r_1}{N_0 - s_1}(N_0 - s_1 - r_1 + I_1 - k_1 - h_1 + B_1 - l_1 - n_1 - s_2 - r_2 + I_2 - h_2 - k_2 + B_2 - n_2 - l_2 + M_1 - d_2 - m_2 - s_3)$
Time t	$\frac{r_1}{N_0 - s_1}\left[\left(N_0 - \sum_{i=1}^{t-1} r_i - \sum_{i=1}^{t} s_i\right) + \left(\sum_{i=1}^{t-1} I_i - \sum_{i=1}^{t-1} h_i - \sum_{i=1}^{t-1} k_i\right) + \left(\sum_{i=1}^{t-1} B_i - \sum_{i=1}^{t-1} n_i - \sum_{i=1}^{t-1} l_i\right) + \left(\sum_{i=1}^{t-2} M_i - \sum_{i=1}^{t-1} d_i - \sum_{i=1}^{t-1} m_i\right)\right.$
	Previous decade's immigrants
71/81 t=1	h_1

81/91 t=2	$\frac{h_1}{I_1 - k_1}(I_2 - k_2)$
91/01 t=3	$\frac{h_1}{I_1 - k_1}(I_3 - k_3)$
Time t	$\frac{h_1}{I_1 - k_1}(I_t - k_t)$
	Previous decade's births
71/81 t=1	n_1
81/91 t=2	$\frac{n_1}{B_1 - l_1}(B_2 - l_2)$
91/01 t=3	$\frac{n_1}{B_1 - l_1}(B_3 - l_3)$
Time t	$\frac{n_1}{B_1 - l_1}(B_t - l_t)$
	New entrants at the previous census
71/81 t=1	N/a
81/91 t=2	$\frac{r_1}{N_0 - s_1}(M_1 - d_2)$
91/01 t=3	$\frac{r_1}{N_0 - s_1}(M_2 - d_3)$
Time t	$\frac{r_1}{N_0 - s_1}(M_{t-1} - d_t)$

Attrition in time period t can be summarised as:

$$Att_t = \frac{r_1}{N_0 - s_1}\left[\left(N_0 - \sum_{i=1}^{t-1} r_i - \sum_{i=1}^{t} s_i\right) + \left(\sum_{i=1}^{t-1} I_i - \sum_{i=1}^{t-1} h_i - \sum_{i=1}^{t-1} k_i\right) + \left(\sum_{i=1}^{t-1} B_i - \sum_{i=1}^{t-1} n_i - \sum_{i=1}^{t-1} l_i\right) + \left(\sum_{i=1}^{t-2} M_i - \sum_{i=1}^{t-1} d_i - \sum_{i=1}^{t-1} m_i\right)\right]$$

$$+ \frac{h_1}{I_1 - k_1}(I_t - k_t) + \frac{n_1}{B_1 - l_1}(B_t - l_t) + \frac{r_1}{N_0 - s_1}(M_{t-1} - d_t)$$

Attrition rates were calculated separately for different sex/ age groups, so that LS members were grouped into five-year age groups up to 85, then those aged 85 and over were grouped together.

Addendum Multiple enumerations at 2001 Census/LS link

The provisional data used for this report included NHSCR records for which there was more than one census record (5,959 NHSCR records relating to 11,9579 census records). Only one census record for each multiple enumeration was used in the report. Since then, multiple enumerations have been examined in more detail by referring back to the census form. Following this investigation, 5,756 were found to have been enumerated more than once. Around 200 records previously believed to be multiple enumerations were, in fact, different individuals. In addition, resolution of outstanding queries identified further records so that the LS database now has 418 more members than described in the report. The detailed examination of multiple enumerations revealed the following types:

Multiple enumerations in the 2001 Census/ LS link	
Type of multiple enumeration	**No. of LS members**
Students enumerated at term-time and parents' addresses *(a)*	**3,690**
Others enumerated more than once *(b)*	**2,066**
People enumerated in communal establishment and at the family home	451
People enumerated at two addresses, one of which was recorded as the 'address one year ago' on the other form	412
Children of separated or divorced parents who were enumerated as living with both	262
People enumerated more than once on the same form	202
Duplicate forms: two forms for the same address	198
Other cases	539
Still under investigation	2
Total number of LS members enumerated more than once *(a+b)*	**5,756**
LS members enumerated once only	**534,327**
Total number of LS members (revised following investigations into multiple enumerations)	**540,083**
Multiple enumerations (excluding students) as a percentage of all LS members	**0.383**

Students enumerated at term-time and parents' addresses
It was intended that students enumerated at their term-time address should also be included on the form at their home address. In these cases full information was requested at the term-time address and partial information at the home address. Indicators were used to ensure that the cases were not double counted in the ONC and to identify the primary record for use in the LS.

People enumerated in communal establishment and at the family home
In these cases the LS member was enumerated as resident in a communal establishment (which should only have occurred if they had lived or intended to live in the establishment for at least six months), but was also enumerated on a household form. The majority of these are older people who had moved into residential care but their partner still lived in the family home.

People enumerated at two addresses, one of which was recorded as the 'address one year ago' on the other form
In a number of cases forms were received and returned prior to Census day. If the household then moved house before census day and completed a second form at the new address, a multiple enumeration was generated. In addition, if the LS member had left the family home but was still enumerated at their old address, a multiple enumeration was generated. The latter were mainly young adults.

Children of separated or divorced parents who were enumerated as living with both
In these cases the LS member is the child of divorced or separated parents, who both enumerated them. These cases are identified by creating fields on both records that indicate the presence of only one biological parent in each household. The LS takes as the primary record the one with the female parent. Some of these cases will require further clerical checking because of inconsistencies in relationship data.

People enumerated more than once on the same form
People appeared more than once on the form when:

- the respondent either made a mistake in the completion of person details and started again in the next person slot
- they completed the personal details on the form "in rough" first
- in some cases, repeated the same information in each person slot.

This also happened when two forms for the same individual, but with slightly different personal details, were submitted with the form for a communal establishment.

Duplicate forms: two forms for the same address
In some of these cases, one of the forms was not completely filled in. This also occurred when two forms were completed for a single communal establishment.

Other cases
These cases include:

- LS members enumerated with parent(s) and other family members (usually grandparents)
- LS members enumerated at home and also alone or with non-family members. These were usually young adults who had recently left the family home. They were not identified as people enumerated at two addresses (as above) using their 'address one year ago' because their postcode one year ago was either blank or misread
- The household moved around the time of census and completed forms at both addresses. They were not identified as people enumerated at two addresses (as above) because one or both post codes was either blank or misread
- LS members enumerated at two addresses. Usually the second was a holiday home or a home during the working week

Cases still under investigation
In these two cases, NHSCR believes that different individuals have been given the same NHS number and are investigating.

Conclusion

There were more multiple enumerations in 2001 (5,756) than in 1981 or 1991 (4,188 and 3,802, respectively, Hattersley and Creeser, 1995,Appendix XIV). However, as the 2001 data include students whom Census intended to enumerate twice, these figures are not directly comparable. Multiple enumerations in 1981, taking account of records that should not lead to a census over-count (being both a visitor and an absent resident in 1981) represented 0.39 per cent of the population of England and Wales (OPCS, 1988). The comparable figure for 2001 was 0.38 per cent.

References

Hattersley, L. and Creeser, R. (1995*) Longitudinal Study 1971-1991: History, organisation and quality of data*, London: HMSO.
OPCS (1988) *Census 1971-1981 The Longitudinal Study*, London: HMSO