

# Fatal methadone and heroin overdoses: time trends in England and Wales

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## Abstract

**Study objective**—Although the total number of self poisonings in England and Wales has dropped by 32%, the number involving methadone and/or heroin rose by 900% in 1974–92. Because of concern about the role of methadone in this increase, the part played by methadone and heroin in poisoning deaths in England and Wales in 1974–92 was investigated.

**Design**—A proportional mortality design was used to study whether the ratio between deaths involving methadone or heroin and other substances had increased. The time trend was examined with logistic regression.

**Setting**—England and Wales, 1974–92.

**Subjects**—Accidental, undetermined, and suicidal poisoning deaths (n = 43 231).

**Main results**—The proportion of poisoning deaths involving methadone (alone or in combination with heroin) rose by 80% (95% CI 69%, 92%) per 3 year period. The proportion of poisoning deaths involving heroin without methadone rose by 76% (95% CI 60%, 93%) per 3 year period. Similar results were obtained when poisoning deaths were examined in relation to gender and legal category (suicide and undetermined versus accidental deaths).

**Conclusions**—The impact of opiate addiction on rates of death by poisoning is rising quickly. This may reflect the growth of the addict population and is an important public health problem. There is no evidence that methadone's involvement in these deaths has risen disproportionately in relation to that of heroin up to 1992.

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Opiate addiction is a strong suicide risk factor,<sup>1</sup> and opiate addicts are also at increased risk of accidental death, principally through overdose.<sup>2</sup> Substitution with methadone has become one of the mainstays of the treatment of opiate addiction and the proportion of opiate addicts using methadone has risen sharply over the past decades.<sup>3</sup>

Clinical research suggests that methadone maintenance reduces mortality (including overdose mortality) among clients.<sup>4</sup> However, like heroin, methadone is dangerous in overdose.<sup>5</sup> Marks<sup>6</sup> and Newcombe<sup>7</sup> have suggested, on the basis of analyses of cause of death returns and estimated numbers of addicts taking methadone and heroin respectively, that in the UK

as a whole methadone in overdose kills proportionately more people than heroin. A limitation of this finding is that it depends crucially on unproven assumptions concerning the number of methadone and heroin users at risk in the population. Nevertheless, these authors suggest that “the current vogue for methadone in the management of addiction should be reviewed”.<sup>6</sup>

If the risk of death through overdose were indeed higher among addicts taking methadone compared with those taking heroin, and given the relatively rapid increase of methadone use in the addict population,<sup>3</sup> the proportion of overdose deaths involving methadone would rise at a faster pace than that involving heroin. We examine the contribution of methadone and heroin overdoses to total mortality from accidental and intentional self poisoning in England and Wales between 1974 and 1992. The proportional mortality design used eliminates the need to make unsafe assumptions concerning the numbers of addicts in the population taking methadone or heroin.

## Method

### DATA

Substances involved in accidental (ICD E850–869), suicidal (ICD E950), and undetermined (ICD E980) poisoning deaths from 1974–92 in England and Wales were obtained by hand-searching Office of Population Censuses and Surveys (OPCS) tabulations (1982 not available).<sup>8</sup> Hand-searching rather than relying on aggregate figures published by the OPCS<sup>8</sup> or the Home Office<sup>9</sup> was necessary in order to identify deaths which had involved heroin without methadone and deaths which had involved both substances simultaneously. Deaths were divided into three categories according to the substances involved as follows:

- Methadone *with or without* heroin regardless of other substances,
- Heroin *without* methadone regardless of other substances,
- Deaths *not involving* methadone or heroin.

The time period was divided into six successive three year spans. In the main tabulation (table 1) the three classes of death (accident, suicide, and undetermined) were combined and ratios were calculated, firstly, of deaths involving methadone with or without heroin versus all other deaths, and, secondly, of deaths involving heroin without methadone versus all others.

### ANALYSIS

The ratios between poisoning deaths associated with methadone/heroin, and those associated

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**Table 1** Death by poisoning (accidental, suicidal, and undetermined. Ratio between methadone/heroin and other substances showing the increase over time (1974–92) in England and Wales.

Period	Methadone with or without heroin		Heroin without methadone	
	Ratio (x 100)	PMR (95% CI)	Ratio (x 100)	PMR (95% CI)
1974–76	26/8932 (0.29)	(1)	7/8951 (0.08)	(1)
1977–79	31/8603 (0.36)	1.24 (0.73, 2.09)	14/8620 (0.16)	2.08 (0.84, 5.15)
1980–83	50/7253 (0.69)	2.37 (1.47, 3.81)	28/7275 (0.38)	4.92 (2.15, 11.27)
1984–86	46/6238 (0.74)	2.53 (1.56, 4.10)	15/6269 (0.24)	3.06 (1.25, 7.51)
1987–89	98/5829 (1.68)	5.76 (3.74, 8.91)	53/5874 (0.90)	11.54 (5.24, 25.39)
1990–92	240/5885 (4.08)	14.01 (9.34, 21.03)	90/6035 (1.49)	19.07 (8.83, 41.18)
1974–92	491/42740 (1.15)	1.80* (1.69, 1.92)	207/43024 (0.48)	1.76† (1.60, 1.93)
LR test‡	$\chi^2 = 20.1$ ; df = 4; p < 0.001		$\chi^2 = 12.5$ ; df = 4; p = 0.01	

\* Men: (n = 20 411); proportional mortality rate (PMR) 1.73 (95% CI 1.62, 1.86); likelihood ratio (LR) test  $\chi^2 = 13.3$ ; df = 4; p = 0.01. Women: (22 820); PMR 1.73 (95% CI 1.50, 1.99); LR test  $\chi^2 = 5.73$ ; df = 4; p = 0.22.

† Men: (n = 20 411); PMR 1.71 (95% CI 1.54, 1.90); LR test  $\chi^2 = 11.3$ ; df = 4; p = 0.02. Women: (n = 22 820); PMR 1.59 (95% CI 1.27, 1.99); LR test  $\chi^2 = 10.5$ ; df = 4; p = 0.03.

‡ Test for departure from the linear trend over time.

with other substances in each three year period were calculated. Given the relative rarity of methadone/heroin poisonings compared with totals, these ratios approximate proportions (eg 1990–92; ratio heroin/other deaths = 90/6035 = 0.015; and the proportion = 90/6125 = 0.015). This was done by gender, class of death, and for deaths involving heroin *without* methadone and deaths involving methadone *with or without* heroin.

Ratios were compared with the ratio in the baseline period (1974–77) by means of a ratio of ratios, the main outcome measure, analogous to the proportional mortality ratio.<sup>10</sup> Logistic regression was used to calculate a summary proportional mortality ratio associated with moving up one, 3 year period in time. The likelihood ratio (LR) test was used to test for departures from linearity over time.

## Results

### CHANGE OVER TIME: SELF POISONINGS INVOLVING HEROIN ALONE VERSUS DEATHS INVOLVING METHADONE WITH OR WITHOUT HEROIN

There was a total of 43 231 self poisoning deaths between 1974 and 1992. The number fell from 8958 between 1974 and 1977 to 6125 between 1990 and 1992 (–32%). By contrast, lethal self poisonings involving heroin alone, and methadone with or without heroin, rose from 7 to 90 (+1186%) and from 26 to 240 (+823%), respectively, between the same time periods (table 1).

The ratio between the numbers of poisoning deaths involving heroin alone and those in-

**Table 2** Summary proportional mortality ratios (PMR) per 3 year period from 1974–92 in relation to gender and class of death

		Methadone with or without heroin		Heroin without methadone	
Suicide/undetermined	M	1.71 (1.48, 1.98)		1.59 (1.27, 1.99)	
		$\chi^2 = 5.2$ ; df = 4; p = 0.27		$\chi^2 = 5.9$ ; df = 4; p = 0.21	
	F	4/2923–43/2240		3/2924–14/2269	
		1.42 (1.15, 1.75)		1.23 (0.84, 1.81)	
Accidental	M	$\chi^2 = 8.2$ ; df = 4; p = 0.08		$\chi^2 = 4.5$ ; df = 4; p = 0.34	
		4/4100–13/2071		0/4104–1/2083	
	F	1.65 (1.53, 1.79)		1.64 (1.45, 1.84)	
		$\chi^2 = 7.5$ ; df = 4; p = 0.11		$\chi^2 = 6.8$ ; df = 1; p = 0.15	
		16/899–159/983		4/911–70/1072	
		1.92 (1.58, 2.34)		1.72 (1.30, 2.27)	
		$\chi^2 = 2.6$ ; df = 4; p = 0.63		$\chi^2 = 9.9$ ; df = 4; p = 0.04	
		2/1010–5/611		0/1012–5/611	

### KEY POINTS

- Drug overdose as a cause of death has fallen over the past decades in England and Wales.
- There are now proportionately more fatal overdoses involving opiates—5% in 1990–92 compared with 0.4% in 1974–77.
- Contrary to the assertion of some commentators, methadone's contribution to fatal overdose does not seem to have increased more quickly than that of heroin.

volving any other substance rose from 7/8951 (= 0.0008; proportion 0.08%) in 1974–77 to 90/6035 (0.01; proportion 1.5%) in 1990–92. The summary proportional mortality ratio (95% CI) (indicating the ratio increase per three year period) was 1.76 (1.60, 1.93) indicating that the ratio in each period was 76% higher than in the previous period.

For deaths involving methadone (with or without heroin), ratios rose at a comparable pace (proportional mortality ratio 1.80 (95% CI 1.69, 1.92) per 3 year period). However, the increase accelerated somewhat faster in the last 3 year period resulting in a departure from linearity (LR test; p < 0.001).

Analysis of these deaths by gender gave proportional mortality ratios per 3 year period for male deaths that were similar for methadone (with or without heroin) (1.73; 95% CI 1.62, 1.86) and heroin alone (1.71; 95% CI 1.54, 1.90). With regard to deaths in women, there was a non-significant suggestion that the contribution of methadone (with or without heroin) to overdose deaths had risen faster (proportional mortality ratio 1.73; 95% CI 1.50, 1.99) than that of heroin (proportional mortality ratio 1.59; 95% CI 1.27, 1.99) (table 1).

### CHANGE OVER TIME: SELF POISONINGS BY HEROIN OR METHADONE IN RELATION TO CLASS OF DEATH AND GENDER

The summary proportional mortality ratios (per 3 year period) calculated by gender for accidental and for suicide/undetermined deaths separately did not differ significantly between poisonings involving methadone (with or without heroin) and heroin alone (table 2). The actual ratios for the periods 1974–77 and 1990–92 show that the total number of suicidal/undetermined self poisonings declined substantially for men and, especially so, women, as did the total number of accidental poisonings among women. By contrast, the rise in opiate related poisonings resulted in a disproportionate contribution of these deaths to total intentional and accidental overdose mortality (table 2).

## Discussion

This analysis suggests that methadone and heroin are involved in a rapidly increasing proportion of poisoning deaths in England and

Wales. Each subsequent 3 year period between 1974 and 1992 saw this proportion rise by around 80%. However, the study's main implication is that there is no evidence that the proportion of poisoning deaths due to methadone has risen faster (80% per 3 year period) than that due to heroin (76% per 3 year period) between 1974 and 1992.

The main implication of this study is at odds with conclusions drawn by others who analysed poisoning death rates involving methadone and heroin using estimated numbers of addicts at risk for the UK as a whole covering the periods until 1991<sup>6</sup> and 1992,<sup>7</sup> respectively. Contrary to these authors we did not rely on published aggregate death figures,<sup>8,9</sup> which do not give details on deaths involving *both* substances. We classified these with those which had involved methadone alone, and by doing so we may, if anything, have overestimated proportions of deaths attributable to methadone. As poisoning deaths are liable to a high degree of misclassification by coroners,<sup>11</sup> we did not limit ourselves to an analysis of accidental deaths only, as done by others.<sup>7</sup> In addition, no assumptions were made concerning the respective sizes of the methadone and heroin using populations in England and Wales. These are subject to large degrees of error. In particular, the numbers of addicts taking methadone according to Home Office figures are likely to underestimate the real methadone consumption in the community,<sup>12</sup> so that death rates calculated on this basis<sup>6,7</sup> are likely to be *over estimates*.

Dead cases (poisoning deaths involving methadone and/or heroin) were compared with dead controls (poisoning deaths involving neither of these substances) according to time of death. This is analogous to a proportional mortality design.<sup>10</sup> The proportional mortality ratio is an indicator of the rate of change over time. It may rise if the number of poisonings involving methadone and/or heroin increases but also if the *total* number of poisonings declines. The total number of poisoning deaths in England and Wales declined by 32% (from 8958 to 6125) between 1974–77 and 1990–92. However, deaths involving methadone and/or heroin rose by 900% (from 33 to 330) over the same period.

Most unnatural deaths in England and Wales are examined by toxicological analysis but death certificates, which provide the basis for the OPCS tabulations,<sup>8</sup> do not routinely record all substances involved. However, it is unlikely that controlled drugs such as heroin and methadone are not mentioned if involved. Certain opiate addicts may have taken a cocktail of other drugs alongside methadone or heroin, but for the purposes of this study they were classified as having died from methadone and/or heroin if either of these were detected. This should have minimised the likelihood of lethal poisonings involving methadone or heroin not being counted as such.

A limitation of this study was the lack of information on the source of the methadone

implicated in the deaths. Future investigations need to examine whether rates of methadone related poisoning differ according to whether the substance was obtained from irregular sources on the black market, or as part of an ongoing treatment. The analysis stopped at 1992. Future analyses of more recent data need to confirm whether the pattern reported here has continued since 1992 or whether the proportionate contributions of methadone and heroin to overdose deaths have started to diverge more recently. This possibility cannot be excluded given the finding that the proportional mortality ratio for methadone related poisonings started to rise faster in more recent 3 year periods.

The rising absolute number of self poisoning deaths involving methadone and/or heroin is undoubtedly related to the fact that there were more opiate addicts in the population at risk of suicide and self poisoning in 1992 than in 1974,<sup>12</sup> and that the availability of these substances has concomitantly risen. The present study has two major implications. First that despite the low prevalence of opiate addiction, suicidal and accidental poisonings with methadone and heroin account for an increasingly important proportion of all such deaths in England and Wales. This has important public health implications both in terms of suicide prevention and organisation of services to drug users.<sup>13</sup> The second important finding is that contrary to suggestions in published studies relating to the UK as a whole,<sup>6,7</sup> the mortality rise in England and Wales up until 1992 was not faster for methadone than for heroin deaths. At the population level, methadone is not more likely than heroin to be involved in lethal poisonings.

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