

# Association Between Deliberate Self-harm and Violent Criminality

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 Supplemental content

**IMPORTANCE** Individuals who self-harm may have an increased risk of aggression toward others, but this association has been insufficiently investigated. More conclusive evidence may affect assessment, treatment interventions, and clinical guidelines.

**OBJECTIVE** To investigate the association between nonfatal self-harm and violent crime.

**DESIGN, SETTING, AND PARTICIPANTS** This population-based longitudinal cohort study, conducted from January 1, 1997, through December 31, 2013, studied all Swedish citizens born between 1982 and 1998 who were 15 years and older (N = 1 850 252). Individuals who emigrated from Sweden before the age of 15 years (n = 104 051) or immigrated to Sweden after the age of 13 years (ie, <2 years before the beginning of the follow-up; n = 22 009) were excluded. Data analysis was performed from April 21, 2016, to June 4, 2016.

**EXPOSURES** Receipt of self-harm-associated clinical care.

**MAIN OUTCOMES AND MEASURES** Conviction of a violent crime according to the Swedish penal code.

**RESULTS** The study cohort consisted of 1 850 525 individuals (950 382 males and 900 143 females), and the mean (SD) follow-up time was 8.1 (4.7) years (range, 0-17.0 years; minimum age, 15 years; maximum age, 32 years). During a mean follow-up period of 8.1 years, 55 185 individuals (3.0%) received clinical care for self-harm. The crude hazard ratio was 4.9 (95% CI, 4.8-5.0) for violent crime conviction in exposed individuals compared with the unexposed group. Women who self-harm were at particularly high risk for expressing violent behaviors. After adjustment for relevant psychiatric comorbidities and socioeconomic status, an almost doubled hazard of violent offense remained (hazard ratio, 1.8; 95% CI, 1.8-1.9).

**CONCLUSIONS AND RELEVANCE** Self-harm is associated with an increased risk of conviction for a violent offense in both sexes. The risk of violence, as well as the risk of suicide and self-harm, should be assessed among offending and self-harming individuals.

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Nonfatal deliberate self-harm (DSH) is the act of inflicting harm on oneself through the ingestion of harmful substances or causing tissue damage (eg, cutting or burning oneself).<sup>1</sup> Although most epidemiologic research in this area has focused on DSH as a risk factor for completed suicide,<sup>2-5</sup> the term also includes self-harming acts performed without suicidal intent (eg, behaviors aimed at regulating an intense negative state).<sup>6-8</sup> Typically, DSH debuts between the ages of 12 and 14 years, and it is increasingly being recognized as a serious global health problem<sup>9-11</sup> and as a risk factor for future attempted or completed suicide<sup>5</sup> and for the development of psychiatric disorders, substance abuse, and antisocial behavior.<sup>12-14</sup>

Impulsive hostility and aggression are linked to violent crime<sup>15</sup> and suicide<sup>16,17</sup> in psychiatric and forensic populations.<sup>18,19</sup> Thus, individuals vulnerable to impulsive aggression and self-harm may share a proneness to emotional dysregulation through increased autonomic arousal and low tolerance for adversities, particularly related to perceived or actual interpersonal threats.<sup>20,21</sup> Research suggests that the expression of aggressive acts toward oneself and others serves a short-term emotion regulative function (ie, immediate reduction of unwanted experiences).<sup>6,22-25</sup>

Several psychiatric disorders have been associated with an increased risk of violent crime (eg, bipolar disorder, borderline personality disorder [BPD], antisocial personality disorder [ASPD]).<sup>26-29</sup> However, not all phenotypes within and between psychiatric disorders may be associated with an increased risk of violence.<sup>30</sup> Because self-harm occurs in the context of many different psychiatric disorders,<sup>31</sup> it could be used as a behavioral marker of an underlying vulnerability of emotional and behavioral dysregulation relevant to violent crime (eg, impulsive aggression and emotion regulation) across diagnoses.

We used a large population register to study the association between clinical care for self-harm and violent crime. We hypothesized that we would find a unique association between nonfatal DSH and violent crime after adjusting for relevant psychiatric comorbidities in a large population-based cohort.

## Methods

### National Registers

We conducted a population-based, nationwide cohort study with data from Swedish longitudinal population registers. Registers were linked and anonymized by an independent government agency (Statistics Sweden) using the personal identification number assigned to all Swedish residents at birth or immigration.<sup>32</sup> After linkage, the data were deidentified, and the link connecting the data with the personal identification number was destroyed.

Data on DSH and psychiatric diagnoses were collected from the National Patient Register (NPR) held by the National Board of Health and Welfare,<sup>33</sup> which covers somatic and psychiatric inpatient care from 1973 and specialized outpatient care from 2001. The NPR contains records and diagnoses accord-

### Key Points

**Question** Are individuals who self-harm prone to aggressive behavior toward others?

**Findings** In this population-based cohort study of 1 850 525 individuals, there was an almost doubled risk of violent crime among self-harming individuals after adjusting for psychiatric comorbidity and socioeconomic status.

**Meaning** The risk of future violence, as well as self-harm and suicide risk, should be assessed among self-harming and offending individuals.

ing to the *International Classification of Diseases, Ninth Revision (ICD-9)* and *International Statistical Classification of Diseases and Health-Related Problems, Tenth Revision (ICD-10)* for visits to private and public caregivers, with approximately 100% coverage for inpatient care and 80% coverage for outpatient care. Information on outcome was collected from the National Crime Register (Swedish National Council for Crime Prevention), which contains information on all criminal convictions in Swedish lower courts since 1973. We used the Total Population Register (Statistics Sweden)<sup>34</sup> for demographic data on sex, birth date, death date, emigration, and immigration and the Multi-Generation Register (Statistics Sweden) for data on family relations. Finally, for information on Swedish residents' highest level of education, the Education Register (Statistics Sweden) was used. This study was approved by the Stockholm Regional Ethics Committee. Because this was a registry study, no individual was contacted, and informed consent was waived by the Stockholm Regional Ethics Committee.

### Study Cohort

Because previous studies<sup>12,35</sup> have indicated that the association between DSH and impulsive aggression is age related, we restricted our cohort to a younger sample. All individuals born from January 1, 1982, through December 31, 1998, and alive and residing in Sweden at the age of 15 years were included in the cohort (N = 1 976 714), excluding all individuals who emigrated from Sweden before the age of 15 years (n = 104 051). To avoid confounding attributable to the stress of being in the asylum-seeking process, all individuals who immigrated to Sweden after the age of 13 years (ie, <2 years before the beginning of follow-up; n = 22 009) were excluded from the cohort. Furthermore, we excluded patients who died during the DSH episode, implicating death caused by DSH (n = 102), or within 1 week after the DSH episode (n = 27) to minimize the risk of classifying completed suicides or late effects of attempted suicide as nonfatal DSH. Data analysis was performed from April 21, 2016, to June 4, 2016.

### Exposure

Exposure was defined as having a record of intentional self-harm (ICD-9 codes E950-9 and ICD-10 codes X60-84) or an event of undetermined intent (ICD-9 codes E980-9 and ICD-10 codes Y10-34)<sup>3</sup> as registered in the NPR during 1994 to 2013.

## Outcome

The studied outcome was conviction of a violent crime, according to the Swedish penal code (chapters 3, 4, 6-8, 13, 16, and 17), during follow-up. Violent crime includes all forms and degrees of homicide, assault, causing death or injury, kidnapping, threats, stalking, coercion, violation of another's liberty, integrity or domiciliary peace, sexual crimes, child pornography crimes, robbery, arson, rioting, disorderly conduct, agitation, or violent resistance against authorities. The cohort was followed up from the age of 15 years (age of criminal responsibility in Sweden) until being convicted of a violent crime, death, first emigration after the age of 15 years, or end of follow-up (December 31, 2013).

## Covariates

We included birth year as a categorical variable in the analyses. Psychiatric diagnoses relevant to DSH and impulsive aggression (BPD, ASPD, bipolar disorder, attention-deficit/hyperactivity disorder, substance use disorders [SUDs], eating disorders, depression, anxiety disorders, any psychotic disorders, and autism spectrum disorders) were included as dichotomous covariates to determine whether a statistically significant association between self-harm and violent crime would remain after adjustment. We constructed one diagnostic group of all SUDs and one diagnostic group of all psychotic disorders. The psychiatric diagnoses were collected from the NPR as having a record of *ICD-9* or *ICD-10* psychiatric diagnoses at any time during the follow-up period (see eTable 1 in the [Supplement](#) for *ICD-9* and *ICD-10* codes). Bipolar disorder, BPD, and ASPD were entered as covariates in an adjusted model to study their effect on the association between DSH and violent crime because these diagnoses repeatedly have been connected to impulsive aggression and DSH in clinical samples.<sup>17</sup> In a final, fully adjusted model, all psychiatric diagnoses described above were entered as covariates. As proxies for socioeconomic status, we used the mother's (biological or adoptive mother) highest level of education (7-point ordinal scale, with 1 indicating not having completed compulsory school to 7 indicating postgraduate education) and family income at the age of 13 years (in quintiles, calculated per each year), which were used as categorical covariates in the fully adjusted analyses.

## Sensitivity Analysis

To test the robustness of our findings and the specific association of violent crime and DSH, we performed additional analyses. First, we investigated the association between DSH and any crime (ie, violent and nonviolent crimes [eg, theft, traffic offenses, crimes related to drugs and smuggling, and economic crimes]). Second, we investigated a reversed statistical model in which DSH was entered as the outcome and violent crime was entered as the exposure. Third, we investigated the particular effect of violent compared with nonviolent crime on DSH in the reversed model by separating violent and nonviolent crimes and entering them as indicators in a Cox proportional hazards regression model. Fourth, we tested the association between DSH and violent crime over differing intent (undetermined, deliberate) and all levels of DSH lethality<sup>2</sup> to ensure that our findings were not driven by only a small group of highly lethal DSH acts (eTables 2-6 in the [Supplement](#)).

## Statistical Analysis

We compared exposed and unexposed groups by using  $\chi^2$  tests for categorical covariates and independent-sample 2-tailed *t* tests for continuous covariates. The Kruskal-Wallis test was used to compare the overall difference in socioeconomic status. We calculated incidence rates (number of events divided by number of person-years) of violent crime conviction for the exposed and unexposed groups.

Incidence rate ratios with 95% CIs were estimated, adjusted for sex for the total cohort analyses (by stratification) and separately for men and women in the sex-specific analyses. We performed 2 sets of Cox proportional hazards regression analyses. During the first step, we did not account for the timing of the exposure (ie, DSH-associated care) so that the exposure could have happened at any time during the observation period (including after a criminal conviction). In the second step, we included the timing of being exposed to a DSH-associated event as a time-varying covariate, where individuals were assumed to be unexposed before their first DSH event and exposed after the event (ie, only individuals exposed to DSH before an eventual violent crime conviction were classified as exposed). Because DSH could occur as early as 12 years of age, individuals with a DSH diagnosis before their 15th birthday were classified as exposed at the beginning of follow-up.

For each set of analyses, we estimated hazard ratios (HRs) for violent criminal convictions among individuals exposed to DSH care compared with those not exposed. Furthermore, we estimated HRs in crude (no covariates), multivariable adjusted (BPD, ASPD, and bipolar disorder), and fully adjusted (all psychiatric comorbidity and socioeconomic status) Cox proportional hazards regression models. All analyses were adjusted for sex using stratified Cox proportional hazards regression models. In addition, all analyses were adjusted for birth year to control for changes in rates of registration of DSH. Because we wanted to explore sex-specific patterns, all analyses were also conducted separately for men and women. The precision of all estimates (ie, the CIs) were adjusted for familial clustering using a cluster-robust sandwich estimator. To ensure comparable estimates among all analyses, individuals with missing information on motherhood, mother's educational level, and/or family income at the age of 13 years were excluded (*n* = 63 100 [3.4%]) from the Cox proportional hazards regression analyses and when estimating the incidence rate ratios. All analyses were conducted with STATA statistical software, version 14.1 (StataCorp). *P* < .05 (2-sided *t* test) was considered statistically significant.

## Results

Our cohort consisted of 1 850 525 individuals (950 382 males and 900 143 females), and the mean (SD) follow-up time was 8.1 (4.7) years (range, 0-17.0 years; minimum age, 15 years; maximum age, 32 years).

## Demographic Data

**Table 1** gives the demographic and clinical data. During follow-up, 55 185 patients (3.0%) from the total cohort

Table 1. Demographic and Descriptive Characteristics of the Study Cohort<sup>a</sup>

Characteristic	Exposed to Self-harm (n = 55 185)	Unexposed (n = 1 795 340)	P Value <sup>b</sup>
Males	24 219 (43.9)	926 163 (51.6)	<.001
Females	30 966 (56.1)	869 177 (48.4)	<.001
Age group, y			
27-32	24 778 (44.9)	588 459 (32.8)	<.001
21-26	23 502 (42.6)	706 537 (39.4)	
15-20	6905 (12.5)	500 344 (27.8)	
Mother's educational level			
No information available	1844 (3.3)	57 024 (3.2)	<.001
Primary or lower secondary education, y			
≤9	1953 (3.6)	59 714 (3.3)	
>9	9747 (17.7)	209 075 (11.7)	
Upper secondary education, y			
1-2	21 746 (39.4)	637 813 (35.5)	
3	6196 (11.2)	256 542 (14.3)	
Postsecondary education, y			
<3	7417 (13.4)	292 586 (16.3)	
≤3	6116 (11.1)	274 672 (15.3)	
Postgraduate education	166 (0.3)	7914 (0.4)	
Violent crime conviction			
During follow-up	8155 (14.8)	58 406 (3.3)	<.001
After DSH <sup>c</sup>	3233 (5.9)	NA	NA
Age at first violent crime, mean (SD), y	18.8 (3.2)	18.5 (3.1)	<.001
Person-years at risk	493 183	14 563 396	NA
Incidence rate per 1000 person-years	16.5	4.0	<.001
Age at first DSH, mean (SD), y			
Males	19.7 (4.1)	NA	<.001
Females	18.7 (3.7)	NA	
Lethality of DSH <sup>d</sup>			
Low	52 148 (94.5)	NA	NA
Medium	2526 (4.6)	NA	
High	511 (0.9)	NA	
Psychiatric diagnosis			
Borderline personality disorder	4706 (8.5)	4171 (0.2)	<.001
Antisocial personality disorder	296 (0.5)	436 (0.0)	
Substance use disorders	17 546 (31.8)	66 195 (3.7)	
ADHD	7630 (13.8)	51 760 (2.9)	
Bipolar disorder	3450 (6.3)	8722 (0.5)	
Psychotic disorders	2599 (4.7)	7652 (0.4)	
Eating disorders	3173 (5.6)	19 158 (1.1)	
Anxiety disorders	17 623 (31.9)	73 616 (4.1)	
Depression	21 165 (38.4)	103 341 (5.8)	
Autism	2654 (4.8)	24 607 (1.4)	

## Abbreviations:

ADHD, attention-deficit/hyperactivity disorder;  
DSH, deliberate self-harm;  
NA, not applicable.

<sup>a</sup> Data are presented as number (percentage) of patients unless otherwise indicated.

<sup>b</sup> Significance testing of differences between exposed vs unexposed (except age at first DSH for which the age difference between males and females in the exposed group is tested) with Pearson  $\chi^2$  test for categorical data, Kruskal-Wallis  $\chi^2$  test for mother's educational level, and independent-sample 2-tailed t test for continuous data.

<sup>c</sup> Proportion of exposed individuals for whom DSH preceded violent crime conviction.

<sup>d</sup> Grouping of lethality of *International Statistical Classification of Diseases and Health-Related Problems, 10th Revision (ICD-10)* and *International Classification of Diseases, Ninth Revision (ICD-9)* self-harm codes derived from Runeson et al.<sup>2</sup> Low includes poisoning and cutting; medium, gassing and drowning; high, strangulation and suffocation.

received DSH-associated clinical care (exposed), with 29 483 DSH events (53.4%) registered in outpatient clinics. Among all exposed patients, 8186 (14.8%) had their first record of DSH before the age of 15 years. The most common form of self-harm was intentional self-poisoning by unspecified drugs, medicaments, and biological substances (*ICD-10* code X64; 15 123 patients [27.4%]) followed by intentional self-harm by a sharp object (*ICD-10* code X78; 4814 patients [8.7%]). Of all patients with DSH, 52 148 (94.5%) had engaged in low-lethality methods of DSH (cutting, poisoning), whereas 2526 (4.6%) engaged in medium-lethality

methods (drowning, gassing), and 511 (0.9%) engaged in high-lethality DSH (suffocation, strangulation).

We observed statistically significant differences between the exposed and unexposed group on all investigated variables (Table 1). Compared with the unexposed group, the exposed group had a larger proportion of women, lower socioeconomic status, and higher psychiatric comorbidity, especially within the ASPD, BPD, and bipolar disorder diagnoses (all  $P < .001$ ).

Of the 66 561 individuals who were convicted of a violent crime during follow-up, 55 873 (83.9%) were male and 10 688

**Table 2. Violent Crime Conviction in Individuals Exposed to DSH-Associated Clinical Care at Any Time Point During Follow-up Compared With Individuals Not Exposed to DSH**

Group	IRR (95% CI)	HR (95% CI) <sup>a</sup>		
		Crude	Adjusted <sup>b</sup>	Fully Adjusted <sup>c</sup>
Total cohort <sup>d</sup>	4.8 (4.7-4.9)	4.9 (4.8-5.0)	4.3 (4.2-4.4)	1.8 (1.8-1.9)
Males (n = 917 388)	4.2 (4.1-4.4)	4.3 (4.2-4.5)	3.9 (3.8-4.0)	1.7 (1.7-1.8)
Females (n = 870 037)	7.2 (6.9-7.6)	7.6 (7.2-7.9)	6.3 (6.0-6.6)	2.1 (2.0-2.3)

Abbreviations: DSH, deliberate self-harm; HR, hazard ratio; IRR, incidence rate ratio.

<sup>a</sup> All HRs are adjusted for familial clustering (n = 1 787 425).

<sup>b</sup> Adjusted for birth year, bipolar disorder, borderline personality disorder, and antisocial personality disorder.

<sup>c</sup> Adjusted for birth year, borderline personality disorder, antisocial personality

disorder, bipolar disorder, any substance use disorders, psychotic disorders, autism, attention-deficit/hyperactivity disorder, anxiety disorders, eating disorders, depression, mother's educational level, and family income at the age of 13 years.

<sup>d</sup> The total cohort estimates are adjusted for sex by stratification.

**Table 3. Violent Crime Conviction With Time-Varying Covariates for Individuals Exposed to DSH Before Having the Outcome (Criminal Conviction) Compared With Individuals Not Exposed to DSH or Exposed to DSH After the Outcome**

Group	IRR (95% CI)	HR (95% CI) <sup>a</sup>		
		Crude	Adjusted <sup>b</sup>	Fully Adjusted <sup>c</sup>
Total cohort <sup>d</sup>	3.5 (3.5-3.6)	4.7 (4.6-4.9)	4.2 (4.0-4.3)	2.2 (2.1-2.2)
Males (n = 917 388)	2.8 (2.7-2.9)	3.8 (3.6-4.0)	3.7 (3.5-3.9)	2.0 (1.9-2.1)
Females (n = 870 037)	5.7 (5.4-6.1)	8.1 (7.6-8.6)	6.1 (5.7-6.6)	2.3 (2.1-2.5)

Abbreviations: DSH, deliberate self-harm; HR, hazard ratio; IRR, incidence rate ratio.

<sup>a</sup> All HRs are adjusted for familial clustering (n = 1 787 425).

<sup>b</sup> Adjusted for birth year, bipolar disorder, borderline personality disorder, and antisocial personality disorder.

<sup>c</sup> Adjusted for birth year, borderline personality disorder, antisocial personality

disorder, bipolar disorder, any substance use disorders, psychotic disorders, autism, attention-deficit/hyperactivity disorder, anxiety disorders, eating disorders, depression, mother's educational level, and family income at the age of 13 years.

<sup>d</sup> The total cohort estimates are adjusted for sex by stratification.

(16.1%) were female. In total, 8155 (0.4%) of the cohort were exposed to DSH and convicted of a violent crime.

### Cox Proportional Hazards Regression Models

We visually inspected the Schoenfeld residuals for violations of the proportional hazards regression assumption. No covariate had unacceptable violations. Individuals with observed DSH events had an almost 5 times higher crude HR of being convicted of a violent crime at any time during follow-up compared with individuals without exposure to DSH-associated care (HR, 4.9; 95% CI, 4.8-5.0) (Table 2). Adjusting for BPD, ASPD, and bipolar disorder reduced the HR to 4.3 (95% CI, 4.2-4.4), whereas in the fully adjusted model including all psychiatric comorbidity and socioeconomic status, the HR was further reduced by more than half (HR, 1.8; 95% CI, 1.8-1.9). Of the psychiatric diagnoses, SUDs had the strongest association with violent criminality in the fully adjusted model (HR, 4.0; 95% CI, 3.9-4.1). When analyzing the HRs separately by sex, women with DSH events had a 6 to 7 times higher hazard of being convicted of a violent crime compared with women without DSH in the crude and adjusted model, whereas men with DSH had an approximately 4 times higher hazard of being convicted. However, in the fully adjusted model, all HRs were considerably more similar, between 1.7 and 2.1, with the highest HR in women.

Adjusting for the timing of exposure (the time-varying covariates model) slightly increased the fully adjusted HR (HR, 2.2; 95% CI, 2.1-2.2), but the overall pattern of HRs in the total cohort and the sex-specific analyses was similar to the

patterns in the first sets of Cox proportional hazards regression analyses described above (Table 3).

### Sensitivity Analyses

Analyzing the association between DSH and any crime revealed lower hazards and fewer sex differences in all models compared with the association with violent crime (eTable 2 in the Supplement). The reversed model, in which we examined the association between violent crime as exposure and DSH as outcome, revealed hazards similar to those of the model presented in Table 2 and Table 3, with an HR of 1.8 (95% CI, 1.8-1.9) for the total cohort fully adjusted model but a slightly lower hazard for the time-varying fully adjusted model (HR, 1.9; 95% CI, 1.8-2.0). Furthermore, separating violent from non-violent crime revealed a significantly stronger hazard (HR, 1.1; 95% CI, 1.1-1.2;  $P < .001$ ) of having received clinical care for DSH if exposed for conviction of a violent crime than for non-violent crime (eTable 4 in the Supplement). Deliberate self-harm, compared with undetermined intent, revealed higher HRs in the crude and adjusted models but was equal in the fully adjusted model (eTable 5 in the Supplement). Finally, degree of DSH lethality was positively correlated with hazards of violent crime (HRs, 4.3-10.2) (eTable 6 in the Supplement).

### Discussion

This population-based cohort study examined the risk of violent crime in individuals aged 15 to 32 years who had been in



contact with the health care system because of DSH. We found a 5 times higher crude HR of being convicted of a violent crime if exposed to DSH-associated clinical care. After adjusting for psychiatric comorbidity and environmental factors, DSH was associated with a doubled risk for a violent crime conviction, suggesting a unique association between nonfatal DSH and violent offense in both sexes. Our results strengthen findings from previous clinical and epidemiologic studies<sup>12,14,36,37</sup> that indicate such a link. With the present study, we extend these observations to a population-based sample of more than 50 000 individuals in the DSH-exposed group and with more than 50% of our data on DSH collected from outpatient clinics.

There was a particularly strong risk of violent offense in self-harming females, in line with findings of increased risk of DSH in female violent offenders.<sup>18,19</sup> In this cohort, this association was partially explained by SUDs rather than BPD, a psychiatric disorder repeatedly associated with aggressive behavior in self-harming women.<sup>38-40</sup> Controlling for comorbid SUDs contributed to the greatest risk reduction for women (and for men) with DSH. Substance use disorders have repeatedly been linked to an increased risk of violent crime, a finding that seems to be of particular relevance to individuals with DSH because difficulties with self-regulation may be exacerbated by alcohol or drug abuse.<sup>41,42</sup>

The sensitivity analyses strengthened our findings because they found a significantly stronger association with violent crime compared with any crime and nonviolent crime. Furthermore, the hazard of violent offense was strong for all degrees of DSH intent and lethality, thus suggesting that this increased risk is relevant to nonfatal DSH and not only to more severe suicidal behaviors or failed suicide attempts.<sup>16,17,20</sup>

We examined DSH-associated care as a separate exposure regardless of other diagnoses in a population-based cohort. This is important because nonfatal DSH is common in community samples (estimated prevalence of 13% to 17% for adolescents and young adults)<sup>43</sup> and typically emerges in early adolescence, sometimes before the onset of any identifiable psychiatric diagnosis. Deliberate self-harm differs topographically (ie, less lethal means used, engaged in more frequently) and demographically (ie, younger individuals, higher percentage of women) from completed suicides but is nevertheless a strong indicator of completed suicide.<sup>5,36,44,45</sup> Although the design of our study did not allow us to determine any causal pathways, our study suggests that nonfatal DSH is also associated with criminal aggression toward others. Of importance, when reversing our analy-

ses, using violent crime as the exposure and DSH as the outcome, we found similar hazards as in our main analysis, suggesting a shared vulnerability to impulsive and aggressive acts rather than a causal relationship. Several such risk factors and mechanisms have been suggested, such as serotonergic dysfunction,<sup>46</sup> impulsive-aggressive traits,<sup>16</sup> and emotion regulation difficulties.<sup>22,24,25,47</sup> Thus, DSH could be viewed as an early behavioral marker of difficulties with emotional and behavioral regulation that, independently of co-occurring psychiatric disorders,<sup>31</sup> may increase the risk of committing violent crimes. Our results are as relevant for antisocial or aggressive individuals as they are for self-harming individuals, and the results point to the need for broad assessments and treatment interventions to support vulnerable individuals across both sexes.

### Strengths and Limitations

There are several strengths to our study. This is the largest population-based study, to our knowledge, on the association between violent crime and DSH, with few missing data and the possibility to study sex differences while controlling for several relevant confounders. Our results provide evidence of a unique, significant association between nonfatal DSH and violent crime by using stringent criteria for exposure and outcome.

Important limitations include that our study design did not allow for examination of suicidal intent, repeated DSH (because we investigated only the first DSH event), or closer examination of contextual factors preceding the self-harm. In addition, our study's focus on patients aged 15 to 32 years may limit its generalizability to older age groups. Furthermore, health care contacts for DSH are rare,<sup>48</sup> and only 3% of our cohort received DSH-associated clinical care, suggesting that we only captured a small proportion of self-harming individuals that may not be representative of the entire self-harming population.<sup>13,48</sup> This limitation is also true for our outcome variable because not all violent acts lead to criminal convictions.

### Conclusions

In the assessment and treatment of individuals who self-harm, impulsive aggression and emotion regulation difficulties should be investigated and addressed, regardless of sex and co-occurring diagnoses. In addition, assessment of DSH in aggressive or antisocial individuals should affect clinical work and treatment guidelines in both sexes.

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