



# Psychiatric disorders among adult deliberate self-harm patients and subsequent risk of dying by suicide, mental and behavioural disorders and other external causes

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## ABSTRACT

**Introduction:** Deliberate self-harm (DSH) treated in general hospital is a well-established risk factor for suicide and other cause mortality. However, few studies have used population data to investigate the differential impact of specific psychiatric disorders on the risk of subsequent suicide, by sex and age of the patient in the context of previous DSH episodes.

**Method:** All patients aged 18 and older treated for DSH in general hospitals during the period 2008–2018 were identified through national registers. Cox proportional hazards regression was used to ascertain the associated risk of death by suicide, mental and behavioural disorder and other external causes.

**Results:** The cohort consisted of 39 479 patients of which 878 died by suicide, 461 by mental and behavioural disorders and 1037 by other external causes. Overall, schizophrenia spectrum disorders, affective disorders and personality disorders increased the risk of suicide. Large gender and age differences were identified in the risk of suicide associated with personality disorders and affective disorders. Alcohol use disorders and dementia increased the risk of dying by mental and behavioural disorders and alcohol use disorders and other substance use disorders increased the risk of death by external causes.

**Conclusion:** Schizophrenia spectrum disorders, affective disorders and personality disorders increased the risk of suicide among DSH patients, but the effect varied by gender, age and history of previous DSH. Psychiatric evaluation of all DSH patients and treatment tailored to the patient's specific needs is essential to reduce the risk of premature death.

## 1. Introduction

Individuals who have received treatment at general hospitals for deliberate self-harm (DSH) and repetition of such behaviour have a strongly increased mortality from suicide as well as other causes (Christiansen and Jensen, 2007). According to the literature, the suicide risk is significantly increased among DSH patients of all ages, with the highest risk seen among the middle-aged and the elderly (Qin et al., 2022; Troya et al., 2019). Other risk factors include male gender and having used DSH methods other than poisoning (Carroll et al., 2014). Individuals referred to or already attending psychiatric treatment at the time of DSH, have an increased risk of suicide (Qin et al., 2022). Bipolar disorder, depressive disorders and schizophrenia spectrum disorders are

associated with death by suicide among DSH patients (Runeson et al., 2016; Tidemalm et al., 2008). However, more longitudinal analyses of this patient population are needed to examine age and gender specific differences in the impact of various psychiatric disorders on the subsequent risk of cause specific mortality.

DSH repetition is common and can further increase the suicide risk in this population. According to a systematic review of studies on deliberate self-harm, approximately 17% will repeat within one year and 24% within three years (Liu et al., 2020). One study found an increased risk of suicide among individuals with multiple DSH episodes diagnosed with alcohol or substance use disorder (Carter et al., 2005). Apart from this study, the impact of specific psychiatric disorders on suicide risk in individuals treated for DSH in general hospitals, taking into account

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history of DSH episodes has been sparingly researched. To enable provision of treatment tailored to each patient's needs and risk profile, knowledge of the impact of specific psychiatric disorders on the risk of mortality by gender and age of the patients and in the context of their DSH history would be particularly useful. In this study based on national register data, we investigate the impact of specific psychiatric disorders on the risk of death by suicide and other external causes as well as death by mental and behavioural disorders in a cohort of adults treated for DSH in general hospitals, taking into account the gender and age of the patients and the number of previous DSH episodes.

## 2. Method

### 2.1. Data source

The study was based on data from four Norwegian longitudinal registers that were interlinked on an individual level via the encrypted personal identifier of all residents in Norway. The Central Population Register, administered by the Norwegian Tax Administration, computerized since 1964, contains demographic data such as country of birth, citizenship, gender and date of birth (SSB, 2023a). The Statistics Norway's Events Database (FD-Trygd) administered by Statistics Norway (SSB), established in 1992, contains socioeconomic data such as place of residence, marital status, income and educational attainment (SSB, 2023b). The Norwegian Patient Register (NPR), administered by the Directorate of Health, has been computerized with data on an individual level since 2008 and provides a wide range of patient related information on hospital treatment (Helsedirektoratet, 2023). Psychiatric diagnoses are provided coded according to ICD-10 (International Classification of Diseases, tenth revision). Lastly, the Cause of Death register records date and cause of death and has been computerized since 1969 (FHI, 2023). The cause of death has been recorded according to ICD-10.

### 2.2. Study population

The cohort included all individuals aged 18 or older with one or more DSH episodes treated in Norwegian general hospitals between January 1st 2008 and December 31st 2018. Deliberate self-harm was defined as "intentional self-poisoning or self-injury, irrespective of motivation" (Hawton et al., 2003). The included DSH episodes were incidents that received urgent somatic treatment (i.e., were treated immediately upon arrival) and that were at least one day apart from any previous episode. All indirect contacts, planned treatments, fatal injuries and poisonings or injuries that were clearly accidental or inflicted by others, or secondary outcomes of other medical conditions were excluded from consideration as being ineligible by the definition of DSH. In line with our previous studies (Bøe et al., 2022; Lunde et al., 2022; Qin et al., 2022), we adopted a broader approach to also include episodes of probable deliberate self-harm, using a data-driven algorithm of coding described elsewhere (Qin and Mehlum, 2020). Briefly, three steps were taken in a hierarchical fashion to ascertain probable DSH episodes. The first step was to include treatment contacts because of injuries with a diagnosis of deliberate self-harm (ICD-code: X6n, Y87). The second step was to include treatment contacts that had a diagnosis of either poisoning with the following ICD-10 codes T4n, T50-T55, T57-T60, T62, T65 and T96 or injuries in ICD-10 codes S10-S11, S15, S19, S21, S25-S27, S31, S35-S39, S41, S45, S50-S51, S54-S56, S59, S61, S64-S65, S69, S71, S88, T01, T09, T11, T18-T19, T27-T28, T31, T68, T69, T71 and T95, with a comorbid psychiatric diagnosis (ICD-10 codes F0-F9). The final step was to include treatment contacts with poisoning (ICD-10 codes T4n, T50 and T96) that were not covered by the previous 2 steps. After these procedures of selection, 39 497 individuals were included, covering both self-injury and self-poisoning among Norwegian adults.

### 2.3. Outcome

Cause of death was extracted from the Cause of Death Register and coded as suicide (X60-X84 and Y87.0), death by mental and behavioural disorders (F00-F99) and death by other external causes (V01-Y98 excluding X60-X84 and Y87.0) including transport accidents, injury with unknown intent and other accidents. In Norway, the underlying cause of death is always reported when possible. Death by mental and behavioural disorders mainly consist of deaths where dementia (56.8%) is the underlying cause. The second largest group consists of deaths caused by alcohol use disorder (22.5%) where the three most frequent acute causes of death is alcohol dependence, alcoholic liver disease and alcohol poisoning (FHI, 2018).

### 2.4. Variables

Clinical data were extracted from the Norwegian Patient register. Variables of interest were hospital treatment of deliberate self-harm, psychiatric disorder diagnosed during hospital treatment for DSH, DSH method and the total number of DSH episodes within the study period. Psychiatric disorders diagnosed at the last DSH episode within the study period were categorized according to ICD-10 as follows: "Acute alcohol intoxication (F10.0)", "Alcohol use disorders (F10)" (excluding F10.0), "Other substance use disorders (F11-19)", "Schizophrenia spectrum disorders (F20-29)", "Bipolar spectrum disorders (F30-31)", "Depressive disorders (F32-39)", "Anxiety disorders (F40-42)", "PTSD and other stress-related disorders (F43)", "Eating disorders (F50)", "Borderline personality disorder (F60.3)", "Other personality disorders (F60-69)" (excluding F60.3), and "Any other psychiatric disorder" (F00-09, F44-48, F51-59, F70-99)". The psychiatric disorders were not coded as mutually exclusive. A patient with more than one psychiatric diagnosis during the observation period will consequently be present in more than one diagnostic group. The method of DSH at the last DSH episode within the study period was coded as "Injury" or "Poisoning", while a combination of the two was labelled "Mixed method". The number of previous DSH episodes was categorized as: "1", "2", "3-5" and "≥6", and reflected previous DSH episodes by the individual during the observation period.

Socioeconomic and sociodemographic information was extracted from The Central Population Register and The Statistics Norway's Events Database (FD-Trygd). Variables of interest were age, marital status, educational attainment, level of income and ethnicity. Age was coded as "18-25", "26-39", "40-64" and "≥65". Marital status, educational attainment, level of income and ethnicity were used for adjustment purposes only and results were omitted from the tables. For the adjustment variables, the category "missing data" was used to control for the possible influence of missing information.

### 2.5. Statistical analysis

Descriptive analysis was used to profile the distribution of clinical variables among DSH patients who died by suicide, mental and behavioural disorders and other external causes.  $\chi^2$  tests were used to evaluate the difference in the distribution of psychiatric disorders between gender and age groups. Cox proportional hazards regression was used to assess mortality risk by the separate causes associated with specific psychiatric disorders and other clinical variables and adjusted for sociodemographic status. Hazard ratio (HR) and corresponding 95% confidence intervals (95% CI) were reported. The adjusted model was applied in the analyses stratified by gender and age group. To investigate the interactive effect of psychiatric disorders and history of DSH repetition on suicide risk, a mutually exclusive variable of psychiatric disorders among individuals with and without DSH repetitions was coded. A log-likelihood ratio test was performed to assess whether a cox regression with psychiatric disorders by repetition status of the individual differed significantly from a cox regression where psychiatric disorders and

repetition status of the individual were included as two separate variables.

### 3. Results

The cohort consisted of 39 479 DSH patients treated in general hospitals with a mean follow-up time of 4.5 years, where 21.8% were recorded with one or more DSH repetitions. In all, 878 (51.8% males) individuals died by suicide, where the two most common causes of death were hanging or strangulation (36.1%) and poisoning (34.5%). There were 461 (46.6% males) deaths by mental and behavioural disorders, primarily death caused by alcohol use disorder or dementia, and 1037 (64.8% males) deaths by other external causes during the observation period. Of the 878 patients who died by suicide, 139 (15.8%) died within 30 days of their last DSH episode, of whom 29.5% had more than one DSH episode. 490 (55.8%) individuals died by suicide within one year of their last DSH episode, of whom 36.1% had a history of more than one DSH episode. Among the DSH patients who died by mental and behavioural disorders, 24 (5.2%) died within 30 days (8.3% repeaters) and 142 (30.8%) died within one year (15.5% repeaters). For death by other external causes, 95 (9.2%) died within 30 days (33.7% repeaters) and 428 (41.3%) died within one year (35.3% repeaters).

#### 3.1. Death by suicide

Among the 878 who died by suicide, depressive disorders (22.5%), other substance use disorders (11.3%), alcohol use disorder (7.8%) and acute alcohol intoxication (7.8%) were the most common disorders

overall (Table 1). Eating disorders (1.4% females, 0.0% males), borderline personality disorder (6.3% females, 0.8% males) and any other personality disorders (6.6% females, 3.1% males) had a significantly higher prevalence among women, while men displayed a significantly higher prevalence of alcohol use disorders (5.1% females, 10.3% males). No other significant gender differences in the distribution of the disorders were found. Other substance use disorders, borderline personality disorder, schizophrenia spectrum disorders and depressive disorders displayed significantly different distributions by age group.

In the adjusted cox regression, suicide was associated with schizophrenia spectrum disorders (HR 1.52, 95% CI 1.11–2.09), bipolar spectrum disorders (HR 1.65, 1.25–2.18), depressive disorders (HR 1.41, 1.19–1.66) and borderline personality disorder (HR 1.78, 1.22–2.60) (Table 2). Borderline personality disorder (HR 1.54, 1.01–2.35) increased the risk of suicide among women only. Among males, significant associations between suicide and bipolar spectrum disorders (HR 1.83, 1.19–2.81), depressive disorders (HR 1.80, 1.43–2.26) and other personality disorders (HR 2.40, 1.23–4.69) (mostly “Unspecified personality disorder (F60.9)”) were found. DSH repetition increased the risk of suicide among both genders, but females displayed a higher risk of suicide in association with having a history of 6 DSH episodes or more prior to suicide (HR females 3.96, 2.63–5.95; HR males 0.99, 0.31–3.15). A combination of poisoning and injury as method of self-harm at the last DSH episode significantly increased the risk of suicide overall and by gender.

By age, bipolar spectrum disorders (HR 2.72, 1.18–6.27) and PTSD and other stress-related disorders (HR 2.88, 1.30–6.39) increased the risk of suicide in the age group “18–24” (Table 3). Bipolar spectrum

**Table 1**  
Clinical characteristics of all DSH patients and those who died by suicide, by gender and age group.

	All patients	Patients who died by suicide						
	Total	Total	Female	Male	18–24	25–39	40–64	≥65
	n = 39 479	n = 878	n = 423	n = 455	n = 123	n = 243	n = 424	n = 88
	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)	n (%)
<b>Psychiatric disorder<sup>1</sup></b>								
Acute alcohol intoxication	4035 (10.2)	69 (7.8)	25 (5.9)	44 (9.6)	12 (9.7)	17 (7.0)	36 (8.4)	4 (4.5)
Alcohol use disorder	3053 (7.7)	69 (7.8)	22 (5.1)	47 (10.3)	3 (2.4)	14 (5.7)	46 (10.8)	6 (6.8)
Substance use disorders	4078 (10.3)	99 (11.3)	45 (10.6)	54 (11.8)	15 (12.2)	38 (15.5)	43 (10.1)	3 (3.4)
Schizophrenia spectrum disorders	1173 (2.9)	44 (5.0)	20 (4.7)	24 (5.2)	5 (4.0)	13 (5.7)	25 (5.9)	0 (0.0)
Bipolar spectrum disorders	1341 (3.4)	55 (6.3)	32 (7.5)	23 (5.0)	6 (4.8)	14 (5.7)	31 (7.3)	4 (4.55)
Depressive disorders	6038 (15.2)	198 (22.5)	93 (21.9)	105 (23.0)	17 (13.8)	47 (19.2)	106 (25.0)	28 (31.8)
Anxiety disorders	1232 (3.1)	38 (4.3)	20 (4.7)	18 (3.9)	4 (3.2)	10 (4.1)	18 (4.2)	6 (6.8)
PTSD and other stress related disorders	907 (2.3)	22 (2.5)	13 (3.0)	9 (1.9)	7 (5.6)	5 (2.0)	9 (2.1)	1 (1.1)
Eating disorders	206 (0.5)	6 (0.7)	6 (1.4)	0 (0.0)	0 (0.0)	5 (2.0)	1 (0.2)	0 (0.0)
Borderline personality disorder	715 (1.8)	31 (3.5)	27 (6.3)	4 (0.8)	5 (4.0)	18 (7.3)	8 (1.8)	0 (0.0)
Other personality disorders	494 (1.2)	20 (2.3)	11 (2.5)	9 (1.9)	3 (2.4)	5 (2.0)	12 (2.8)	0 (0.0)
Any other psychiatric disorder	3106 (7.8)	33 (3.7)	17 (4.0)	16 (3.5)	6 (4.8)	9 (3.7)	16 (3.7)	2 (2.2)
<b>DSH method</b>								
Poisoning	33 003 (83.6)	702 (79.8)	355 (83.7)	347 (76.2)	103 (83.7)	194 (79.5)	335 (79.0)	70 (79.5)
Injury	5397 (13.6)	131 (15.0)	50 (11.7)	81 (17.8)	16 (13.0)	38 (15.5)	65 (15.3)	12 (13.6)
Mixed method	1079 (2.7)	46 (5.2)	19 (4.4)	27 (5.9)	4 (3.2)	12 (4.9)	24 (5.6)	6 (6.8)
<b>Previous DSH episodes</b>								
0	30 852 (78.1)	592 (67.3)	253 (59.6)	339 (74.5)	83 (67.4)	162 (66.3)	285 (67.2)	62 (70.4)
1	4884 (12.3)	151 (17.2)	79 (18.6)	72 (15.8)	18 (14.6)	41 (16.8)	76 (17.9)	16 (18.1)
2	1641 (4.1)	55 (6.2)	30 (7.0)	25 (5.4)	6 (4.8)	17 (6.9)	25 (5.9)	7 (7.9)
3–5	1335 (3.3)	47 (5.3)	31 (7.3)	16 (3.5)	6 (4.8)	10 (4.1)	28 (6.6)	3 (3.4)
≥6	767 (1.9)	34 (3.8)	31 (7.3)	3 (0.6)	10 (8.1)	14 (5.7)	10 (2.4)	0 (0.0)
<b>Gender</b>								
Female	21 430 (54.2)	423 (48.2)	–	–	61 (49.9)	114 (46.7)	211 (49.7)	38 (43.1)
Male	18 049 (45.7)	455 (51.8)	–	–	62 (50.4)	130 (53.2)	213 (50.2)	50 (56.8)
<b>Age group</b>								
18–24	8186 (20.7)	123 (14.0)	61 (14.3)	62 (13.6)	–	–	–	–
25–439	10 340 (26.1)	243 (27.8)	114 (26.8)	130 (28.5)	–	–	–	–
40–64	13 684 (34.6)	424 (48.2)	211 (49.7)	213 (46.8)	–	–	–	–
≥65	7269 (18.4)	88 (10.0)	38 (8.9)	50 (10.99)	–	–	–	–

<sup>1</sup> “Acute alcohol intoxication”: F10.0, “Alcohol use disorders”: F10 (excluding F10.0), “Substance use disorders”: F11–19, “Schizophrenia spectrum disorders”: F20–29, “Bipolar spectrum disorders”: F30–31, “Depressive disorders”: F32–39, “Anxiety disorders”: F40–42, “PTSD and other stress related disorders”: F43, “Eating disorders”: F50, “Borderline personality disorder”: F60.3, “Any other personality disorder”: F60–69 excluding F60.3 and “Any other psychiatric disorder”: F codes not covered above.

**Table 2**Association between psychiatric disorders at last DSH episode and risk of suicide among DSH patients overall and by gender<sup>b</sup>.

	Crude		Adjusted	
	Total		Total	Female Male
<b>Psychiatric disorder<sup>a</sup></b>				
Acute alcohol intoxication	0.67 (0.52–0.85)**		0.65 (0.51–0.84)**	0.57 (0.38–0.68)** 0.70 (0.51–0.96)*
Alcohol use disorder	1.08 (0.84–1.38)		0.82 (0.63–1.05)	0.78 (0.51–1.21) 0.87 (0.63–1.19)
Other substance use disorders	1.11 (0.89–1.36)		1.04 (0.83–1.29)	1.33 (0.97–1.82) 0.90 (0.66–1.21)
Schizophrenia spectrum disorders	1.71 (1.26–2.32)**		1.52 (1.11–2.09)**	1.49 (0.93–2.36) 1.54 (1.00–2.36)
Bipolar spectrum disorders	1.85 (1.41–2.44)**		1.65 (1.25–2.18)**	1.44 (1.00–2.09) 1.83 (1.19–2.81)**
Depressive disorders	1.38 (1.18–1.62)**		1.41 (1.19–1.66)**	1.11 (0.88–1.42) 1.80 (1.43–2.26)**
Anxiety disorders	1.40 (1.01–1.94)		1.26 (0.90–1.75)	1.24 (0.79–1.95) 1.27 (0.78–2.04)
PTSD and other stress related disorders	1.06 (0.69–1.63)		1.04 (0.68–1.60)	0.93 (0.53–1.63) 1.09 (0.56–2.13)
Eating disorders	1.13 (0.50–2.53)		1.17 (0.52–2.64)	1.26 (0.55–2.87) –
Borderline personality disorder	2.07 (1.44–2.96)**		1.78 (1.22–2.60)**	1.54 (1.01–2.35)* –
Other personality disorders	1.70 (1.09–2.65)**		1.44 (0.91–2.26)	1.05 (0.57–1.93) 2.40 (1.23–4.69)**
Any other psychiatric disorder	0.75 (0.53–1.07)		0.68 (0.48–0.97)*	0.75 (0.46–1.23) 0.61 (0.37–1.02)
<b>Previous DSH episodes</b>				
0	1.00		1.00	1.00 1.00
1	1.66 (1.39–1.99)**		1.61 (1.34–1.93)**	1.82 (1.41–2.36)** 1.46 (1.12–1.89)**
2	1.88 (1.42–2.47)**		1.83 (1.38–2.42)**	1.98 (1.35–2.92)** 1.71 (1.13–2.59)**
3–5	2.14 (1.59–2.89)**		2.08 (1.53–2.82)**	2.51 (1.71–3.70)** 1.62 (0.97–2.71)
≥6	3.19 (2.25–4.52)**		3.10 (2.14–4.49)**	3.96 (2.63–5.95)** 0.99 (0.31–3.15)
<b>Method of DSH</b>				
Poisoning	1.00		1.00	1.00 1.00
Injury	1.35 (1.12–1.63)**		1.29 (1.06–1.56)**	1.44 (1.06–1.95)** 1.18 (0.92–1.52)
Mixed method	2.25 (1.67–3.04)**		2.02 (1.50–2.73)**	1.98 (1.25–3.16)** 2.04 (1.37–3.03)**
<b>Age group</b>				
18–24	0.50 (0.38–0.66)**		0.63 (0.44–0.89)**	0.65 (0.38–1.10) 0.59 (0.37–0.96)*
25–39	0.81 (0.63–1.03)		0.79 (0.59–1.07)	1.00 (0.63–1.57) 0.65 (0.43–0.97)
40–64	1.19 (0.95–1.50)		1.11 (0.86–1.44)	1.46 (0.98–2.16)* 0.88 (0.62–1.25)
≥65	1.00		1.00	1.00 1.00
<b>Gender</b>				
Female	1.00		1.00	1.00 1.00
Male	1.34 (1.17–1.53)**		1.50 (1.30–1.73)**	– –

<sup>a</sup> "Alcohol use disorders": F10 (excluding F10.0 "Acute intoxication"), "Substance use disorders": F11-19, "Schizophrenia spectrum disorders": F20-29, "Bipolar spectrum disorders": F30-31, "Depressive disorders": F32-39, "Anxiety disorders": F40-42, "PTSD and other stress related disorders": F43, "Eating disorders": F50, "Borderline personality disorder": F60.3, "Any other personality disorder": F60-69 excluding F60.3 and "Any other psychiatric disorder": F00–09, F44–48, F51–59, F70-99.

<sup>b</sup> All analyses, except the crude, were controlled for marital status, education, income and ethnicity. \* sig at .05 \*\* sig. at .01.

disorders (HR 2.00, 1.15–3.48), depressive disorders (HR 1.41, 1.01–1.97), eating disorders (HR 2.77, 1.12–6.87) and borderline personality disorder (HR 2.61, 1.54–4.41) increase the risk of suicide among individuals aged "25–39". Schizophrenia spectrum disorders (HR 1.61, 1.05–2.46), bipolar spectrum disorders (HR 1.50, 1.03–2.19), depressive disorders (HR 1.37, 1.09–1.72) and other personality disorders (HR 2.08, 1.16–3.72) increased the risk of suicide among those aged "40–64". Depressive disorders (HR 1.78, 1.10–2.86) increased the risk of dying by suicide for those aged 65 or over.

Among the 878 individuals who died by suicide, 287 (32.7%) had a history of more than one DSH episode treated in a general hospital. DSH repeaters without a psychiatric disorder displayed close to a twofold risk of suicide compared to non-repeaters without a psychiatric disorder (HR 1.99, 1.57–2.52) (Table 4). As the log-likelihood ratio test yielded insignificant results, the risk of suicide associated with a psychiatric disorder is not significantly higher for DSH repeaters than non-repeaters, but the risk of suicide is associated with a greater number of psychiatric disorders among the repeaters than the non-repeaters. Schizophrenia spectrum disorders, anxiety disorders and PTSD and other stress-related disorders increased the risk of suicide among DSH repeaters only.

### 3.2. Death by mental and behavioural disorders and other external causes

Among the individuals who died by mental and behavioural disorders (n = 461), a large proportion (45%) were diagnosed with disorders falling into the heterogenous group "Any other psychiatric disorder", consisting mainly of dementia, followed by alcohol use disorders

(14.9%) (Table 5). Among the individuals who died by other external causes (n = 1037) the most prevalent psychiatric disorders were other substance use disorders (23.0%), any other psychiatric disorder (19.2%) and alcohol use disorders (13.4%).

Death by mental and behavioural disorders was associated with alcohol use disorders (HR 1.86, 1.41–2.45) and other psychiatric disorders (HR 2.95, 2.42–3.59). Death by other external causes was associated with alcohol use disorders (HR 1.43, 1.18–1.72) and other substance use disorders (HR 2.07, 1.77–2.41), while acute alcohol intoxication (HR 0.70, 0.56–0.88), schizophrenia spectrum disorders (HR 0.63, 0.42–0.94), depressive disorders (HR 0.56, 0.45–0.70) and PTSD and other stress-related disorders (HR 0.48, 0.25–0.94) were associated with a reduced risk of death by other external causes. DSH repetition increased the risk of death by other external causes.

## 4. Discussion

### 4.1. Main findings

In the present cohort of individuals treated for DSH in general hospitals, overall, suicide was associated with having received a diagnosis within the groups of schizophrenia spectrum disorders, affective disorders and personality disorders. Still, the effect varied considerably by age, gender and history of repeated DSH. Alcohol use disorders and dementia increased the risk of death both by mental and behavioural disorders and by other external causes, whereas other substance use disorders increased the risk of death by other external causes.

**Table 3**  
Association between psychiatric disorders at last DSH episode and risk of suicide among DSH patients by age group<sup>2</sup>.

	18–24	25–39	40–64	≥65
<b>Psychiatric disorder<sup>1</sup></b>				
Acute alcohol intoxication	0.88 (0.47–1.63)	0.63 (0.38–1.04)	0.61 (0.43–0.86)**	-
Alcohol use disorder	0.94 (0.29–2.98)	1.28 (0.74–2.20)	0.79 (0.58–1.09)	0.52 (0.22–1.25)
Other substance use disorders	1.16 (0.67–2.02)	1.09 (0.76–1.57)	0.92 (0.66–1.28)	-
Schizophrenia spectrum disorders	1.73 (0.67–4.44)	1.46 (0.83–2.55)	1.61 (1.05–2.46)*	-
Bipolar spectrum disorders	2.72 (1.18–6.27)**	2.00 (1.15–3.48)**	1.50 (1.03–2.19)*	-
Depressive disorders	1.16 (0.68–1.96)	1.41 (1.01–1.97)*	1.37 (1.09–1.72)**	1.78 (1.10–2.86)**
Anxiety disorders	-	1.25 (0.66–2.38)	1.06 (0.66–1.72)	1.69 (0.71–4.03)
PTSD and other stress related disorders	2.88 (1.30–6.39)**	0.69 (0.28–1.69)	0.83 (0.42–1.61)	-
Eating disorders	-	2.77 (1.12–6.87)*	-	-
Borderline personality disorder	1.13 (0.42–3.00)	2.61 (1.54–4.41)**	1.30 (0.63–2.67)	-
Other personality disorders	-	1.04 (0.42–2.57)	2.08 (1.16–3.72)**	-
Any other psychiatric disorder	0.91 (0.39–2.00)	0.81 (0.41–1.59)	0.92 (0.55–1.53)**	-
<b>Previous DSH episodes</b>				
0	1.00	1.00	1.00	1.00
1	1.72 (1.03–2.89)*	1.42 (1.00–2.01)*	1.60 (1.24–2.07)**	2.32 (1.32–4.08)**
2	2.14 (0.92–4.94)	1.52 (0.91–2.53)	1.62 (1.07–2.45)*	4.64 (2.09–10.31)**
3–5	2.80 (1.20–6.55)**	1.05 (0.54–2.02)	2.60 (1.74–3.87)**	3.36 (0.99–11.39)
≥6	9.05 (4.09–20.03)**	2.81 (1.55–5.11)**	1.97 (1.02–3.79)*	-
<b>Method of DSH</b>				
Poisoning	1.00	1.00	1.00	1.00
Injury	1.18 (0.68–2.02)	1.37 (0.96–1.97)	1.38 (1.05–1.82)**	1.05 (0.54–2.01)
Mixed method	1.32 (0.47–3.72)	2.17 (1.20–3.90)**	2.14 (1.41–3.26)**	1.50 (0.64–3.50)
<b>Gender</b>				
Female	1.00	1.00	1.00	1.00
Male	2.00 (1.36–2.94)**	1.52 (1.14–2.02)**	1.28 (1.05–1.58)**	2.07 (1.26–3.40)**

<sup>1</sup> "Acute intoxication": F10.0, "Alcohol use disorders": F10 (excluding F10.0 "Acute intoxication"), "Substance use disorders": F11-19, "Schizophrenia spectrum disorders": F20-29, "Bipolar spectrum disorders": F30-31, "Depressive disorders": F32-39, "Anxiety disorders": F40-42, "PTSD and other stress related disorders": F43, "Eating disorders": F50, "Borderline personality disorder": F60.3, "Any other personality disorder": F60-69 excluding F60.3 and "Any other psychiatric disorder": F00-09, F44-48, F51-59, F70-99.

<sup>2</sup> All analyses were controlled for marital status, education, income and ethnicity. \* sig at 0.05 \*\* sig at 0.01.

#### 4.2. DSH repetition

Individuals with previous episodes of DSH, but no history of psychiatric disorders, displayed close to a twofold risk of suicide compared to those who had no previous episodes, illustrating that even in the absence of a psychiatric disorder, DSH repetition is a strong risk factor for suicide. The risk of suicide associated with several psychiatric disorders was shared between DSH repeaters and non-repeaters, but the

repeaters displayed stronger associations. Additionally, DSH repeaters displayed an increased risk of suicide associated with a larger number of psychiatric disorders. All DSH patients need suicide-risk-specific treatment to avoid future repetition, as our results show that DSH repetition increases the risk of suicide across both genders and all age groups and is not confined to any specific diagnostic groups.

**Table 4**  
Interactive effect of psychiatric disorders and DSH repetition on risk of suicide among DSH patients<sup>2</sup>.

	Distribution		HR	
	Non-repeaters (N = 591)	Repeaters N = 287	Non-repeaters	Repeaters
	n (%)	n (%)	HR (CI)	HR (CI)
<b>Psychiatric disorder<sup>1</sup></b>				
No psychiatric disorder	238 (40.2)	100 (34.8)	1.00	1.99 (1.57–2.52)**
Acute alcohol intoxication	46 (7.7)	23 (8.0)	0.74 (0.47–1.08)	1.12 (0.59–2.11)
Alcohol use disorders	22 (3.7)	12 (4.1)	0.72 (0.47–1.09)	1.39 (0.80–2.39)
Other substance use disorders	42 (7.1)	25 (8.7)	1.02 (0.73–1.43)	1.52 (1.00–2.31)
Schizophrenia spectrum disorders	24 (4.0)	17 (5.9)	1.38 (0.90–2.12)	3.32 (2.01–5.48)**
Bipolar spectrum disorders	37 (6.2)	18 (6.3)	1.99 (1.40–2.82)**	2.47 (1.52–4.01)**
Depressive disorders	137 (23.1)	53 (18.5)	1.42 (1.15–1.76)**	2.45 (1.81–3.30)**
Anxiety disorders	16 (2.7)	9 (3.1)	1.33 (0.80–2.21)	2.54 (1.30–4.96)**
PTSD and other stress related disorders	7 (1.1)	6 (2.1)	0.77 (0.36–1.65)	2.28 (1.01–5.14)*
Eating disorders	1 (0.1)	1 (0.3)	-	-
Borderline personality disorder	10 (1.7)	21 (7.3)	2.42 (1.28–4.57)**	3.81 (2.41–6.00)**
Other personality disorders	7 (1.1)	7 (2.4)	2.20 (1.03–4.69)*	2.39 (1.12–5.08)*
Any other psychiatric disorder	52 (8.7)	19 (3.2)	0.64 (0.38–1.07)	1.71 (0.80–3.64)

<sup>1</sup> "Alcohol use disorders": F10 (excluding F10.0 "Acute intoxication"), "Substance use disorders": F11-19, "Schizophrenia spectrum disorders": F20-29, "Bipolar spectrum disorders": F30-31, "Depressive disorders": F32-39, "Anxiety disorders": F40-42, "PTSD and other stress related disorders": F43, "Eating disorders": F50, "Borderline personality disorder": F60.3, "Any other personality disorder": F60-69 excluding F60.3 and "Any other psychiatric disorder": F codes not mentioned above.

<sup>2</sup> The analysis was controlled for age, gender, method of DSH, marital status, education, income and ethnicity. \* sig at 0.05, \*\* sig at 0.01.



Table 5

Association between psychiatric disorders and death by mental and behavioural disorders and other external causes<sup>2</sup>.

	Mental and behavioural disorders (N = 461)		Other external causes (N = 1037)	
	Distribution	Regression	Distribution	Regression
	n (%)	HR (CI)	n (%)	HR (CI)
<b>Psychiatric disorder<sup>1</sup></b>				
Acute alcohol intoxication	27 (5.8)	0.69 (0.46–1.03)	83 (8.0)	0.70 (0.56–0.88)**
Alcohol use disorders	69 (14.9)	1.86 (1.41–2.45)**	139 (13.4)	1.43 (1.18–1.72)**
Other substance use disorders	26 (5.4)	0.72 (0.48–1.08)	239 (23.0)	2.07 (1.77–2.41)**
Schizophrenia spectrum disorders	15 (3.2)	1.03 (0.60–1.74)	26 (2.5)	0.63 (0.42–0.94)*
Bipolar spectrum disorders	15 (3.2)	0.75 (0.44–1.26)	39 (3.8)	1.06 (0.76–1.46)
Depressive disorders	36 (7.8)	0.50 (0.35–0.71)	90 (8.7)	0.56 (0.45–0.70)**
Anxiety disorders	9 (1.9)	0.59 (0.30–1.15)	31 (3.0)	0.82 (0.57–1.18)
PTSD and other stress related disorders	1 (0.2)	–	9 (0.9)	0.48 (0.25–0.94)*
Eating disorders	3 (0.6)	–	1 (0.1)	–
Borderline personality disorder	1 (0.2)	–	11 (1.0)	0.74 (0.40–1.35)
Other personality disorders	5 (1.0)	1.37 (0.56–3.36)	14 (1.4)	1.00 (0.59–1.72)
Any other psychiatric disorder	211 (45.7)	6.39 (5.11–7.98)**	200 (19.2)	2.02 (1.66–2.47)**
<b>DSH method</b>				
Poisoning	310 (67.2)	1.00	835 (80.5)	1.00
Injury	134 (29.1)	1.33 (1.06–1.67)**	163 (15.7)	0.99 (0.83–1.18)
Mixed method	17 (3.7)	1.09 (0.67–1.79)	39 (3.8)	1.18 (0.85–1.64)
<b>Previous DSH episodes</b>				
0	390 (84.6)	1.00	731 (70.5)	1.00
1	47 (10.2)	1.14 (0.83–1.56)	166 (16.0)	1.40 (1.18–1.66)**
2	10 (2.2)	0.79 (0.42–1.50)	55 (5.3)	1.39 (1.06–1.84)**
3–5	11 (2.4)	1.51 (0.82–2.79)	61 (5.8)	2.28 (1.74–2.98)**
≥6	3 (0.6)	0.90 (0.28–2.87)	24 (2.3)	2.32 (1.53–3.53)**
<b>Gender</b>				
Female	246 (53.4)	1.00	365 (35.2)	1.00
Male	215 (46.6)	1.49 (1.22–1.83)**	672 (64.8)	2.27 (1.98–2.61)**
<b>Age group</b>				
18–39	27 (5.8)	1.00	381 (36.7)	1.00
40–64	126 (27.3)	7.86 (2.34–26.32)**	418 (40.3)	1.80 (1.42–2.28)**
≥65	308 (66.8)	54.42 (17.00–174.21)**	238 (22.9)	2.86 (2.24–3.66)**

<sup>1</sup> "Alcohol use disorders": F10 (excluding F10.0 "Acute intoxication"), "Substance use disorders": F11–19, "Schizophrenia spectrum disorders": F20–29, "Bipolar spectrum disorders": F30–31, "Depressive disorders": F32–39, "Anxiety disorders": F40–42, "PTSD and other stress related disorders": F43, "Eating disorders": F50, "Borderline personality disorder": F60.3, "Any other personality disorder": F60–69 excluding F60.3 and "Any other psychiatric disorder": F codes not mentioned above.

<sup>2</sup> All analyses were controlled for marital status, education, income and ethnicity. \* sig at 0.05, \*\* sig at 0.01.

#### 4.3. Personality disorders

Previous analyses of large cohorts have identified an increased suicide risk in females and males with personality disorders treated for DSH in general hospitals (Runeson et al., 2016; Tidemalm et al., 2008), however, in our study, we were able to analyse the impact of a diagnosis of borderline personality disorder separately. Borderline personality disorder displayed the strongest overall association with suicide in the present cohort, but the finding was confined to females and individuals aged 25–39. This resonates well with previous studies reporting an increased suicide risk among individuals with borderline personality disorder (Pompili et al., 2005; Temes et al., 2019). Borderline personality disorder combined with a history of multiple DSH episodes, a known feature of the disorder (Bøe et al., 2022; Temes et al., 2019), yielded the strongest risk for suicide in the present analyses and a higher hazard ratio than that of borderline personality without a history of DSH repetition. To prevent suicide in this patient group, individuals with borderline personality disorder, and especially those with a history of multiple DSH episodes, should receive psychiatric evaluation and psychosocial follow-up measures during the first few weeks after somatic discharge and then be referred for evidence based and borderline personality disorder specific treatment (Simonsen et al., 2019). Currently, clinical guidelines to strengthen and systematise treatment for this patient group are lacking within healthcare systems (Mehlum, 2022) in most countries (Simonsen et al., 2019) despite that effective treatment methods have been developed (Storebø et al., 2020).

#### 4.4. Affective disorders

Our finding that depressive disorders and bipolar spectrum disorders increased the overall risk of suicide, corresponds well with research on the risk of suicide following DSH (Qin et al., 2022; Runeson et al., 2016), but the present analysis provides further details on suicide risk by sex-age subgroups. Bipolar spectrum disorders increased the risk of subsequent suicide more strongly among younger individuals and males. A higher suicide risk among younger individuals with bipolar disorder could be linked to a higher risk of suicide at the onset of the disorder or the first depressive episode (Gonda et al., 2012). Both young age and young age at onset of bipolar disorder are associated with treatment non-adherence (Perlis et al., 2010), which may lead to an increased suicide risk among individuals diagnosed with this progressive disorder (Leclerc et al., 2013). Depressive disorders increased the overall risk of suicide, with significant findings for men only and the highest risk of suicide found among the elderly. There is growing evidence of gender differences in the clinical manifestation of depressive disorders (Rice et al., 2020) and this may, in combination with barriers toward help-seeking (Herreen et al., 2021), complicate the identification and treatment of depressive disorders among males, and especially among males of older age (Herreen et al., 2022). Identification of depressive disorders among elderly males may require adjustment of the established screening scales currently used and alternative outreach methods, such as community-based suicide prevention programs (Lapierre et al., 2011). Both bipolar spectrum disorders and depressive disorders increased the risk of suicide among DSH repeaters and non-repeaters, but with stronger associations among repeaters. In light of our

previous findings not showing an association between depressive disorders and DSH repetition (Bøe et al., 2022), one understanding of the suicide risk established in the present analysis and previous papers is that suicide intent may be higher among individuals with depressive disorders causing them to die rather than repeat the act of DSH. The low risk of DSH repetition and increased risk of suicide associated with affective disorders leaves few points of contact. Therefore, psychiatric evaluation and timely follow-up of this patient group is important.

#### 4.5. Schizophrenia spectrum disorders

Schizophrenia spectrum disorders increased the risk of suicide overall and reached significance for the age group 40–64. Psychotic disorders, covering schizophrenia spectrum disorders, have been linked to suicide among DSH patients in previous research (Runeson et al., 2016). However, in the present cohort, individuals with schizophrenia spectrum disorders and a history of multiple DSH episodes displayed a more than threefold risk of suicide. In contrast, non-repeaters with schizophrenia spectrum disorders did not display an increased suicide risk as compared to non-repeaters without a psychiatric disorder. DSH repetition amongst patients with schizophrenia spectrum disorders, thus, is a particularly important risk factor that should lead to strengthening of follow-up care and patient safety measures as well as adherence to pharmacological antipsychotic treatment (Sher and Kahn, 2019).

#### 4.6. Substance use disorders

Epidemiological findings show that substance use disorders of any kind (Poorolajal et al., 2016), and alcohol use disorders specifically (Conner et al., 2019) or even alcohol use (Isaacs et al., 2022) increase the risk of suicide. Among individuals previously treated for DSH, the findings are not as clear, where both an increase (Runeson et al., 2016) and no increase (Christiansen and Jensen, 2007) in suicide risk have been identified in association with substance use disorders. Alcohol use disorders specifically were linked to suicide among women only, in a large cohort of DSH patients (Tidemalm et al., 2008). In the present cohort, we found no association between alcohol use disorders or any other substance use disorders and suicide, which could be explained by an underdiagnosing of said disorders in general hospitals. However, considering the association presently found between any substance use disorder and death by mental and behavioural disorders and other external causes, the results might be affected by misclassifications of suicide in the context of addiction.

We found a relative protective effect of acute alcohol intoxication at the time of DSH on the risk of subsequent suicide. Although acute alcohol intoxication is frequently reported among suicide decedents as well as suicide attempters (Kaplan et al., 2013), the literature does not cover the explicit association between alcohol intoxication at the time of treatment for DSH and the risk of later suicide. A possible explanation of our finding would be that a sizeable proportion of those who self-harmed whilst under acute alcohol intoxication would probably not have a very high suicide intent and, thus, would not display suicidal or self-harming behaviour while being sober.

Death by mental and behavioural disorders was associated with alcohol use disorders and any other psychiatric disorder, consisting mainly of dementia. This corresponds well with dementia and alcohol use disorders being the most prominent specific causes of death within this group. Alcohol use disorders and other substance use disorders increased the risk of death by other external causes. An increased risk of general mortality associated with inpatient treatment for alcohol use disorder is identified among DSH patients (Christiansen and Jensen, 2007) and the present analyses are thus an extension of these previous findings. However, by analysing specific psychiatric disorders, we identify subgroups of DSH patients at increased risk of death by other causes than suicide. DSH repetition increased the risk of death by other

external causes, emphasizing the importance of follow-up of these patients not long after discharge.

#### 4.7. Strengths and limitations

Among the strengths of this study are the large and complete set of national cohort data including information of each subject's specific psychiatric disorders and the longitudinal design allowing for examination of the effect of previous DSH episodes on future risk of death.

Psychiatric disorders may be underdiagnosed in general hospitals as the treatment focuses on the somatic injury. As a result, our findings may be underestimations of the true risk of death by suicide, mental and behavioural disorders and other external causes associated with psychiatric disorders. Additionally, we did not have information through the registers on whether a specialist psychiatric evaluation was performed. As we do not have lifetime data coverage, the total number of DSH episodes could be an underestimation of the true number of episodes.

### 5. Conclusion and implications

We were able to demonstrate that DSH repetition increased the risk of suicide among DSH patients without psychiatric disorders and that DSH repetition further increased the risk of suicide among individuals with psychiatric disorders. Females with borderline personality disorder and multiple DSH episodes displayed a particularly elevated risk of suicide in the present cohort. In many countries, there is a need for establishing and adhering to clinical guidelines for evidence-based treatment and follow-up of individuals with borderline personality disorder shortly after discharge from general hospitals and referral to borderline-specific evidence-based treatment. Suicide was strongly associated with schizophrenia spectrum disorders among individuals with multiple DSH episodes. Strengthened continuity of care, patient's safety and treatment adherence is essential in this patient group. Bipolar disorder increased the risk of suicide among younger individuals, suggesting the importance of providing disorder specific treatment close to the onset of the disorder. Depressive disorders increased the risk of suicide among males and more strongly among the elderly, calling for focused attention toward disease identification and treatment provision targeting this age group. Alcohol use disorders and dementia increased the risk of dying by mental and behavioural disorders, whereas alcohol use disorders, other substance use disorders and any other psychiatric disorders increased the risk of death by other external causes.

All DSH patients should receive a psychiatric evaluation before discharge from general hospital. Our findings of large gender and age differences in the association between specific psychiatric disorders and cause specific death highlight the importance of timely follow-up after discharge and tailoring of treatment to the patients' specific risk profiles.

#### Data availability

This study was based on individual-level data from The Norwegian Cause-of-Death Register (held by Norwegian Institute of Public Health), The Norwegian Patient Registry (held by Norwegian Directorate of Health), The Central Population Register and the Statistics Norway's events database (held by Statistics Norway). The ethical approval of this research project does not include permission to publicly share the raw data. Qualifying researchers can apply for access to relevant data with the Norwegian Institute of Public Health (<https://www.fhi.no/en/>), the Statistics Norway (<https://www.ssb.no/en/omssb/tjenester-og-verktoy/data-til-forskning>) and Norwegian Directorate of Health (<http://helsedirektoratet.no/english/norwegian-patient-registry>) upon the approval from the Regional Committees for Medical and Health Research Ethics (<https://helseforskning.etikkom.no/>).

## Ethical considerations

Access to the data for this study was approved by the Regional Ethical Committee for Medical and Health Research and owners of the relevant individual registers.

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## CRediT authorship contribution statement

PQ prepared the data and conceived the idea of the study together with ASB. ASB performed the statistical analysis, interpreted the results and prepared the manuscript. PQ, LM and IM contributed to the data interpretation and critically revised the manuscript. All authors read and approved the final version of the manuscript. PQ and ASB had access to the data.

## Declaration of competing interest

Declaration of interest: none.

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Data from the Norwegian Patient Registry has been used in this publication. The interpretation and reporting of these data are the sole responsibility of the authors, and no endorsement by the Norwegian Patient Registry is intended nor should be inferred.

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