

# Inequalities in life expectancy by social class, 1972–1999

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## INTRODUCTION

The *Independent Inquiry into Inequalities in Health*, chaired by Sir Donald Acheson,<sup>3</sup> highlighted the fact that increases in life expectancy since the 1970s had occurred at different rates across the social classes (Box 1) resulting in a widening of differences between the least and most advantaged group. Following that report, in the NHS Plan, the Government announced its intention to tackle health inequalities.<sup>4</sup> It has since announced targets for reducing the gap in infant mortality and in life expectancy between areas, as well as in some of the factors associated with health inequalities (smoking, child poverty and teenage pregnancies).

Central to the evidence for widening health inequalities was the calculation of life expectancy by social class based on occupation from the ONS Longitudinal Study (LS).<sup>5</sup> The method used in these calculations relied predominantly on social class at entry to the study. For most of those now aged thirty and over, this was in 1971. Since the *Inquiries' Report*, ONS have published figures<sup>1,2</sup> extending the monitoring of social class difference to 1999. The most recent analysis showed a slight narrowing of the gap between men in Social Class I and V in the 1990s, raising the question of whether this may be partly due to the decreasing relevance to current health of an individual's social class 25 or more years earlier.

Previous findings based on the LS have found an artefactual explanation for some of the widening in inequalities in the period immediately following the recording of occupational class.<sup>6</sup> This was associated with health related influences in the recording of occupation at the 1971 Census resulting in reduced mortality rates for those in Social Class V. This 'health selection' effect wore off over time, thus resulting in an apparent widening of inequalities.

This paper examines trends in life expectancy by social class, based on the ONS Longitudinal Study (LS) from 1972 to 1999. Figures published previously<sup>1,2</sup> were based largely on social class at entry to the study from 1971 onwards. By looking at figures based on social class at or after subsequent censuses (in 1981 and 1991), it is confirmed that some of the initial widening in inequalities between Social Classes I and V since 1971 can be attributed to health selection effects. However, average deviation across all social classes, shows a steady widening of the social gradient that is largely unaffected by health selection.

The analyses also suggests that, as an indirect effect of greater longevity, measures of inequality in life expectancy are less reliable when calculated using predominantly 1991 social class than when using 1971 or 1981 social class. This has implications for the use of the new National Statistics Socio-Economic Classification (NS-SEC) for monitoring these inequalities.

The narrowing of differences in male life expectancy between Social Classes I and V in the 1990s was examined. This was due to an above average improvement in the life expectancy of those in Social Class V that began in the early 1990s.

To establish the best method for estimating long-term trends in life expectancy by social class and to explain variations seen, this paper addresses three questions:

- is social class assigned earlier in life as relevant to mortality differences as that based on more recent occupation?
- are trends in life expectancy distorted by health selection effects immediately following the recording of occupation and, if so, what can be done to minimise the impact on trend analysis? and
- when, in the 1990s, did the apparent narrowing of the gap in male life expectancy differences begin?

To achieve this, life expectancy figures are presented based on social class assigned not only at or after 1971, but also at or after 1981 and 1991, and for a number of time periods during follow-up.

This analysis has particular relevance as, from 2001, the Registrar General's Social Class classification was replaced by the National Statistics Socio-Economic classification (NS-SEC) in official statistics and surveys.<sup>7</sup> There is limited scope for re-classifying information on occupations that were coded in the 1970s to NS-SEC.

## METHODS

### Data

The LS is a study of a representative sample of approximately 1 per cent of the population of England and Wales, linking data from censuses from 1971 onwards with birth and death registrations and other life events.<sup>8</sup> All members of the LS who had entered the study between 1971 and 1999 (through census, birth or as an immigrant) and were traced in the NHS Central Register were eligible for these analyses. Cumulatively approximately 800,000 people have been included in the study – around 550,000 at any one time point.

## Box one

### REGISTRAR GENERAL'S SOCIAL CLASS (BASED ON OCCUPATION)

Class Description	Examples of occupations
<b>Non-manual</b>	
I Professional	Doctors, chartered accountants, professionally qualified engineers
II Managerial and technical/intermediate	Managers, school teachers, journalists
IIIN Skilled non-manual	Clerks, cashiers, retail staff
<b>Manual</b>	
IIIM Skilled manual	Supervisors of manual workers, plumbers, electricians, goods vehicle drivers
IV Partly skilled	Warehousemen, security guards, machine tool operators, care assistants, waiters and waitresses
V Unskilled	Labourers, cleaners and messengers

### Assigning social class

To date all life expectancy figures by social class, derived from the LS, were based on categorising people according to their occupation at entry to the study, from 1971 onwards, following Hattersley.<sup>2,5</sup> They retained their social class at entry throughout the analysis. Thus, in the majority of cases, social class was assigned on the basis of occupation recorded at the 1971 Census.

For this paper new analyses were also carried out, separately assigning social class at or after the 1981 and 1991 Censuses, respectively, rather than at the earliest point at which social class information was available (1971 or subsequently). The method of assigning class to individuals was, in all other respects, the same as that based on 1971. Individuals who entered the study before 1981, but were not found in the 1981 Census were excluded from tabulations showing social class assigned at or after 1981. Figures based on 1991 similarly excluded existing sample members not found in the 1991 Census.

Where possible an individual's own social class was used. For those with no assigned occupation and for those who had been classified as armed forces, inadequately described, students, retired, permanently sick or housewives an attempt was made to classify them to a social class. If their spouse had a social class this was used. If not, for anyone who had been a child during the study period, their father's social class was used (or, failing that, their mother's). For new births the social class of the father, or failing that the mother, was assigned at either at the first census in which they appeared, or if they died, and no census record was not found, at birth. Immigrants were assigned a social class at census, and were not included in the sample unless they were identified as having a census record. If none of this additional information was available, the individual was included in the analysis as 'unclassified'.

### Calculating life expectancy

Life expectancy at birth for a particular social class and time period is an estimate of the number of years a new born baby would survive, were he or she to experience the average age specific mortality rates of the social class in that time period throughout his or her life. Life expectancy at 65 for a social class is an estimate of the number of additional years a person who had reached the age of 65 would survive, were he or she to experience the average age specific mortality rates of the social class in that time period for the remainder of his or her life.

In this analysis, as in previous analyses based on the LS, life expectancy was calculated using abridged life tables for men and women separately.<sup>9,10</sup> The probability of dying ( $q_x$ ) was calculated using Reed-Merrell tables<sup>11</sup> to transform  $m_x$  to  $q_x$ . The variance and standard errors of the expectation of life were calculated using Chiang's method.<sup>12</sup> Expectations of life ( $e^o_x$ ) were produced for each age group in the life table up to age 90 where they were truncated unless otherwise indicated.

### Comparing life expectancies

Previous life expectancy publications have presented life expectancies for all social class groups. However discussion has often focused only on the difference between Social Class I and Social Class V, as a measure of inequality. Figure 1 illustrates, for males and females the size of the social class groups. On average just 5 per cent of males and 3 per cent of females fall into Social Class I and around 6 per cent fall into Social Class V. Thus concentrating only on this range makes no use of data for 90 per cent of those allocated to a social class. A further limitation of using a range is that the same weight is given to Social Classes I and V, irrespective of the size of the groups.

The gradient of inequality from Social Class I to V can be calculated using a conventional measure of dispersion, such as the average deviation (AD).<sup>13</sup> This measure is used here. It has recently been used to compare regional and socio-economic life expectancy figures across Europe.<sup>14</sup> The average deviation provides an indication of the average distance of individual social class groups from the mean of all social classes. When calculating the average deviation each class is weighted by the size of the population used in the calculation of life expectancy for that social class. The mean for all social classes is the weighted average of all life expectancies. The unclassified group were excluded from the analyses presented here.

Life expectancies are also presented for non-manual (I, II and IIIN) and manual (IIIM, IV and V) social classes. For all life expectancies confidence intervals are presented to assist in identifying statistically significant differences between two life expectancy figures.

### Standardised Mortality Ratios

Standardised Mortality Ratios (SMRs) are provided for males of all ages, and those aged between 20 and 64. These are included to help explain trends in life expectancy and focus on mortality variations at working ages. The SMR indicates by how much death rates in a social

**Table 1** Life expectancy at birth and at age 65 by gender and social class, 1972–97

England and Wales

Social Class	Year											
	1972–76		1977–81		1982–86		1987–91		1992–96		1997–99	
	Life expectancy	95% Confidence interval	Life expectancy	95% Confidence interval	Life expectancy	95% Confidence interval	Life expectancy	95% Confidence interval	Life expectancy	95% Confidence interval	Life expectancy	95% Confidence interval
<b>Males</b>												
<b>At birth</b>												
I	72.0	± 1.4	74.7	± 1.4	75.1	± 1.2	76.7	± 1.1	77.7	± 1.0	78.5	± 1.3
II	71.7	± 0.3	72.4	± 0.6	73.8	± 0.6	74.4	± 0.6	75.8	± 0.5	77.5	± 0.7
IIIN	69.5	± 0.5	70.8	± 0.8	72.2	± 0.8	73.5	± 0.8	75.0	± 0.8	76.2	± 1.0
IIIM	69.8	± 0.3	70.0	± 0.5	71.4	± 0.4	72.4	± 0.4	73.5	± 0.4	74.7	± 0.5
IV	68.4	± 0.4	68.8	± 0.7	70.6	± 0.6	70.4	± 0.6	72.6	± 0.6	72.7	± 0.8
V	66.5	± 0.9	67.0	± 1.1	67.7	± 1.1	67.9	± 1.0	68.2	± 1.2	71.1	± 1.3
Non manual	71.0	± 0.5	72.5	± 0.5	73.5	± 0.4	74.5	± 0.4	75.8	± 0.4	77.3	± 0.5
Manual	68.9	± 0.4	69.9	± 0.4	70.7	± 0.3	71.3	± 0.3	72.6	± 0.3	73.8	± 0.4
All males	69.2	± 0.2	70.0	± 0.3	71.4	± 0.2	72.3	± 0.2	73.9	± 0.2	75.0	± 0.3
<b>At age 65</b>												
I	14.2	± 1.3	15.5	± 1.2	15.4	± 1.0	15.8	± 1.0	16.8	± 0.8	17.5	± 1.0
II	13.3	± 0.1	14.2	± 0.5	14.4	± 0.4	14.8	± 0.4	15.5	± 0.4	16.8	± 0.5
IIIN	12.6	± 0.1	13.3	± 0.6	13.6	± 0.5	14.1	± 0.5	15.1	± 0.6	16.3	± 0.7
IIIM	12.2	± 0.1	12.6	± 0.3	13.0	± 0.3	13.4	± 0.3	14.2	± 0.3	15.1	± 0.4
IV	12.3	± 0.1	12.1	± 0.4	12.6	± 0.4	12.7	± 0.4	13.8	± 0.4	13.8	± 0.6
V	11.6	± 0.1	11.9	± 0.5	11.7	± 0.6	11.8	± 0.6	12.6	± 0.7	13.4	± 0.9
Non manual	13.1	± 0.3	14.0	± 0.3	14.2	± 0.3	14.7	± 0.3	15.6	± 0.3	16.8	± 0.4
Manual	12.3	± 0.2	12.3	± 0.2	12.7	± 0.2	13.0	± 0.2	13.9	± 0.2	14.6	± 0.3
All males	12.3	± 0.04	12.7	± 0.2	13.1	± 0.2	13.5	± 0.2	14.6	± 0.2	15.4	± 0.2
<b>Females</b>												
<b>At birth</b>												
I	79.2	± 2.4	79.9	± 2.2	80.4	± 1.5	80.9	± 1.2	83.4	± 1.2	82.8	± 1.5
II	77.0	± 0.7	78.1	± 0.6	78.5	± 0.6	80.0	± 0.6	81.1	± 0.5	81.5	± 0.7
IIIN	78.0	± 0.9	78.1	± 0.7	78.6	± 0.6	79.4	± 0.6	80.4	± 0.6	81.2	± 0.7
IIIM	75.1	± 0.8	76.1	± 0.6	77.1	± 0.5	77.6	± 0.5	78.8	± 0.5	79.2	± 0.6
IV	75.0	± 0.8	76.1	± 0.7	77.3	± 0.6	77.0	± 0.6	77.7	± 0.6	78.5	± 0.7
V	73.9	± 1.4	74.9	± 1.2	75.3	± 1.1	76.2	± 1.0	77.0	± 1.0	77.1	± 1.3
Non manual	77.5	± 0.5	78.3	± 0.5	78.7	± 0.4	80.5	± 0.4	80.9	± 0.4	81.4	± 0.5
Manual	74.9	± 0.5	75.9	± 0.4	76.9	± 0.4	77.2	± 0.3	78.0	± 0.3	78.6	± 0.4
All females	75.1	± 0.3	76.3	± 0.3	77.1	± 0.2	77.9	± 0.2	79.3	± 0.2	79.7	± 0.3
<b>At age 65</b>												
I	19.3	± 2.4	19.9	± 2.2	18.5	± 1.4	18.7	± 1.0	20.8	± 1.0	20.8	± 1.2
II	17.1	± 0.6	17.7	± 0.5	18.0	± 0.5	18.7	± 0.4	19.5	± 0.4	19.9	± 0.5
IIIN	17.7	± 0.8	17.6	± 0.5	18.0	± 0.5	18.3	± 0.4	18.9	± 0.4	19.6	± 0.5
IIIM	16.3	± 0.7	16.9	± 0.5	16.8	± 0.4	16.8	± 0.4	17.9	± 0.4	17.9	± 0.5
IV	16.8	± 0.6	16.7	± 0.5	17.4	± 0.4	16.9	± 0.4	17.1	± 0.4	17.4	± 0.5
V	16.4	± 0.9	16.3	± 0.8	16.1	± 0.6	16.0	± 0.6	16.4	± 0.6	16.3	± 0.8
Non manual	17.4	± 0.4	17.8	± 0.4	18.0	± 0.3	19.8	± 0.4	19.2	± 0.3	19.8	± 0.3
Manual	16.5	± 0.4	16.7	± 0.3	16.9	± 0.3	16.7	± 0.2	17.3	± 0.2	17.4	± 0.3
All females	16.2	± 0.2	16.7	± 0.2	16.9	± 0.2	17.2	± 0.2	18.0	± 0.2	18.4	± 0.2

class group differ from those for the population as a whole. A value greater than 100 indicates that they are likely to die sooner, a value less than 100 indicates that they likely to live longer.

## RESULTS

Trends in life expectancy at birth and at age 65 by social class were published on the National Statistics website for the period 1972 to 1999.<sup>1</sup> These show a consistent gradient of life expectancy, with Social Class I living the longest and Social Class V the least (Table 1). There was a widening gap between Social Classes I and V in the period 1972–76 to 1992–96. However in 1997/99 the gap narrowed for men.

### Alternative methods of assigning social class

To investigate the degree to which the method of assigning social class at or after 1971, and the long subsequent duration of follow-up, may have contributed in some way to observed trends in life expectancy by social class, Table 2 presents a comparison of results based on assigning social class at or after the 1971, 1981 and 1991 Censuses, respectively.

### A rise in the numbers of deaths not classified to a social class

Figure 1 indicates that the proportion of person years that were not classified to a social class increased the later social class was assigned (up from 6 to 11 per cent for males between 1972–76 and 1992–96 and from 15 to 19 per cent for females). As shown in Table 2, the proportion of deaths not classified to a social class increased even more rapidly the later social class was assigned. Among females, 54 per cent of deaths in 1972–76 were not allocated a social class when this was assigned at or after 1971, rising to 79 per cent in 1992–96 when social class was attached at or after 1991. Among males, 14 per cent of deaths were not allocated to a social class in 1972–76 based on 1971 information, rising to 55 in 1992–96 when based on 1991 information. These increases in those not allocated a social class at census are largely due to an ageing population. Occupation is not recorded at census above age 75. For

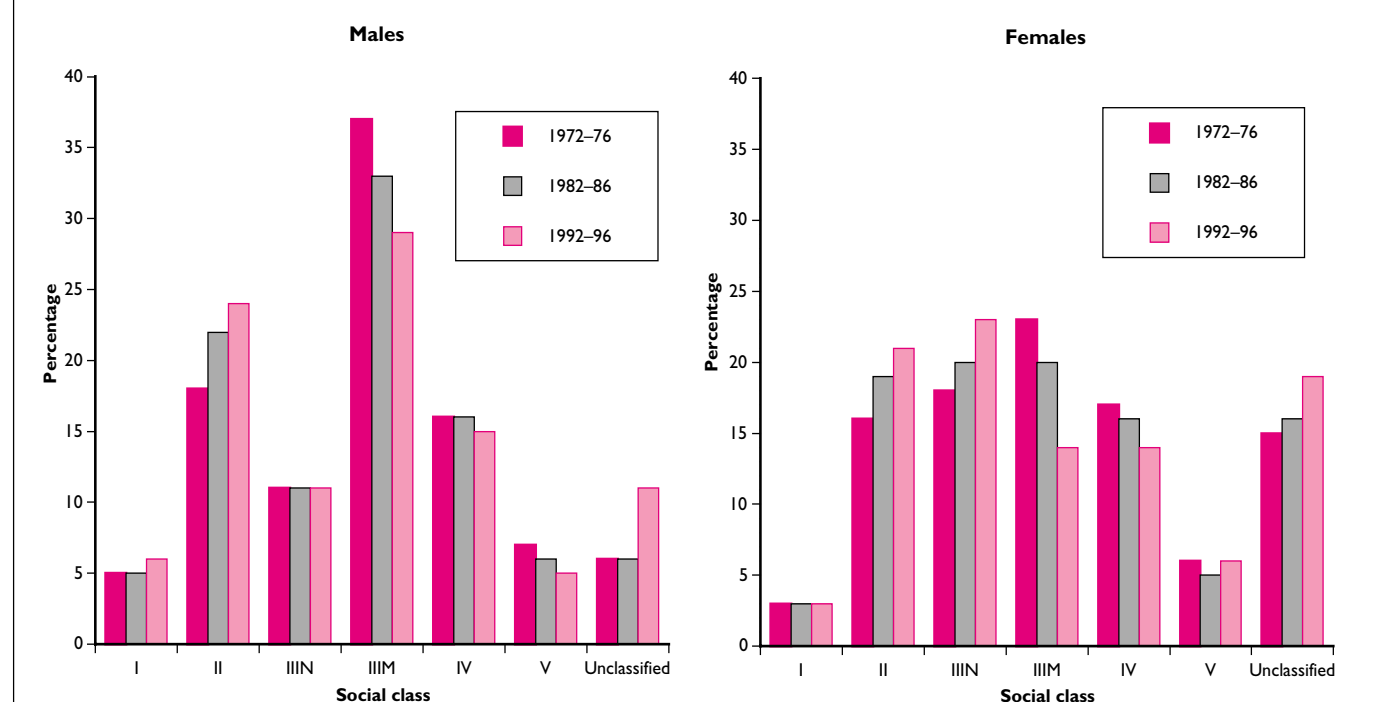
deaths the impact of this is heightened over time due to the increase in age at death. The average age at death for women in 1971 was 72.5. This increased to 75 in 1981, to 77.1 in 1991 and by 2000 had reached 78.7, with the most common age at death being 86. The average age at death for males has also increased, although at present it is only 72.5 years. The problem in assigning social class from occupation is, therefore, significantly worse for females. In addition, the 1991 Census question on occupation did not require an answer for someone who had not worked in the previous ten years. This will have further reduced the number for whom social class information was available, particularly at older ages.

In contrast to the increase in unallocated death the later social class is assigned, the number unallocated decreases with length of follow up time. For example, while in 1972–76, 54 per cent of female deaths were unclassified, by 1992–96, just 17 per cent of female deaths were unclassified on the basis of social class assigned at or after 1971. For males 14 per cent of deaths were unclassified in 1972–76, compared to just 5 per cent in 1992–96. This mainly reflects the fact that most of those still alive after lengthy follow-up would have had their social class assigned at working ages or in childhood. It could also reflect health selection effects wearing off (see below).

The combined effect of both of the above can be seen by comparing life expectancy figures for 1997–99. Using social class assigned at or after 1971, 83 per cent of deaths to females in 1997–99 were allocated to a social class. However using social class assigned at 1991, just 28 per cent of deaths in the same time period were allocated a social class. For this reason confidence intervals around life expectancy figures for females based predominantly on 1991 social class are very wide. For males, confidence intervals are wider than when social class was assigned at an earlier time point, although not as wide as for females. For both males and females, the life expectancy calculations for some of the social classes had to be truncated at age 85 due to the lack of deaths assigned to a social class in the 90 and over age group.

Figure 1

Distribution of person years at risk by social class in the five years following the 1971, 1981 and 1991 Censuses



**Table 2** Life expectancy at birth by social class assigned at or after 1971, 1981 and 1991 Censuses

England and Wales

	Year											
	1972–76		1977–81		1982–86		1987–91		1992–96		1997–99	
Males												
Social class assigned at or after 1971: Life expectancy at birth and (± 95% confidence interval)												
I	72.0	± 1.4	74.7	± 1.4	75.1	± 1.2	76.7	± 1.1	77.7	± 1.0	78.5	± 1.3
V	66.5	± 0.9	67.0	± 1.1	67.7	± 1.1	67.9	± 1.0	68.2	± 1.2	71.1	± 1.3
Unclassified	58.7	± 1.6	63.9	± 1.3	66.3	± 1.3	67.9	± 1.2	71.3	± 1.1	73.7	± 1.1
All males	69.2	± 0.2	70.0	± 0.3	71.4	± 0.2	72.3	± 0.2	73.9	± 0.2	75.0	± 0.3
Summary statistics												
Percentage of deaths unclassified	13.9		10.6		8.2		6.4		6.6		5.3	
Range I-V, years	5.5		7.7		7.4		8.8		9.5		7.4	
Average deviation	1.0		1.3		1.3		1.5		1.5		1.7	
Social class assigned at or after 1981: Life expectancy at birth and (± 95% confidence interval)												
I					76.0	± 1.3	78.0	± 1.1	77.6	± 1.1	78.4	± 1.4
V					69.2	± 1.1	69.5	± 1.1	69.8	± 1.2	71.3	± 1.4
Unclassified					65.5	± 1.2	68.0	± 1.2	69.9	± 1.1	70.8	± 1.5
All males					71.8	± 0.3	72.9	± 0.3	74.1	± 0.3	75.2	± 0.3
Summary statistics												
Percentage of deaths unclassified					17.7		13.2		11.7		9.2	
Range I-V years					6.8		8.5		7.8		7.1	
Average deviation					1.3		1.3		1.5		1.6	
Social class assigned at or after 1991: Life expectancy at birth and (± 95% confidence interval)												
I									79.6	± 1.4	78.7	± 1.9
V									72.1	± 1.5	72.7	± 1.6
Unclassified									68.2	± 1.0	69.2	± 1.3
All males									74.2	± 0.3	75.5	± 0.3
Summary statistics												
Percentage of deaths unclassified									55.3		44.4	
Range I-V years									7.5		6.0	
Average deviation									2.0		1.6	
Females												
Social class assigned at or after 1971: Life expectancy at birth and (± 95% confidence interval)												
I	79.2	± 2.4	79.9	± 2.2	80.4	± 1.5	80.9	± 1.2	83.4	± 1.2	82.8	± 1.5
V	73.9	± 1.4	74.9	± 1.2	75.3	± 1.1	76.2	± 1.0	77.0	± 1.0	77.1	± 1.3
Unclassified	70.3	± 1.5	72.4	± 1.2	73.4	± 0.9	74.2	± 0.9	76.5	± 0.8	78.2	± 1.0
All females	75.1	± 0.3	76.3	± 0.3	77.1	± 0.2	77.9	± 0.2	79.3	± 0.2	79.7	± 0.3
Summary statistics												
Percentage of deaths unclassified	54		45		38		29		22		17	
Range I-V years	5.3		5.0		5.1		4.7		6.4		5.7	
Average deviation	1.4		1.2		0.9		1.3		1.4		1.5	
Social class assigned at or after 1981: Life expectancy at birth and (± 95% confidence interval)												
I					81.9	± 1.9	80.6	± 1.6	82.2	± 1.5	83.4	± 1.8
V					76.6	± 1.2	77.0	± 1.1	78.1	± 1.0	78.0	± 1.3
Unclassified					74.0	± 0.9	75.3	± 0.8	76.3	± 0.8	77.2	± 1.0
All females					77.5	± 0.2	78.5	± 0.2	79.4	± 0.2	79.9	± 0.3
Summary statistics												
Percentage of deaths unclassified					59		50		43		35	
Range I-V years					5.3		3.6		4.1		5.4	
Average deviation					1.0		1.0		1.3		1.5	
Social class assigned at or after 1991: Life expectancy at birth and (± 95% confidence interval)												
I									81.5	± 2.9	86.0	± 2.8
V									79.0	± 3.4	80.3	± 1.4
Unclassified									75.8	± 0.8	77.0	± 1.0
All females									79.5	± 0.2	80.1	± 0.3
Summary statistics												
Percentage of deaths unclassified									79		72	
Range I-V years									2.5		5.7	
Average deviation									1.6		1.0	

Notes:

The data in italics are based on life expectancy tables truncated at age 85 due to small numbers.

L.E. Life expectancy at birth, years

Table 3

## Standardised Mortality Ratios, males, Social Classes I, V and unclassified, 1972–99

	Year											
	1972–76		1977–81		1982–86		1987–91		1992–96		1997–99	
Social class assigned at or after 1971												
All ages: SMR (95% confidence interval)												
I	79	72-87	70	63-77	72	66-79	71	65-78	72	66-78	75	67-83
V	114	109-120	116	111-122	123	117-129	130	123-137	136	128-144	132	122-143
Unclassified	128	123-134	131	124-137	126	119-133	124	117-132	112	105-120	100	91-110
Summary statistics												
Percentage of deaths unclassified	13.9		10.6		8.2		6.4		6.6		5.3	
Age 20–64: SMR (95% confidence interval)												
I	82	70-95	64	54-76	67	56-78	61	51-73	61	51-73	61	48-78
V	121	110-133	130	117-144	141	127-157	160	143-178	171	152-191	157	133-184
Unclassified	276	251-302	185	161-210	163	142-187	155	134-178	135	117-155	139	116-165
Summary statistics												
Percentage of deaths unclassified	9.6		5.3		5.2		5.6		6.4		7.2	
Social class assigned at or after 1981												
All ages: SMR (95% confidence interval)												
I					69	62-76	67	60-73	74	67-80	74	66-83
V					115	109-122	125	118-132	125	118-133	126	116-137
Unclassified					121	116-125	115	110-120	116	110-122	116	108-125
Summary statistics												
Percentage of deaths unclassified					17.7		13.2		11.7		9.2	
Age 20–64: SMR (95% confidence interval)												
I					61	50-73	59	48-71	68	56-81	74	58-92
V					133	119-149	143	127-162	148	129-169	160	134-191
Unclassified					217	192-243	182	158-208	169	146-194	178	148-214
Summary statistics												
Percentage of deaths unclassified					7.8		6.2		6.8		7.2	
Social class assigned at or after 1991												
All ages: SMR (95% confidence interval)												
I									63	56-71	71	62-81
V									113	104-123	120	108-133
Unclassified									112	110-115	113	109-116
Summary statistics												
Percentage of deaths unclassified									55.3		44.4	
Age 20–64: SMR (95% confidence interval)												
I									68	56-81	73	58-92
V									125	108-144	150	124-179
Unclassified									210	190-232	218	188-250
Summary statistics												
Percentage of deaths unclassified									14.2		12.2	

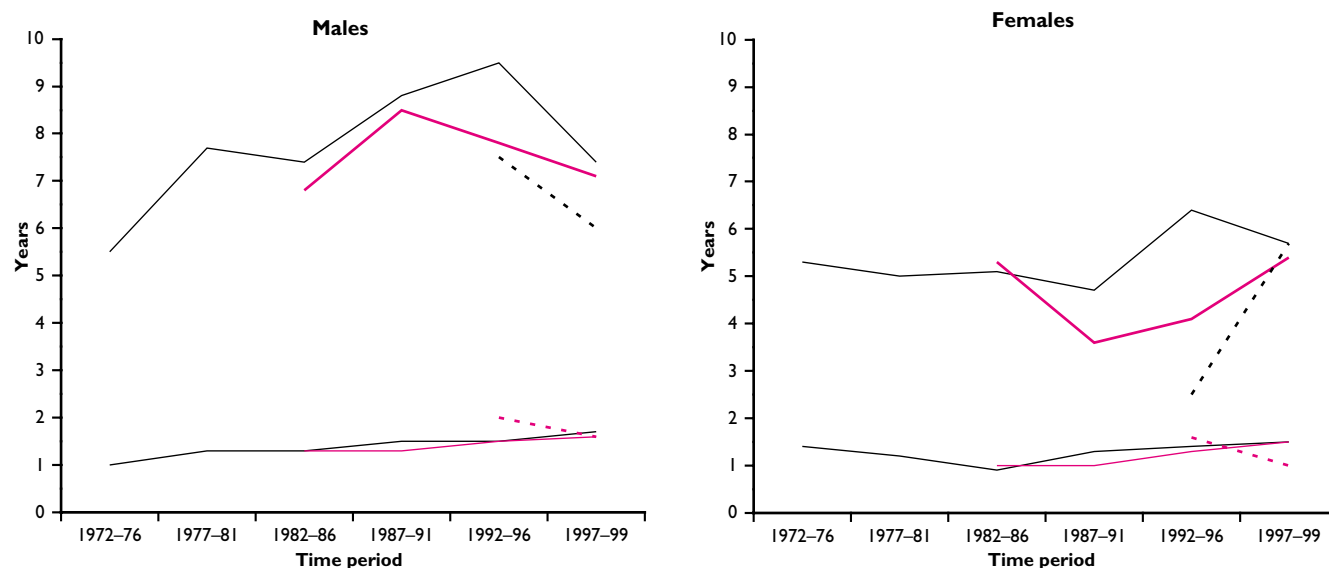
95% confidence intervals are based on the assumption of Poisson distribution.

### Selection effects

For both men and women, the estimate of life expectancy for the sample as a whole increased the shorter the length of follow-up (Table 2). That is to say the estimates of life expectancy in 1992–76 and 1997–99 were greatest for the sample identified in 1991 and least for the sample identified in 1971. Comparisons in the 1980s indicate a similar relationship between the 1981 and 1971 samples. This reflects our decision to exclude existing study members from tabulations based on 1981 and 1991 if they were not found in these censuses. The group we excluded would, in part, have comprised individuals who, although they had emigrated were not recoded as emigrants at NHSCR. Any deaths abroad to this group are unlikely to have been recorded by NHSCR, resulting in an under-estimation of their death rates.<sup>9</sup>

The extent and direction of the variation in life expectancy by duration of follow-up differed by social class. Life expectancy immediately following the assignment of social class at census appeared to be enhanced, especially for Social Class V. This was accompanied either by a reduction or a very modest increase in the life expectancy of those unclassified. In particular, for males in 1992–96, life expectancy among those assigned to Social Class V at or after 1971 was 68.2 while among those assigned to this class at 1991 it was 72.1. The corresponding figures for the unclassified were 71.3 and 68.2, respectively. In view of the decrease in the numbers of deaths to the unclassified with length of follow up for the 1971, 1981 and 1991 cohorts, these trends may well be due to health selection effects.<sup>6</sup>



**Figure 2****Variation in mortality between social classes, 1972–99**

Note: Dashed lines are based on at least one life expectancy figure truncated at age 85 and over.

— Range, SC from 1971	— Range, SC from 1981	- - - Range, SC from 1991
— Av. deviation, SC from 1971	— Av. deviation, SC from 1981	- - - Av. deviation, SC from 1991

If present, health selection effects will be most easily identified from standardised mortality ratios for the population of working age (Table 3). Because life expectancy calculations incorporate the age specific mortality rates of study members who are not of working age, the selective effect of current employment on occupational recording is diluted. For social class assigned in 1971 or 1981, those of working age who were unclassified had significantly higher SMRs in the five year period immediately after census, than in the next five years, while the SMRs for those in Social Class V rose. This effect was less evident for SMRs at all ages. It can also be seen from this table that the proportion of deaths at working ages that were unclassified also fell with increased length of follow-up, contributing further to the evidence for the presence of health selection effects.

One consequence of the operation of health selection effects was that the difference in life expectancy between Social Classes I and V was generally narrower immediately after the census at which social class was assigned. This is illustrated in Figure 2. In 1992–96, differences based on 1991 were less than those based on 1971 or 1981 for males and females. A similar pattern held in 1982–86 for males but not females.

### Changes in the size and structure of the labour force

One factor contributing to variation in life expectancy according to when social class is attached may be the changes in the size and structure of the labour force over time. It can be argued that grouping individuals according to the Registrar General's classification has become less relevant as the nature of employment has changed. The underlying changes are evident from the distribution of person years in Figure 1. As well as the previously mentioned increase in the unclassified, the proportion of males in Social Classes IIIM and V decreased with an increase in Social Class II. For females, the proportions in Social Classes IIIM and IV decreased with increases in Social Classes II and IIIN. There was little change in the overall proportion in Social Class I (or in Social Class V among females).

## Trends

### Trends in life expectancy 1972–99

Life expectancies by social class at birth and age 65 for the period 1972 to 1999, as published on the National Statistics website,<sup>1</sup> are shown in Table 1 (with additional figures for manual and non-manual social classes). This table presents life expectancies by social class assigned at entry to the LS, from 1971 onwards. As indicated in the previous section, life expectancy in the years immediately following the census at which social class was assigned were affected by health selection effects. For this reason, the analysis presented in this section focuses mainly on the period from 1977, although figures are presented for the earlier period.

For both men and women there was a social class gradient throughout the period, such that those in Social Class I lived longest and those in Social Class V least. Among women the difference between Social Class I and Social Class V remained relatively constant. The difference in life expectancy at birth was 5 years in 1977–81 and 5.7 years in 1997–99. Among men the difference in life expectancy at birth between Social Class I and Social Class V was 7.7 years in 1977–81. By 1992–96 this difference had increased to 9.5 years but fell back to 7.4 years in 1997–99. This finding is consistent with the SMRs presented in Table 3.

Females in Social Class I consistently had the highest life expectancy at birth and males in Social Class V the lowest. In the years to 1982–86 males in Social Class I had a lower life expectancy than females in Social Class V. However, in the period 1987–91 and beyond the life expectancy of males in Social Class I was greater than that of females in Social Class V.

The comparison between Social Classes I and V over time does not take into account changes in the size of social class groups or the gradient between other social classes. At an aggregate level, the difference in life expectancy between non-manual and manual social classes (Table 1)

widened consistently for males between 1977–81 and 1997–99 (the difference at birth widened from 2.6 to 3.5 years and at age 65 from 1.7 years to 2.2 years). For females there were no consistent trends. Between 1992–96 and 1997–99 the differences at birth between non-manual and manual social classes changed very little. For males there was a small increase, from 3.2 years to 3.5 years (in contrast to the narrowing of the range between Social Classes I and V). For females the differences in 1992–96 and 1997–99 were 2.9 and 2.8 years, respectively.

Among males, whether social class was based on information obtained in 1971, 1981 or 1991, those in the professional social class lived longer than those in the unskilled social class. This result was statistically significant for social class assigned from any of these censuses. For females, those in professional social classes also had a higher life expectancy than those in the unskilled social class. These differences were statistically significant for social class assigned at 1971 and 1981, but not at 1991.

Figure 2 illustrates the change in average deviation across social classes. For life expectancy based on social class at or after the 1971 Census the average deviation in 1977–81 for men was 1.3 years. This increased steadily to reach 1.7 years by 1997–99. For males, basing life expectancy on social class in 1981 or after produced the same average deviation, 1.3, in 1982–86 as assigning social class in 1971. Assigning social class in 1991 or after was associated with an average deviation of 2.0 in 1992–96, considerably greater than the figure of 1.5 using either 1971 or 1981 social class. However by 1997–99, figures for all three start-points were similar (1.7 for 1971-based social class and 1.6 for 1981 and 1991).

For females, when life expectancy was based on social class in 1971 or after, the average deviation narrowed from 1.2 in 1977–81 to 0.9 in 1982–86 and then increased to 1.5 in 1997–99. When based on social class in 1981 or after, the average deviation followed a similar pattern to that based on 1971 social class. Average deviation based on 1991

social class was slightly greater (1.6) in 1992–96 than when based on 1971 (1.4) or 1981 (1.3). However in 1997–99, the average deviation based on 1991 social class had narrowed to 1.0 (compared to the widening to 1.5 based on 1971 and 1981).

In general, the average deviation across social classes provides a more consistent indication of the trend in mortality inequality than the numeric difference between Social Classes I and V. For males there is evidence of a consistent increase in inequality since 1977–81. As noted above, a similarly consistent widening was also seen in the aggregate difference between manual and non-manual social classes.

### *Trends in mortality rates at working ages*

SMRs for males at all ages and at working ages are presented in Table 3, to indicate how the mortality trends underpinning changes in life expectancy varied by age and whether they suggest a different picture to that provided by life expectancy.

Differences in mortality by social class were more marked for men of working ages than at all ages in every time period and whenever social class was assigned (1971, 1981 or 1991). Although the very wide confidence intervals around the SMRs for Social Classes I and V limit the conclusions that can be made about changes over time, it is clear that the relative mortality of Social Class V did worsen until 1996. In particular, all SMRs for this class prior to 1986 were significantly lower than those in 1987/91 and 1992/96. By contrast, SMRs for those in Social Class I were largely constant from 1977/81 onwards.

### **Changes in the range of male life expectancy during the 1990s**

Tables 1 and 2 indicate a narrowing of inequalities between men in Social Classes I and V between 1992–96 and 1997–99 when based on social class allocated in 1971 or after (although as noted above there was no narrowing in the average deviation).

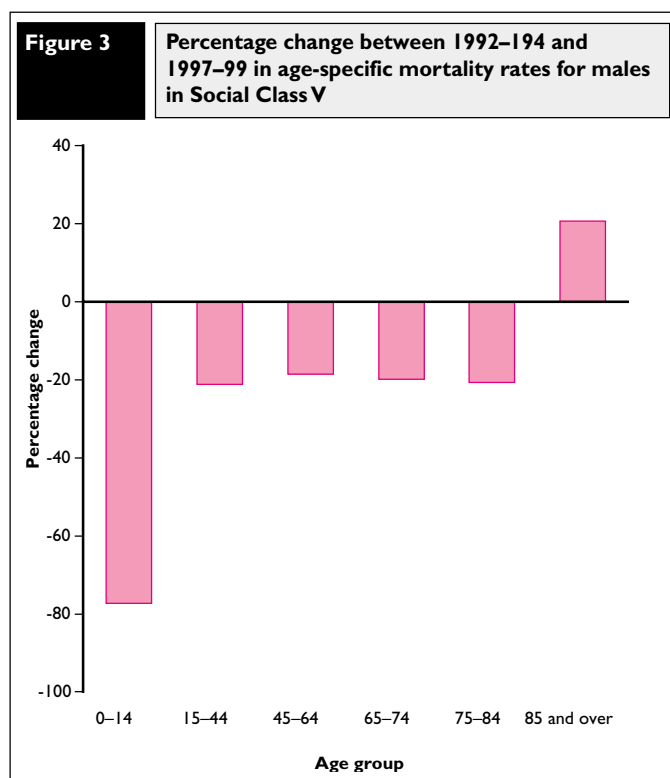
**Table 4**

**Life expectancy by social class: three-year rolling averages for males at birth and at age 65, 1992–99**

England and Wales

Social Class	Year											
	1992–94		1993–95		1994–96		1995–97		1996–98		1997–99	
	Life expectancy	95% Confidence interval	Life expectancy	95% Confidence interval	Life expectancy	95% Confidence interval	Life expectancy	95% Confidence interval	Life expectancy	95% Confidence interval	Life expectancy	95% Confidence interval
<b>At birth</b>												
I	77.5	1.4	77.6	1.3	77.6	1.4	78.1	1.4	78.7	1.4	78.5	1.3
II	75.6	0.7	75.9	0.7	76.3	0.7	76.3	0.7	76.8	0.7	77.5	0.7
IIIN	74.4	1.0	74.6	1.0	75.0	1.0	75.9	0.9	76.0	0.9	76.2	1.0
IIIM	72.9	0.5	73.2	0.5	73.8	0.5	74.2	0.5	74.6	0.5	74.7	0.5
IV	72.4	0.8	72.4	0.8	72.7	0.9	72.9	0.8	72.8	0.8	72.7	0.8
V	67.3	1.5	68.9	1.4	69.2	1.5	70.3	1.4	70.3	1.4	71.1	1.3
Unclassified	71.1	1.4	71.0	1.4	71.9	1.4	71.9	1.4	72.7	1.5	73.7	0.2
All males	73.3	0.3	73.6	0.3	74.1	0.3	74.4	0.3	74.7	1.2	75.0	0.3
<b>At age 65</b>												
I	16.7	1.2	16.6	1.1	16.9	1.1	17.5	1.0	17.7	1.0	17.5	1.0
II	15.4	0.5	15.6	0.5	16.0	0.5	16.0	0.5	16.6	0.5	16.8	0.5
IIIN	14.9	0.7	15.0	0.7	15.3	0.7	15.7	0.7	16.0	0.7	16.3	0.7
IIIM	14.0	0.4	14.1	0.4	14.4	0.4	14.5	0.4	14.9	0.4	15.1	0.4
IV	13.7	0.5	13.6	0.5	13.9	0.6	13.9	0.6	14.1	0.6	13.8	0.6
V	12.0	0.8	12.3	0.8	13.2	0.9	13.5	0.9	13.3	0.9	13.4	0.9
Unclassified	13.2	1.1	12.9	1.1	13.6	1.2	13.7	1.2	14.5	1.2	15.7	1.3
All males	14.3	0.2	14.4	0.2	14.8	0.2	14.9	0.2	15.3	0.2	15.4	0.2





To provide some insight into the time trends underlying this change in the 1990s, Table 4 presents the figures for males over the decade using three-year rolling averages. This shows that reductions in inequality in life expectancy between Social Classes I and V were due to an improvement in the life expectancy of males in Social Class V, this was particularly marked between 1992–94 and 1993–95. That is to say, the main changes occurred in the middle of 1992–96 and persisted into the period 1997–99. Differences in the trend in life expectancy at age 65 were much less dramatic. This highlights the fact that changes in life expectancy differences were driven by changes in age specific mortality rates at younger ages, as illustrated in Figure 3.

Life expectancy increased by approximately two years in each five-year age band under 65 between 1992–94 and 1997–99. Life expectancy at birth increased by more than three and a half years. Analysis of national infant mortality indicates that babies born within marriage to fathers in Social Class V had lower infant mortality in the 1990s than in the 1970s and 1980s. However these rates have not declined since 1993. In this analysis, if information was not available on the father's social class at birth then mother's social class was used. There is evidence showing that infant mortality to sole registered births has declined since 1993,<sup>15</sup> although this information has not been analysed by social class and gender of child.

## DISCUSSION

The results presented here show significant inequalities in both male and female life expectancy when social class was assigned at or after the 1971 and 1981 censuses, and a significant difference in male life expectancy with social class assigned at or after 1991. These broad statements apply both to the difference between Social Classes I and V and to the average deviation across social classes.

The difference between Social Classes I and V initially increased with the length of follow-up from each of the censuses used to assign social class. This, at least in part, reflects the gradual wearing-off of health selection effects operating at the point at which occupation was

recorded at census.<sup>6</sup> At such points, many of those who are already ill are likely to be out of work due to their health problems. This particularly affects those in less secure employment, such as unskilled manual jobs, who are then recorded as unoccupied at census (eg. those permanently sick or prematurely retired).<sup>16</sup> Health selection has more limited impact on those with more secure employment or whose work is more sedentary and less physically demanding, such as those in professional occupations. By excluding the sick, mortality rates for those assigned to a social class are initially reduced and those of the unclassified increased. The effect is greatest for Social Class V and least for Social Class I. As follow-up progresses, these effects decrease as the sick either die or recover. The proportion in the unclassified group should also decrease, as a result of their much higher death rate. Given these findings when reporting on time trends the recommendation has been made to discount the first five years data after occupation was recorded or to make appropriate adjustments to the figures.<sup>5,6,16</sup>

There may also be other factors contributing to the narrowing of life expectancy differences associated with re-basing social class to a more recent census. First, social class measured earlier in life may have a more profound long-term effect than that collected at older ages, because health advantage and disadvantage build up over the life course. Social position early in life has been argued by many to cast a long shadow over future attainment and health outcomes. Second, there has been a growing recognition that the Registrar General's Social Class classification became increasingly inappropriate to the measurement of differences in the modern labour force.<sup>17</sup> It was criticised by writers who claimed it had no coherent theoretical base. Its conceptual basis was as a hierarchy in relation to social standing or occupational skill, reflecting a nineteenth century view of social structure. Changes in the labour market, such as the decline in manufacturing and the growth in service-sector employment in the 1980s, finally removed any remaining rationale for any classification based on the differentiation of skills and the manual/non-manual divide. These concerns led to the eventual replacement of all previous occupational socio-economic classifications by NS-SEC in 2001. NS-SEC was constructed<sup>7,17</sup> to measure employment relations and conditions of occupations, central to the structure of socio-economic positions in modern societies. These help to more clearly explain variations seen in social behaviour and other social phenomena.

Third, hierarchical occupational segregation, however measured, may not have been as marked in the 1990s as it was in 1970s as a result of these shifts in the labour market. Since the results based on assigning social class in 1971 indicate a widening health divide, this explanation would suggest that recent occupationally based classifications provide a less powerful indication of the social determinants of health than in the past.

To see whether the second or third of these explanations has greater relevance, the ideal approach is to compare the differences based on Registrar General's Social Class to those obtained using NS-SEC.<sup>17</sup> However, there are some practical limitations to the inferences that could be drawn from such an approach. NS-SEC is based on a new standard occupational classification, SOC2000 and it is possible to create a version of NS-SEC, known as NS-SEC90, for data coded to the previous classification, SOC90. However this is only an approximation and analysis of dual coded data shows that 10 per cent of death records are not assigned to the same categories in NS-SEC90 and NS-SEC.<sup>18</sup> While it would be possible to create an estimated NS-SEC based on data coded to the 1980 occupational classification, the likelihood of misclassification would increase further. This effectively restricts analysis to comparisons based on 1991 onwards.

Although there were significant differences in male life expectancy if social class was assigned at or after 1991, the confidence intervals were

wider than those based on 1971 or 1981. The reason for this is that an increasing number of deaths could not be allocated to a social class as a result of the combination of the rising age at death and fact that the 1991 Census only collected occupational information for those aged under 75. A similar rule applied in the 2001 Census.

The issues arising from this last point create particular problems in reliably assessing differences in life expectancy for females based on occupation measured at a single point in time. When social class was attached at different censuses, the life expectancy of women varied more markedly than for men. Further work is needed to look at how indicators can be developed across the life course, to provide a more stable basis for comparison of changes in inequalities among women over time. In doing so, consideration needs to be given to the appropriateness of alternatives as other research suggests that indicators based on occupation are less sensitive than those which measure, for example, access to resources and social networks.

From 1991, it is possible to assign social group on the basis of a cohabiting partner's occupation at Census. This has not been done in the analyses presented here to ensure comparability. However doing so would increase the number of those allocated a social status.

The above discussion points to significant challenges in basing ongoing analyses of health inequalities on NS-SEC, particularly in devising a method for reliably rebasing the series presented in this paper, on trends in life expectancy by social class. Further work is therefore required to

## Key findings

- Inequalities in male and female life expectancy by social class from the ONS Longitudinal Study have persisted since the study began in the 1970s.
- Inequalities in life expectancy at birth across all social classes, as measured by the Average Deviation, have increased consistently since the study began for both males and females.
- There was a steady increase in the gap between the life expectancy of those in non-manual classes and manual classes in 1971. In 1997–99, life expectancy at birth for men in non-manual classes was 3.5 years longer than for those in manual classes. The comparable difference in 1977–81 was 2.6 years. For women the difference was 2.8 years in 1997–99, up from 2.4 years in 1977–81.
- The difference between the life expectancy at birth of males in Social Classes I and V in 1971 was more volatile over these years. It rose steadily from 7.7 years in 1977–81 to 9.4 years in 1992–96 and was 7.4 years in 1997–99.
- Life expectancy at birth for Social Class V males increased more rapidly than life expectancy for all males during the 1990s reflecting, in particular, a fall in their mortality at younger ages.
- Inequalities in life expectancy persist whether social class is assigned at or after the 1971, 1981 or 1991 Censuses. However, using a more recent census base results in less reliable estimates, particularly for women, as a larger proportion of deaths are not classified to a social class. This has important implications for the introduction of the the National Statistics Socio-Economic Classification for monitoring these health inequalities.

explore the most effective way to monitor socio-economic inequalities in mortality. These will need to take into account the introduction of NS-SEC and the classification difficulties associated with increasing age at death.

A number of alternatives might be considered. For example, refining the comparability of occupational classifications over time – either by developing broad occupational groupings within NS-SEC that have broad equivalents in the earlier classification or developing better methods of mapping earlier occupational classifications to broad NS-SEC groupings. A different approach would be to investigate the robustness over time of non-occupational classifications based on consistently collected census information at the level of the individual (for example, educational attainment), household (for example, housing tenure) or area (for example, area deprivation score).

Consideration will also need to be given to the most appropriate indicator of mortality levels – balancing the increasing instability of indicators (such as life expectancy at birth and working age SMRs) that depend heavily on death rates at younger ages against the poor quality of lifetime socio-economic information at ages at which death rates are higher.

## CONCLUSIONS

The evidence presented illustrates that social inequalities in health, as measured using life expectancy by social class in the LS, have persisted since 1977. They are evident whether social class was assigned in 1971 or more recently. Inequality, measured using average deviation has steadily increased for men since 1977. There was a less consistent pattern for women.

As indicated in the discussion, further work is planned to explore the most effective way to monitor inequalities in mortality, taking account of the introduction of NS-SEC and increasing age at death.

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