

ORIGINAL ARTICLE

Intentional injury mortality in the European Union: how many more lives could be saved?

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Objective: To explore the scope for reducing the number of intentional injury deaths, hypothesizing that all European Union (EU) countries are able to match the experience of the country with the lowest mortality rate for intentional injuries.

Design: Intentional injury mortality data for the three last available years and denominator population estimates were obtained from the World Health Organisation mortality database for the 22 EU countries with more than one million population. To estimate the potential saving of lives, the yearly average age adjusted injury mortality rates were calculated. This issue done for children (0–14), adults (15–64), and elderly people (65 and over), both including and excluding deaths from undetermined cause.

Main outcome measures: Number of lives that might potentially be saved if all EU member states matched the lowest intentional injury rate reported by an EU member state.

Results: Over 73% of all intentional injury deaths could have been avoided if all EU countries matched the country with the lowest intentional injury mortality rate. EU member states would have suffered about 600 fewer intentional injury deaths in children, about 40 000 fewer adult deaths, and over 14 000 fewer intentional injury deaths in the elderly. This amounts to over 55 000 lives in a single year.

Conclusions: Many lives lost through injury might be saved if all countries were to achieve the lowest intentional injury mortality rates reported in the EU. How this theoretical observation might be translated into practice needs to be further explored as the international variation in intentional injury mortality rates in the EU results from a range of factors.

Injury is a leading cause of death and disability throughout the world in all age groups under 60.^{1–2} Around five million people worldwide died as a result of an injury in 2000, accounting for nearly one in every 10 deaths. Of these, more than one in four were caused by an intentional injury.²

Suicide is a significant problem in the European region, outnumbering the commonest cause of unintentional injury deaths, namely road traffic injuries, and is one of the top two causes of death in young adults (aged 15–44).¹ Standardized suicide rates tend to be lower in the Mediterranean countries, with higher rates reported by northern and eastern European countries, particularly Finland, Hungary, and the Baltic States.^{3–6} These Eastern European countries and Finland share some historical and sociocultural characteristics and have the highest suicide rates in the world for both men and women.⁷

Violence (other than self inflicted) comprises diverse components including interpersonal (family and intimate partner violence and community violence) and collective forms (social, political, and economic violence).⁸ Relatively low rates of youth homicide are found in most of western Europe while high rates are found in some south-eastern European countries.

The varying rates of suicide within the European Union (EU) may reflect variation in the prevalence of risk factors including exposure to sunshine,⁹ psychiatric disease,¹⁰ levels of economic development,¹¹ degree of social support, rapid socioeconomic change,^{5–8–10} and cultural attitudes.^{12–14} The contribution of preventive efforts to this variation has not been adequately assessed. This paper aims to explore the relative performance of the EU member states with regard to intentional injury mortality in an attempt to quantify the potential scope for more effective prevention.

METHODS

All current EU member states were included in the study with the exception of countries with fewer than one million

population (Cyprus, Luxembourg, and Malta), as small numbers may be subject to excessive random variation. The 22 countries included in the analysis were: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, the Netherlands, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, and the United Kingdom.

Mortality data for intentional injury and corresponding denominator population estimates for the relevant countries were retrieved from the mortality database of the European Office of the World Health Organisation (WHO Europe) using the respective causes of death codes of the 9th and 10th editions of the *International Classification of Diseases* (suicides: ICD9: E950-E959 and ICD10: X60-X84, Y870; homicides: ICD9: E960-E969 and ICD10: X85-Y09, Y871; injuries of undetermined intent: ICD9: E980-E989 and ICD10: Y10-Y34, Y872).

Deaths caused by legal intervention and war (ICD9: E970-E979, E990-E999 and ICD10: Y35-Y36, Y890-Y891) were excluded. Our decision to exclude such deaths was taken for two reasons. First, the numbers were relatively small (36 for the whole sample). Second, both the causal pattern and prevention strategies relating to this group are very different from those of homicide and suicide. If, for example, our analysis had included later years for the UK, casualties from the Iraq war would have been considerable and either distorted the homicide category (if included there), or would have required a separate analysis. A category of legal and war deaths is therefore desirable in future studies if their frequency is great enough to withstand excessive random variation.

For the main analysis, data from the last three consecutive available years were obtained for each country (except the UK, where, Scotland, Wales, and England began using ICD10 at different times; consequently only two consecutive years were available at the time of analysis). The availability of data

by country at the time of analysis is shown in fig 1. In addition, we carried out a regression analysis on intentional injury mortality rates over an approximately 10 year period in an attempt to discern longer term time trends.

Yearly averages of age adjusted mortality rates (based on the European standard population provided by WHO) were calculated to estimate—overall and within age groups—the potential number of lives saved in the EU if all member states achieved the same rate as the country with the lowest rate. The results were obtained from the formula:

$$LS = N * (PPR/100)$$

where LS = yearly average number of lives saved, N = average number of yearly deaths, and PPR = percent of potential reduction, based on the lowest yearly average mortality rate for the “best performing country” as derived from the formula:

$$PPR = 100 * (AMR_x - AMR_s) / AMR_x$$

where AMR_x = average yearly age adjusted mortality rate of country X and AMR_s = average yearly age adjusted mortality rate of the best performing country S.

Whether or not the “injury of undetermined intent” category includes intentional injury is a matter for debate.⁴ We therefore carried out two calculations, including and excluding injuries of undetermined intent.

RESULTS

Our calculations suggest that more than 55 000 deaths of about 63 000 reported each year from suicide, homicide, and injuries of undetermined intent might have been avoided in the EU if all countries had achieved the intentional injury mortality reported by the member state with the lowest rate, namely Greece (4.1 per 100 000) (table 1). Two other Mediterranean countries, Italy and Spain, reported very low total intentional injury mortality rates. The rates of the three Baltic countries reached an average of over 10 times higher than that of Greece.

Country	Years					
	1995-97	1998	1999	2000	2001	2002
Austria				+	+	+
Belgium	+++					
Czech Republic				+	+	+
Denmark		+	+	+		
Estonia				+	+	+
Finland				+	+	+
France		+	+	+		
Germany			+	+	+	
Greece			+	+	+	
Hungary				+	+	+
Ireland			+	+	+	
Italy			+	+	+	
Latvia				+	+	+
Lithuania				+	+	+
Poland				+	+	+
Portugal				+	+	+
Slovakia			+	+	+	
Slovenia				+	+	+
Spain			+	+	+	
Sweden			+	+	+	
Netherlands		+	+	+		
UK					+	+

Figure 1 Availability of injury mortality data in the WHO database by country and year.

Children (0–14 years)

These results are shown in table 2 (see <http://www.injuryprevention.com/supplemental>). Over 67% of homicide and suicide deaths in children (n = 348) might have been avoided each year in the EU if all countries had matched the rate reported by Greece (0.2 per 100 000). A further 11% might have been avoided if injuries of undetermined intent are included. This amounts to nearly four fifths (78%) of all intentional injury deaths in children, or 601 lives. The potential savings range from 20% to 95% across countries. The Baltic states had a high rate in all causation categories, whereas Portugal and Slovakia had a notably higher rate of injuries of undetermined intent compared to suicide and homicide. The average intentional mortality rate for children was higher for homicides than suicides or injuries of undetermined intent (0.4, 0.2, and 0.3 per 100 000, respectively).

Adults (15–64 years)

These results are shown in table 3 (see <http://www.injuryprevention.com/supplemental>). Almost 68% (n = 32 000) of adult deaths from homicide and suicide might have been avoided each year if all countries had achieved the same rate as Greece, the country with the lowest rate (5.0 per 100 000). About 40 000 deaths (73%) from intentional injury in the EU might have been avoided when injuries of undetermined intent are included. Most of the potentially avoided deaths would be from suicides as they are on average nearly 10 times more frequent than homicides in adults (14.0 and 1.5 per 100 000, respectively). The potential savings across member states range from 45% to 94%. Lithuania had a substantially higher rate of suicides than any other country (59 per 100 000), whereas Estonia and Latvia had more homicides than other countries (17.6 and 15.3 per 100 000, respectively). Injuries of undetermined intent comprised a relatively high proportion of intentional injury deaths in Portugal, the UK, and Poland compared with the other countries.

Elderly (65 and over)

These results are shown in table 4 (see <http://www.injuryprevention.com/supplemental>). Over 68% of elderly deaths (n = 10 600) from homicide and suicide in EU might have been avoided each year if all countries had achieved the same rate as Greece (6.7 per 100 000). A further 4000 lives might be saved if injuries of undetermined intent are included in the calculation. In the elderly, suicides are on average over 20 times more frequent than homicides and four times more frequent than deaths from injuries of undetermined intent (20.1, 1.0, and 4.9 per 100 000, respectively). Hungary, Slovenia, and Lithuania had the highest rates of suicides (53.1, 50.4, and 47.3 per 100 000, respectively), whereas Portugal and Slovenia reported high death rates of injuries of undetermined intent (20.5 and 17.0 per 100 000, respectively). Ireland had the lowest and Latvia the highest rate of homicide in this age group (0.3 and 10.5 per 100 000, respectively).

Finally, the stability of these intercountry variations over approximately 10 years is shown in table 5. Although several countries experienced significant declines in intentional injury mortality between the earlier and later periods, the ranking according to rates remains virtually unchanged.

DISCUSSION

At the beginning of the new millennium, the potential scope for reduction of intentional injury deaths in the EU appears greatest for suicide as the rates are about 20 times those of homicide and five times those of injuries of undetermined intent. The elderly have the highest rates of suicide in most countries, while Finland, Ireland, Lithuania, Poland, and the

Table 1 Percent potential reduction in overall intentional injury mortality per 100 000 population by cause*, excluding and including injuries of undetermined intent, and annual number of lives saved in the EU countries based on the average of the last three available years (circa 2000)

Country	Mortality rate by cause					Without injuries of undetermined intent					With injuries of undetermined intent				
	Suicide	Homicide	IUI	Deaths/year	Average yearly age adjusted MR	Lowest total rate			Deaths/year	Average yearly age adjusted MR	Potential reduction (%)†	Lives saved	Lowest total rate		
						Potential reduction (%)†	Average yearly age adjusted MR	Lives saved					Potential reduction (%)†	Average yearly age adjusted MR	Lives saved
Greece	3.1	1.1	0.0	489	4.1	0.0	0	489	4.1	0.0	0	489	4.1	0.0	0
Italy	6.0	1.0	1.1	4703	7.0	41.0	1928	5569	8.1	49.1	2737	5569	8.1	49.1	2737
UK	6.6	0.9	3.4	4551	7.4	44.7	2033	6620	10.8	62.0	4105	6620	10.8	62.0	4105
Spain	7.0	0.9	0.2	3660	7.9	47.8	1751	3774	8.1	49.4	1865	3774	8.1	49.4	1865
Portugal	7.0	1.3	7.5	970	8.2	50.0	485	1852	15.8	73.9	1369	1852	15.8	73.9	1369
Netherlands	9.0	1.2	0.4	1701	10.1	59.3	1009	1762	10.5	60.7	1070	1762	10.5	60.7	1070
Germany	11.8	0.8	2.4	11763	12.5	67.1	7897	14209	14.9	72.4	10286	14209	14.9	72.4	10286
Ireland	12.1	1.0	1.5	497	13.0	68.4	340	554	14.6	71.7	397	554	14.6	71.7	397
Sweden	12.2	1.1	3.3	1278	13.2	68.9	880	1581	16.5	75.0	1186	1581	16.5	75.0	1186
Denmark	12.9	1.1	3.6	810	14.0	70.6	572	1010	17.6	76.6	773	1010	17.6	76.6	773
Slovakia	13.0	2.2	3.6	826	15.2	72.9	602	1020	18.8	78.1	797	1020	18.8	78.1	797
Czech Republic	14.3	1.3	3.0	1743	15.7	73.7	1285	2073	18.7	77.9	1615	2073	18.7	77.9	1615
Poland	14.9	1.8	6.0	6588	16.7	75.3	4964	8958	22.7	81.9	7335	8958	22.7	81.9	7335
France	16.5	0.8	2.3	11003	17.2	76.1	8373	12476	19.6	79.0	9851	12476	19.6	79.0	9851
Austria	17.0	0.9	0.8	1617	17.9	76.9	1244	1689	18.7	78.0	1317	1689	18.7	78.0	1317
Belgium	19.2	1.8	2.3	2287	21.0	80.3	1838	2526	23.2	82.2	2078	2526	23.2	82.2	2078
Finland	21.2	2.7	1.9	1297	23.9	82.7	1073	1400	25.7	84.0	1175	1400	25.7	84.0	1175
Slovenia	26.1	1.0	4.0	592	27.1	84.8	502	683	31.1	86.8	593	683	31.1	86.8	593
Hungary	27.0	2.4	1.4	3279	29.4	86.0	2820	3441	30.8	86.6	2982	3441	30.8	86.6	2982
Estonia	26.8	13.0	7.4	569	39.8	89.6	510	678	47.2	91.3	619	678	47.2	91.3	619
Latvia	28.9	11.9	9.9	1000	40.7	89.9	899	1239	50.6	91.9	1138	1239	50.6	91.9	1138
Lithuania	44.9	9.1	9.0	1892	54.0	92.4	1747	2205	63.0	93.5	2061	2205	63.0	93.5	2061
EU	11.6	1.2	2.5	63113	12.9	68.0	42923	75807	15.4	73.3	55555	75807	15.4	73.3	55555

*Deaths due legal intervention or war operations are excluded.

†Bold numbers indicate a statistically significant difference between the average yearly age adjusted MR of the respective country and the average yearly age adjusted MR of Greece.

Rankings are by average yearly age adjusted MR without injuries of undetermined intent.

EU, European Union; IUI, injury of undetermined intent; MR, mortality rate.

Table 5 Age adjusted mortality from intentional injuries* (per 100 000 person years) and regression derived annual change in the EU member states, ~1991 to ~2000

Country	Average yearly age adjusted MR of the first 3 available years (c 1991)	Average yearly age adjusted MR of the last 3 available years (c 2000)	Annual change (%)	95% CI	p Value
Greece	4.5	4.1	-1.21	-2.80 to 0.40	0.18
Italy	8.8	7.0	-3.22	-3.77 to -2.67	0.0001
UK	8.3	7.4	-1.31	-2.10 to -0.52	0.01
Spain	8.0	7.9	0.02	-0.89 to 0.95	0.96
Portugal	8.9	8.2	-1.12	-6.32 to 4.36	0.69
Netherlands	11.1	10.1	-1.19	-1.58 to -0.79	0.0004
Germany	15.3	12.5	-2.81	-3.22 to -2.40	0.0001
Ireland	11.5	13.0	2.15	0.62 to 3.70	0.02
Sweden	15.6	13.2	-2.37	-2.93 to -1.80	0.0001
Denmark	17.5	14.0	-5.15	-6.20 to -4.10	0.0002
Slovakia	17.0	15.2	-1.82	-2.86 to -0.77	0.01
Czech Republic	19.2	15.7	-2.82	-3.83 to -1.80	0.0007
Poland	17.9	16.7	-0.90	-1.14 to -0.65	0.0004
France	20.3	17.2	-2.22	-3.01 to -1.43	0.0006
Austria	21.2	17.9	-2.42	-3.18 to -1.64	0.0003
Belgium	19.6	21.0	1.10	-0.06 to 2.27	0.10
Finland	29.5	23.9	-2.91	-3.53 to -2.28	0.0001
Slovenia	31.0	27.1	-2.02	-2.69 to -1.34	0.0004
Hungary	36.2	29.4	-2.94	-3.60 to -2.26	0.0001
Estonia	66.2	39.8	-6.66	-7.95 to -5.36	0.0001
Latvia	62.9	40.7	-6.06	-6.76 to -5.36	0.0001
Lithuania	59.7	54.0	-1.56	-2.44 to -0.68	0.009
EU	15.1	12.9	-1.84	-3.27 to -0.40	0.03

*Suicides and homicides, but excluding injuries of undetermined intent.
CI, confidence interval; MR, mortality rate.

UK appear to have a larger problem with adult (15–64 years) rather than elderly suicide, a peculiarity further magnified if injuries of undetermined intent are included with suicides. Adults (15–64 years) have the highest rates of homicide in most countries.

There is an intriguing geographical pattern of intentional injury mortality (largely due to suicide) in the EU: countries around the Mediterranean (Greece, Italy, and Spain) report low rates (fewer than 10 per 100 000 when injuries of undetermined origin are included); the Netherlands, UK, Germany, Ireland, Portugal, Sweden, Denmark, Czech Republic, Austria, Slovakia, France, Poland, Belgium, and Finland report intermediate rates (10–30 per 100 000); while Slovenia, Hungary, and the Baltic States report the highest rates (more than 30 per 100 000). Indeed Hungary and the Baltic states are among the countries that have the highest rates of suicides in the world,⁶ the reasons for which are obscure. These countries have had a turbulent history before, during, and since the break up of the Soviet Union. Alcohol consumption,¹⁵ together with social disorganization and the psychological stresses associated with rapid social, economic, and political changes, are thought to be contributing factors.⁵ In the Baltic states, for example, the trend in suicides was downwards (by over 20%) in the late 1980s followed by a sharp increase (approximately 60–70%) in the early 1990s (fig 2), during the dismantling of corporate socialism.⁵

The specific reasons for the very low intentional injury mortality rate of Greece are a matter for conjecture. A necropsy is required by law in the case of every violent death in Greece and the country's necropsy rate for hospital deaths (around 45%) is not especially low in EU terms.¹⁶ Our findings accord with those of crime surveys that indicate a relatively low level of homicide in Greece compared with other EU member states including the UK.¹⁷ Greece also appears to have lower risk factor levels for violence than many other EU countries. Alcohol consumption, for example, is below the EU average and only Italy, Norway, and Sweden had lower alcohol consumption rates in 2003, and binge drinking appears less common in Mediterranean regions.¹⁶

Low rates of suicide in Mediterranean regions have been attributed to climate. Sunshine appears to have a beneficial impact on mood, and annual total sunshine has been shown to correlate negatively with suicide rates within countries even after adjusting for confounding variables such as sociodemographic factors. Paradoxically, although sunshine appears to exert a long term protective effect on suicide risk, intense short term exposure may act as a trigger for suicide.⁹ Other factors influencing intentional injury mortality rates are the prevalence of psychiatric diseases and especially that of mood disorders and substance abuse, socioeconomic and cultural differences, the quality of medical care, educational level, legislation (for example, relating to gun ownership¹⁸), and media reporting¹⁹. In England and Wales there was an increase in suicides following Princess Diana's funeral in 1997²⁰ and a decrease following the terrorist attacks of 11 September 2001.²¹

Although national and regional cultural and religious characteristics may influence intentional injury risk, we acknowledge that these factors may also produce methodological artifacts. Any investigation of international variation in injury rates is bedeviled by varying recording, coding and classification practices. The diagnosis and recording of intentional injury is particularly problematic as intent can often be difficult to assess. The WHO highlights two important points: first, the use of force does not necessarily correlate with intention to damage; second, there may be differences in intent to injure and intent to use violence—forms of which may be culturally acceptable in some settings.⁸ There are also difficulties in assessing the accuracy of causation classification. Resistance to the recording of suicide may contribute to the low reported suicide rates of some Mediterranean countries though, in common with a previously reported study,⁴ we could identify no empirical evidence to suggest that this is a major explanatory factor.

Procedures for recording a death as suicide are not uniform. Some countries require a suicide note to register a death as suicide while others require that a coroner undertakes an assessment of intent. Assessment of intent appears

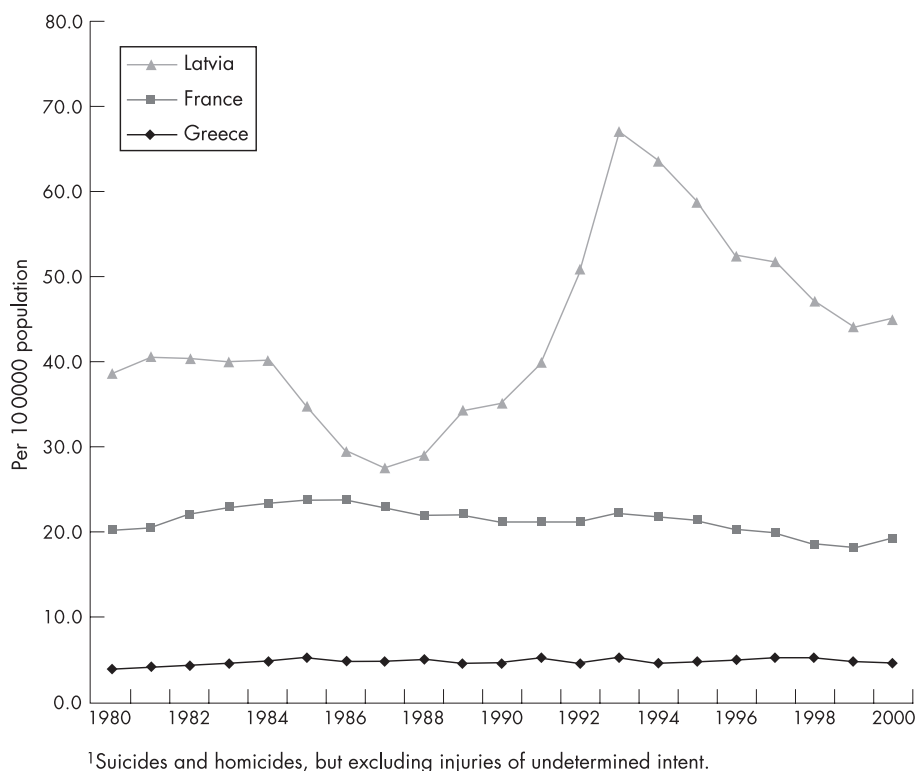


Figure 2 Intentional injury mortality rates in three EU countries 1980–2000 (source: WHO-Europe injury database). Injuries of undetermined intent excluded.

to be related to the chosen suicide method, and under-reporting may be as high as 40%.²² In situations where suicide is socially or culturally unacceptable, the death may be recorded and classified as undetermined or even unintentional, depending on the method used—for example, a suicide disguised in a motor vehicle crash²³ (covert suicide). Some hospital admissions for unintentional injury, including motor vehicle crashes, may be unrecognized suicide attempts.²⁴ In Portugal the rate of undetermined deaths tends to surpass that of suicides, prompting concern about possible misclassification of cause of death. Homicides are also liable to misclassification as undetermined or unintentional injury. Some cases of infant homicide (infanticide) may be misclassified as SIDS (sudden infant death syndrome).²⁵ Some elderly deaths classified as natural, accidental, and undetermined causes may be the result of neglect or abuse.⁸

On the other hand, all the mortality data are derived from real death certificates, the coding of which is subject to strict WHO quality control procedures.²⁶ Moreover, the differences between high rate and low rate countries are not confined to a narrow time window but persist over approximately a decade. To explore and illustrate the longer term time trends, we carried out an additional analysis of the period 1980 to 2000 for three countries—Greece, France, and Latvia—that experienced low, middle, and high intentional injury rates, respectively (fig 2). Their relative positions are remarkably stable over time with the exception of the temporary surge in rates in Latvia during the period of political upheaval to which we have referred above. In other words, the intercountry differences we have observed are so large and consistent that underrecording or other methodological artifact is, in our view, unlikely to explain the magnitude of the variation.

Whether the potential reductions in fatal intentional injuries presented here represent more than a theoretical opportunity is a matter for speculation, as we do not fully

understand the reasons underlying the varying mortality rates. For the purpose of this exercise, we hypothesized that all countries, through the implementation of effective prevention strategies, could achieve the lowest reported national intentional injury rate. Such an assumption may be too optimistic as intentional injury reduction is notoriously difficult to achieve and it is debatable whether a low mortality rate is an indication of “best practice”. Furthermore, preventive measures that work well in one country might not easily be transferred to another. Conversely, there is little evidence that the country with the lowest rate has achieved the absolute limit in intentional injury reduction, which in turn raises the possibility that we may have underestimated the potential number of lives saved. The relative importance of these two possible sources of error operating in opposite directions is difficult to assess.

An international consensus is growing that the prevention of intentional injury is possible though, in common with other branches of public health, the extent to which research based knowledge is applied varies widely from country to country. Successful suicide prevention strategies include limiting the availability of lethal methods, such as reducing the access to barbiturates,²⁷ to lethal pesticides such as paraquat,²⁸ domestic gas detoxification,²⁹ the introduction of catalytic converters on cars,³⁰ the reduction of the pack size and introduction of blister packs of analgesics^{31–32} and regulation of handguns (a measure that also helps prevent homicides).³³ Some researchers have suggested that restricting firearms will result in suicide methods being substituted with, for example, leaping.³⁴ Other interventions include screening for suicide risk in primary care setting through targeting high risk groups such as young men, patients newly discharged from psychiatric care, and people with a history of parasuicide or deliberate self harm. The role of the effective treatment of depression as a suicide prevention measure should not be overlooked.³⁵

Key points

- Globally, more than one in four injury deaths are caused by intentional injury.
- About 63 000 people die annually in the European Union from intentional injury, but there is wide variation in mortality from intentional injury across the EU countries.
- Over 73% (~55 000 per annum) of all intentional injury deaths could have been avoided if all EU countries had matched the country with the lowest rate.
- How this theoretical observation might be translated into practice requires further exploration.

Interpersonal violence prevention is even more challenging. Measures that seem to be effective include early life interventions (prenatal to age 6) to avoid youth violence^{36,37} and home visitation in pregnancy and infancy to reduce the likelihood of child neglect and abuse.³⁸ Legislation outlawing corporal punishment may protect children at risk of abuse,³⁹ and promoting sex equality has a role in preventing violence against women.³⁷

In conclusion, our epidemiological analyses have shown that there may be substantial scope for the avoidance of intentional injury deaths in the EU, were all member states to reduce their intentional injury mortality rates to those of the country reporting the lowest rate. How this hypothetical potential saving of lives might be translated into practice requires further exploration.

Implications for prevention

There is a clear requirement for a more intensive research effort into the development, implementation, and evaluation of preventive interventions in the field of intentional injury. Nevertheless, we suggest that the wide international variation in mortality from these causes reflects, in part at least, varying commitment to and implementation of preventive interventions of known efficacy. Above all, this study points to the urgent need for public health policy makers in Europe to redouble their efforts to increase the effectiveness of current suicide and violence prevention strategies throughout the continent.

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Tables 2–4 are available on our website