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The iceberg of suicide and self-harm in Irish adolescents: a population-based study

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Abstract
Purpose Suicide is a leading cause of death among adolescents. Self-harm is the most important risk factor for suicide, yet the majority of self-harm does not come to the attention of health services. The purpose of this study was to establish the relative incidence of adolescent suicide, hospital-treated self-harm and self-harm in the community.
Methods Annual suicide rates were calculated for 15–17 year-old in the Cork and Kerry region in Ireland based on data from the Central Statistics Office. Rates of hospital-treated self-harm were collected by the Irish National Registry of Deliberate Self-Harm. Rates of self-harm in the community were assessed using a survey of 3,881 adolescents, the Child and Adolescent Self-harm in Europe study.
Results The annual suicide rate was 10/100,000. Suicide was six times more common among boys than girls. The annual incidence rate of hospital-treated self-harm was approximately 344/100,000, with the female rate almost twice the male rate. The rate of self-harm in the community was 5,551/100,000, and girls were almost four times more likely to report self-harm. For every boy who died by suicide, 16 presented to hospital with self-harm and 146 reported self-harm in the community. For every female suicide, 162 girls presented to hospital with self-harm and 3,296 reported self-harm.
Conclusions Gender differences in relative rates of self-harm and suicide are very large, with boys who have harmed themselves at particularly high risk of suicide. Knowledge of the relative incidence of self-harm and suicide in adolescents can inform prevention programmes and services.

Keywords Suicide · Self-harm · Adolescent

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Introduction

One million people die from suicide annually, a global mortality rate of 16 per 100,000. In the last 45 years, suicide rates have increased by 60 % worldwide [1]. Suicide is uncommon before 15 years of age but increases in prevalence through adolescence and into adulthood [2]. Globally, male adolescents are more likely to die by suicide than females, with the suicide rate in boys aged 15–19 years 2.6 times that of girls of the same age [3]. Suicide is the leading cause of death in men aged 15–34 years in Ireland, with suicide rates among young men aged 15–19 in Ireland the third highest in the European Union [4].

The "iceberg" of suicidal behaviour has been postulated, in which the tip of the iceberg is the highly visible but rare event of suicide, beneath this higher rates of

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hospital-treated self-harm, and at the base the very common but often hidden phenomenon of self-harm which does not come to the attention of health services [5]. The relative incidence of each of these behaviours has not previously been reliably established for any population.

There are strong associations between self-harm and suicide, and a history of self-harm is the largest risk factor for suicide [5–7]. The majority of those who die by suicide have a history of self-harm, and self-injury can be viewed as a "gateway" to potentially lethal suicidal behaviour [6]. In the Child and Adolescent Self-Harm in Europe (CASE) survey, over half of adolescents who had harmed themselves reported a wish to die amongst their motives for self-harm [8]. One prospective study found that, in the 6 years following presentation to hospital with self-harm, 2.8 % of participants had died by suicide and a further 57.4 % had engaged in repeated self-harm [9]. A systematic review reported that subsequent suicide occurs in around 1 in 15 people within 9 years of an episode of hospital-treated self-harm [7]. The majority of adolescents who present to hospital with self-harm report previous episodes which had not resulted in hospital presentation [10]. There are few differences between adolescents who present to hospital following self-harm and those who do not, other than in method of self-harm and prior help-seeking [11].

Adolescent self-harm is a major public health problem [5], with a prevalence of approximately 10 % [5]. Rates among girls are higher than among boys [12]. A small minority of adolescents who have harmed themselves report seeking help from health services [13]. The CASE study reported that lifetime history of self-harm was reported by 9.1 % of Irish adolescents surveyed, of whom nearly half reported repeated episodes [14].

Few countries have reliable data on hospital-treated self-harm [15]. The National Registry of Deliberate Self-Harm in Ireland is the world's only national registry of Deliberate Self-Harm, and allows for the examination of rates of hospital-treated self-harm at both national and regional level [16]. Analyses of data from the Irish register show that, as with self-harm in the community, rates of hospital-treated self-harm are higher in adolescent girls than in boys [17], and that rates of hospital-treated self-harm peak in women at age 17 and in men at age 20 [18].

In this study, we aimed to quantify the relative incidence of adolescent suicide and self-harm in one region of Ireland using three data sources: data on deaths by suicide, hospital-treated deliberate self-harm and self-reported self-harm assessed through an anonymous school-based questionnaire. Establishing for the first time the relative incidence of these phenomena can inform prevention strategies and the planning of services for young people who have engaged in self-harm.

Method

The study region and population (15–17 year-old adolescents in counties Cork and Kerry in Ireland) were chosen based on the CASE study for which survey data have been gathered on a large, representative sample of this population.

Suicide rates

The Irish Central Statistics Office (CSO) provided data relating to all deaths by suicide (ICD9 codes E950–959 and ICD10 code X60–X84), and undetermined deaths (ICD-9 codes E980–989 and ICD-10 codes Y10–34). As adolescent suicide is a rare event, data from 1997 to 2011 were used to estimate average annual suicide rates for this period separately by gender for adolescents in the age group 15–17 years in the Cork and Kerry regions of Ireland. This time period was chosen to allow for comparison with rates of self-harm over a similar period. Rates can also be calculated including both suicides and undetermined deaths when a significant number of cases of undetermined deaths suggest that suicide rates may be inaccurate.

Hospital-treated self-harm

The National Registry of Deliberate Self-Harm collects data on self-harm presentations to all 40 hospital emergency departments in the Republic of Ireland. Data are collected by trained data registration officers using standard methods of case ascertainment and definition. The registry uses the following definition of deliberate self-harm: 'an act with non-fatal outcome in which an individual deliberately initiates a non-habitual behaviour, that without intervention from others will cause self-harm, or deliberately ingests a substance in excess of the prescribed or generally recognised therapeutic dosage, and which is aimed at realising changes that the person desires via the actual or expected physical consequences' [10]. This definition was derived from the WHO/Euro Multicentre Study on Suicidal Behaviour and is consistent with that used in a UK Multicentre study [19]. The definition includes acts involving varying levels of suicidal intent and various underlying motives.

For the purposes of this study, data from the Cork and Kerry regions in the south of Ireland were used and data were extracted for males and females aged 15-17 years who were resident in these regions. The years 2003–2011 were used to generate reliable average annual incidence rates of hospital-treated self-harm, as well as data on methods of self-harm. Rates generated refer to persons

presenting annually, rather than number of presentations, thereby excluding repeat presentations within the same year.

Self-harm in the community

Child and Adolescent Self-Harm in Europe (CASE) study

The Child and Adolescent Self-Harm in Europe (CASE) study is a multicentre study which used a standardised, internationally validated, anonymous questionnaire designed by the CASE collaborators for data collection by each of the seven centres involved in the study (six centres in Europe and one in Australia) [12]. The survey was conducted using a cross-sectional design, with data gathered in schools in counties Cork and Kerry in Ireland in 2003 and 2004. Using a random selection from all second-level schools in the region, 54 schools were invited to take part and 39 schools participated in the survey. The Clinical Research Ethics Committee of the Cork Teaching Hospitals granted ethical approval for the survey. Of the 4,583 students invited to complete the questionnaire, 3,881 participated in the survey (85 % response rate), of whom 3,631 were included in this study as they were aged 15, 16 or 17 years and data on gender and history of self-harm were complete. 52 % of the participants were girls and the majority (53.1 %) of students were 16 years old.

The study design, procedure, measures and sample have been more fully described elsewhere [20].

A distinctive characteristic of this study was that participants reporting self-harm were asked to describe in their own words, the method(s) they had used to harm themselves. This description was then coded according to a standardised definition of deliberate self-harm: "An act with a non-fatal outcome in which an individual deliberately did one or more of the following:

- Initiated behaviour (for example, self-cutting, jumping from a height), which they intended to cause self-harm.
- Ingested a substance in excess of the prescribed or generally recognised therapeutic dose.
- Ingested a recreational or illicit drug that was an act that the person regarded as self-harm.
- Ingested a non-ingestible substance or object.

Meeting the study criteria for self-harm was not dependent on the motives for self-harm other than that the act appeared deliberate. Three independent raters classified reported episodes using standardised criteria (Cohen's Kappa 0.77). In cases where ratings were inconsistent, decisions were made based on majority rating. For those who indicated they had harmed themselves, the questionnaire included a series of questions relating to motives, methods and help-seeking behaviour. Participants also reported the timing of their most recent act of self-harm. Those who had harmed themselves in the past year were included as cases for the calculation of annual incidence rates. Repeat episodes within the past year by the same individual were not included.

Calculation of rates

Rates of suicide and self-harm were calculated based on the number of persons aged 15, 16 or 17 resident in the study region according to the 2006 census. The population aged 15–17 in the region was 25,002, 12,880 boys and 12,122 girls.

Annual rates per 100,000 of suicide and self-harm were calculated for boys and girls aged 15–17. 95 % confidence intervals (CIs) for rates of suicide and self-harm were calculated. Assuming that the number of deaths or persons presenting with deliberate self-harm (x) followed a Poisson distribution, 95 % CIs for the rates were calculated using the Normal approximation, i.e. $\mathrm{CI} = (x \pm 2 \times \sqrt{x}) \times 100{,}000/\text{population}$.

Results

Suicide rates among 15–17 year olds between 1997 and 2011

There were 37 suicide deaths (5 girls and 32 boys) in the 15-year period examined. There was only one undetermined death in this group in the study period, and this has not been included when calculating suicide rates. The average number of cases of suicide in this age group annually in the study region was 2.46. Based on census 2006 population data, the average annual suicide rate in this population was therefore 10.0/100,000 (95 % CI 0–22.39) (Table 1). The rate among boys was 16.5/100,000 (95 % CI 0–38.75) while the rate among girls was 2.7/100,000 (95 % CI 0–12.01). The incidence rate ratio of the male to female rate was 6.1:1.

Rates of hospital-treated self-harm among 15–17-year-old between 2003 and 2011 (National Registry of Deliberate Self-Harm)

In the period from 2003 to 2011, there were 775 index hospital presentations with self-harm among adolescents in this age group in the region, or an average of 86.11 persons annually. Based on the size of the population in this age

Table 1 Annual rates of suicide, hospital-treated self-harm and self-harm in the community among 15–17 years old

	Total		Males		Females		Ratio of male rate to female rate
	Average no. of cases annually	Rate per 100,000 (95 % CI)	Average no of cases annually	Rate per 100,000 (95 % CI)	Average no. of cases annually	Rate per 100,000 (95 % CI)	
Suicide[a]	2.46	10.0 (0–22.39)	2.13	16.5 (0–38.75)	0.33	2.7 (0–12.01)	6.1:1
Hospital-treated self-harm[b]	86.11	344.1 (271.67–417.16)	33.00	256.2 (168.79–343.63)	53.11	438.1 (320.30–555.96)	1:1.7
Self-harm in the community[c]	1,388	5,551 (5259.49–5843.62)	309.1	2,400 (1,703.23–3,131.93)	1,078.9	8,900 (7,523.25–10,252.10)	1:3.7

[a] Average annual figures for deaths by suicide for period 1997–2011 in Cork and Kerry region

[b] Average annual figures for hospital-treated self-harm for period 2003–2011 in Cork and Kerry region

[c] Figures extrapolated from incidence of self-harm in sample of 3,631 adolescents from CASE study, data collected 2003/2004 in Cork and Kerry region

group (25,002), the incidence rate was 344.4/100,000 (95 % CI for rate 271.67–417.16). The male rate was 256.2/100,000 (95 % CI 168.79–343.63) and the female rate was 438.1/100,000 (95 % CI 320.30–555.96). The incidence rate ratio of the male rate to the female rate was 1:1.7.

Rates of self-reported self-harm in the community among 15–17-year-old (CASE study)

Of the 3,631 adolescents surveyed, 8.9 % of girls and 2.4 % of boys reported self-harm in the past year which met study criteria. The rate of self-harm in the past year for both genders was 5,551/100,000 (95 % CI 5259.49–5843.62). The rate among boys was 2,400/100,000 (95 % CI 1,703.23–3,131.93), while the rate for girls was 8,900/100,000 (95 % CI 7,523.25–10,252.10). The incidence rate ratio of the male rate to the female rate was 1:3.7.

Relative incidence of adolescent suicidal behaviours

Based on the incidence rates reported above, the relative frequency of suicide and self-harm was calculated. For every adolescent suicide, approximately 34 adolescents presented to hospital with self-harm, and approximately 555 adolescents reported having harmed themselves. For every male suicide in this age group, 16 boys presented to hospital with self-harm, and approximately 146 boys reported self-harm (Fig. 1). For every female suicide, approximately 162 girls presented to hospital with self-harm, and approximately 3,296 girls reported self-harm. Therefore, only 6 % those who reported episodes of self-harm presented to hospital: 11 % of boys and 5 % of girls.

Methods of suicide and self-harm

Hanging was the suicide method used by over 90 % of males, while overdose was used by 3 of the 5 females who died by suicide, and hanging by the remaining 2 (Table 2). In hospital-treated self-harm, overdose was the most common method, among both males and females. Self-cutting was the next most common method of self-harm among adolescents presenting to hospital. Among adolescents reporting self-harm in the community, self-cutting was the most common method for both genders with overdose the next most common method.

Discussion

We have found that many adolescents report having harmed themselves, with a rate of 5,551 per 100,000 per year, while hospital data show that only 6 % of these result in hospital presentation. Suicide is a rare event in this age group, with an incidence rate of 10/100,000 per year, and is six times more common among males than females in this age group. A novel aspect of this study is that we have reported relative rates of suicide and self-harm in the population examined. We found that for each suicide death, approximately 34 adolescents present to hospital with self-harm and approximately 555 adolescents report having harmed themselves.

Rates of hospital-treated self-harm reported here among girls are lower than those reported in a UK multicentre study. The rate in our study was 438 per 100,000 compared with 1,422 per 100,000 in the UK study [21]. This may be due to the different age profile of participants, as our study did not include 18 year olds, while the UK study included those aged 15–18. Regional differences are often marked,

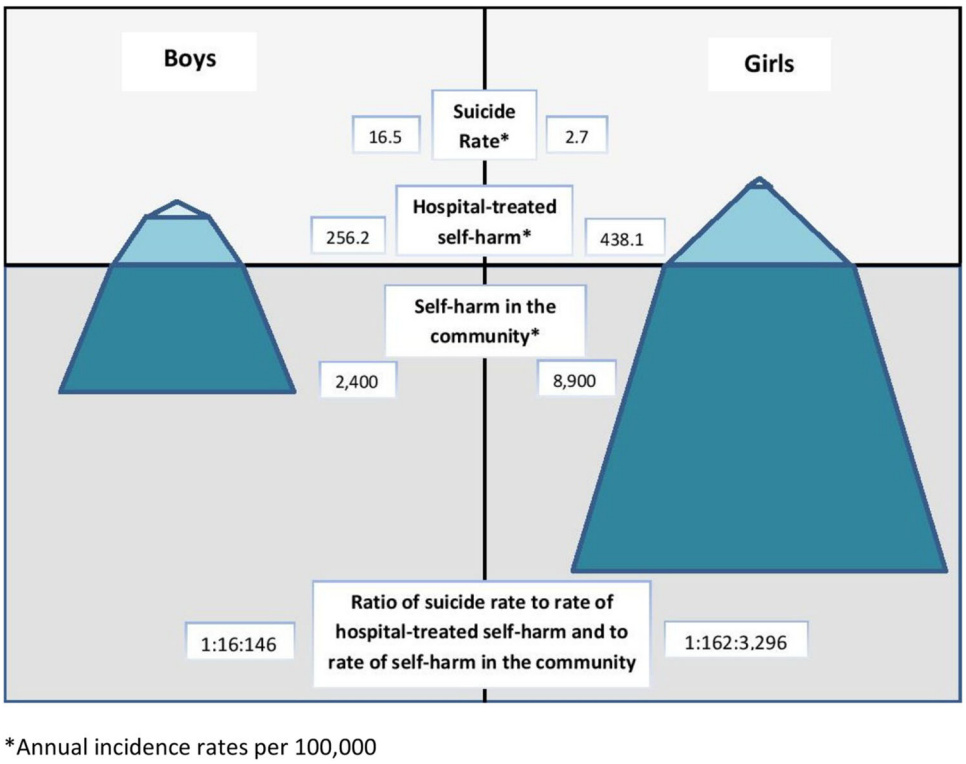

Fig. 1 Relative incidence of suicide, hospital-treated self-harm and self-harm in the community for boys and girls aged 15–17

Table 2 Methods of suicide and self-harm among 15–17 year olds

Methods of suicide/self-harm	Suicides (1997–2011)			Hospital-treated self-harm (2003–2011)			Self-harm in the community (2003/2004)[b]		
	Male ($n = 32$) *n* (%)	Female ($n = 5$) *n* (%)	Total ($n = 37$) *n* (%)	Male ($n = 297$) *n* (%)	Female ($n = 478$) *n* (%)	Total ($n = 775$) *n* (%)	Male ($n = 44$) *n* (%)	Female ($n = 163$) *n* (%)	Total ($n = 207$) *n* (%)
Overdose[a]	1 (3.1)	3 (60)	4 (10.8)	161 (54.2)	348 (72.8)	509 (65.7)	12 (27.3)	43 (26.4)	55 (26.6)
Hanging	29 (90.7)	2 (40)	31 (83.8)	10 (3.4)	8 (1.7)	18 (2.3)	3 (6.8)	1 (0.6)	4 (1.9)
Overdose and self-cutting	0 (0)	0 (0)	0 (0)	8 (2.7)	19 (4.0)	27 (3.5)	2 (4.6)	18 (11.0)	20 (7.3)
Drowning	1 (3.1)	0 (0)	1 (2.7)	7 (2.7)	2 (0.4)	9 (1.2)	0 (0)	0 (0)	0 (0)
Cutting	0 (0)	0 (0)	0 (0)	76 (25.6)	70 (14.6)	146 (18.8)	26 (59.1)	95 (58.3)	121 (58.5)
Other	1 (3.1)	0 (0)	1 (2.7)	35 (11.8)	31 (6.5)	66 (8.5)	5 (11.4)	11 (6.8)	16 (7.7)

[a] Includes overdose of prescription medication, recreational drugs and alcohol

[b] Percentages add up to more than 100 % due to multiple methods of self-harm reported

with higher rates in urban areas. Our study region is predominantly rural and so rates may not be comparable.

Our findings illustrate the gender paradox whereby suicide mortality is generally higher among men than women in Western cultures, despite lower prevalence of non-fatal suicidal behaviour [22]. The ratio of male to female suicide was 6:1 in our study, while hospital-treated self-harm was almost twice as common among girls than boys and self-harm in the community was reported by almost four times as many girls than boys. However, in this study, methods of self-harm used by males and females who presented to hospital were broadly similar, but with a higher preponderance of overdose among females and of self-cutting among males. Previous research has shown that men inflict more severe damage when self-cutting compared to women, which suggests that male self-harm is associated with greater lethality [16].

Our findings also reflect the narrowing gender gap in rates of hospital-treated self-harm, which is a trend that has been noted over the past 10 years, as male rates of self-harm have increased [18]. Since the advent of the economic recession in Ireland, increased rates of both self-

harm and suicide have been observed among men in Ireland and elsewhere [23]. Nonetheless, we have found that very large gender differences remain in rates of self-harm in the community. It has previously been suggested that gender differences in non-fatal suicidal behaviour among adolescents can be explained to a large extent by the gender differences in emotional and behavioural problems during this period [24].

We found that for every adolescent boy who dies by suicide, approximately 16 have presented to hospital with self-harm and 145 report having harmed themselves in the past year. The relatively low prevalence of self-harm among boys, combined with their high rates of suicide, may indicate that the sub-group of boys who have self-harmed is a particularly high-risk group. Most self-harming behaviour in adolescence resolves spontaneously, with continuity of self-harming behaviour higher among girls than boys [25]. However, our findings highlight the elevated risk of suicide in boys who have self-harmed. In a previous analysis of the same study population, we have reported that adolescent boys with a history of self-harm have high levels of impulsivity and anxiety, high rates of drug use, and are more likely to have peers who have also self-harmed [20]. This profile bears a close resemblance to that of young men who die by suicide [26], and therefore the continuum of suicidal behaviours may be particularly apparent among boys. The fact that very high rates of self-harm among girls do not translate to high suicide rates may reflect differing patterns and psychological functions of self-harm, or different levels of acceptance of reporting of self-harm between boys and girls.

We found that hanging was the most common method of suicide, while drug overdose was involved in the majority of deliberate self-harm presentation. We found that cutting was also common, accounting for approximately one-fifth of presentations and over half of self-harm episodes in the community involved self-cutting. High rates of self-cutting are a particular feature of adolescent self-harm [5]. Self-cutting as a method of self-harm in children and adolescents conveys greater risk of suicide (and repetition of self-harm) than self-poisoning although different methods are usually used for suicide [27]. We found gender differences in methods of self-harm to be small.

In a previous study based on the same community sample of adolescents it was reported that only half of those who had harmed themselves had sought help afterwards, with friends and family being the most common sources of help, and only 3.8 % seeking help from their GP and 4.6 % from a psychologist or psychiatrist [14]. This underlines the need for school-based interventions to identify young people at risk and to provide appropriate support and referral where necessary to appropriate services to prevent repeated episodes of self-harm. The very high risk associated with self-harm among boys can inform screening efforts. A recent multicentre study has found some evidence that barriers to seeking help from the family doctor and mental health services could be reduced by providing adolescents with training in awareness of mental health issues [28].

Limitations of this study include the potential unreliability of suicide statistics [29]. It is possible for that there may have been suicide cases which were classified as accidents. Rates of suicide, hospital-treated self-harm and self-harm in the community were calculated based on differing, but overlapping, time periods. This was necessary in order to have a large enough number of cases of suicide and hospital-treated self-harm. However, this may have had an impact on reported rates. A strength of the study is the availability of reliable data on hospital-treated self-harm from the unique National Registry of Deliberate Self-Harm, as well as robust cross-sectional survey data on self-reported self-harm in the community. Data on self-harm in the community were gathered using a rigorous methodology and a large representative sample of adolescents in the region which included almost one tenth of the target population in the region.

The vast majority of adolescent self-harm remains unidentified by health services, underlining the need for interventions to promote awareness of mental health problems and help-seeking in this group, and to reduce repetition of self-harm and rates of suicide. Gender differences in relative rates of self-harm and suicide are very large, with boys who have harmed themselves appearing to be at particularly high risk of suicide, while suicide among adolescent girls remains rare despite high rates of self-harm. Knowledge of the relative incidence of self-harm and suicide in adolescents can inform the development of appropriate prevention programmes and services.

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Conflict of interest On behalf of all authors, the corresponding author confirms that there are no conflicts of interest.

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