

# Trends in injury and poisoning mortality using the ICE on injury statistics matrix, England and Wales, 1979–2004

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## Introduction

Although deaths from injury and poisoning account for less than 5 per cent of all deaths in England and Wales<sup>1</sup> it is important to examine them in more detail for several reasons. Deaths from injury and poisoning account for over half of deaths at ages 15–34. In men in this age group, the five most common causes of death are all categories of injury or poisoning, as are five of the top ten in women.<sup>2</sup> Thus deaths from injury and poisoning have a large impact in terms of premature deaths and potential years of life lost. Many of the events that lead to injuries are thought to be largely preventable through public policies, and so resulting deaths should be largely avoidable; for example, motor vehicle accidents can be prevented through promotion of behaviour change, legislation and enforcement, and design of roads, vehicles and safety devices.

There is a need for consistent and comparable information on injury mortality over time, to highlight increasing hazards, and monitor the effects of interventions. This is particularly difficult when new revisions of the International Classification of Diseases (ICD), used to code cause of death, are introduced. The standard ICD classification has two dimensions for classifying the underlying cause for deaths from injury and poisoning – the mechanism of death, for example poisoning or drowning, and the intent, for example unintentional, suicide, homicide. In the ICD, intent takes precedence over mechanism, so deaths are first grouped according to whether they were unintentional (accidental in the ICD), suicide, homicide etc and then within these categories they are classified according to mechanism.

This article shows trends in injury and poisoning mortality in England and Wales using a matrix of mechanism (e.g. fall, fire) by intent (e.g. accident, suicide) developed by the International Collaborative Effort (ICE) on injury statistics. Overall injury and poisoning mortality rates have declined for both males and females. Declines were greatest during the 1980s and early 1990s, with rates falling only slightly since. Rates were generally higher for males and were highest in the elderly. Transport death rates declined substantially. Death rates from falls declined to the mid 1990s but then increased. There were increases in death rates from drug abuse/dependence in both sexes and in homicide rates among males.

In many standard tabulations it is common to separate out accidents by mechanism but present the other intents as a whole. This reflects, in part, the larger numbers of deaths that are accidental compared to other intents and in part the different groups that have been interested in preventing particular subsets of injury deaths, such as motor vehicle accidents, accidents in the home, the workplace or in children. There are good reasons for doing this, when thinking about some methods of prevention, but it can underemphasise the overall importance of unintentional injuries. It is also useful to be able to look easily at comparisons of mechanisms across all intents. For example, the headline indicator of drug-misuse mortality in England and Wales includes all deaths due to poisoning with one or more controlled drug, whatever the intent or coroner's verdict.<sup>3</sup> This is not easy with the standard ICD shortlists. The mechanism of death is important when looking at preventing injury deaths by modification of products/environment, for example gun control legislation, or improvements in car safety. Categorising deaths by intent is important when looking at interventions that aim to prevent deaths across all mechanisms of death for the same intent, for example provision of mental health services and antidepressant prescribing to prevent suicides.

## The ICE matrix

### Why analyse data using the ICE matrix

The International Collaborative Effort (ICE) on injury statistics matrix classifies injury and poisoning deaths according to both mechanism and intent, using standard groups of ICD codes.<sup>4,5,6,7</sup> This was done in an effort to standardise how comparisons across mechanisms and intents are carried out, as there are a number of potential ways of doing this. Intent may be established and reported in very different ways in different countries, and this may distort international comparisons. An example is the apparently very low rate of accidental drownings in England and Wales, compared to other ICE participant countries.<sup>8</sup> This is largely an artefact due to a much larger proportion of our drowning deaths being coded as suicide and particularly as 'undetermined intent'. The latter reflects coroners' 'open' verdicts where there is no evidence of intent. In many countries such deaths are simply assumed to be accidental. Use of the matrix facilitates comparison of deaths between countries independent of these potential complications. A study carried out in the 1990s using the matrix showed that France had mortality rates from injury and poisoning twice those in England and Wales and rates for poisoning and falls were nearly twice as high in Denmark as in the comparison countries.<sup>9</sup>

ONS has used the ICE matrix to look at injury and poisoning mortality in England and Wales in two annual reports.<sup>10,11</sup> Presentation of data using the ICE matrix allows easy access to information on both mechanism and intent.

### Modifications of the matrix in our analysis

We modified the matrix from the international version in the following ways:

- **Grouped deaths with an underlying cause of Y33.9 with deaths from homicide (unspecified mechanism).** This code is used for the underlying cause for deaths in England and Wales which have been registered before legal proceedings have been completed and the inquest has therefore been adjourned. These deaths are known as accelerated registrations. It has been possible to register these deaths in this way since 1978 and these deaths were identified in ICD-9 using code E988.8.<sup>1</sup> A large proportion of these deaths are subsequently found to be homicides, so to exclude them from the homicide grouping would underestimate deaths from homicide. These deaths accounted for 52 per cent of homicides in 2004.

- **Included deaths from 'Mental and behavioural disorders due to psychoactive substance use' (F10–F19) with poisoning.** In England and Wales, over 90 per cent of these deaths are in fact acute poisonings where the coroner has given a verdict of drug misuse or addiction, instead of one of accident, suicide or an open verdict.<sup>12</sup> To leave out these deaths would underestimate mortality from poisoning; including them increases the number of deaths in this mechanism by 1,260 (54 per cent) (Table 1). These deaths are referred to as deaths from drug abuse/dependence in the article.
- **Included deaths coded to E887 (fracture, cause unspecified) in ICD-9 and the nearest equivalent to this in ICD-10 (deaths with an underlying cause of X59- unspecified accident, with a secondary cause of S72 – fracture of femur (Box One)) with deaths from falls.** Previous analysis showed that these codes in ICD-10 give a good approximation to the E887 code in ICD-9. Many deaths from falls simply state the resulting fracture on the death certificate and to leave these deaths out of the falls category would underestimate deaths from falls.<sup>13</sup> Including them increases the number of deaths included in this mechanism by 2,042 deaths (67 per cent) (Table 1).
- **Added deaths from osteoporosis (M80–M81) to the falls mechanism.** This is because it is possible, in both ICD-9 in England and Wales and in ICD-10 in most countries, for deaths from fractures following falls to be coded as due to osteoporosis.<sup>13</sup> In 2004, over 80 per cent of deaths from osteoporosis were stated to have involved a pathological fracture.<sup>1</sup> In order not to further underestimate falls we therefore included osteoporosis deaths in our analysis – increasing the number of deaths included in this mechanism by 1,478 (48 per cent) (Table 1). These deaths do not have an intent recorded, as they are not within the injury and poisoning chapter of the ICD, but they are most likely to be unintentional deaths. We have kept them separate in the results presented to show their contribution to overall numbers.

## Box one

### Secondary cause of death

Deaths where the underlying cause is an external cause are also assigned at least one nature of injury code (from Chapter XIX, S00–T98). Thus, it is possible to have more than one nature of injury code for a single death. For example, a car occupant injured in a transport accident (V40–V49) may have suffered a fracture to the skull (S02) and femur (S72), as well as injuries of the spleen (S36). However, it is necessary to select which one of the nature of injury codes is to be identified as the one causing death. This one cause code is referred to by ONS as the secondary cause. To do this, WHO provides selection guidelines or 'rules' to ensure that the most useful information is derived from the death certificate and that it is done uniformly.<sup>14</sup>

The codes from ICD-10 and ICD-9 used in this analysis for each intent and mechanism category are shown in Appendix A.

## Data and Methods

### Mortality data

Mortality data were extracted from the deaths databases held by ONS. Most deaths from injury and poisoning are certified by a coroner – 84 per cent in 2004. The exception to this is deaths from falls and fractures, usually in the elderly, which are often certified by doctors, after consultation with the coroner, if there is no public interest that requires an

**Table 1** Injury and poisoning deaths by mechanism and intent, 2004

England and Wales

Persons	Intent							Numbers
	Unintentional	Suicide	Undetermined probable homicide	Homicide and intervention/	Legal abuse/dependence	Drug	Osteoporosis	TOTAL
<b>a) Y33.9 included with homicide, with F10–F19 and M80–M81 added</b>								
Cut/pierce	13	110	18	141				282
Drowning	169	87	148	5				409
Fall and fracture	2,915	99	55	0			1,478	4,547
Fire/flare, hot object/substance	283	39	31	14				367
Firearm	2	81	14	18				115
Machinery	10							10
Transport	2,728	6		1				2,735
Natural/environmental	139							139
Overexertion	0							0
Poisoning	927	888	514	9		1,260		3,598
Struck by, against	49		1	7				57
Suffocation	480	1,748	309	28				2,565
Other specified	123	145	60	5	1			334
Unspecified	2,897	103	140	530				3,670
<b>Total</b>	<b>10,735</b>	<b>3,306</b>	<b>1,290</b>	<b>758</b>	<b>1</b>	<b>1,260</b>	<b>1,478</b>	<b>18,828</b>
<b>b) Additional adjustment made: X59 with S72 secondary cause removed from unspecified and added to fall</b>								
Cut/pierce	13	110	18	141				282
Drowning	169	87	148	5				409
Fall and fracture	4,957	99	55	0			1,478	6,589
Fire/flare, hot object/substance	283	39	31	14				367
Firearm	2	81	14	18				115
Machinery	10							10
Transport	2,728	6		1				2,735
Natural/environmental	139							139
Overexertion	0							0
Poisoning	927	888	514	9		1,260		3,598
Struck by, against	49		1	7				57
Suffocation	480	1,748	309	28				2,565
Other specified	123	145	60	5	1			334
Unspecified	855	103	140	530				1,628
<b>Total</b>	<b>10,735</b>	<b>3,306</b>	<b>1,290</b>	<b>758</b>	<b>1</b>	<b>1,260</b>	<b>1,478</b>	<b>18,828</b>

inquest. Data for 1981 have been excluded from analysis by mechanism of death because of the registrars' strike of that year, which reduced the amount of detail supplied to ONS for deaths from injury and poisoning.

Annual mortality statistics for the years up to and including 1992 were published by the year in which the death was registered. Each year, the file of deaths used for analysis therefore contained details of some deaths that had occurred in previous years but had not been registered in the year of death. It omitted deaths that had occurred during the calendar year but had not been registered before the end of the year. The two categories were assumed to balance out each year. A large proportion of deaths in these groups were from injury and poisoning, because of the time taken to hold an inquest and subsequently register the death. Mortality statistics for 1993 onwards have been tabulated by the year in which the deaths occurred, not when they were registered. The annual file is closed in September following the year end, so deaths registered after this date are never included in the annual files used for routine outputs and analysis.

1979 was chosen as the start year for analysis because this was the first year that ICD-9 coding was used in England and Wales. ICD-10 was introduced in 2001.

ONS usually combines deaths from suicide and injury/poisoning of undetermined intent to give an overall estimate of suicides in England and Wales.<sup>15</sup> In this analysis, however, we have presented them separately

to show any differences in the distribution of mechanisms within the two intents.

### Mortality rates and populations

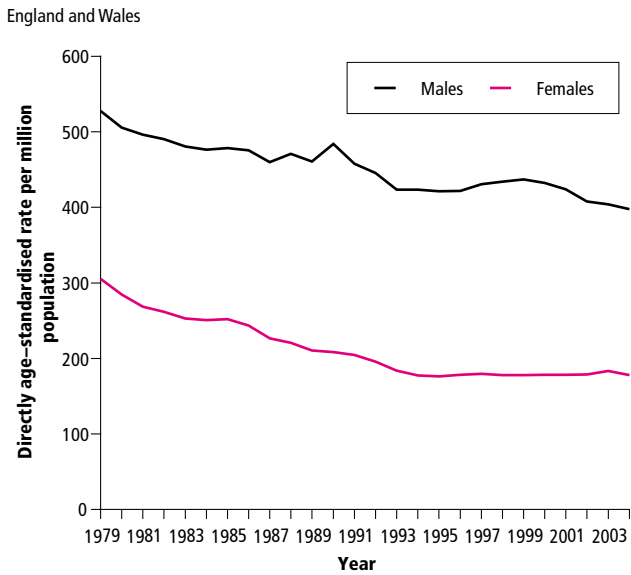
To take into account differences in age/sex distributions over time, we calculated directly age-standardised mortality rates for males and females separately for each cell of the matrix, using the European Standard Population.<sup>16</sup> Revised mid-year population estimates based on the 2001 Census were used to calculate the rates for 1982 to 2002. For 1992 to 2002, these were final revised populations published in Autumn 2004. For 1982 to 1991, these were final revised populations published in Spring 2003. Populations prior to 1982 were not revised following the 2001 Census.<sup>17</sup>

## Results

### Trends and patterns in overall injury and poisoning mortality

Overall injury and poisoning mortality rates have declined since 1979 for both males and females from 528 per million population for males and 305 per million for females in 1979 to 398 per million and 178 per million respectively in 2004 (Figure 1). For both sexes, declines were greatest during the 1980s and early 1990s; rates for males declined almost 20 per cent between 1979 and 1993, and for females the decline

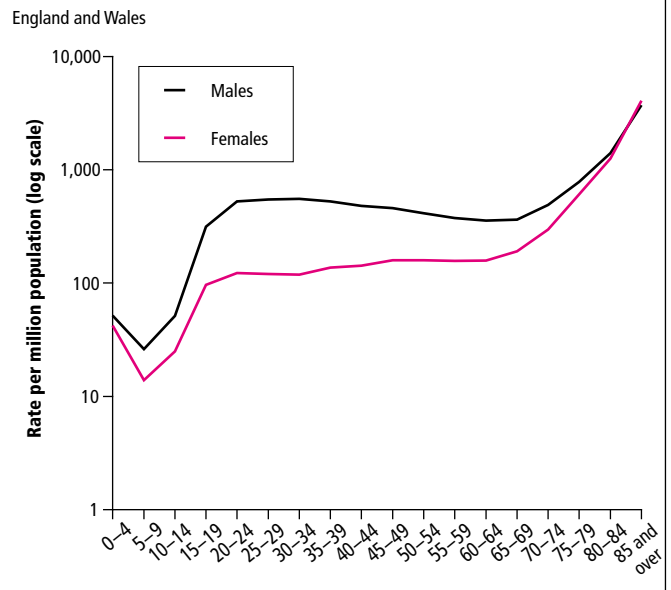
**Figure 1** Trends in mortality rates for all injury and poisoning: by sex, 1979–2004



was almost 40 per cent. In contrast, between 1993 and 2004, rates for males declined 6 per cent, after increasing during the mid to late 1990s, and for females rates declined only 3 per cent between 1993 and 2004.

Injury and poisoning mortality rates also vary substantially by age and sex. The highest rates are in the oldest age group, and this is the only age group where rates are higher for females than for males (Figure 2). This is likely to be at least partly due to the fact that in the 85 and over age group, women are generally older than men and thus have higher mortality. Rates are substantially higher for males than females between ages 15 and 64, with this gap starting to narrow for ages 65–69 and older. At ages up to 15, rates are also more similar between males and females, but are still higher among males, even in the 0–4 age group. For both sexes rates decrease between the 0–4 and 5–9 age group then begin to

**Figure 2** Injury and poisoning mortality rates by five-year age group and sex, 2000–2004



increase to ages 20–24. In men, rates decline from ages 20–24 to 65–69 and then start to increase to the oldest age group. For women, the pattern is different, with rates slowly increasing from ages 20–24 to 65–69, and then increasing more rapidly to the oldest age groups (Figure 2).

Looking at trends by broad age group, rates in the 75 and over age group for both males and females were far higher than in any other age group throughout the period 1979–2004. Rates in this age group declined to the mid 1990s before beginning to rise again. In females, rates under 15 and at ages 35–74 declined over the period. However, mortality in the 15–34 age group changed very little. For males, the under 15s also had the lowest rates and they declined throughout the period. Rates in the age groups 15–34, 35–54 and 55–74 were more variable – in the early part of the period rates were higher in the 55–74 age group, but these declined

**Figure 3** Trends in mortality rates for all injury and poisoning: by sex and broad age group, 1979–2004

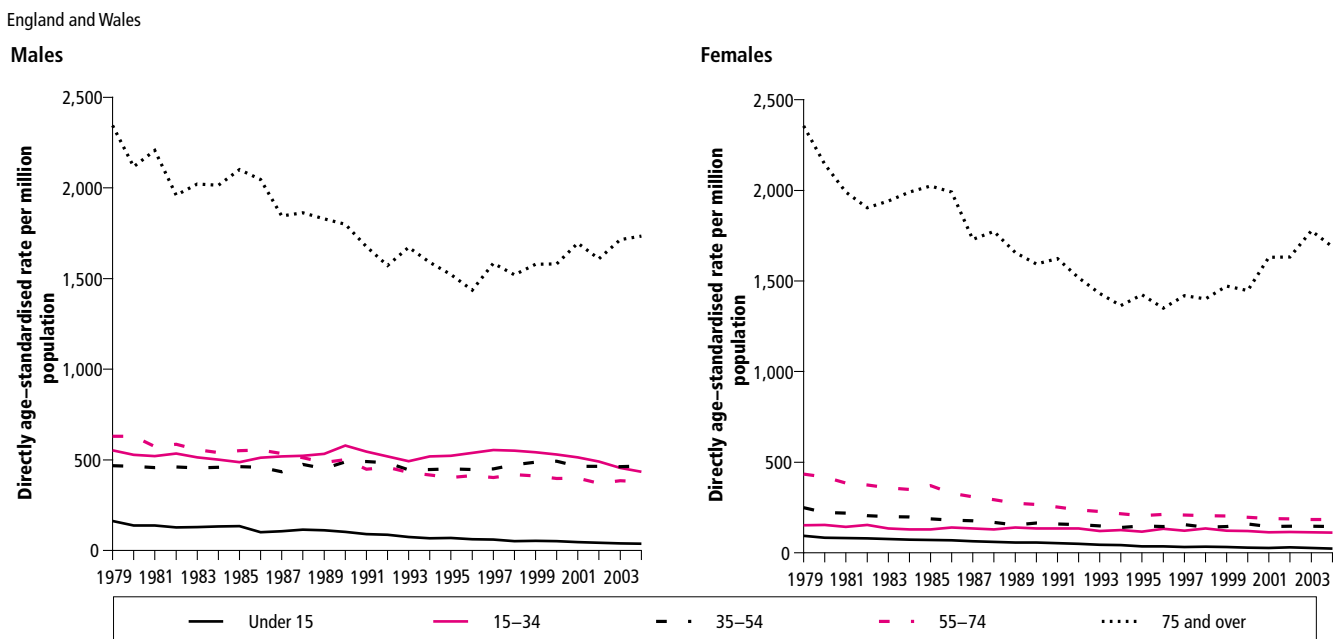
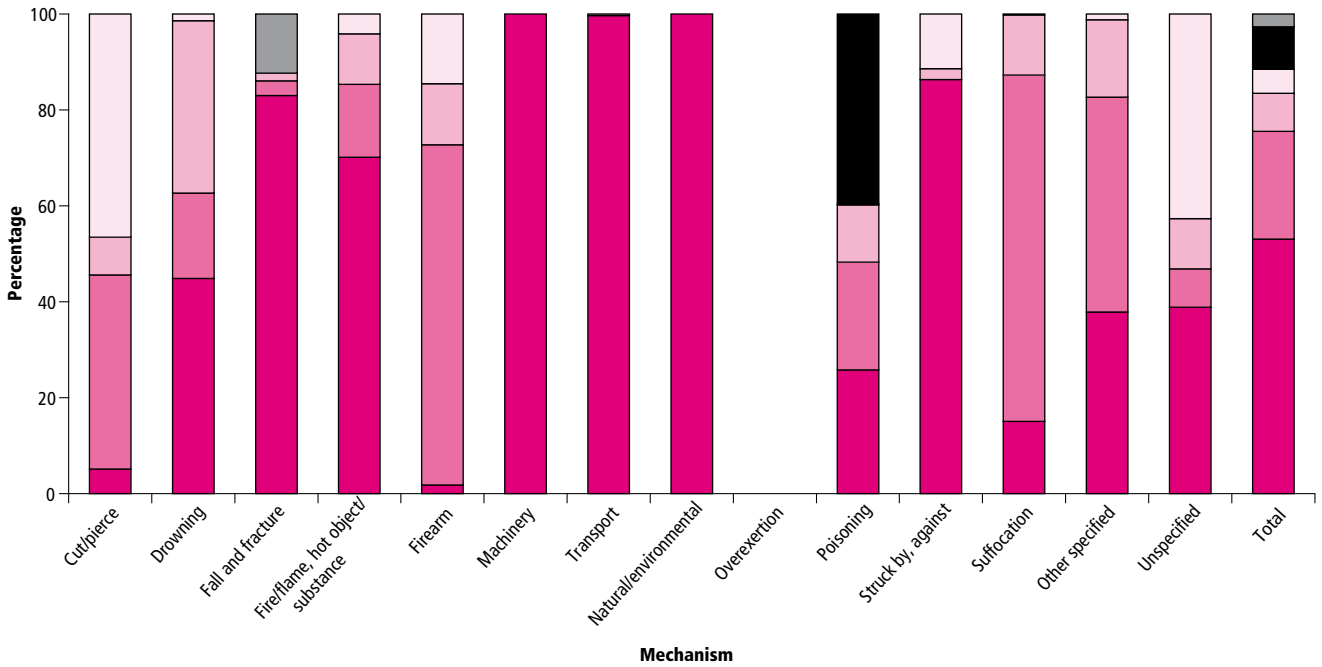


Figure 4

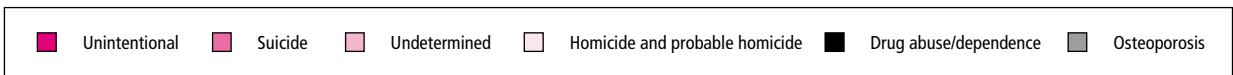
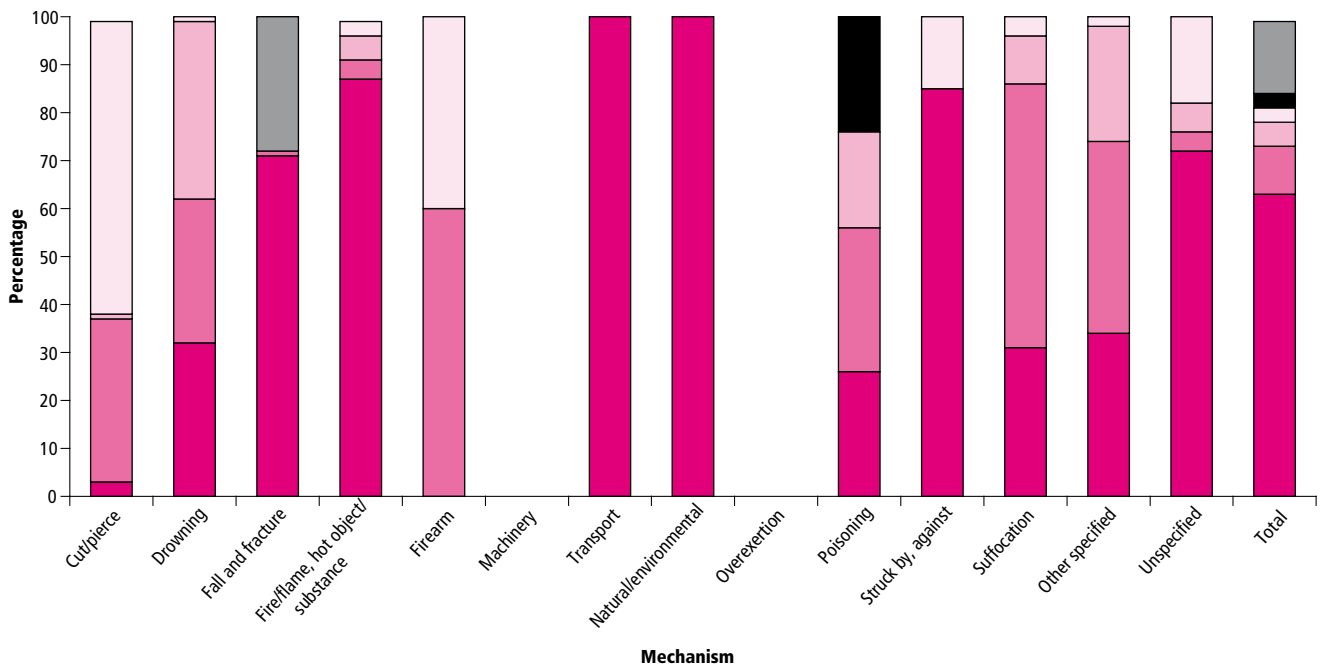
Mechanism of injury by intent, by sex, 2004

England and Wales

Males



Females



substantially, so that by 2004, men in this age group had lower rates than men in the other two age groups. Rates in the 35–54 age group did not decline over the period, so they went from being the lowest of the three middle age groups to being the highest. The 15–34 age group had the highest rates of the three from the early 1990s until 2002, but in 2003 and 2004 their rate was below that of the 35–54 age group (Figure 3).

**Patterns of mortality by intent, within mechanism**

In 2004, the majority of falls and fractures were unintentional (83 per cent for males and 71 per cent for females) (Figure 4). If we assume that deaths from osteoporosis were also unintentional, these proportions increase to 95 and 99 per cent. The majority of deaths from cutting/piercing injuries were homicides (47 per cent for males and 61 per cent for females) and the majority of deaths from suffocation, which includes hanging and asphyxiation by plastic bags, were suicides (72 per cent for males and 55 per cent for females). Poisoning, by contrast, was split across four main intents – drug abuse/dependence (40 per cent for males and 24 per cent for females), unintentional (26 per cent for both males and females), suicide (22 per cent and 30 per cent) and undetermined intent (12 per cent and 20 per cent).

Almost all deaths due to transport incidents were unintentional. This is partly due to ICD coding rules – even deaths with a verdict of ‘death by dangerous driving’ or an open verdict are coded as unintentional. This is largely because measures aimed at improving road safety, including enforcement of legislation on speeds, seat belts, drink driving etc, as well as design of roads and vehicles are aimed at preventing all motor vehicle deaths.

Since 1979 an increased proportion of poisonings have been recorded as due to drug abuse/dependence (11 per cent for males and 6 per cent for females in 1979 compared with 40 and 24 per cent in 2004) (data not shown). Other mechanisms had a more similar distribution of intents in 1979 compared with 2004.

**Patterns of mortality by mechanism, within intent**

In 2004 the most common mechanisms for unintentional injuries among males were transport and falls (35 and 34 per cent respectively). In 1979, a much higher percentage of unintentional deaths were due to transport (53 per cent) (Table 2). For females, the majority of unintentional deaths in both 1979 and 2004 were due to falls/fractures (48 per cent in 1979 and 62 per cent in 2004), followed by transport (27 per cent and 13 per cent). In 2004, for suicides, suffocation was the most common mechanism for males (57 per cent), compared with poisoning in 1979 (44 per cent). There was a similar percentage allocated to both suffocation (40 per cent) and poisoning (41 per cent) for females. In 1979, 59 per cent of female suicides were due to poisoning.

As might be expected, deaths from undetermined intent were more mixed in terms of the mechanisms involved. In 1979 for both sexes, the two most common mechanisms were poisoning (37 per cent for males and 56 per cent for females) and drowning (28 per cent for males and 26 per cent for females). By 2004, a reduced proportion were drownings (12 per cent for males and 11 per cent for females) and an increased proportion due to suffocation (28 per cent for males and 15 per cent for females compared with 7 per cent and 1 per cent respectively in 1979).

For deaths from homicide the picture is less clear. This is because a large proportion are ‘probable homicides’, registered when the inquest is adjourned. A large proportion of homicides therefore have an unspecified mechanism (74 per cent for males and 60 per cent for females in 2004 compared with 39 per cent and 38 per cent in 1979). The coroner cannot give detailed cause information before completion of legal proceedings. For homicides with a stated mechanism, the most common was cutting/piercing injuries for males in both 1979 and 2004 and for females in 2004. For females in 1979 suffocation was the most common mechanism.

However, because of the increase in homicides with no information on mechanism, these changes are hard to interpret.

**Trends in injury and poisoning mortality by intent**

For males, the most common intent group for injury and poisoning deaths was unintentional across the period 1979 to 2004, with a substantial decline from 353 per million in 1979 to 205 per million in 2004 (Figure 5). Suicide rates fell across the period but only slightly from 109 per

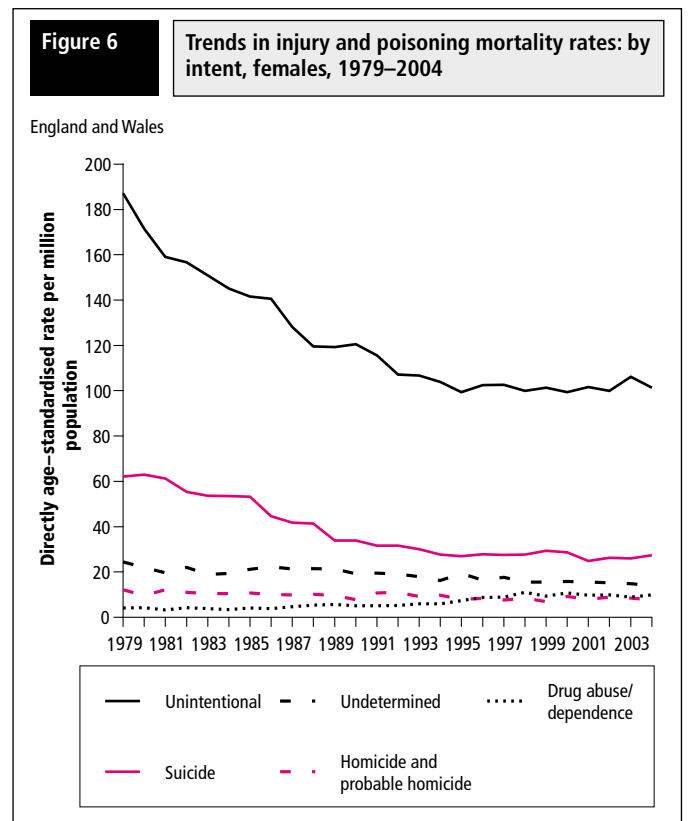
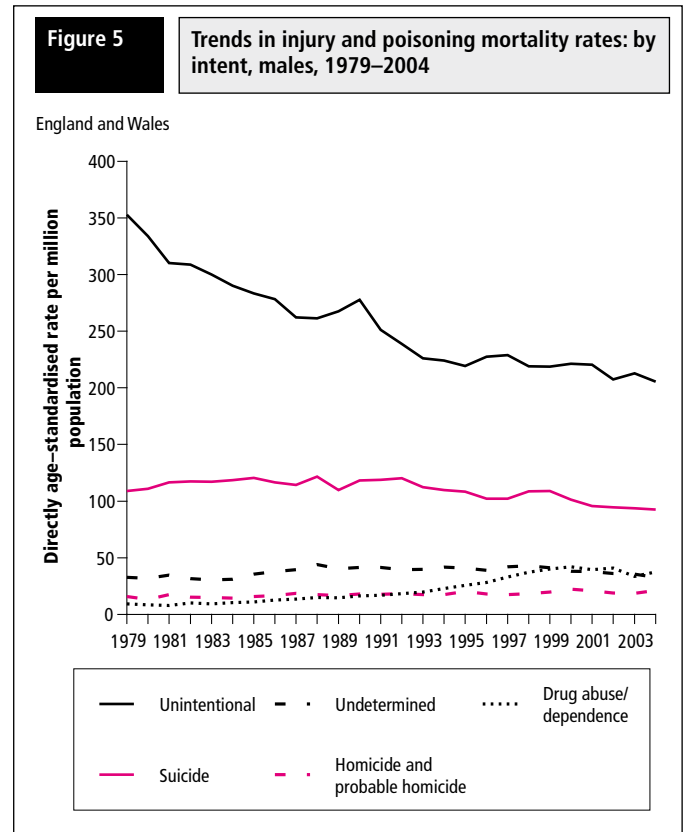


Table 2

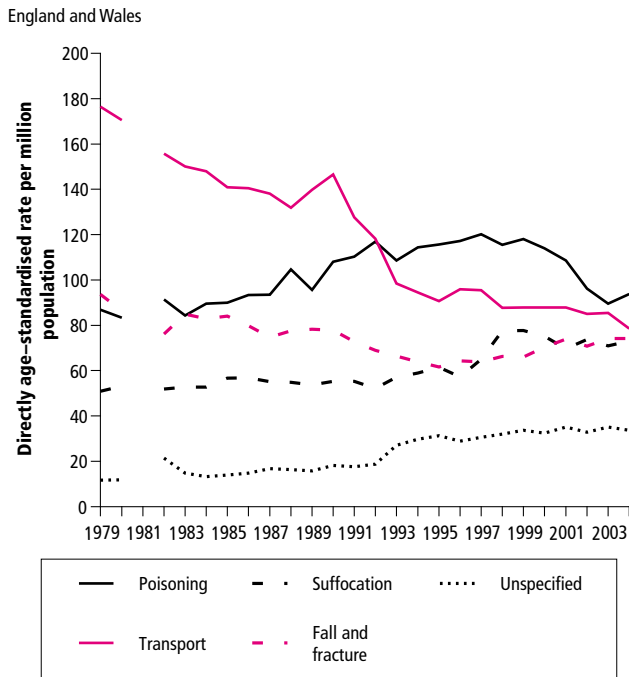
Percentage of deaths by mechanism within intent groups: by sex, 2004 and 1979

England and Wales

Mechanism	Intent						Percentages
	Unintentional	Suicide	Undetermined	Homicide and probable homicide	Drug abuse/dependence	Osteoporosis	Total
<b>2004</b>							
<b>Males</b>							
Cut/pierce	0	3	2	18	0	0	2
Drowning	2	2	12	1	0	0	3
Fall and fracture	34	3	4	0	0	100	21
Fire/flame, hot object/substance	3	1	3	2	0	0	2
Firearm	0	3	2	3	0	0	1
Machinery	0	0	0	0	0	0	0
Transport	35	0	0	0	0	0	19
Natural/environmental	1	0	0	0	0	0	1
Overexertion	0	0	0	0	0	0	0
Poisoning	11	22	34	1	100	0	23
Struck by, against	1	0	0	1	0	0	0
Suffocation	5	57	28	1	0	0	18
Other specified	2	4	5	1	0	0	2
Unspecified	6	3	11	74	0	0	9
Total	100	100	100	100	100	100	100
<b>Females</b>							
Cut/pierce	0	3	0	20	0	0	1
Drowning	1	4	11	0	0	0	2
Fall and fracture	62	3	4	0	0	100	55
Fire/flame, hot object/substance	3	1	2	2	0	0	2
Firearm	0	0	0	1	0	0	0
Machinery	0	0	0	0	0	0	0
Transport	13	0	0	0	0	0	8
Natural/environmental	1	0	0	0	0	0	1
Overexertion	0	0	0	0	0	0	0
Poisoning	6	41	53	2	100	0	14
Struck by, against	0	0	0	1	0	0	0
Suffocation	4	40	15	12	0	0	8
Other specified	1	4	5	1	0	0	1
Unspecified	10	3	10	60	0	0	9
Total	100	100	100	100	100	100	100
<b>1979</b>							
<b>Males</b>							
Cut/pierce	0	4	1	32	0	0	2
Drowning	4	6	28	1	0	0	6
Fall and fracture	19	5	9	0	0	100	16
Fire/flame, hot object/substance	4	2	4	1	0	0	4
Firearm	0	7	3	6	0	0	2
Machinery	2	0	0	0	0	0	1
Transport	53	0	0	0	0	0	35
Natural/environmental	3	0	0	0	0	0	2
Overexertion	0	0	0	0	0	0	0
Poisoning	5	44	37	2	100	0	16
Struck by, against	1	0	0	9	0	0	1
Suffocation	5	28	7	6	0	0	10
Other specified	2	5	4	5	0	0	3
Unspecified	1	0	8	39	0	0	2
Total	100	100	100	100	100	100	100
<b>Females</b>							
Cut/pierce	0	2	0	21	0	0	1
Drowning	1	10	26	2	0	0	4
Fall and fracture	48	5	6	0	0	100	40
Fire/flame, hot object/substance	7	2	2	2	0	0	5
Firearm	0	1	1	5	0	0	0
Machinery	0	0	0	0	0	0	0
Transport	27	0	0	0	0	0	18
Natural/environmental	4	0	1	0	0	0	3
Overexertion	0	0	0	0	0	0	0
Poisoning	6	59	56	1	100	0	18
Struck by, against	0	0	0	3	0	0	0
Suffocation	5	17	1	24	0	0	7
Other specified	1	3	1	3	0	0	1
Unspecified	1	0	5	38	0	0	2
Total	100	100	100	100	100	100	100

**Figure 7**

**Trends in injury and poisoning mortality rates by mechanism, top five mechanisms in 2004, males, 1979–2004**



million in 1979 to 92 per million in 2004. Death from undetermined intent rose during the early and mid 1980s, with a peak rate of 44 per million in 1988. For the next 11 years, rates remained fairly stable before decreasing consistently from 1998 to stand at 33 per million in 2004 – the same rate as in 1979. ONS normally combines suicide and undetermined intent when presenting overall suicide trends for England and Wales. Over the period there was an increase in drug abuse/dependence death rates, from 9 per million in 1979 to 37 per million in 2004, though the peak was 42 per million in 2000. Homicide rates increased from 16 per million in 1979 to 21 per million in 2004, with a peak of 22 per million in 2000.

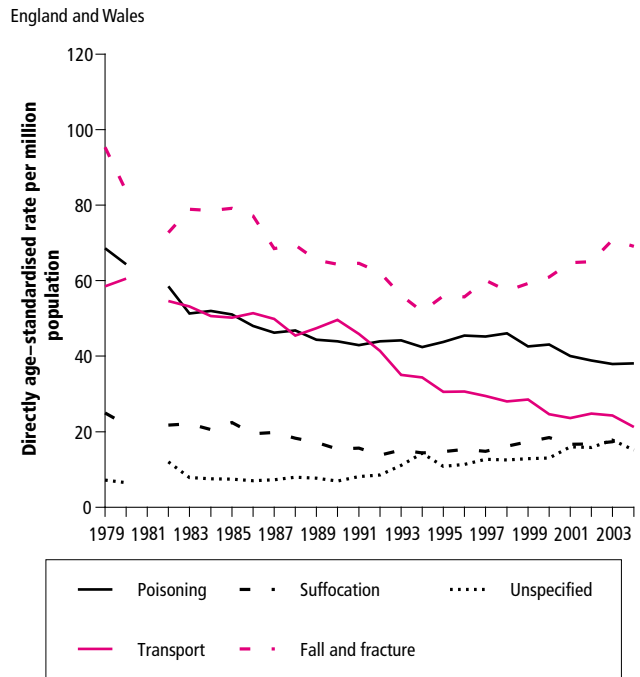
Among females, the most common intent was also unintentional, with a substantial decrease between 1979 (187 deaths per million population) and 1995, when the lowest rate in the period of 99 per million was recorded (Figure 6). Since 1995 rates have remained stable at around 100 per million. Suicide was the second most common intent, and suicide rates among females declined from 62 per million in 1979 to 27 per million in 1995. Since then rates have been fairly stable. Deaths with undetermined intent declined from 24 per million in 1979 to 14 per million in 2004. Deaths from homicide also declined, from 12 per million in 1979 to 8 per million in 2004. Deaths from drug abuse/dependence increased from 4 per million in 1979, varying between 9 per million and 11 per million during 1996 to 2004.

**Trends in injury and poisoning mortality by mechanism**

The five most common mechanisms in 2004 for both males and females were poisoning, transport, suffocation, falls and fractures and unspecified. Figures 7 and 8 show trends for these mechanisms from 1979 to 2004. For males, there was a large decrease in transport death rates, from 176 per million in 1979 to 79 per million in 2004 (Figure 7). Since 1993, poisoning has been the most common mechanism for males, with rates increasing from 87 per million in 1979 to a peak of 120 per million in 1997. Rates then declined to 2003. Deaths from falls and fractures declined from 94 per million in 1979 to a low of 62 per million in 1995. Since then rates have increased to stand at 74 per million in 2004. Rates for suffocation and for unspecified mechanisms both increased over the period.

**Figure 8**

**Trends in injury and poisoning mortality rates by mechanism, top five mechanisms in 2004, females, 1979–2004**



For females, the most common mechanism throughout the period was falls and fractures. Death rates for these followed a similar pattern to that seen for males, declining from 95 per million in 1979 to a low of 52 per million in 1994, increasing since then, to stand at 69 per million in 2004 (Figure 8). There was a decline in deaths from poisoning, though rates did increase slightly during the 1990s before decreasing again. Rates for transport incidents also declined during the period, from 58 per million in 1979 to 21 per million in 2004. The pattern for suffocation was different to that for males, with rates declining to the early 1990s and then increasing, to stand at 19 per million in 2004. Deaths with unspecified mechanism increased throughout the period.

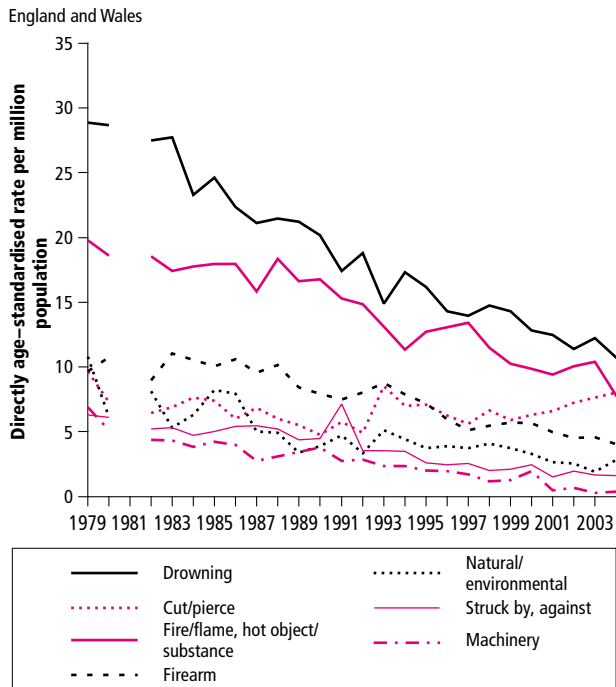
Figures 9 and 10 present trends in death rates for the less common mechanisms. For males, rates for drowning, fire/flame and firearm all declined (Figure 9). Rates for cutting/piercing injuries have been more variable, but have increased in recent years. Rates for deaths involving machinery decreased to almost zero by 2004. For females, rates for fire/flame and drowning decreased from around 16 per million in 1979 to around 4 per million in 2004 (Figure 10). Rates for natural/environmental factors and cutting/piercing injuries also declined overall during the period, but rates for cutting/piercing injuries have been stable in recent years.

As discussed above, the distribution of intents for deaths from poisoning shows an interesting pattern over the period. For males, the overall rate for mortality from poisoning has increased from 87 per million in 1979 to a peak of 120 per million in 1997, declining to 2003, as described above. Within this there has been a shift in the distribution of the intent of the deceased, which may tell us something about changes in the types of these deaths. From 1979, throughout the 1980s, suicide was consistently the most common intent, but from the early 1990s this pattern started to change, with unintentional deaths and deaths from drug abuse/dependence becoming increasingly more important (Figure 11). By 2004, both of these intents had higher rates than suicide. For females, the overall trend is one of decline, particularly in suicides. Deaths from drug abuse/dependence have increased over the period.



**Figure 9**

**Trends in injury and poisoning mortality rates by other mechanisms, males, 1979–2004**

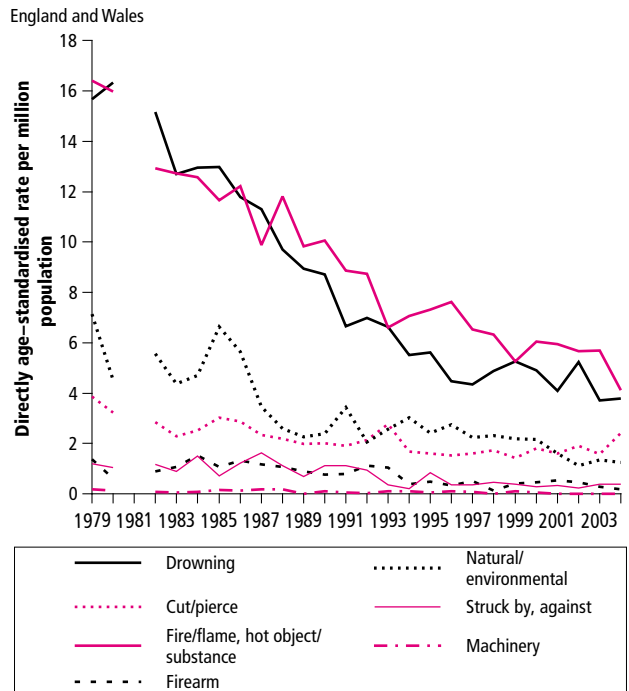


**Patterns of injury and poisoning mortality for the top four mechanisms by age**

Mortality varies by five-year age group according to the mechanism of death. For falls, in both males and females there is a strong relationship with age, with rates increasing dramatically from ages 5–9, with the lowest rates, to age 85 plus, where rates for falls are substantially higher than for the other main mechanisms of death (Figure 12). The other mechanisms show more similar patterns to each other by age, particularly in males. In males, for poisoning and suffocation, rates are lowest in the

**Figure 10**

**Trends in injury and poisoning mortality rates by other mechanisms, females, 1979–2004**



5–9 age group. For transport, rates are lowest in the 0–4 age group. Rates rise steeply to a peak in young adulthood. The age group of the peak varies by mechanism – for transport it is in men aged 20–24, whereas for poisoning and suffocation it is in men aged 30–34. For each of these, rates then start to decline, before rising again in the older age groups.

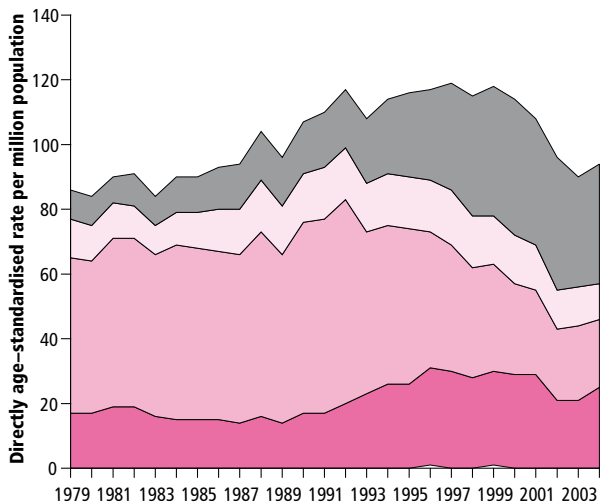
For females, rates for transport, poisoning and suffocation are lowest in the 5–9 age group. Rates then rise with age, but there is only a clear peak in young adults for transport, where the peak is in 15 to 19-year-olds. Rates for transport then decrease, levelling off between ages 30 and 59

**Figure 11**

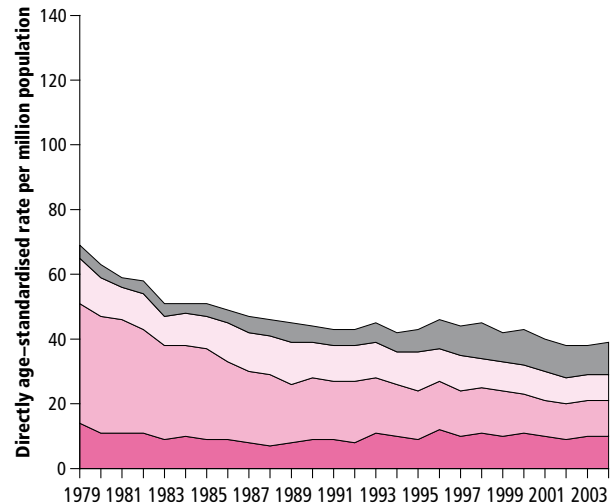
**Poisoning mortality rates by intent, 1979–2004**

England and Wales

**Males**



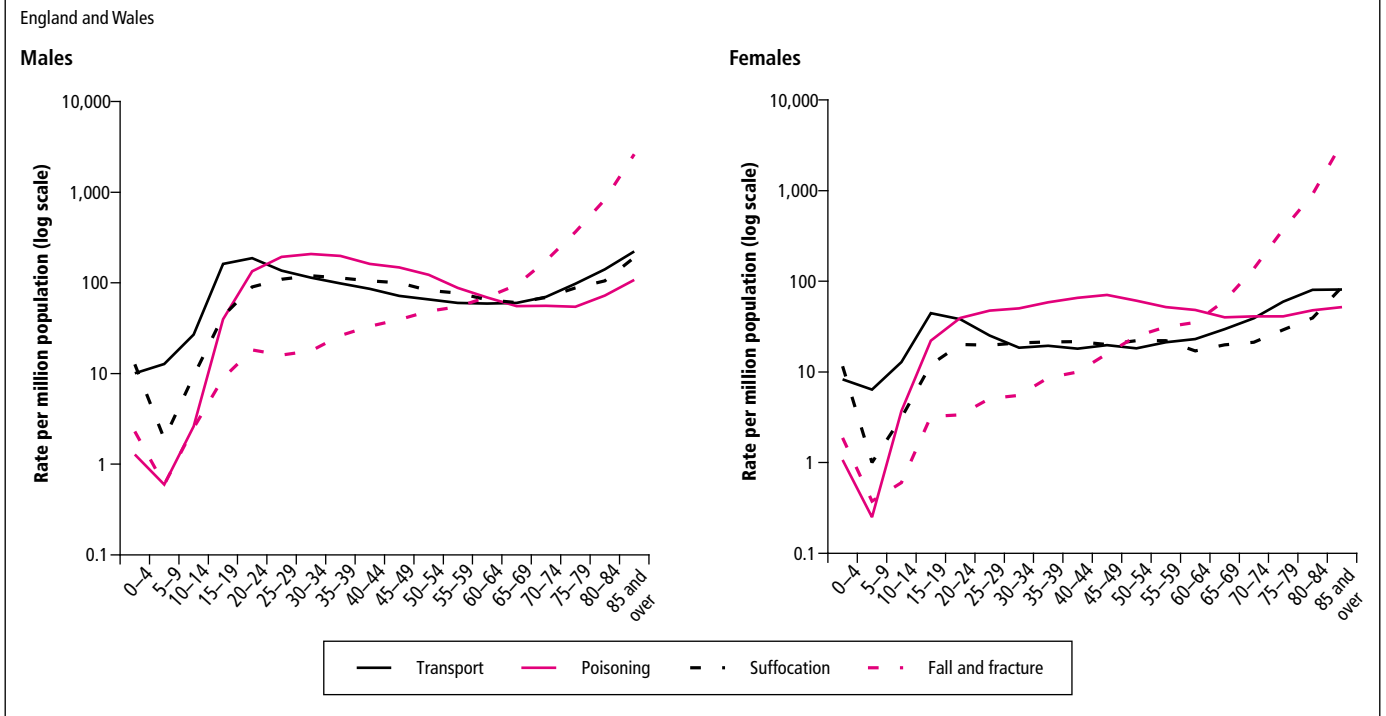
**Females**



■	Drug abuse/dependence	■	Undetermined	■	Suicide	■	Unintentional	■	Homicide
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Figure 12

Injury and poisoning mortality rates by five year age group for the top four specific mechanisms, 2000–2004



before starting to rise again from age 60–64. For suffocation, rates are stable between ages 20–24 and 65–69, where they again start to rise. For poisoning, rates peak in the 45–49 age group.

## Discussion

Overall injury and poisoning mortality rates have declined since 1979 for both males and females; for both sexes the reductions in rates were greatest during the 1980s and early 1990s, with rates decreasing only slightly since then. Overall rates were significantly higher for males than for females and were highest in the elderly, throughout the period 1979 to 2004, and have increased since the 1990s in this age group.

Transport incidents have seen a large decline. Various national and local Government campaigns and regulations have targeted road safety. Compulsory seatbelt wearing for front-seat passengers was introduced in 1982 and for adult back-seat passengers in 1991. Soon after the law came into effect there was 90 per cent wearing by car drivers and front-seat passengers. The introduction of the breathalyser test came in 1967,<sup>18</sup> predating the period examined in our article.

Deaths from falls and fractures declined to the mid 1990s but then increased in more recent years. Some of this may be related to aging of the population, though this should be minimised through age standardising the rates. There has been a large shift away from holding inquests in deaths from falls in the elderly to allowing doctors to certify the death after consulting the coroner. It is possible, though it is difficult to find evidence to check, that this could have led to an increased willingness amongst doctors to certify deaths as due to falls and fractures. However, research is needed to establish whether this is a real increase in risk of dying from falls, and what the reasons for such a rise could be.

Deaths from fires have decreased substantially in both sexes. This is despite an increase over the same time period in total fires and domestic fires in the UK.<sup>19</sup> Deaths from drowning have also declined over the same period, although the reasons for this decline are unclear.

Homicide rates have increased among males, particularly young adults, but have decreased in women and not changed much in infants and children. This pattern is similar to the trends in suicide rates. ONS mortality data do not provide any information about the perpetrator or apparent reason for homicides. Homicide remains a rare cause of death in England and Wales, even after the standard ONS addition of adjourned inquest deaths or ‘probable homicides’ as in this paper. Nevertheless, it is now one of the ten leading causes in young men and women.<sup>2</sup>

There have been increases in deaths attributed to drug abuse/dependence in both males and females. This is related to an increase during the 1990s in deaths involving opiates, with a peak in 2000.<sup>20</sup> The change in distribution of deaths from poisoning from being mainly suicides to having a more mixed distribution of intents is probably related to a variety of factors, including the reduction in suicides from motor vehicle exhaust gas poisoning, as well as from drug poisoning, with drugs such as antidepressants and paracetamol, and the increase in deaths from drug abuse/dependence referred to above. There may also have been a shift in the way that coroners use verdicts, with some deaths that would in the past have been given a verdict of accident or ‘open’, being specified instead as drug abuse/dependence.

This article has demonstrated how using the ICE matrix can reveal patterns of injury and poisoning mortality which are not easily visible using traditional tabulations based on ICD shortlists. The overall patterns and trends in deaths from poisoning are obscured by the traditional method of tabulating them in different intent categories. Transport crashes, in contrast, are not underestimated because they are almost all coded as unintentional.

Including osteoporosis (M80–M81) and fracture with no external cause specified (X59 with secondary cause S72) increases deaths classed as falls from about 3,000 to around 6,500. This shows that the traditional ICD codes for examining falls in ICD-10 underestimate falls in England and Wales by about half. The Mortality Reference Group (MRG) of the World Health Organisation proposes to introduce new codes in a

future update of ICD-10 which would allow deaths from fractures with the cause unspecified to be coded to X59.0, with the code X59.9 being used for other deaths currently coded to X59 (exposure to unspecified factor).<sup>13</sup> X59.0 would then be equivalent to E887 in ICD-9. This would allow these deaths to be more easily grouped with deaths from falls for analysis purposes.

In England and Wales, deaths from poisoning are seriously underestimated unless we include deaths coded to mental and behavioural disorders due to psychoactive substance use. The MRG has recommended changes to coding guidance in ICD-10, so that deaths from acute 'intoxication' or toxicity of drugs would be coded to poisoning, in chapter XX, instead of the F10–F19 codes in the mental and behavioural chapter.

Making these changes to falls and poisoning means that, in 2004, falls were the most common mechanism of injury, followed by poisoning, then transport incidents. This is different to the traditional picture of injury mortality in England and Wales, where transport is often seen as the most common mechanism of injury.<sup>10</sup> The demotion of transport to third commonest mechanism of deaths from external causes reflects both the dramatic real decline in transport-related deaths during this period, and the grouping of deaths from other mechanisms across intent categories. In 2004, falls and fractures accounted for nearly twice as many deaths as poisoning and more than two and a half times as many as transport.

Usually ONS combines deaths from suicide and undetermined intent to give an overall estimate of suicides. This is because in England and Wales, it has been customary to assume that most injuries and poisonings of undetermined intent are cases where the harm was self-inflicted but there was insufficient evidence to prove that the deceased deliberately intended to kill themselves.<sup>15</sup> We have kept these two intents separate in this article to show the different patterns of mechanism across each. These patterns may of course be because the mechanism used may well influence whether or not a suicide verdict is given in particular cases. For example, it may be felt easier to establish intent for deaths from hanging (included in suffocation in this article) than for deaths from poisoning or drowning.

One limitation of this analysis is that mechanisms common in homicides will be underestimated due to the large number which have no mechanism allocated to them. More detailed analysis of homicides can be done using a special extract from the mortality database, but even so, only a small percentage have information on the mechanism of death.<sup>21</sup> The Home Office does publish information on method of homicide – the most common method in 2004/05 was stabbing with a sharp instrument (29 per cent),<sup>22</sup> which ties in with the most common mechanism in the mortality data being cutting and piercing injuries.

This example, and the general increase in injury deaths with an unspecified mechanism, highlights issues of data quality. To be useful, injury and poisoning mortality data should be based on accurate and specific information about the circumstances around the death, collected at death registration. The coroner has a key role in supply of good quality information to inform policy on injury and poisoning prevention measures. Doctors too play a role in certifying deaths from fractures, but often do not include information on how the fracture was sustained. Lack of information, or imprecise information, can lead to bias in reporting for some injury deaths. Homicides are clearly affected by missing information, as the analysis in this paper has shown. An increasing proportion of deaths involving fractures in the elderly are certified by doctors, who have not traditionally been taught to specify the external causes that led to injury. Additional training and prompts may be needed to improve the quality of information available about these deaths for prevention. For injury and poisoning mortality data to be useful for

policy formulation, they must also be timely. Deaths from injury and poisoning are often subject to delays in registration, which can mean that numbers in the annual occurrences datasets used in this article for 1993 onwards may be less complete for some causes.<sup>23</sup>

## Key findings

- Overall injury and poisoning mortality rates have declined since 1979 for both males and females. For both sexes, declines were greatest during the 1980s and early 1990s
- Overall rates were significantly higher for males than for females and were highest in the elderly of both sexes throughout the period 1979–2004, and have risen since the mid 1990s in this age group.
- In 2004, falls and fractures were the most common mechanism of injury mortality, followed by poisoning and transport. This is due to the inclusion of deaths from drug abuse/dependence with deaths from poisoning and deaths from osteoporosis and fracture with external cause unspecified with deaths from falls.
- There was a large decline in transport death rates, from 176 per million for males and 58 per million in females in 1979 to 79 per million and 21 per million respectively in 2004.
- For both sexes, death rates for falls and fractures declined to the mid 1990s but have increased in more recent years.
- There have been increases in death rates for drug abuse/dependence in both males and females and homicide rates have increased among males since 1979.

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Appendix A Codes used in this analysis

ICD-10 codes

Mechanism	Intent									
	Unintentional	Suicide	Undetermined	Homicide and probable homicide	Legal intervention / war	Mental and behavioural disorders due to psychoactive substance use (Drug abuse/dependence)	Osteoporosis	All intents		
Cut/pierce	W25-W29, W45	X78	Y28	X99	Y35.4	-	-	W25-W29, W45, X78, X99, Y28, Y35.4		
Drowning	W65-W74	X71	Y21	X92	-	-	-	W65-W74, X71, X92, Y21		
Fall and fracture <sup>1</sup>	W00-W19, X59 with secondary cause S72	X80	Y30	Y01	-	-	M80-M81	M80-M81, W00-W19, X59 (with secondary cause S72) X80, Y01, Y30		
Fire/flare, hot object/substance	X00-X19	X76-X77	Y26-Y27	X97-X98	Y36.3	-	-	X00-X19, X76-X77, X97-X98, Y26-Y27, Y36.3		
Firearm	W32-W34	X72-X74	Y22-Y24	X93-X95	Y35.0	-	-	W32-W34, X72-X74, X93-X95, Y22-Y24, Y35.0		
Machinery	W24, W30-W31	-	-	-	-	-	-	W24, W30-W31		
Transport	V01-V99	X82	Y32	Y03	Y36.1	-	-	V01-V99, X82, Y03, Y32, Y36.1		
Natural/environmental	W42-W43, W53-W64, W92-W99, X20-X39, X51-X57	-	-	-	-	-	-	W42-W43, W53-W64, W92-W99, X20-X39, X51-X57		
Overexertion	X50	-	-	-	-	-	-	X50		
Poisoning <sup>2</sup>	X40-X49	X60-X69	Y10-Y19	X85-X90	Y35.2	F10-F19	-	F10-F19, X40-X49, X60-X69, X85-X90, Y10-Y19, Y35.2		
Struck by, against	W20-W22, W50-W52	X79	Y29	Y00, Y04	Y35.3	-	-	W20-W22, W50-W52, X79, Y00, Y04, Y29, Y35.3		
Suffocation	W75-W84	X70	Y20	X91	-	-	-	W75-W84, X70, X91, Y20		
Other specified	W23, W35-W41, W44, W49, W85-W91, X58, Y85, Y86	X75, X81, X83, Y87.0	Y25, Y31, Y33 (excl. Y33.9), Y87.2	X96, Y02, Y05-Y08, Y87.1	Y35(1, 5, 6), Y36(0, 2, 4-8), Y89(0, 1)	-	-	W23, W35-W41, W44, W49, W85-W91, X58, X75, X81, X83, X96, Y02, Y05-Y08, Y25, Y31, Y33 (excl. Y33.9), Y35(1, 5, 6), Y36(0, 2, 4-8), Y85-Y86, Y87.0-Y87.2, Y89(0, 1)		
Unspecified	X59 (excl. X59 with secondary cause S72)	X84	Y34, Y89.9	Y09, Y33.9	Y35.7, Y36.9	-	-	X59 (excl. X59 with secondary cause S72), X84, Y09, Y33.9, Y34, Y35.7, Y36.9, Y89.9		
All mechanisms <sup>3</sup>	V01-X59, Y85-Y86 <sup>*</sup>	X60-X84, Y87.0	Y10-Y34 (excl. Y33.9), Y87.2, Y89.9	X85-Y09, Y33.9, Y87.1	Y35-Y36, Y89(0-1)	F10-F19	M80-M81	F10-F19, M80-M81, V01-Y36, Y85-Y87, Y89		

Changes from the traditional ICD-10 matrix:<sup>4</sup>

- 1 Fall and fracture includes deaths due to osteoporosis (M80-M81). Fall and fracture with unintentional intent includes deaths coded to exposure to unspecified factor with fracture of the femur as the secondary cause (X59 with S72).
- 2 Poisonings include those deaths coded to mental and behavioural disorders due to psychoactive substance use (F10-F19).
- 3 Undetermined intent excludes deaths coded to Y33.9. These have been added to homicide with unspecified mechanism. Note: deaths attributed to complications of medical and surgical care (Y40-Y84) and sequelae with surgical and medical care as external cause (Y88) are not included in this table.

\* This differs from the ICD grouping for accidents, which is V01-X59 only.

ICD-9 codes

Mechanism	Intent									
	Unintentional	Suicide	Undetermined	Homicide and probable homicide	Legal intervention / war	Mental and behavioural disorders due to psychoactive substance use (Drug abuse/dependence)	Osteoporosis	All intents		
Cut/pierce	E920	E956	E986	E966	E974	-	-	E920, E956, E966, E974, E986		
Drowning	E830, E832, E910	E954	E984	E964	-	-	-	E830, E832, E910, E954, E964, E984		
Fall and fracture <sup>1</sup>	E880-E888	E957	E987	E968.1	-	733.0	733.0	733.0, E880-E888, E957, E968.1, E987		
Fire/flare, hot object/substance	E890-E899, E924	E958.1, .2, .7	E988.1, .2, .7	E961, E968.0, .3	-	-	-	E890-E899, E924, E958.1, .2, .7, E961, E968.0, .3, E988.1, .2, .7		
Firearm	E922	E955.0-4	E985.0-4	E965.0-4	E970	-	-	E922, E955.0-4, E965.0-4, E970, E985.0-4		
Machinery	E919	-	-	-	-	-	-	E919		
Transport	E800-E829, E831, E833-E845	E958.5-E958.6	E988.5-E988.6	-	-	-	-	E800-E829, E831, E833-E845, E958.5-E958.6, E988.5-E988.6		
Natural/environmental	E900-E909, E928.0-2	E958.3	E988.3	-	-	-	-	E900-E909, E928.0-2, E958.3, E988.3		
Overexertion	E927	-	-	-	-	-	-	E927		
Poisoning <sup>2</sup>	E850-E869	E950-E952	E980-E982	E962	E972	291-292, 303-305	-	291-292, 303-305, E850-E869, E950-E952, E962, E972, E980-E982		
Struck by, against	E916-E917	-	-	E960.0, E968.2	E973, E975	-	-	E916-E917, E960.0, E968.2, E973, E975		
Suffocation	E911-E913	E953	E983	E963	-	-	-	E911-E913, E953, E963, E983		
Other specified	E846-E848, E914-E915, E918, E921, E925-E926, E928.8, E929.0-5, E929.8, E955.5-9, E958.0, .4, .8, E959, E960.1, E965.5-9, E967, E968.4, .8, E969, E971, E977-E978, E985.5, E988.0, .4, E989, E990-E996, E997.0-.2, .8, E998, E999	E955.5, .9, E958.0, .4, .8, E959	E985.5, E988.0, .4, E989	E960.1, E965.5-9, E967, E968.4, .8, E969	E971, E977-E978, E990-E996, E997.0-2, .8, E998, E999	-	-	E846-E848, E914-E915, E918, E921, E923, E925-E926, E928.8, E929.0-5, E929.8, E955.5-9, E958.0, .4, .8, E959, E960.1, E965.5-9, E967, E968.4, .8, E969, E971, E977-E978, E985.5, E988.0, .4, E989, E990-E996, E997.0-.2, .8, E998, E999		
Unspecified	E928.9, E929.9	E958.9	E988.9	E968.9, E988.8	E976, E997.9	-	-	E928.9, E929.9, E958.9, E968.9, E976, E988.8, E988.9, E997.9		
All mechanisms <sup>3</sup>	E800-E869, E880-E929	E950-E959	E980-E989 (excl. E988.8)	E960-E969, E988.8	E970-E978, E990-E999	291-292, 303-305	733.0	291-292, 303-305, 733.0, E800-E869, E880-E929, E950-E999		

Changes from the traditional ICD-9 matrix:<sup>7</sup>

- 1 Fall and fracture includes deaths due to osteoporosis (733.0). Fall and fracture with unintentional intent includes deaths coded to fracture, cause unspecified (E887).
- 2 Poisonings include those deaths coded to mental and behavioural disorders (291-292, 303-305).
- 3 Undetermined intent excludes deaths coded to E988.8. These have been added to homicide with unspecified mechanism.

Note: the following causes are not included in this table:

- Misadventures to patients during surgical and medical care (E870-E876)
- Surgical and medical procedures as the cause of abnormal reaction of patient or later complication, without mention of misadventure at the time of procedure (E878-E879)
- Drugs, medicaments and biological substances causing adverse effects in therapeutic use (E930-E949)