

## Relationship of suicide rates to social factors and availability of lethal methods

### Comparison of suicide in Newcastle upon Tyne 1961–1965 and 1985–1994<sup>†</sup>

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**Background** The UK Government's White Paper *Saving Lives: Our Healthier Nation* included among its targets a reduction in suicide.

**Aims** To study causes of change in suicide rate over a 30-year period in Newcastle upon Tyne.

**Method** Suicide rates and methods, based on coroners' inquest records, were compared over two periods (1961–1965 and 1985–1994) and differences were related to changes in exposure to poisons and prescribed drugs, and to socio-demographic changes.

**Results** Demographic and social changes had taken place which would adversely affect suicide rates. However, a dramatic fall was found in the rate for women, and a modest decline in that for men. Reduced exposure to carbon monoxide and to barbiturates coincided with the fall in rates.

**Conclusions** Reduced exposure to lethal methods was responsible for the fall in rate in both genders, while the gender difference in favour of women may be related to their preference for non-violent methods or to their being less affected by the social changes.

**Declaration of interest** None.

Suicide statistics and trends in England and Wales from 1911 have been published (Charlton *et al*, 1992, 1993). This area of research has been encouraged by the goals set out in the UK Government White Paper *Saving Lives: Our Healthier Nation* (Department of Health, 1999), which defines a target as a reduction in the overall suicide rate of at least 15% by the year 2000. Two of the present authors (D.W.K.K. and K.S.) had previously carried out a study (unpublished) of suicide in the city of Newcastle upon Tyne during the period 1961–1965 (period A) and the findings are here compared with suicide during the period 1985–1994 (period B) using comparable methods.

#### METHOD

Both studies were based on cases in which a verdict of suicide was recorded by the Newcastle coroners. Persons living outside the city boundaries were excluded to allow comparison of the data with appropriate demographic data of the city, and to avoid bias because of persons from outside the city who overdosed being transferred to a regional centre within the city for treatment. Residents of Newcastle who committed suicide outside the area of the city (and whose inquests were therefore held elsewhere) were not included, since we were unable to obtain comparable data for these cases. We calculated that there were on average 1.5 men and 0.9 women who committed suicide outside the area per year (Office of Population Censuses and Surveys, 1985–1992), that is, they would not have affected the results.

#### Statistics

Comparisons of continuous variables using Student's *t* were undertaken only after Kolmogorov–Smirnov tests had indicated that data distribution did not differ significantly from normality. Categorical

variables were subjected to chi-square analysis with continuity correction, although in several cases (Tables 1 and 2) this was based on very small sample sizes and caution is therefore required in interpretation of the data. Statistical analysis was undertaken with SPSS for Windows 8.0 and relative risks and confidence intervals were calculated using EPInfo 6.0 software (Dean, 1995). Logistic regression was performed, with period (A or B) as the dependent variable to determine which variables contributed significantly to the model predicting group membership. Cohen's  $\kappa$  statistic was calculated to measure the agreement between observed and predicted membership.

## RESULTS

### Demographics

#### Age- and gender-specific rates

There were 157 suicides (84 male, 73 female) in period A and 143 (104 male, 39 female) in period B. The Newcastle population over 15 years of age was 216 234 in 1961 and 211 844 in 1991 (General Register Office, 1963a; Office of Population Censuses and Surveys, 1992a). Per 100 000 population at risk, the mean annual rates in men were 15.67 in period A and 10.48 in period B, and in women 13.39 in period A and 3.46 in period B, a decline of 33% and 74%, respectively. The difference is significant in men and highly significant in women (unpaired *t*-test, 2-tailed, men  $P=0.016$ , women  $P<0.001$ ). A similar pattern of decline from 12.52 to 11.64 per 100 000 in men (–7% change), and from 12.90 to 4.51 per 100 000 in women (–58% change) has occurred in England and Wales (Registrar General, 1968; Office for National Statistics, 1985–1994). Age and gender-specific rates for Newcastle are presented in Table 1. When the genders are combined, but not when they are separate, the differences between periods are statistically significant ( $\chi^2=20.73$ , d.f.=6,  $P=0.002$ ), indicating a fall in age of suicide overall, though the rates in males below age 35 did not change.

Figure 1 shows the number of suicides occurring in Newcastle during the period 1960–1995, calculated as a rolling 3-year average. Coal gas was replaced by non-toxic domestic gas early in 1974. Changes of coroner are also shown. The fall in suicides began in the early 1980s in both genders.

<sup>†</sup>See pp. 465–468, this issue.

**Civil status**

There have been significant changes in the distribution of suicide by civil status. In Table 2, to allow comparison with population figures for 1961–1965 (General Register Office, 1963a) and for 1985–1994 (Office of Population Censuses and Surveys, 1992a), a person cohabiting or living with a partner is classed as single and a separated

person as married. The percentage of single persons among suicides has risen from 19% to 39% and of divorced persons from 4% to 14%, while that of married persons has decreased from 57% to 30% ( $\chi^2=28.8$ , d.f.=3,  $P<0.001$ ). Because of changes in marital status in the general population, the actual rate in single men shows little change, while in single women the rates have fallen by 50%. The increase in the

number of divorces in the general population resulted in the suicide rates in divorced persons falling dramatically. The relative risks attached to civil status among the suicides and in the general population are shown in Table 3.

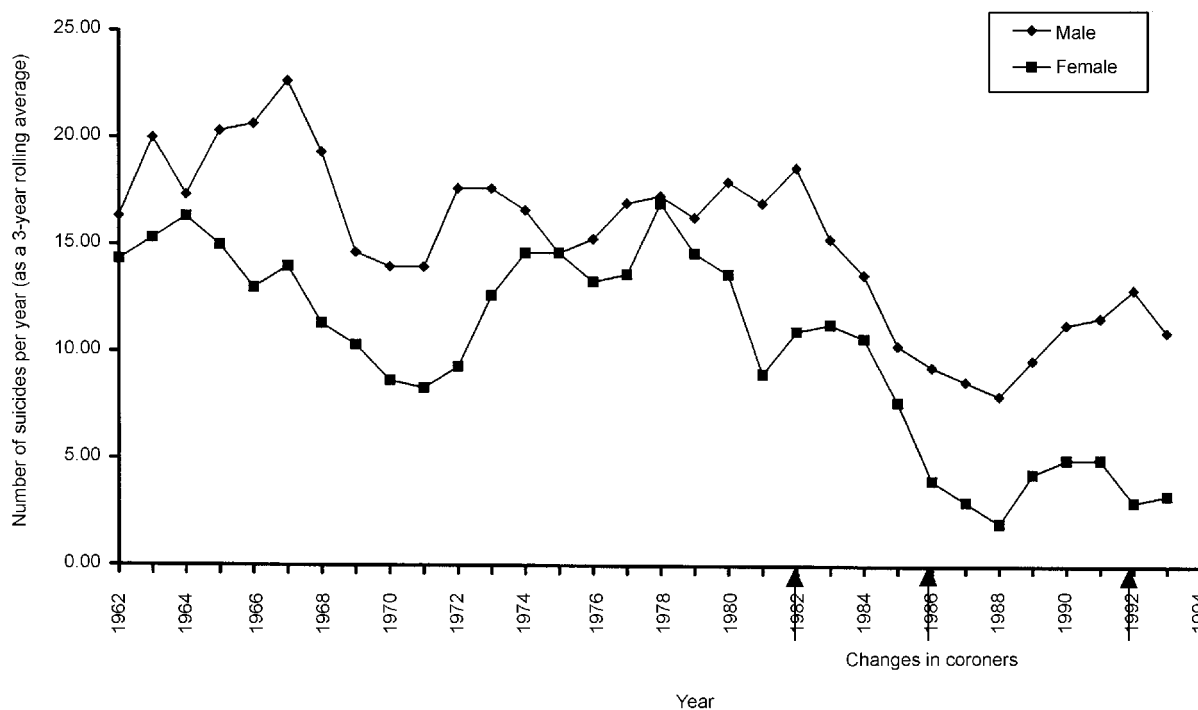
**Unemployment and retirement**

There were 19 unemployed men and 6 unemployed women among suicides in period A and 26 unemployed men and 3 unemployed women in period B. Unemployment in the general population of Newcastle had increased during the period 1961–1991 from 2880 to 12 673 among men, and from 800 to 5014 among women (General Register Office, 1966; Office of Population Censuses and Surveys, 1992b), and the suicide rate among unemployed persons had fallen from 131.9 to 20.5 per 100 000 in men and from 150.0 to 6.0 per 100 000 in women. The relative risks show that unemployment among suicides remained significantly increased in period B compared with the general population in men, but not in women (Table 3). A similar situation existed concerning retirement, which continued to be a risk factor in period B in men but not in women (Table 3).

**Table 1** Mean annual age- and gender-specific rates per 100 000 population at risk<sup>1</sup> in two periods, Newcastle upon Tyne

Age group	Male				Female			
	Period A		Period B		Period A		Period B	
	n	Rate	n	Rate	n	Rate	n	Rate
15–24	4	4.46	9	5.00	2	2.15	2	1.08
25–34	10	12.15	26	12.79	5	6.32	7	3.26
35–44	18	20.29	19	11.06	11	12.14	4	2.36
45–54	19	21.01	14	10.73	15	15.42	4	2.94
55–64	17	22.59	17	12.98	17	19.08	7	4.91
65–74	12	28.68	9	8.00	18	28.67	8	5.63
75+	4	22.51	10	15.62	5	14.95	7	5.13

Mean age, men, period A 49.62 (s.d.=25.92); period B 46.71 (s.d.=19.03).  
 Mean age, women, period A 54.95 (s.d.=24.82); period B 54.41 (s.d.=19.58).  
 1. 1961–1965, General Register Office (1963a); 1985–1994, Office of Population Censuses and Surveys (1992a).



**Fig. 1** Suicides in Newcastle upon Tyne, 1962–94, calculated as a rolling 3-year average.

### Residence

There was a significant change in place of residence among suicides in both genders, with proportionately more in hostels, sheltered homes and institutions and fewer in psychiatric hospitals or living with others in the community. More of the women were living alone. As the number of people living alone in the whole population had increased almost threefold (from 13 643 to 37 068) (General Register Office, 1963*b*; Office of Population Censuses and Surveys, 1992*d*), the actual suicide rate among those living alone had fallen markedly. Despite this, living alone remained a significant risk factor (Table 3). The relative risk of being a psychiatric hospital in-patient or a resident in a hostel or sheltered accommodation was significantly raised in period B (Table 3). The number of suicides who were psychiatric in-patients at the time of suicide increased despite the fall in the hospital population. Of the 24 suicides who were currently resident in sheltered accommodation (10) or were hospital in-patients (14), four were in period A and 20 in period B, a significant difference ( $\chi^2=11.92$ , d.f.=1,  $P=0.001$ ).

### Mode of suicide

Table 4 compares the number of suicides in each period, by method and gender. The tests of significance refer to differences between periods. In period A, 94% of carbon monoxide (CO) deaths were due to domestic gas, whereas in period B deaths from gas were entirely due to car exhausts. Neither selective serotonin reuptake inhibitors (SSRIs) nor paracetamol were available in the earlier period but, whereas paracetamol was frequently used later, no suicide was associated with SSRIs; moreover, there was no case of overdose with an SSRI among those admitted to the intensive treatment unit (ITU) in Newcastle in period B. Other substances were mostly drugs such as codeine, co-proxamol and anticholinergics, but included poisons such as paraquat and phenol. In period B, the most commonly used substances in combination were paracetamol, anxiolytics, antidepressants and codeine, and less frequently salicylates, anticholinergics and insulin; 15 had taken alcohol, but this is similar in proportion to the group as a whole. Violent methods of all kinds, particularly hanging, increased in period B.

**Table 2** Mean annual suicide rates per 100 000 by civil state and period, Newcastle upon Tyne

	Male $\geq 15$ yrs					
	Period A 1961–1965			Period B 1985–1994		
	Population <sup>1</sup>	Suicides	Rate	Population <sup>2</sup>	Suicides	Rate
Single <sup>3</sup>	27 182	18	13.24	34 324	42	12.24
Married <sup>4</sup>	65 284	51 <sup>5</sup>	15.62	54 291	33 <sup>6</sup>	6.08
Widowed	4147	11	53.05	4542	11	24.22
Divorced	576	4	138.89	6075	16	26.34
Total	97 189	84	17.29	99 232	102	10.28

$\chi^2=19.09$ , d.f.=3,  $P<0.001$ ; civil state unknown in two men, period B.

	Female $\geq 15$ yrs					
	Period A 1961–1965			Period B 1985–1994		
	Population <sup>1</sup>	Suicides	Rate	Population <sup>2</sup>	Suicides	Rate
Single <sup>3</sup>	25 352	12	9.47	30 706	13	4.23
Married	66 385	38 <sup>7</sup>	11.45	55 427	9 <sup>8</sup>	1.62
Widowed	16 365	21	25.66	18 060	13	7.20
Divorced	943	2	42.42	8419	3	3.56
Total	109 045	73	13.39	112 612	38	3.37

$\chi^2=9.97$ , d.f.=3,  $P<0.019$ ; civil state unknown in one women, period B.

1. General Register Office (1963*a*).
2. Office of Population Censuses and Surveys (1992*a*).
3. Includes cohabiting couples.
4. Excludes cohabiting couples.
5. 15 separated.
6. 10 separated.
7. 5 separated.
8. 1 separated.

**Table 3** Relative risks of social indices with references (=1.00) based on the general population rates

Social index	Period A 1961–1965 (95% CI)	Period B 1985–1994 (95% CI)
Female gender	0.77 (0.57–1.06)	0.33 (0.27–0.48)*
Married	0.74 (0.54–1.02)	0.40 (0.28–0.57)*
Single	0.69 (0.46–1.03)	1.46 (1.04–2.05)*
Widowed	2.25 (1.52–3.31)*	1.73 (1.12–2.69)*
Divorced men	8.36 (3.05–22.90)*	2.86 (1.68–4.88)*
Divorced women	3.23 (0.54–13.20)	1.06 (0.33–3.45)
Men unemployed	9.57 (5.74–15.98)*	2.34 (1.50–3.65)*
Women unemployed	12.12 (5.26–27.92)*	1.84 (0.57–5.98)
Living alone	11.91 (8.64–16.42)*	4.34 (3.11–6.05)*
Psychiatric hospital/sheltered accommodation	1.96 (0.72–5.28)	12.06 (7.51–19.39)*
Retired men	1.99 (1.14–3.49)*	1.76 (1.13–2.27)*
Retired women	4.71 (2.16–10.27)*	1.08 (0.51–2.28)

\* $P<0.05$ .

### Psychiatric morbidity

Sixty-four subjects (41%) had received psychiatric in-patient treatment at some time in their lives in period A and 38 (27%) in period B – a significant difference ( $\chi^2=6.72$ , d.f.=1,  $P=0.14$ ) – while the number of those who had never received psychiatric treatment decreased from 46% to 39%; the remainder had obtained out-patient or general practitioner treatment. Forty-four subjects in period A and 61 in period B had made previous suicide attempts, of whom 12 and 26, respectively, had made more than one ( $\chi^2=9.59$ , d.f.=2,  $P<0.01$ ); the difference was significant only in men.

### Multivariate analysis

Logistic regression was carried out with period as the dependent variable. All those variables, entered both singly or as a group, that had significant  $P$  values ( $P<0.05$ ) based on the Wald statistic, were then entered in four blocks: throughout age/gender, socio-demographic, psychiatric morbidity and methods. Using the forward stepwise method, the overall predictions of group membership (period A or B) with a cut point of 50%, were compared at each step, and Cohen's  $\kappa$  calculated. Baseline prediction was 52.3%. Age and gender increased prediction to 57.2% ( $\kappa=0.147$ ), with gender ( $P=0.007$ ) but not age making a significant contribution. Both gender and age remained in the analysis, showing that the significant associations with other variables were not explained by gender or age differences between the periods. With the socio-demographic variables (being single, divorced or retired), prediction was 69.9% with  $\kappa$  of 0.391. (When married was substituted for single divorced, prediction was 64.7% and  $\kappa=0.293$ .) Addition of the three psychiatric variables (history of in-patient care, psychiatric history, previous suicide attempts) together increased prediction to 70.9% ( $\kappa=0.414$ ). The addition of methods – poisoning by CO, barbiturates, salicylates and combinations of drugs – increased prediction to 83.6% ( $\kappa=0.671$ ). The four methods entered alone gave 80.7% prediction and a Cohen's  $\kappa$  of 0.612. Other methods (poisoning by paracetamol or other substances, hanging and jumping from heights) also had significant associations with period B individually but did not improve prediction when methods were entered as a block. Stepwise analyses were also carried out on men and women

**Table 4** Mode of suicide by period and gender (numbers)

	Male		Female	
	Period A 1961–1965	Period B 1985–1994	Period A 1961–1965	Period B 1985–1994
Carbon monoxide	41	20**	35	3**
Barbiturates	20	1**	25	2**
Antidepressants	1	5	2	10**
Anxiolytics	0	7*	2	8**
Neuroleptics	0	4	1	0
All prescribed psychotropic drugs	21	17	30	20
Salicylates	7	1*	5	5
Paracetamol	0	12**	0	8**
Other substances	2	18**	3	11**
Drug combinations	1	14**	2	15**
Hanging	8	38**	2	2
Jumping	4	10	0	6**
Drowning	3	4	1	0
Other violent methods	4	11	5	4
Combinations of methods	5	8	3	3

$\chi^2$  for significance of difference between periods; \* $P<0.05$ , \*\* $P<0.01$ .

Male 21/84 v. 17/104,  $\chi^2=2.16$ ,  $P=0.14$ .

Female 30/73 v. 20/39,  $\chi^2=1.07$ ,  $P=0.3$ .

separately. In women, prediction was 87.5% and  $\kappa=0.725$ , but none of the socio-demographic or psychiatric variables was significant in the presence of methods. In men, age, being divorced, retired, a history of in-patient care, and previous attempts were all significant ( $P<0.05$ ) in the presence of methods; prediction was 80.7% and  $\kappa=0.611$ .

## DISCUSSION

### Reliability and validity of data

Although the information obtained at the inquests had not been entered on a standard schedule, the procedure was the same in both periods, and the relevant items were extracted by the same person (K.S.), who used the same protocol. There is no reason to doubt the accuracy and completeness of the coroner's records so far as age, civil status and place of residence are concerned, but history of past psychiatric treatment and of previous attempts may be incomplete. For social circumstances, such as unemployment and residential status, it was not possible to apply exactly the same definitions as used in the official statistics, and comparisons with the general population must take this into account. There were four different coroners during the

period of the study (Fig. 1) but the possible effects on the suicide verdict are best considered in relation to the undetermined verdicts, an issue examined by Linsley *et al* (2001). When open verdicts are included, the fall in suicide rate in men is reduced to 15% and in women to 51% (compared with 33% and 74%, respectively).

The purpose of the study was to compare suicide rates in two periods in Newcastle upon Tyne, with a view to identifying factors that might be responsible for a change in rates and areas where intervention might be practicable.

### Demographic and social changes

Between the two periods, the population of the city of Newcastle had undergone a dramatic increase in the number of divorced persons and a considerable increase in that of single persons, a marked increase in the general level of unemployment, and an exodus from psychiatric hospitals probably associated with an increase in those living alone or in supported accommodation. The proportion of persons aged 65 years or over had increased.

### Age, gender and civil status

Hawton (1992) drew attention to a rise in suicide in the UK among young males, a

trend also observed throughout Europe and North America (Diekstra, 1993), but in Newcastle the rate among 15- to 24-year-olds remained low. Rates for older people are more variable, usually increasing in men but decreasing in women (Diekstra, 1993). Nearly one-quarter of the suicides in Newcastle in both periods were aged 65 or over, and this is the age group that is, in general, at greatest risk for completed suicide (Cattell, 1998) and in which diagnosis and treatment of physical illness and of major depression rank high among potential preventative strategies available to clinicians.

Being widowed remained a significant risk factor in both genders, as did divorce in men. The increase in the number of divorced men but not women who committed suicide suggests that divorce may be more traumatic for men. The relative risk of being single became significant in period B, while being married was protective in that period (Table 3). The association of being single or divorced with period B was not merely due to the effects of changes in age and gender and it is concluded that, despite the fall in suicide rates, being single or divorced continued to identify vulnerable individuals.

### Unemployment and retirement

Lewis & Sloggett (1998) found that the association between suicide and unemployment accounted for all or most of the association between suicide and socio-economic indices, but they were unable to adjust for the effects of psychiatric illness. In Newcastle, unemployment and retirement decreased in importance for both genders over the study period, the relative risks becoming non-significant in women. These changes suggest that when unemployment or early retirement are comparatively uncommon they are more likely to be associated with ill-health, whereas when they are common they are experienced by many healthy people who are not disposed to suicide.

### Living alone and social isolation

In Newcastle, the nearly threefold increase in the number living alone in the general population was associated with a marked fall in suicide among them, suggesting that the social disorganisation of urban areas with high suicide rates found by Sainsbury (1955) did not occur in Newcastle. However, living alone was still associated with

a significantly increased risk (Table 3). At the other end of the scale, among those hospitalised or resident in sheltered environments, it is not surprising that the risk was greater in period B, when only the most vulnerable remained outside the community.

### Exposure and methods

Our findings indicate that the fall in suicide rates coincided with marked changes in pattern of exposure and method.

#### Carbon monoxide and drugs

A fall in the suicide rate in all age groups following the abolition of coal gas was demonstrated by Kreitman (1976). However, poisoning by car exhausts has recently been increasing, and accounted for some male suicides in Newcastle. Will the enforced introduction of catalytic converters (which reduce the CO content from car exhausts) reduce fatalities of this kind, as it appears to have done in the USA (Clarke & Lester, 1987)? Suicide due to drug overdoses in England and Wales decreased in the 20 or so years prior to 1990 (Charlton *et al*, 1992). This undoubtedly reflected the changes in prescribing practices. Oliver & Hetzel (1973) showed that barbiturate suicide in Australia decreased subsequent to legislation on barbiturate prescribing, and that this decrease occurred particularly in women. Additionally, and most importantly, *overall* suicide rates also decreased, which implies that barbiturates were not entirely replaced by increased use of other methods.

There was a significant increase in period B in the use of antidepressants. Nationally, there has been a 50% increase in prescription of tricyclics over the past 10 years compared with an increase of almost 200% for SSRIs and related antidepressants which became available in the 1980s (Department of Health, 1997). But the drugs used by those committing suicides in our study were all tricyclics. This supports the view that SSRIs are an attractive choice for treatment of depressed patients who are at risk of suicide (Edwards, 1995; Kasper *et al*, 1996). We also believe that the development of ITUs, which did not exist in period A and where most cases are admitted after a life-threatening overdose, may have contributed to the general fall in suicide rates. Among over-the-counter drugs, aspirin and paracetamol accounted for almost one in five cases of suicide. Paracetamol

appears to have replaced salicylates not only as a widely used analgesic in both genders but also as a very effective method of suicide both alone and in combination with other drugs. From September 1998, the Royal Pharmaceutical Society of Great Britain limited the size of packs of aspirin or paracetamol to 32 tablets or capsules. Although this has been shown to have reduced the amount taken in single overdoses (Robinson *et al*, 2000) it remains to be seen whether this will be effective in reducing attempted or completed suicide from these drugs.

#### Violent methods

There was a dramatic rise in Newcastle in hanging among men, which did not occur in women. Hanging increased in the general population in the 20 years up to 1990 (Charlton *et al*, 1992), when it accounted for 38% of male and 29% of female suicides in England and Wales (Office for National Statistics, 1995). Cooper & Milroy (1994) looked specifically at violent suicides and observed that hanging was the method of choice when the suicide was precipitated by the end of a relationship.

#### Relative risks and multivariate analysis

The results of the multivariate analyses have to be interpreted in the light of the relative risks and the changes in exposure (Tables 3 and 4). The relative risks (Table 3) show the magnitude of the risk of suicide associated with a characteristic in comparison with its frequency in the general population, and could be calculated only when population data were available. The lower risks associated with divorce and unemployment in period B are at least in part attributable to the increased frequency of these conditions in the population. The multivariate analyses show which variables were significantly associated with period A or B, but do not take population changes into account. Appleby *et al* (1999) in a controlled study found mental disorder and social withdrawal among the characteristics of young suicides. In Newcastle, socio-demographic characteristics such as being widowed or living alone, and in men unemployment, retirement and divorce, were found to be significant risk factors common to both periods (Table 3). The significant association of some of these adverse characteristics with period B, together with under-representation of marriage with its protective effect, would by itself predict

that the suicide rate should have increased. This discrepancy suggests the fall in rates occurred despite adverse social trends in the community at large. Adverse social conditions are of course not always adverse for the individual and may sometimes be beneficial; moreover, if they become common, less-vulnerable individuals will be affected and the adverse effects will be diluted. The smaller decline in suicide in men may perhaps be due to the differential effects of some of these factors in men and women.

The three psychiatric variables all contributed significantly and independently to the prediction. Also, their association with period A or B probably reflects the marked changes in patterns of psychiatric care that had taken place: for instance, the increase in the numbers of patients from hospital or institutions may have been a consequence of the planned exodus into the community, resulting in the retention of only the most disturbed; and the fall in the number of suicides with a history of in-patient psychiatric treatment may have been due to the closure of hospitals and the reduction in number of beds.

The fall in suicide rates that occurred from period A to B can be most clearly related to the changes in methods of suicide, with the methods-only model producing a satisfactory level of prediction. An increase in hanging among men and in jumping from heights in women only partly nullified the effects of reduced exposure to CO and barbiturates. It seems that women choose methods of suicide that are both intrinsically less lethal and for which resuscitation is often successful, whereas men employ violent methods. This difference cannot be due to social factors alone and may be related to the greater propensity to violence in men.

## ACKNOWLEDGEMENTS

We thank the coroners Mr F. A. Waller and Mr Leonard Coyle for their permission to examine records, and the coroners' officers Mr David Hopwood and Mr Jim McDonald for their most helpful cooperation. We are indebted to Dr A. M. Batchelor for permission to see the records of the Newcastle ITU, Royal Victoria Infirmary, Newcastle, and to Miss Loraine Dobson for providing data about hospital admissions. The A. & S. H. Burton Trust provided generous financial support.

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## CLINICAL IMPLICATIONS

- In women, the fall in suicide rates appears largely to have been due to the decreased availability of non-violent methods, of which the replacement of barbiturates by less toxic drugs such as the selective serotonin reuptake inhibitors (SSRIs) is clinically most notable. The propensity of men to use violent methods suggests that future benefits of improvement in the safety of drugs will be largely confined to women.
- Paracetamol use is common and its lethal effect in overdose would seem to support the attempt to restrict the quantity sold over the counter.
- In considering suicide prevention at a practical level, persons with serious past or present psychiatric illness are at high risk. Within this group, a combination of conditions associated with emotional deprivation or social isolation points to a need to target hospital and community services to particularly vulnerable persons such as those who are widowed and living alone, and to young men who are unemployed and divorced.

## LIMITATIONS

- Coroners' records do not use a structured schedule from which data for research could be systematically extracted.
- Data on social indices such as unemployment and living alone, as determined from coroners' records, may not be strictly comparable with the official population statistics.
- Open verdicts are not included.

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(First received 17 January 2000, final revision 6 November 2000, accepted 20 November 2000)

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