

# Suicide mortality in the European Union

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on behalf of the EUROSAVE Working Group \*

**Background:** There are an estimated one million completed suicides per year worldwide. As a response to increasing concern about suicide within Europe, the EUROSAVE (European Review of Suicide and Violence Epidemiology) study was undertaken to examine recent trends in the epidemiology of suicide and self-inflicted injury mortality in the European Union (EU). **Methods:** Suicide and self-inflicted injury mortality data for the 15 EU countries for the years 1984–1998 were obtained from the World Health Organisation (WHO), the European Statistical Office of the European Commission (EUROSTAT) and national statistical agencies. Data were also obtained for a second group of deaths classified as ‘undetermined’ or ‘other violence’. Age-standardized mortality rates were calculated and examined for trends over time. **Results:** Finland had the highest suicide rate, while Greece had the lowest for the latest available year (1997). Age-standardized suicide rates tended to be lowest in the Mediterranean countries. Significant downward linear time trends in suicide mortality were observed in most countries, although rates varied markedly between countries. Both Ireland and Spain displayed significant upward linear trends in suicide mortality. Portugal had the highest rate of undetermined deaths both in 1984 and 1998 while Greece had the lowest in both 1984 and 1997. Five countries (including Ireland and Spain) showed significant downward trends in deaths due to undetermined causes whereas Belgium and Germany showed borderline significant upward linear trends in deaths due to undetermined causes. **Conclusions:** Although suicide rates in most countries seem to be decreasing, the validity of the data is uncertain. Misclassification may contribute to the geographical and temporal variation in suicide rates in some EU countries but it does not explain the phenomenon. More detailed research comparing suicide-recording procedures and practices across the EU is required. In the absence of adequate EU wide data on suicide epidemiology, effective prevention of this distressing phenomenon is likely to remain elusive.

**Keywords:** epidemiology, mortality, suicide, trends

Suicide and self-inflicted injuries are leading causes of injury-related deaths worldwide. There are an estimated 10–20 million attempted suicides each year and one million completed suicides.<sup>1</sup> Moreover, suicide has become recognized as a serious public health problem that is causing increasing concern, particularly in the

European Union (EU). There has been much debate worldwide, however, about the accuracy of official national suicide figures. Death certification practices as well as cultural and social norms may be the main reasons for the variation in rates across countries. ‘Undetermined death’ is the most common alternative verdict given in cases of probable suicide.

A report published by the World Health Organisation<sup>2</sup> (WHO) assessing suicide in western Europe in the 1990s revealed that suicide rates increased in Ireland and Italy between 1989 and 1993 (the latest year for which data were available). Rates remained stable for eight countries and declined for six (1989–latest year). An earlier study examining worldwide trends in suicide mortality<sup>3</sup> showed that Finland and a number of central European countries had some of the highest suicide mortality rates among males, while mortality from suicide was low in the UK and southern Europe. Patterns for females were similar though their rates were considerably lower.

As part of its ‘Health for All’ strategy,<sup>4</sup> WHO Europe stated in 1985 that by the year 2000 there should be a sustained and continuing reduction in the prevalence of mental disorders, an improvement in the quality of life of all people with such disorders, and a reversal of the rising trends in suicide and attempted suicide (Target 12). In 1998, European countries were urged to reduce existing rates by at least a further one-third by the year 2020.<sup>2</sup>

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The EUROSOLVE (European Review of Suicide and Violence Epidemiology) project was undertaken with the main aim of pooling expertise in suicide research across the EU. The project was based at the University of Glasgow, Scotland, and involved a collaboration between the University and 15 injury experts throughout Europe. The purpose of this paper is first, to describe recent geographical and time trends in suicide rates in the EU and second, to attempt to determine whether misclassification of suicide as undetermined death was likely to explain variations in suicide rates in place and time.

## METHODS

Suicide rates in the EU were examined for the period 1984 to 1998 or the latest year for which data were available. 1984 was chosen as the base year as a follow-on from a previous European project entitled EURORISC (European Review of Injury Surveillance and Control).<sup>5</sup> EU mortality data were obtained from the World Health Organisation (WHO—Europe) using cause of death codes E950–E959 and X60–X84 of the Ninth and Tenth Editions of the International Classification of Diseases (ICD9 and ICD10) respectively. These codes represent all deaths recorded as being due to suicide and self-inflicted injury (subsequently referred to as suicide). A second source of data was the European Statistical Office of the European Commission (EUROSTAT). It uses a coding system termed the ‘65-list’ that is compatible with all the versions of ICD (Eighth, Ninth and Tenth revisions). For years for which data were unavailable from the WHO, national data for the relevant member states were obtained from their statistical agencies. The latest year for which data were obtained ranged from 1995 to 1998. For most countries the latest available year was 1997 or 1998; however Belgium could not provide data later than 1995. Trends in undetermined causes of death were also examined for the same time period using causes of death codes E980–E999 (ICD9) and Y10–Y36, Y87, Y89 (ICD10), as it is widely believed that classification of suicide as undetermined causes is common in cases of probable suicide, where suicide has not been proven.

To allow comparison between EU member states, age-standardized suicide mortality rates (with 95% confidence intervals) were computed by the direct method using the world standard population.<sup>6</sup> The proportional changes in rates between the base year and the latest year for which data were available were also calculated. To determine the nature and statistical significance of the trends, methods of simple linear regression were employed in each instance. For each member state, the estimated slope parameter  $b$ , 95% confidence interval and associated  $p$ -value were calculated. The slope parameter  $b$  is an estimate of the per unit change in the age-standardized suicide mortality rate and the  $p$ -value indicates the significance of the relationship between the mortality rate and the year. In the case of undetermined causes of death, age-standardized rates were calculated and compared to the corresponding suicide rates. To assess the nature and significance of the linear relationship between the suicide

rates and undetermined death rates for each country, correlation coefficients were calculated along with the appropriate 95% confidence intervals. This assists in the detection of possible inverse relationships between the two sets of rates and might help explain some of the variation in suicide rates. Furthermore, undetermined cause of death cases were added to those of suicide and the corresponding total rates calculated.

## RESULTS

### *Suicide – overall rates*

Finland had the highest suicide rate for the latest available year (21.6 per 100,000 in 1997), while Greece had the lowest (2.8 per 100,000 in 1997) (*figure 1, table 1*). The rates in Finland were consistently high throughout the study period, peaking in 1990. A fall in the age-standardized suicide rate was observed for most member states over the study period. The rates for Luxembourg fluctuated considerably over the study period due to its small population. Rates in Germany began to decline after 1985 and then rose briefly in 1991 possibly due to the inclusion of the former German Democratic Republic in the national statistics in that year. Belgium displayed a dip in suicide rates during the late 1980s and early 1990s followed by an increase thereafter.

*Figure 1* and *table 1* show that significant downward trends occurred in Austria, Denmark, France, Germany, Greece, Netherlands, Portugal, Sweden and UK while significant upward trends were observed in Ireland and Spain. The greatest decrease in rates over the study period occurred in Portugal (–56%) while the greatest increase in rates was observed for Ireland (89%). No significant trend was observed in the suicide rates of Belgium, Finland, Italy and Luxembourg.

### *Undetermined causes of death*

Portugal had the highest rate of undetermined deaths both in 1984 and 1998 while Greece had the lowest (*figure 1* and *table 2*). Rates for Ireland decreased during the study period, a drop of approximately 34%. As with suicide rates, undetermined causes of death rates were also lowest for most Mediterranean states, the southern country of Portugal being the exception.

When the suicide rates and undetermined deaths rates were compared (*figure 1*), Austria and Denmark showed a decline in suicide rates over time while the corresponding undetermined deaths rates remained fairly stable. Irish suicide rates began to increase around 1989 when the undetermined death rates began to decrease. Taking 1989 as the base year, the increase in Irish suicide rates over the study period was 65% compared to a decrease of 50% in undetermined causes of death. In Portugal, uniquely, rates for undetermined deaths were higher than the suicide rates throughout the study period, peaking in 1988 followed by a decline thereafter apart from a short-lived rise in 1996. Despite the fluctuation in rates of undetermined causes of death throughout the study period, Portuguese suicide rates declined steadily.

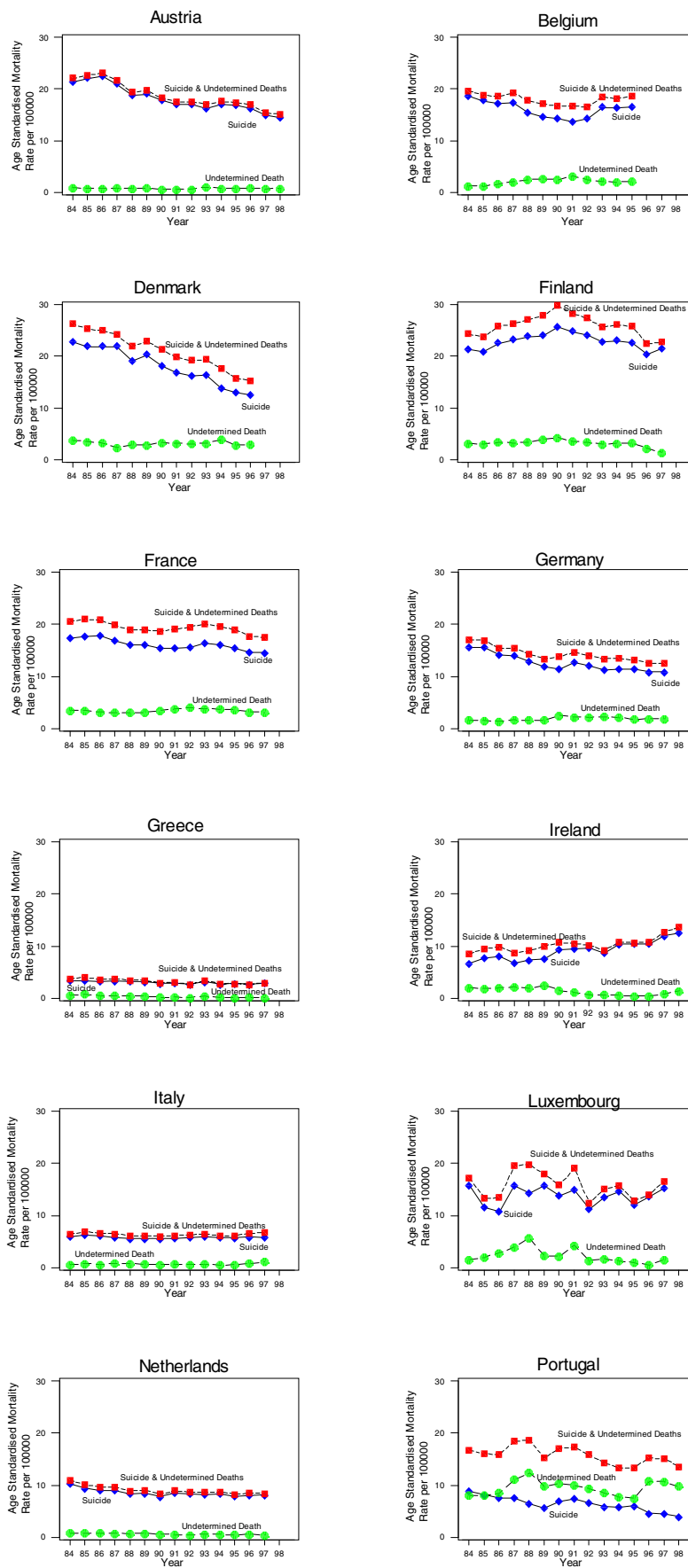
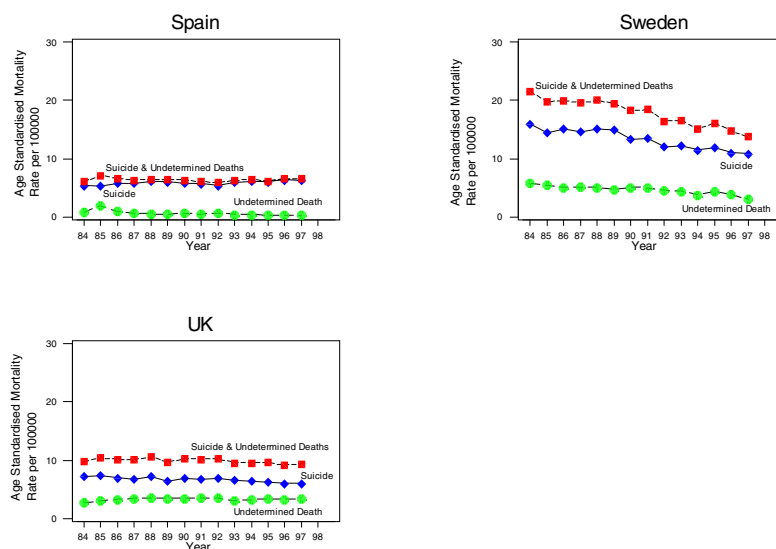


Figure 1 Age-standardized mortality rates. Comparison of suicide rates, undetermined death rates and both combined, by country, 1984-1998 (to be continued on next page)



**Figure 1 Continued** Age-standardized mortality rates. Comparison of suicide rates, undetermined death rates and both combined, by country, 1984-1998

Significant downward linear trends in undetermined causes of death occurred in Greece (−100%), Ireland (−34%), Netherlands (−59%), Spain (−64%) and Sweden (−48%) over the study period (table 2). Borderline significant upward trends were observed for Belgium and Germany. No significant trends were observed for the remaining member states.

Significant negative correlations between the suicide rates and undetermined death rates were observed for Belgium, Germany, Ireland and Spain while significant positive correlations were observed for Finland, Greece, the Netherlands and Sweden (table 3). For the remaining

countries there was no evidence of a direct or inverse relationship between the two sets of rates.

*Suicide and undetermined deaths combined*

Finland, France, Portugal and Sweden all had substantially higher combined rates of suicide and undetermined deaths compared to suicide rates alone, while Belgium, Denmark, Germany and the UK all had moderately higher rates (figure 1). Irish suicide rates and combined rates appeared to converge towards the end of the study period suggesting a decrease in undetermined deaths over time.

**Table 1** Suicide by country, percentage change in age-standardized rates, and results of the linear regression (test for significant linear trend)

Country (Latest available year for data)	Rate per 100,000 1984 (95% CI)	Rate per 100,000 latest year (95% CI)	Change 1984–Latest available year %	Estimated slope parameter <i>b</i> (95% CI)	P-value	Statistical significance
Austria (1998)	21.3 (20.4; 22.3)	14.4 (13.7; 15.2)	−32.3	−0.5 (−0.6; −0.4)	≤0.001	***
Belgium (1995)	18.6 (17.8; 19.4)	16.6 (15.8; 17.3)	−10.8	−0.2 (−0.5; 0.03)	0.11	NS
Denmark (1996)	22.8 (21.6; 24.0)	12.5 (11.7; 13.4)	−45.0	−0.9 (−1.0; −0.8)	≤0.001	***
Finland (1997)	21.3 (20.1; 22.6)	21.6 (20.4; 22.8)	+1.2	−0.02 (−0.2; 0.2)	0.87	NS
France (1997)	17.3 (17.0; 17.6)	14.5 (14.2; 14.8)	−16.0	−0.2 (−0.3; −0.1)	≤0.001	***
Germany (1997)	15.5 (15.2; 15.8)	10.8 (10.6; 11.0)	−30.4	−0.3 (−0.2; −0.4)	≤0.001	***
Greece (1997)	3.3 (2.9; 3.6)	2.8 (2.5; 3.1)	−13.8	−0.05 (−0.1; −0.03)	≤0.001	***
Ireland (1998)	6.6 (5.7; 7.4)	12.4 (11.4; 13.5)	+89.0	0.4 (0.3; 0.5)	≤0.001	***
Italy (1997)	5.9 (5.7; 6.1)	5.7 (5.6; 5.9)	−2.9	−0.02 (−0.05; 0.01)	0.26	NS
Luxembourg (1997)	15.7 (11.9; 19.5)	15.2 (11.7; 18.7)	−3.0	0.01 (−0.2; 0.3)	0.94	NS
Netherlands (1997)	10.2 (9.7; 10.7)	8.1 (7.6; 8.5)	−21.2	−0.1 (−0.2; −0.07)	0.001	***
Portugal (1998)	8.8 (8.2; 9.3)	3.8 (3.5; 4.2)	−56.3	−0.3 (−0.4; −0.2)	≤0.001	***
Spain (1997)	5.3 (5.1; 5.5)	6.2 (6.0; 6.4)	+17.2	0.05 (0.02; 0.1)	0.008	**
Sweden (1997)	15.8 (15.0; 16.7)	10.8 (10.1; 11.4)	−31.9	−0.4 (−0.5; −0.3)	≤0.001	***
UK (1997)	7.1 (6.9; 7.3)	6.0 (5.8; 6.2)	−16.5	−0.09 (−0.1; −0.05)	≤0.001	***

\* 0.01<p≤0.05, \*\* 0.001<p≤0.01, \*\*\* p≤0.001, NS: not significant

Comparing *table 1* and *table 4*, Austria, Belgium, Denmark, France, Germany, Portugal and UK all experienced a smaller percentage change over the study period when undetermined deaths were combined with suicides compared to suicides alone. Ireland and Spain showed a less marked increase over time.

Significant downward trends in the combined rates (*table 4*) occurred in Austria, Denmark, France, Germany, Greece, Netherlands, Portugal, Sweden and UK while a significant upward trend was observed in Ireland. Whereas Spain had a significant upward trend in suicide, the trend was not significant for the combined rate.

**DISCUSSION**

Variations in suicide rates can be attributable to many different influences. While personal and social factors have most often been investigated, the external environment may play a role. A recent report<sup>7</sup> from 20 OECD (Organisation for Economic Co-operation and Development) countries, investigating the hypothesis that sunshine exposure may trigger suicidal behaviour, suggested that suicide followed a seasonal pattern with a dominant peak during the month of maximum daylight. Seasonal trends in suicide are not the only time patterns investigated in the past. Increased suicide attempts around the time of major public holidays have also been highlighted. A study<sup>8</sup> examining the relationship between suicide attempts and major public holidays in Europe (1989–1996) reported that there were fewer suicide attempts before Christmas and 40% more attempts after Christmas than expected.

An attempt to investigate the causes of international differences in suicide rates is bedevilled by varying recording, coding and classification systems. Some of the

variation in suicides across Europe may be due to artefacts of death registration. In a previous study on the comparability of cause of death statistics in the EU, suicide was highlighted as an issue requiring special attention.<sup>9</sup> Procedures for recording a death as suicide are not uniform. Some countries (e.g. Luxembourg) require a suicide note in order to register a death as suicide while others (e.g. UK) require an assessment of intent to be made by a coroner. Cultural and social norms also play a role in death registration. Where suicide is socially and culturally unacceptable, the death may be recorded or classified as undetermined. In other situations where a pre-existing mental illness is present, that illness rather than suicide may be recorded as the cause of death. In the case of a

**Table 3** Relationship between suicide and undetermined cause of death: correlation results

Country	Correlation coefficient	P-value
Austria	0.16 (-0.39; 0.62)	0.57
Belgium	-0.91 (-0.98; -0.71)	≤0.001
Denmark	0.01 (-0.54; 0.56)	0.97
Finland	0.75 (0.37; 0.92)	0.002
France	-0.07 (-0.58; 0.48)	0.80
Germany	-0.61 (-0.86; -0.11)	0.021
Greece	0.91 (0.73; 0.97)	≤0.001
Ireland	-0.71 (-0.90; -0.31)	0.003
Italy	0.11 (-0.45; 0.61)	0.70
Luxembourg	0.25 (-0.32; 0.69)	0.39
Netherlands	0.73 (0.33; 0.91)	0.003
Portugal	-0.27 (-0.69; 0.28)	0.33
Spain	-0.70 (-0.90; -0.27)	0.005
Sweden	0.88 (0.66; 0.96)	≤0.001
UK	-0.29 (-0.71; 0.29)	0.32

**Table 2** Death by undetermined causes by country, percentage change in age-standardized rates, and results of the linear regression (test for significant linear trend)

Country (Latest available year for data)	Rate per 100,000 1984 (95% CI)	Rate per 100,000 latest year (95% CI)	Change 1984–Latest available year %	Estimated slope parameter <i>b</i> (95% CI)	P-value	Statistical significance
Austria (1998)	0.77 (0.58; 0.96)	0.65 (0.48; 0.83)	-15.6	-0.003 (-0.02; 0.01)	0.65	NS
Belgium (1995)	1.07 (0.88; 1.27)	2.06 (1.79; 2.33)	+92.5	0.09 (0.004; 0.2)	0.063	BL
Denmark (1996)	3.60 (3.11; 4.10)	2.77 (2.35; 3.19)	-23.1	-0.01 (-0.08; 0.05)	0.66	NS
Finland (1997)	3.01 (2.55; 3.47)	1.22 (0.94; 1.50)	-59.4	-0.08 (-0.2; 0.002)	0.076	NS
France (1997)	3.34 (3.18; 3.48)	2.97 (2.84; 3.11)	-11.1	0.02 (-0.03; 0.06)	0.43	NS
Germany (1997)	1.51 (1.42; 1.61)	1.71 (1.62; 1.79)	+13.2	0.04 (0.0004; 0.08)	0.07	BL
Greece (1997)	0.43 (0.31; 0.55)	0.0 (0; 0)	-100.0	-0.04 (-0.06; -0.03)	≤0.001	***
Ireland (1998)	1.87 (1.42; 2.33)	1.24 (0.89; 1.58)	-33.7	-0.1 (-0.2; -0.07)	0.001	***
Italy (1997)	0.43 (0.38; 0.49)	0.99 (0.93; 1.07)	+130.2	0.008 (-0.01; 0.03)	0.47	NS
Luxembourg (1997)	1.40 (0.36; 2.44)	1.35 (0.17; 2.52)	-3.6	-0.2 (-0.3; 0.01)	0.91	NS
Netherlands (1997)	0.70 (0.57; 0.83)	0.29 (0.21; 0.36)	-58.6	-0.03 (-0.04; -0.02)	≤0.001	***
Portugal (1998)	7.99 (7.45; 8.54)	9.69 (9.11; 10.27)	+21.3	0.03 (-0.1; 0.2)	0.77	NS
Spain (1997)	0.67 (0.59; 0.75)	0.24 (0.19; 0.29)	-64.2	-0.07 (-0.1; -0.02)	0.007	**
Sweden (1997)	5.69 (5.21; 6.18)	2.96 (2.62; 3.29)	-48.0	-0.16 (-0.2; 0.1)	≤0.001	***
UK (1997)	2.63 (2.50; 2.76)	3.39 (3.24; 3.53)	+28.9	0.02 (-0.01; 0.05)	0.20	NS

\* 0.01<p≤0.05, \*\* 0.001<p≤0.01, \*\*\* p≤0.001, NS: not significant, BL: borderline significant

child fatality, there may also be unwillingness to use the label of suicide.

Routine suicide mortality data have several weaknesses. Although most national statistical agencies in the EU record variables such as age, sex, method of suicide (i.e. overdose, hanging, etc.) and region, not all countries record variables such as marital status, occupation and social class, all of which may be important factors in contributing to suicide and suicidal behaviour. Confidentiality and the release of personal data can also pose problems when investigating determining factors of suicide. Factors such as exposure to risk are sometimes difficult to obtain in certain countries (where these data are recorded) due to confidentiality clauses disallowing public access to such information. Suicide is a sensitive issue and while it is agreed that some level of confidentiality is maintained it is also important for epidemiologists and health care professionals assisting in the development of prevention strategies to have access to detailed information.

Analyses of suicide trends often include 'undetermined deaths' in their calculations to take account of misclassification. Separate analyses were conducted on suicides and undetermined deaths to determine whether misclassification explained some of the geographical and temporal variation in suicide rates. The pattern varied greatly. For most member states, changing suicide rates could not be explained by misclassification. While suicide rates declined in five member states, their rates of undetermined causes of death remained stable over time. Greece consistently had the lowest rates of both suicide and undetermined cause of death. Correlations between suicide rates and undetermined death rates suggested significant inverse relationships for only four countries

(Belgium, Germany, Ireland and Spain) suggesting that misclassification may explain some of the temporal variation in suicides in these cases.

Combining suicide and undetermined causes of death data showed that, although the combined rates were higher than the suicide rates alone, there were no major differences in the pattern or significance of the trends over time with the exception of Spain. For this country, the increase over the study period changed from a significant +17.2% for suicide alone to a non-significant +8.2% for the combined rate. Although most member states did exhibit a decline in the combined rates over the study period, for some countries these reductions were less than those observed for suicides alone.

There have been several previous attempts to explain the recent rise in Irish suicide rates.<sup>10,11</sup> The misclassification of suicides as undetermined deaths in the earlier years may have led to underreporting at that time. According to this hypothesis it has become increasingly acceptable in Ireland to record suicide as a cause of death. We observed that the rates of undetermined causes of death for Ireland decreased during the study period by 34%. This drop was small compared to the rise in Irish suicide rates (89%). Irish suicide rates began to increase in 1989, the year when the rates for undetermined causes of death began to decrease. When 1989 was chosen as the base year, the increase in suicide rates was 65% compared to a decrease of 50% in undetermined causes of death, suggesting that misclassification might partially explain temporal variations in suicide rates in Ireland. Results from a linear regression analysis (using 1984 as the base year) suggested that undetermined death rates in the linear regression model statistically explained 46% of the variation in Irish suicide rates due to their fairly strong correlation (-0.71).

**Table 4** Death by suicide and undetermined causes combined, by country, percentage change in age-standardized rates, and results of the linear regression (test for significant linear trend)

Country (Latest available year for data)	Rate per 100,000 1984 (95% CI)	Rate per 100,000 latest year (95% CI)	Change 1984–Latest available year %	Estimated slope parameter <i>b</i> (95% CI)	P-value	Statistical significance
Austria (1998)	22.1 (21.1; 23.1)	15.1 (14.3; 15.9)	-31.7	-0.5 (-0.6; -0.4)	≤0.001	***
Belgium (1995)	19.7 (18.9; 20.5)	18.6 (17.9; 19.4)	-5.2	-0.1 (-0.3; 0.05)	0.17	NS
Denmark (1996)	26.4 (25.1; 27.7)	15.3 (14.3; 16.3)	-42.0	-0.9 (-1.0; -0.8)	≤0.001	***
Finland (1997)	24.4 (23.0; 25.7)	22.8 (21.6; 24.1)	-6.3	-0.1 (-0.4; 0.2)	0.49	NS
France (1997)	20.6 (20.3; 21.0)	17.4 (17.2; 17.8)	-15.1	-0.2 (-0.3; -0.1)	0.002	**
Germany (1997)	17.0 (16.7; 17.3)	12.5 (12.3; 12.7)	-26.5	-0.3 (-0.4; -0.2)	≤0.001	***
Greece (1997)	3.7 (3.3; 4.0)	2.8 (2.5; 3.1)	-23.8	-0.09 (-0.1; -0.06)	≤0.001	***
Ireland (1998)	8.5 (7.5; 9.4)	13.7 (12.5; 14.8)	+61.8	0.2 (0.1; 0.3)	≤0.001	***
Italy (1997)	6.3 (6.2; 6.5)	6.7 (6.6; 6.9)	+6.2	-0.01 (-0.05; 0.03)	0.67	NS
Luxembourg (1997)	17.1 (13.2; 21.0)	16.6 (12.9; 20.3)	-3.1	-0.15 (-0.5; 0.2)	0.39	NS
Netherlands (1997)	10.9 (10.4; 11.5)	8.3 (7.9; 8.8)	-23.7	-0.16 (-0.2; -0.1)	≤0.001	***
Portugal (1998)	16.8 (16.0; 17.5)	13.5 (12.8; 14.2)	-19.3	-0.2 (-0.4; -0.1)	0.006	**
Spain (1997)	6.0 (5.8; 6.2)	6.5 (6.2; 6.7)	+8.2	-0.01 (-0.05; 0.03)	0.55	NS
Sweden (1997)	21.5 (20.6; 22.5)	13.7 (13.0; 14.5)	-36.2	-0.5 (-0.6; -0.4)	≤0.001	***
UK (1997)	9.8 (9.5; 10.0)	9.3 (9.1; 9.6)	-4.3	-0.07 (-0.1; -0.03)	0.008	**

\* 0.01 < p ≤ 0.05, \*\* 0.001 < p ≤ 0.01, \*\*\* p ≤ 0.001, NS: not significant

The rise in suicide rates in Ireland cannot therefore be entirely 'explained' by misclassification and so other factors may be implicated. There have been many changes in Irish society in the recent past. Not only has the wealth of the country increased but there have also been radical changes in social structure and religious attitudes.<sup>11</sup>

Whatever the reasons may be for changes in suicide rates, of which there are theoretically many, the problem of misclassification remains a complex one. Our findings suggest that in most EU countries there is no consistent geographical or temporal inverse relationship between death rates from suicide and from undetermined causes. Misclassification appears to contribute to a minor proportion of the variation in suicide rates in the EU and does not explain it. Future research should explore alternative hypotheses as well as documenting varying suicide recording, classification and reporting across the EU with a view to promoting a standardized approach. Ultimately, a European-wide code of practice for collecting, recording and reporting such data would be desirable. In the absence of adequate EU wide data on suicide epidemiology, effective prevention of this distressing phenomenon is likely to remain elusive.

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