Research paper

Advancing early detection of suicide? A national study examining socio-demographic factors, antecedent stressors and long-term history of self-harm

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ABSTRACT

Background: A range of factors including mental disorders, adverse events and history of self-harm are associated with suicide risk. Further examination is needed of the characteristics of suicides which occur without established risk factors, using national surveillance systems.
Methods: Data on all suicides in Ireland from 2015 to 2017 were drawn from the Irish Probable Suicide Deaths Study (IPSDS). Variables examined included socio-demographics, psychiatric history and precipitant stressors. Suicide data were linked with data on prior self-harm from the National Self-Harm Registry Ireland (NSHRI). Latent Class Analysis (LCA) was used to identify sub-groups of suicide cases.
Results: Of the 1809 individuals who died by suicide, 401 (22.2 %) had a history of hospital-treated self-harm. Four distinct profiles of suicides were identified. One group was marked by high levels of prior self-harm and mental health conditions. Two of the groups included few individuals with a history of self-harm but had notably high levels of mental health conditions. These two groups had relatively high levels of reported chronic pain or illness but differed in terms of socio-demographics. The final group, predominantly male, had markedly low levels of mental health conditions or self-harm but high levels of personal stressors and substance use.
Limitations: The use of coronial data may be limited by bias in the collecting of information from the deceased's family members.
Conclusions: A sub-group of suicide cases exists without any psychiatric or self-harm history but with salient occupational or health-related proximal stressors. Suicide prevention interventions should include occupational settings and should promote mental health literacy.

1. Introduction

Suicide is a major global health concern, with over 700,000 people around the world dying by suicide every year (WHO, 2021). The causes of suicide are complex, encompassing individual factors such as genetic influences and mental disorders, contextual factors such as family influences, history of abuse, socioeconomic conditions, exposure to suicidal behaviour by others, access to means for a suicidal act and lack of support in a crisis (Hawton and Pirkis, 2017). Self-harm is associated with a significant risk of subsequent death through suicide (Hawton et al., 2015; Vuagnat et al., 2019). Risk of suicide among individuals in the year after a suicide attempt has been estimated to be up to 100 times higher than matched community controls (Tidemalm et al., 2015), while

a meta-analysis of psychological autopsy studies reported that self-harm history was associated with a ten-fold increase in suicide risk (Favril et al., 2022). A recent national Irish study reported one-year risk of suicide following an episode of hospital-treated self-harm to be 0.8 % (Griffin et al., 2023).

Psychological autopsy studies which deploy a systematic methodology to enhance understanding of the psychological and contextual circumstances preceding suicide can inform understanding about risk and protective factors for suicide (Favril et al., 2022). A recent Irish psychological autopsy study of 132 consecutive cases of suicide found that half of those who died by suicide had no history of self-harm of which their GP was aware (McMahon et al., 2022). In a UK case series examining 544 suicide deaths of young people aged 10–19 years, it was

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reported that, based on coroner records, 30 % had no history of self-harm and had given no indication of suicidal intent (Rodway et al., 2020). This sub-group had lower rates of risk factors and were less likely to have been in contact with services, compared to other young people who died by suicide. A Korean psychological autopsy study including 5228 suicide cases found that 60.2 % had no prior recorded suicide attempt (Yook et al., 2022). Those who were male, older than 65, employed, and married/widowed were less likely to have a history of prior attempts. Those without a history of suicide attempt were also less likely to have been diagnosed with psychiatric disorders. An Australian study which involved an examination of coroner records identified four clusters of people who had died by suicide. In two of those clusters mental illness appeared to be a significant factor; in one of those two clusters the mental illness was compounded by additional drug and alcohol and relationship problems whilst the other was without such levels of comorbidity. The third group was predominantly male, older and with physical illness as a significant factor. The final group was characterised by low rates of mental illness, but marked by relationship and financial difficulties (Judd et al., 2012). Favril and colleagues examined forty risk factors for suicide and found the largest associations for mental disorders and history of self-harm, with smaller effect sizes for socio-demographic factors, family history and adverse events. In the pooled sample 28.5 % of those who died by suicide had a prior suicide attempt (Favril et al., 2022).

Potential issues with the reliability of the information obtained from various sources within the psychological autopsy methodology mean that studies utilising health service records of self-harm presentations are needed. Due to the lack of national recording systems for self-harm in many countries, few national studies have been carried out examining history of hospital-treated self-harm prior to suicide. In some Nordic countries, however, the ability to link complete nationwide registers of socio-demographic, health-related, and cause of death data provide detailed data sets and large sample sizes required for robust studies of associations between suicide and prior self-harm (Nordentoft, 2007). Studies which have linked complete registers of health and mortality data in order to examine suicide have rarely retrospectively examined a complete national cohort of suicide deaths to identify individuals with and without prior self-harm. In Ireland, the National Self-Harm Registry Ireland (NSHRI) records all self-harm presentations to emergency departments in Ireland, and is the world's first national self-harm registry (Perry et al., 2012).

Further examination is needed of the proportion and characteristics of suicides which occur without prior self-harm or other established risk factors, in order to inform appropriate interventions. The objectives of this study were to identify clinical and demographic risk profiles of a national cohort of suicide cases through examination of psycho-social, mental health and antecedent stressor factors, as well as long-term history of hospital-treated self-harm.

2. Methods

2.1. Setting and sample

2.1.1. Suicide data

Data on suicides that occurred between 1st January 2015 and 31st December 2017 were obtained from the Irish Probable Suicide Deaths Study (IPSDS) (Cox et al., 2022). This study gathers data from closed coronial files in all coroner districts in Ireland. The data were collected by researchers from the Health Research Board (HRB), using the methodology of the National Drug-Related Deaths Index (NDRDI) (Lynn et al., 2009).

Criteria for inclusion of a death in the study are based on coroners' verdicts and expert consensus concerning the identification of probable suicides through coroners' records. Specifically, the IPSDS includes deaths based on the following criteria: where there was a verdict of suicide (within the Irish system this is based on the death being

considered suicide beyond reasonable doubt); or where the death was in line with the Rosenberg criteria of suicide, on the balance of probabilities (Rosenberg et al., 1988); or where multiple risk factors for suicide were present (Kielty et al., 2015). Researchers visited all coroners' districts throughout Ireland and examined coronial files in their entirety, identified 'probable suicide' deaths and extracted relevant information. The coronial files contain all relevant documentation furnished to, and compiled by, the coroner as part of the death-investigation process. The following variables from the IPSDS were obtained for the current study: age, sex, marital status, living arrangements, employment status, method of suicide and whether a suicide note had been left, any noted history of a mental health condition, alcohol dependency or drug dependency. In addition, any events that may have affected the deceased's emotional state in the period prior to suicide were noted and were subsequently categorised as follows: current mental health symptoms; relationship difficulties; physical illness or pain; bereavement (including through suicide); employment or school problems; legal difficulties; financial difficulties; abuse; bullying/humiliation; and housing issues.

2.1.2. Hospital-treated self-harm data

We identified individuals who had presented to hospital following self-harm via the NSHRI between 1st January 2007 and 31st December 2017. The Registry defines self-harm as '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' (Schmidtke et al., 1996). Data on self-harm are collected by dedicated data registration officers that operate independently of the hospitals with a standardised application of case definition and inclusion/exclusion criteria (Joyce et al., 2022).

2.1.3. Data linkage

To identify history of hospital-presenting self-harm, data from the NSHRI and data from the IPSDS were electronically linked. In lieu of a national unique health identifier, the NSRHI generates a unique identifier for each presentation recorded, using a combination of selected letters from the person's name, sex and date of birth. The software used to generate this identifier was used to generate identifiers for cases in the IPSDS, by the researchers who had access to necessary information from the records. Self-harm and suicide records with identical codes were matched (deterministic matching).

2.2. Statistical analyses

Descriptive statistics were produced, including number and valid percentages for categories. Chi-squared tests were used to examine associations between all categorical variables and history of hospital-presenting self-harm. Logistic regression was used to examine factors associated with history of self-harm separately by sex, reporting odds ratios and 95 % confidence intervals. Variables included in the regression were: age group; living arrangements; employment; mental health condition; history of alcohol dependence; history of drug dependence; relationship difficulties; employment/school issues; financial difficulties; chronic pain/illness; bereavement/experience of suicidal behaviour of others; victim of abuse; current mental health symptoms. Variables associated with self-harm history in crude analyses at the significance level of $p < 0.2$ were included in the fully adjusted regression model.

2.2.1. Latent Class Analysis

Latent Class Analysis (LCA) was performed to discriminate homogeneous sub-groups of people who died by suicide based on the following 13 dichotomous indicator variables: single/divorced/separated or widowed relationship status, living alone, unemployed,

Table 1
Characteristics of suicide cases with and without a previous self-harm history.

	All	Previous self-harm history		*p* value
		No	Yes	
	n (%)	n (%)	n (%)	
Sex				
Male	1390 (76.8)	1120 (79.6)	270 (67.3)	
Female	419 (23.2)	288 (20.5)	131 (32.7)	<0.001
Age				
10–17 years	56 (3.1)	50 (3.6)	6 (1.5)	
18–24 years	172 (9.5)	131 (9.3)	41 (10.2)	
25–34 years	323 (17.9)	236 (16.8)	87 (21.7)	
35–44 years	411 (22.7)	300 (21.3)	111 (27.7)	
45–54 years	375 (20.7)	286 (20.3)	89 (22.2)	
55–64 years	283 (15.6)	236 (16.8)	47 (11.7)	
65+ years	189 (10.5)	169 (12.0)	20 (5.0)	<0.001
Marital status				
Married/civil/co-habiting	627 (35.9)	516 (37.8)	111 (28.9)	
Single	923 (52.8)	698 (51.1)	225 (58.6)	
Separated/divorced/widowed	199 (11.4)	151 (11.1)	48 (12.5)	0.006
Living arrangements				
Partner and/or children	520 (32.6)	434 (24.1)	86 (33.7)	
Family of origin	510 (31.0)	412 (27.5)	98 (32.0)	
Alone	459 (27.9)	333 (35.3)	126 (25.8)	
Other shared	70 (4.3)	56 (3.9)	14 (4.3)	
Institution/halfway house/homeless	47 (2.9)	23 (6.7)	24 (1.8)	
Other	40 (2.4)	31 (2.5)	9 (2.4)	<0.001
Employment				
Employed	585 (38.3)	497 (41.6)	88 (26.3)	
Unemployed	490 (32.1)	324 (27.1)	166 (49.6)	
Trainee/student	142 (9.3)	124 (10.4)	18 (5.4)	
Homemaker	64 (4.2)	45 (3.8)	19 (5.7)	
Retired/unable to work/other	248 (16.2)	204 (17.1)	44 (13.1)	<0.001
History of mental health condition				
Yes	1181 (65.3)	845 (60.0)	336 (83.8)	
No	628 (34.7)	563 (40.0)	65 (16.2)	<0.001
History of drug dependence				
No	1337 (73.9)	1093 (77.6)	244 (60.9)	<0.001
Yes	472 (26.1)	315 (22.4)	157 (39.2)	
History of alcohol dependence				
No	1494 (82.6)	1216 (86.4)	278 (69.3)	
Yes	315 (17.4)	192 (13.4)	102 (30.7)	<0.001
Suicide note				
Yes	542 (49.3)	418 (48.2)	124 (53.7)	
No	557 (50.7)	450 (51.8)	107 (46.3)	0.136
Suicide method				
Poisoning	211 (11.7)	166 (11.8)	45 (11.2)	
Hanging	1103 (61.0)	883 (62.7)	220 (54.9)	
Shooting	69 (3.8)	66 (4.7)	3 (0.8)	
Drowning	249 (13.8)	157 (11.2)	92 (22.9)	
Other	177 (9.8)	136 (9.7)	41 (10.2)	<0.001

previous self-harm, mental health condition, history of drug dependence, history of alcohol dependence, chronic pain/illness, employment/school problems, financial concerns, legal or criminal issues, experience of bereavement or suicidal behaviour of others and victim of abuse. Models with two to five classes were run, adding classes incrementally in each subsequent model. Both statistical and clinical considerations informed the identification of the number of classes that best described the heterogeneity within the data. The fit indices used to evaluate the class solutions were the Lo-Mendell-Rubin (LMR) Likelihood Ratio test, the Akaike Information Criterion (AIC), and the Bayesian Information Criterion (BIC), with lower values representing more optimal model fit. The accuracy of the groups from a clinical and theoretical perspective was informed by examining the endorsement probabilities of the items. Entropy was also used to examine the accuracy of the model classification, with values closer to one reflecting better classification. After the enumeration of the classes, the classes were presented descriptively in relation to age, sex and method of suicide.

All analyses were carried out using Stata version 17.

2.3. Ethical approval

This study has received ethical approval from the Clinical Research Ethics Committee of the Cork Teaching Hospitals (reference number ECM 4 (f) 13/08/19). Ethical approval for the NSHRI has been granted by the National Research Ethics Committee of the Faculty of Public Health Medicine and from individual hospital or regional health committees. The NSHRI has received a waiver of consent by the Irish Health Research Consent Declaration Committee. Ethical approval for the IPSDS was granted by the Ethics Committee of the Irish College of General Practitioners (ICGP).

3. Results

3.1. Characteristics of suicide cases

During the study period from January 2015 to December 2017, 1809 suicides were recorded: 1390 males (76.8 %) and 419 (23.2 %) females, with a median age of 43 (inter-quartile range for age: 23) (Table 1). Over half of suicides were in single people (*n* = 923; 52.8 %), while over a

Table 2
Stressors prior to suicide among those with and without a previous self-harm history.

	All	Previous self-harm history		
		No	Yes	*p*-Value
Current mental health symptoms	589 (32.6)	432 (30.7)	157 (39.2)	0.001
Relationship difficulties	466 (25.8)	347 (24.5)	119 (30.0)	0.042
Experience of physical illness/pain	291 (16.1)	237 (16.8)	54 (13.5)	0.106
Bereavement (including through suicide)	225 (12.4)	164 (11.7)	61 (15.2)	0.056
Employment/school problems	181 (10.1)	155 (11.0)	26 (6.5)	0.008
Legal/criminal issues	131 (7.2)	97 (6.9)	34 (8.5)	0.279
Financial difficulties	112 (6.2)	95 (6.8)	17 (4.2)	0.066
Abuse	57 (3.2)	33 (2.3)	24 (6.0)	<0.001
Bullying/humiliation	26 (1.4)	19 (1.4)	7 (1.8)	0.556
Housing issues	21 (1.2)	14 (1.0)	7 (1.8)	0.215
Number of adverse events reported				
Zero	520 (28.8)	417 (29.6)	103 (25.7)	
One	664 (36.7)	531 (37.7)	133 (33.2)	
2 or more	625 (34.6)	460 (32.7)	165 (41.2)	0.007

third were married or co-habiting with a partner (*n* = 627; 35.9 %), and 199 (11.4 %) were divorced or widowed. The most common living arrangement was with partner and/or children (520; 32.6 %), followed by living with family of origin (510; 31.0 %), and living alone (459; 27.9 %). Over one third of suicide deaths were in individuals who were employed at the time of death (585; 38.3 %), while 490 (32.1 %) were unemployed and 248 (16.2 %) were retired or unable to work. Almost two thirds of those who died by suicide had a history of a mental health condition (*n* = 1181; 65.3 %). There was a history of drug dependence in 472 cases (26.1 %), and a history of alcohol dependence in 315 cases (17.4 %). The most common suicide method was hanging (61 % of cases), followed by drowning (13.8 %) and intentional drug overdose/ ingestion of chemical substances (11.7 %). Just under half had left a suicide note (542; 49.3 %).

3.2. Comparison of suicide cases with and without a history of hospital-treated self-harm

Examination of National Self-Harm Registry Ireland data identified 127,436 presentations to hospital following self-harm in the period from 1st January 2007 and 31st December 2017. Data linkage of the suicide cohort with the Registry identified 401 individuals (22.2 % of the suicide cases) who had presented to hospital with non-fatal self-harm prior to suicide. There were significant differences between cases with and without a history of hospital-treated self-harm in terms of many demographic, mental health and suicide-related factors examined (Table 1). Those with a history of self-harm were more likely to be female (32.7 % of those with prior self-harm compared with 20.5 % of those without; *p* < 0.001). Those aged 25–34, 35–44 and 45–54 were more likely to have a history of self-harm than the younger and older age groups (*p* < 0.001). Those with a history of self-harm were more likely to be single and less likely to be married or co-habiting than those without prior self-harm. A higher proportion of those with a history of self-harm were reported as living with partner and/or children or living with their family of origin, while a lower proportion was living alone (p < 0.001). A higher proportion of those with a history of self-harm had a known mental health condition (83.8 % compared with 60 % of those with no self-harm history; p < 0.001), and they were also more likely to have a history of drug dependence (39.2 % of those with self-harm history, 22.4 % of those without; p < 0.001) or alcohol dependence (30.7 % vs 13.4 %; p < 0.001). There was no significant difference between the groups in terms of the proportion who left a suicide note. A lower proportion of those with a history of self-harm died by hanging (54.9 % vs 62.7 %), while a higher proportion died by drowning (22.9 % vs 11.2 %; *P* < 0.001).

3.3. Stressors prior to suicide

A range of potential stressors preceding suicide which were recorded in coroner files was examined (Table 2). The most frequently reported stressors prior to suicide were current mental health symptoms (589; 32.6 %), relationship difficulties (466; 25.8 %) and physical illness or pain (291, 16.1 %). A higher proportion of those with a history of self-harm had current mental health symptoms (*p* = 0.001) and relationship difficulties (*p* = 0.042), as well as a higher proportion having a history of abuse (*p* < 0.001), while work or employment difficulties were less likely among those with a history of self-harm than those without (*p* = 0.008).

3.4. Factors associated with history of self-harm prior to suicide: logistic regression

Factors potentially associated with history of self-harm from socio-demographic, mental health, suicide-related and antecedent stressor domains were examined separately for males and females using logistic regression. The factors associated with history of self-harm among males were living alone (OR 1.89; CI 1.03–3.44) or in an institution/homeless (OR 3.34; CI 1.22–9.05), being unemployed (OR 1.81; CI 1.21–2.71) having a mental health condition (OR 2.98; CI 1.9–4.69), alcohol dependence (OR 2.34: CI 1.56–3.51). Several stressors were associated with lower odds of self-harm history among males, including employment or school difficulties (OR 0.49; CI 0.26–0.93); financial difficulties (OR 0.40; CI 0.18–0.89) and physical illness or pain (OR 0.34; CI 0.19–0.63). Among females, factors associated with history of self-harm were being aged between 25 and 44 (OR 2.21; CI 1.01–4.85); being a homemaker (OR 3.15; CI 1.22–8.90); having a mental health condition (OR 3.76; CI 1.38–10.31) and drug dependence (OR 2.53; CI1.25–5.09).

3.5. Characteristics of prior hospital-treated self-harm

Of the cohort of suicide cases, 401 (22.2 %) had a history of hospital-treated self-harm recorded between 2007 and 2017. Half of those with a history of self-harm had one hospital attendance with self-harm (*n* = 201, 50.1 %), while 68 had presented twice (17 %), 48 (12 %) had 3 presentations and the remainder (75; 18.7 %) had between 4 and 51 presentations. The median time between self-harm presentation and death was 349 days. Following hospital presentation with their most recent self-harm episode, 162 (40 %) were not admitted, 136 (33.9 %) were admitted to a general ward, 58 (14.5 %) were admitted to a psychiatric ward, 40 (10 %) left without being seen, and 5 (1.2 %) refused to be admitted. Of those for whom data were available, 197 (68 %) had a psychiatric review or assessment.

Table 3
Latent class analysis of suicide cohort based on self-harm history, psycho-social factors and antecedent stressors.

	Class 1: Poor mental health but low levels of self-harm; pain or physical illness; employment/school difficulties n = 499 (27.6 %)	Class 2: Poor mental health but low levels of self-harm; single; living alone n = 671 (37.1 %)	Class 3: High Risk Prior self-harm; mental disorders; alcohol/drug dependency, unemployment and relationship difficulties n = 381 (21.1 %)	Class 4: "Hidden" Risk Very low levels of self-harm and mental health conditions; high levels of personal stressors n = 258 (14.3 %)
Indicator variables	**Probability estimates for individual characteristics by latent class**			
Previous self-harm history	0.127	0.170	0.510	0.082
Single relationship status (inc widowed, divorced)	0.000	1.000	0.702	0.679
Living alone	0.069	0.480	0.296	0.061
Unemployed	0.093	0.244	0.527	0.232
History of mental health condition	0.648	0.670	0.945	0.278
History of drug dependency	0.028	0.105	0.622	0.383
History of alcohol dependency	0.096	0.104	0.443	0.067
Relationship difficulties	0.137	0.099	0.442	0.455
Employment/school problems	0.141	0.060	0.096	0.121
Financial difficulties	0.050	0.028	0.088	0.101
Pain or physical illness	0.226	0.162	0.188	0.042
Bereavement/exposure to suicidal behaviour	0.074	0.102	0.236	0.091
Victim of abuse	0.016	0.000	0.100	0.020
Legal/criminal issues	0.026	0.028	0.132	0.135
Characteristics of classes	**n (%)**	**n (%)**	**n (%)**	**n (%)**
Male sex, n (%)	52 (78.8)	60 (58.3)	135 (65.2)	23 (92.0)
Age				
10–24 years	8 (1.6)	95 (14.2)	48 (12.6)	77 (29.8)
25–44 years	143 (28.7)	246 (36.7)	203 (53.3)	142 (55.0)
45–64 years	255 (51.1)	244 (36.4)	122 (32.0)	37 (14.3)
65+ years	93 (18.6)	86 (12.8)	8 (2.1)	2 (0.8)
Suicide method				
Drowning	73 (14.6)	84 (12.5)	40 (10.5)	14 (5.4)
Hanging	292 (58.5)	384 (57.2)	221 (58.0)	206 (79.8)
Shooting	28 (5.6)	29 (4.3)	4 (1.1)	8 (3.1)
Poisoning	57 (11.4)	103 (15.4)	75 (19.7)	14 (5.4)
Other	49 (9.8)	71 (10.6)	41 (10.8)	16 (6.2)

3.6. Latent Class Analysis

LCA identified four distinct classes within the suicide cohort (Table 3). Fit indices are presented in the Supplementary Table. The four-class model had lower AIC, BIC, and LMR likelihood ratio test statistics compared with the two and three class models. Compared to the five-class model, the BIC was lower and the entropy was closer to one for the four-class model. Whilst the AIC and likelihood ratio statistics were lower for the five compared to the four-class model, the differences were small and the four-class model was considered to present the data in the most clinically meaningful way.

Group 1: Poor mental health but low levels of self-harm; pain or physical illness; employment/school difficulties.
Group2: Poor mental health but low levels of self-harm; single; living alone.

In groups 1 and 2 a high proportion had a history of a mental health condition (65 %+); however few had self-harm history (12.7 % and 17.0 %, respectively) (Table 3). These two groups were the largest with 27.6 % of cases in Group 1 and 37.1 % in Group 2. Relationship status and living circumstances were the main characteristics that differentiated the two groups; nobody in group 1 had a single (including separated, widowed or divorced) relationship status and few lived alone (6.9 %), in contrast to group 2, with all having a single relationship status and a high proportion living alone (48.0 %). Males were over-represented in group 1 (78.8 %), while group 2 had the highest proportion of females across all groups (41.7 %). Employment or school problems and chronic pain or illness were factors most common for group 2, compared to all other groups.

Group 3: High Risk (prior self-harm; mental health conditions; alcohol/drug dependence, unemployment and relationship difficulties)

This group included 21.1 % of the suicide cases. Over half of this group had a previous history of self-harm and almost all (94.5 %) had a history of a mental health condition. This group are also characterised by single relationship status (70.2 %), history of drug dependence (62.2 %), unemployment (52.7 %), alcohol dependence (44.3 %) and relationship difficulties (44.2 %). It is also the group most likely to have experienced bereavement or exposure to suicidal behaviour (23.6 %) and to have been a victim of abuse (10 %). The age profile of this group was younger compared to the overall sample.

Group 4: "Hidden" Risk (Very low levels of self-harm and mental health conditions; high levels of stressors)

Group 4 was the smallest group (14.3 % of cases) and was characterised by low proportions of self-harm and mental health history, and a high degree of single, separated, divorced or widowed relationship status (67.9 %) and relationship difficulties (45.5 %). Other characteristics of this group include history of drug dependency (38.3 %), legal issues (13.5 %), and employment or school problems (12.1 %). >90 % of this group were male, the age profile was younger (84.8 % aged under 45 years) and 79.8 % died by hanging.

4. Discussion

In this national retrospective study, we have used coronial records to identify socio-demographic and clinical characteristics of those who died by suicide, as well as using data linkage with a national self-harm surveillance system to identify prior history of hospital-treated self-harm in the cohort. Prior history of self-harm was identified in 22.2 % of those who died by suicide, with females, those with a mental disorder and those with a history of drug or alcohol dependence more likely to have had prior self-harm presentations. Latent class analysis revealed four distinct profiles of suicide cases. High proportions of individuals with a mental health condition but low prior self-harm were characteristic of two of the groups. The third group was comprised of those with high levels of a range of established risk factors, and commonly prior self-harm. The final group was typically male and often without clear indicators of risk or psychiatric history, but with high levels of stressors and adverse events.

The characteristics of the study cohort of suicide cases were similar to previous studies internationally (Favril et al., 2022; Kõlves et al., 2015; Richardson et al., 2021). Just over three quarters were male and highest proportions of the sample were in the middle-aged groups. Over half had died by hanging. The suicide cohort involved high proportions who were single, unemployed and living alone. Almost two thirds had a history of a mental health condition, which is higher than reported in a large-scale US study (Stone et al., 2018). Those individuals with a history of hospital-treated self-harm were more likely to be female, to be single, unemployed, and to have a history of alcohol or drug dependence or a psychiatric diagnosis, when compared to those without. These differing profiles of those with and without a history of self-harm mirror previous studies internationally (Rodway et al., 2020; Yook et al., 2022).

Self-harm has been identified as the strongest risk factor for suicide, with risk of suicide among those with recent self-harm >80 times higher than in the general population (Griffin et al., 2023). Nonetheless, in almost four out of five suicide cases examined the individual had no history of hospital-treated self-harm. This figure is higher than reported in other studies internationally, but this may reflect different methodologies used, including different indicators of risk or a broader definition of prior self-harm (Rodway et al., 2020; Yook et al., 2022). Where prior suicide attempt was assessed, similar findings have been reported (Judd et al., 2012).

The four classes of individuals who died by suicide identified using latent class analysis illustrate the diversity within this cohort and highlight opportunities for suicide prevention efforts. Two of the four groups (Group 1 and Group 2) had high levels of mental health conditions but low levels of prior hospital-treated self-harm. These individuals may have had prior self-harm that didn't result in hospital presentation. A previous Irish study reported that in 50 % of suicides examined, the person had a history of self-harm that their GP was aware of (McMahon et al., 2022), and in many cases self-harm doesn't come to the attention of any services (McMahon et al., 2014).

The overall suicide cohort, and in particular Group 3, was marked by high levels of alcohol and drug dependence, as reported in coronial files. Previous research has reported that, among suicide attempters with mood disorders, a history of substance use disorder was associated with more frequent and more lethal suicide attempts (Rizk et al., 2021). This is supported by the latent class analysis reported here, where one subgroup was marked by very high levels of concomitant mental health conditions, prior self-harm and history of alcohol or substance dependence.

More unexpected was the group we have identified (Group 4), representing one in seven suicides, in which the vast majority were males with no history of hospital-treated self-harm. The individuals in this group did not have clear indicators of risk, but were marked by high levels of stressors and adverse events. A much lower proportion of this group had a mental health condition than in the overall sample (less than one third). Two thirds were single, divorced or separated and just

under half had relationship difficulties prior to suicide. It may be the case that unidentified and untreated depression (and other mental disorders) may have contributed to some suicides, highlighting the important role of primary care professionals in diagnosing and treating such disorders. A recent review has reported evidence that training primary care doctors in depression recognition and treatment prevents suicide (Mann et al., 2021).

Our finding that one third of suicide cases did not have a diagnosed mental health condition is similar to the findings of Milner et al.'s international review (Milner et al., 2013), and also highlights the importance of the inclusion of antecedent stressors from relationship, occupational and other domains in studies of this kind. Assessment of a wide range of factors provides valuable information on these suicides which are often described as completely unexpected. Mainly young and male, Group 4 in our study reflects the population targeted by mental health campaigns aiming to prevent suicides often seen as occurring "out of the blue". In a previous psychological autopsy study which estimated the population attributable fraction for clinical and social risk factors for suicide, adverse life events were responsible for the largest proportion of suicide deaths, followed by mental disorders, sexual abuse, and social isolation (Arafat et al., 2021). While Favril and colleagues reported smaller effect sizes for adverse events and stressors than for clinical factors, adverse events in the month prior to suicide were associated with a ten-fold increase in risk, with relationship, family and legal issues showing strongest associations (Favril et al., 2022). In a Northern Ireland study of coroner's records, suicides which occurred with no prior primary care consultation were primarily linked to relationship breakdown and job loss (Mallon et al., 2019). While this group represents a minority of suicide deaths, these findings underline the need for universal interventions including in the workplace (Greiner and Arensman, 2022). Important elements for consideration in the design of suicide prevention strategies targeting men outside of clinical and mental health domains include receiving support from a trusted and respected individual in an informal setting; connecting with others; reframing help-seeking as masculine; and the use of emotional regulation techniques (Struszczyk et al., 2019).

4.1. Strengths and limitations

A strength of this study is the robust methodology of the IPSDS, which had complete national coverage of coronial data on probable suicides within the 3-year study period from 2015 to 2017. The use of data linkage to the National Self-Harm Registry, a national system for the monitoring of hospital-treated self-harm, allowed for long-term review of history of self-harm up to 10 years prior to death. This allows for an examination of prior self-harm history without the risk of bias involved in other methodologies including psychological autopsy.

However, the use of coronial data may be limited by the tendency of family members of the deceased to disproportionately recall adverse events that might help them to make sense of the suicide, or to minimise indicators of risk which could have prompted intervention. The deterministic record linkage methodology used in this study requires matching variables to agree exactly across record pairs in order to be considered a match, therefore any coding errors in the matching variables may result in some true matches being missed. Unique identifiers were unavailable for this study; therefore, the data may have included missing information or data entry errors.

Notwithstanding these limitations, this novel examination of a large national cohort of suicide cases has allowed for the identification distinct profiles of suicide cases using data from socio-demographic and clinical domains.

5. Conclusion

The majority of suicides occurred in individuals with no prior history of hospital-treated self-harm. Those who had previously presented to

hospital had higher levels of known risk factors from socio-demographic and psychiatric domains. Among males in particular, a sub-group was identified without any psychiatric history and low levels of known risk factors, but with salient occupational or health-related proximal stressors. Suicide prevention interventions should include occupational settings as well as promoting support for those with chronic physical health conditions.

While mental illness remains a major risk factor, these findings suggest that emphasis needs to be placed on the broader psychosocial issues which may influence the pathway to suicide. In addition, it may be that the relative contribution of mental health conditions and other factors is fluid in relation to both life stage and life circumstances.

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CRediT authorship contribution statement

E.M. McMahon: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Writing – original draft, Writing – review & editing. **G. Cully:** Data curation, Formal analysis, Writing – original draft, Writing – review & editing. **P. Corcoran:** Conceptualization, Formal analysis, Investigation, Methodology, Writing – review & editing. **E. Arensman:** Conceptualization, Investigation, Supervision, Writing – review & editing. **E. Griffin:** Conceptualization, Data curation, Investigation, Methodology, Writing – original draft, Writing – review & editing.

Declaration of competing interest

All authors: declaration of interests: None.

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