Mortality of drug addicts in the United Kingdom 1967–1993

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Background
Mortality in specified clinical populations has often been regarded as a measure of treatment effectiveness. This study examined time trends in mortality of drug addicts in the UK notified to the Home Office over a 27-year period.

Methods
The study was a longitudinal analysis of routine mortality data of a population of newly notified addicts from 1967 to 1993. Altogether, 92,802 addicts were newly notified during the study period, and they accounted for 687,673 person-years of observation. The main outcome measures were age-specific all-causes mortality; drug-related mortality; and age- and sex-specific standardized mortality ratios (SMR) 1967–1993.

Results
There were significant differences in death rates between the periods 1967–1976 (19/1000 person-years) and 1984–1993 (10.5/1000 person-years). Excess deaths were significantly higher among the 1967–1976 cohorts than in the 1984–1993 cohorts (SMR ratio = 1.80, 95% CI : 1.64–1.97). The majority of deaths were drug-related, with those aged <45 years more likely to die of a drug-related cause than those older (OR = 6.29, 95% CI : 4.97–7.96).

Conclusions
It appears that service provision has some impact on all-causes mortality among opiate addicts. As services improved, there was a corresponding decline in mortality rates during the study period. Further preventive measures, however, should be devised to reduce drug-related deaths.

Keywords
Drug dependence, opiate addicts, drug-related mortality, treatment effectiveness

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At a time of substantial focus on the effectiveness of treatment programmes for drug addicts in the UK, it seems appropriate to demonstrate the usefulness of the study of addicts’ death in providing information about the outcome of drug control and treatment policies and practices. For example, early studies of addicts in the UK showed that death rates among addicts declined following the introduction of policies and regulations that restricted the prescription of certain drugs, notably opiates. The subsequent decline in barbiturate-related deaths was consistent with the controlled status, and reduced availability, of barbiturates. A potential outcome of any change in policies and practices relating to the care of addicts, or other specified population, is improvement in quality of life, reduction in death rate and increased life expectancy.

If treatment programmes are effective in the long-term and drug regulatory control measures and secondary and tertiary prevention activities are effective, one would expect a long-term reduction in age-adjusted death rates and excess mortality among addicts. Conversely, stability or minimal reduction in death rates may indicate that certain segments of the addict population are being missed by, or are not benefiting from current practices, and in cases where certain controlled drugs are implicated in deaths, it may be necessary to examine further the reasons for this. Some of these may include undue accessibility to drugs through inappropriate prescribing practices, illicit diversion of drugs from licit sources into the black market, or ineffective law enforcement and regulatory control measures.

Generally, mortality rates among drug addicts are known to be higher than those of the general population. However, these excess mortality rates, or heightened relative risk of death, vary depending on the population studied. For instance, the following excess rates have been reported: 18.3% in a Swedish cohort of 188 opiate users followed up for 12 years; 6 11.9% in an English cohort of 128 heroin addicts followed up for 22 years; 7 11.1/1000/year in a 12-year follow-up of a cohort of 307 Australian heroin addicts in a methadone maintenance programme. 8 The small samples in these studies, however, limit their suitability to inform and evaluate population-based policies relating to the outcome of care of addicts.

This paper reports on one of a series of studies of long-term trends in the mortality of addicts notified to the Home Office. We estimated (1) the likelihood of drug-related deaths by sex, age and addict type, (2) age-adjusted mortality rates, (3) age-specific mortality rates and (4) age- and sex-specific standardized mortality ratios (SMR).
Method

Routine data on deaths, from all causes, of notified addicts in the UK reported to the Home Office from 1967 to 1993 were studied. Sources of these data include death certificates, coroners’ reports, death notifications from the Office of National Statistics (formerly Office of Population Censuses and Surveys: England & Wales), and Registrar General’s Office (Scotland and Northern Ireland).

The cumulative newly notified population during the study period was 92,802 addicts. Demographics, drugs implicated in death and other death-related information were systematically extracted from death certificates, while those on addict type (therapeutic/non-therapeutic) were collected from the Home Office Addicts Index. ‘Therapeutic addicts’ are people addicted to any of the 14 notifiable drugs as a result of treatment to alleviate diagnosed medical conditions; they are notified to the Home Office only when they become addicted to notified drugs that are no longer clinically necessary for the treatment of their medical condition. ‘Non-therapeutic addicts’ are those addicted to any of the 14 drugs and whose addiction is unrelated to medical treatment.

Matching of the two datasets was possible through the Home Office unique identifier system for notified drug addicts. To ensure confidentiality, extracted data were entered on a database without the names of the deceased. As death notifications often arrive late, sometimes years in arrears, death records were continuously monitored and updated by the researchers to ensure completeness of the dataset. Consequently, the annual number of deaths reported in this study is higher than that published annually by the Home Office.

Analysis

We calculated annual age-standardized mortality rates (per 1000 person-years at risk of death). The denominators for the rates among addicts were obtained by arithmetical interpolation from the cumulative age distribution of newly notified addicts supplied by the Home Office Addicts Index, including those published in the Home Office Statistical Bulletin. The numerators referred to the number of deaths that occurred each year while the annual denominators referred to person-years since notification.

Adjusted mortality rates were calculated for the following 10-year age groups: 15–24, 25–34, 35–44, and 45–54 years. The age range 15–54 years was chosen for two reasons. Firstly, the age group is usually small and disproportionate to both observed and expected deaths, and can, therefore, invalidate age-adjusted rates.

Annual age-standardized mortality rates for each 10-year age group (15–24, 25–34, 35–44, 45–54) were computed by adjusting the number of deaths in each 10-year age group to the estimated mid-year resident population distribution in the UK (Central Statistical Office, 1996). Rate ratios were used to compare rates in the first (1967–1976; D1) and last (1984–1993; D2) decennial (D) of the study.

Calculations for D1 and D2 were made respectively for addicts newly notified during these periods.

Sex-specific SMR were calculated with 95% confidence intervals (95% CI). Published age-specific death rates from all causes in the UK were used to calculate expected deaths. Male-female and age-related SMR ratios were calculated, with 95% CI, for D1 and D2. Calculation of SMR, their ratios and 95% CI was undertaken using CLJNSTAT. Odds ratios and 95% CI regarding drug-related deaths were calculated to compare the decedents in terms of their addict type, sex and age using Epilinfo version 6. All other analyses were carried out using SPSS for Windows.

Results

A total of 5310 people, 4134 males and 1176 females, died during the 27-year study. The majority of cases (96%) were aged between 15 and 44 years, with a median age at death of 30.6 years (Semi interquartile range = 12.5). Ninety-one per cent of the deaths were of non-therapeutic addicts (Table 1).

Crude death rate

The total population of newly notified addicts during the 27-year period was 92,802, contributing a total of 687,673 person-years during this period. Of these 5310 were dead by the end of 1993, giving an average annual crude death rate of 7.7/1000 person-years.

Drugs implicated in deaths

During the study, drugs caused, or were implicated in 2641 deaths. Since data on drug-related deaths were not available in 1203 cases, drug-related deaths accounted for about 64% of deaths in cases (N = 4097). The majority (68%) of deaths in non-therapeutic addicts was drug-related, compared to about 10% in therapeutic addicts (OR = 19.9, 95% CI = 3.04–30.57; P = 0.0001). About 66% of deaths among males was drug-related, compared to 59% in females (OR = 1.30, 95% CI = 1.11–1.52, P = 0.00083); and deaths among those <45 years of age were more likely to be drug-related than in those aged ≥45 years (OR = 6.29, 95% CI = 4.97–7.96, P = 0.0001).

Table 1 Characteristics of dead addicts

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>No. of cases</th>
<th>% of all deaths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at death</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15–24</td>
<td>1104</td>
<td>20.8</td>
</tr>
<tr>
<td>25–34</td>
<td>491</td>
<td>46.9</td>
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<tr>
<td>35–44</td>
<td>1009</td>
<td>19.0</td>
</tr>
<tr>
<td>45–54</td>
<td>191</td>
<td>3.6</td>
</tr>
<tr>
<td>≥55</td>
<td>515</td>
<td>9.7</td>
</tr>
<tr>
<td>Total</td>
<td>5310</td>
<td>100.0</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>4134</td>
<td>77.9</td>
</tr>
<tr>
<td>Female</td>
<td>1176</td>
<td>22.1</td>
</tr>
<tr>
<td>Total</td>
<td>5310</td>
<td>100.0</td>
</tr>
<tr>
<td>Addict type</td>
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<td></td>
</tr>
<tr>
<td>Non-therapeutic</td>
<td>4820</td>
<td>91.1</td>
</tr>
<tr>
<td>Therapeutic</td>
<td>473</td>
<td>8.9</td>
</tr>
<tr>
<td>Total</td>
<td>5293*</td>
<td>100.0</td>
</tr>
</tbody>
</table>

* Numbers are less than 5310 because of unknowns for addict type.
Figure 1 shows the percentage of deaths each year according to the main drug implicated at death. Heroin and barbiturates accounted for the smallest percentage (12%) of drug-related deaths during the 27-year study, with each implicated in 316 deaths. The number of barbiturate-related deaths peaked in 1972 with a sharp but consistent decline thereafter. Other opiates, notably morphine, dipipanone (diconal) and dextromoramide (palfium) accounted for the highest number of drug-related deaths (865). The trend in deaths due to methadone was relatively stable until the last 4 years of the study where an increase in trend was indicated.

Altogether, opiates of one kind or another accounted for about 65% of drug-related deaths (heroin, 12%; methadone 19.7%; other opiates, e.g. dextromoramide, dipipanone, etc., 32.8%).

Annual age-standardized rates
During the period of study, there was a consistent decline in annual age-standardized rates, from an average annual rate of 19.0/1000 person-years in D1 to 10.5/1000 person-years in D2 (Figure 2).

Annual age-specific rates
Although mortality rates, in general, declined throughout the study, different patterns emerged with age. Death rates were highest in the older age groups. A relatively low and stable trend in annual rates in the lower age groups was recorded during D2. The average annual death rate per 1000 person-years in each age group in D2 was as follows: 3.2 (15–24), 8.3 (25–34), 13.9 (35–44) and 10.7 (45–54) (Table 2). When compared to the 15–24 age group, the ratios of average annual death rates in D2 were 2.6, 4.4, and 3.3 in the 25–34, 35–44, and 45–54 age groups respectively (Figure 2).

Statistically significant reductions in rates were recorded between D1 and D2 in the 15–24, 25–34 and 45–54 age groups. The converse was the case, however, in the 35–44 age group (Table 2).

Excess mortality
Generally, excess mortality declined throughout the study, from about 13 in D1 to 7 in D2, with a D1:D2 ratio of 1.80 (95% CI = 1.64–1.97, P = 0.0003). However, there were different patterns for age and sex.

Males
In D1, age-specific SMR in males ranged between 16.95 in the 25–34 age group and 2.89 in the 45–54 age group. The pattern in D2 was similar. However, the number of excess deaths in all age groups, except in the 35–44 age group, declined significantly. At D2, the SMR in the 35–44 age group was significantly higher than at D1. Altogether, an overall decrease of about 46% in excess deaths was recorded at D2. The greatest decline was observed in the 15–24 age group (Table 3).

Females
The pattern in females was slightly different. At D1, SMR ranged between 21.78 in the 15–24 age group and 4.97 in the 35–44 age group. By D2, the highest SMR (13.66) was recorded in the 25–34 age group while the lowest (2.31) was in the 45–54 year group. Just as in males, all D1:D2 SMR ratios were statistically significant except in the 35–44 age group. Altogether, there was an overall reduction of about 38% in excess deaths at D2. The highest rate of decline (54%) was observed in the 45–54 age group (Table 4).

In general, excess deaths in females were higher than in males at both D1 (Ratio = 1.25, 95% CI = 1.01–1.54; P = 0.04) and D2 (Ratio = 1.43, 95% CI = 1.28–1.60, P = 0.0004).

Discussion
This study covered 27 years of numerous policies on specialist services for drug addicts. Consistent with other reports, this period had witnessed a consistent decline in overall age-adjusted death rates of addicts from 19/1000 person-years in the period 1967–1976 to 10.5/1000 person-years during the period 1984–1993. This decline, however, did not apply to all age groups. While the age-specific death rates in those aged 15–24, 25–34, and the 45–54 years had declined significantly by the last decade of the study, the death rate of those aged 35–44 years had increased by about 40% over the figures for the first decade of study. While the overall average age at death of about 31 years showed an improvement over figures from earlier studies, the increase in the death rate of the 35–44 age group is of concern, and may require further investigation.

Perhaps one of the most important aspects of this study was the possibility of calculating age- and sex-specific excess deaths in a systematic fashion, in a large population, and on a
Figure 2  Annual age-adjusted and age-specific rates

long-term basis. Many previous studies of excess deaths in UK addicts\textsuperscript{1,2} are of small samples, with sometimes difficult-to-replicate methods for estimating excess deaths, and often with no confidence intervals of the excess mortality ratios. Our study addressed these deficiencies.

Excess mortality declined throughout the study in both males and females. In the first and last decades of the study, excess mortality in males decreased from about 13 to 7 in males and from 16 to 10 in females. Overall, the SMR for both decades were higher in females than males, a trend also reported in Italy.\textsuperscript{17}

If excess mortality was 28 before the introduction of specialists clinic in 1968,\textsuperscript{1} then development of services and improvement in the care of drug addicts have contributed in some way
To the consistent reduction in excess mortality over the years. On the other hand, consistently larger excess mortality among females may suggest that, over the years, specialist services have remained more sensitive to the needs of male addicts. A study of presentation to services by males and females of major ethnic groups has revealed consistently lower female presentation rates to specialist drug services.

Altogether, the influence of improvement in health and social care provision for the entire population of the UK on deaths among addicts should not be discounted. Improved health care provision and quality of life in the general population during the study period have resulted in reduction in death rates at all ages and increased life expectancy. The findings of this study are therefore consistent with the trend in the general population.

Furthermore, the last decade of the study also witnessed increased involvement of the primary health care sector in the care of addicts alongside specialist services. through a mechanism now commonly referred to as 'shared care'. What this implies is that addicts now have better access to care for life-threatening medical conditions, such as hepatitis, commonly associated with problematic drug use. Also, general improvement in accident and emergency care during this period would imply a more responsive care for addicts with acute drug reactions.

Altogether, all these measures would have contributed directly or indirectly to the significant decline in death rates reported in this study.

Despite the decline in death rates throughout the 27-year study, the majority of deaths were drug-related, with opiates, other than methadone and heroin, accounting for the highest proportion of these deaths. Addicts <45 years of age were six times more likely to have died of a drug-related cause than those ≥45 years. Not surprisingly, non-therapeutic addicts were about 20 times more likely to die of a drug-related cause. This higher risk is attributable to illicit drug consumption that readily exposes non-therapeutic addicts to the dangers associated with adulterants and other impurities in 'street' drugs.

Of concern is the rise in the trend of methadone-related and other drugs-related deaths since 1987. Overall, there are three possible explanations for this rise in trend. The first can be linked with prescribing practices in the general population where unsuspecting doctors issue prescriptions, especially of opiates, that are far in excess of therapeutic needs. Some of this 'excess' is known to find its way into illicit sources from where it is procured by the addict. Another related practice is one in which addicts seek substitution therapy for opiate dependence, and also benzodiazepine dependence, from two or more sources.

### Table 2 Changes in age-specific mortality rates

<table>
<thead>
<tr>
<th>Age at notification</th>
<th>D1 (1967-1976)</th>
<th>D2 (1984-1993)</th>
<th>Rate ratio</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>O§ SMR</td>
<td>O§ SMR</td>
<td>(b/a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-24</td>
<td>14 30</td>
<td>3.20</td>
<td>0.22</td>
<td>0.05-0.61</td>
<td>0.0007</td>
</tr>
<tr>
<td>25-34</td>
<td>16.80</td>
<td>8.30</td>
<td>0.49</td>
<td>0.20-0.94</td>
<td>0.028</td>
</tr>
<tr>
<td>35-44</td>
<td>8.40</td>
<td>13.94</td>
<td>1.65</td>
<td>0.87-2.65</td>
<td>0.13</td>
</tr>
<tr>
<td>45-54</td>
<td>36.16</td>
<td>10.66</td>
<td>0.29</td>
<td>0.15-0.51</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

* Observed death

### Table 3 Standardized mortality ratios (SMR) for males

<table>
<thead>
<tr>
<th>Age at notification</th>
<th>D1 (1967-1976)</th>
<th>D2 (1984-1993)</th>
<th>Rate ratio</th>
<th>95% CI</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>O§ SMR</td>
<td>O§ SMR</td>
<td>(b/a)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15-24</td>
<td>255</td>
<td>15.97</td>
<td>14.06-18.05</td>
<td>0.0001</td>
<td>378</td>
</tr>
<tr>
<td>25-34</td>
<td>192</td>
<td>16.95</td>
<td>14.63-19.52</td>
<td>0.0001</td>
<td>835</td>
</tr>
<tr>
<td>35-44</td>
<td>28</td>
<td>3.57</td>
<td>2.37-5.16</td>
<td>0.0001</td>
<td>414</td>
</tr>
<tr>
<td>45-54</td>
<td>13</td>
<td>4.49</td>
<td>2.40-7.69</td>
<td>0.0001</td>
<td>44</td>
</tr>
<tr>
<td>All</td>
<td>488</td>
<td>12.83</td>
<td>11.71-14.02</td>
<td>0.0001</td>
<td>1671</td>
</tr>
</tbody>
</table>

* Observed death
thereby simultaneously increasing illicit accessibility to these medically prescribed drugs as well as the concomitant risk of drug-related fatality. The mechanism of this illicit diversion is yet unclear, and may require further investigation. Furthermore, published data on consumption of methadone in the UK from 1987 to 1991,19,20 have revealed an increase in trend that is similar to that observed in our data on methadone-related deaths. A similar trend was also reported for morphine.

This study describes death trends only in notified addicts. Its findings, therefore, should be interpreted with this limitation in mind. Studies of this kind have sometimes been criticized for being 'selective' and not applicable to out-of-treatment addicts.21 There is evidence in the US, and Italy, however, that excess mortality among out-of-treatment addicts is similar to that reported for addicts in treatment.17,22,23 It is, therefore, unlikely that studies of out-of-treatment addicts in the UK would reveal a substantially different trend than that demonstrated in this study. On the other hand, if indeed treatment works, one would expect a higher life expectancy among notified addicts than in those not notified. This, however, is a subject of further investigation.

Another limitation of this study is its inability to identify specific policies and/or practices during the study period that account for the significant decline. Furthermore, area of residence (urban, suburban, rural) and regional variations in drug-related mortality have not been investigated. These are areas of focus in on-going studies.

This article describes a 27-year trend in the mortality of UK addicts. The study reveals a general decline in death rates and excess deaths over the period of study. Cohorts of addicts newly notified between 1984 and 1993 reported significantly lower death rates and excess mortality than those notified between 1967 and 1976. Males reported greater rates of decline than females during this period. There was also a general decline in all age groups except in the 35–44 age group where an increase in excess deaths between the first and last decade of study was reported.

This article also reports changes in drug-related deaths with opiates accounting for the majority (65%) of these deaths, and with the majority of drug-related deaths occurring among non-therapeutic addicts who are <45 years.

References