

Suicide Attempt and Risk of Substance Use Disorders Among Female Youths

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 Supplemental content

IMPORTANCE Suicide attempts are prevalent among female youths, yet little is known about the subsequent development of substance use disorders.

OBJECTIVE To assess the association between suicide attempts among females before 20 years of age and future risk of substance use disorders.

DESIGN, SETTING, AND PARTICIPANTS In this longitudinal cohort study, females aged 8 to 19 years (hereafter referred to as youths) who attempted suicide were matched with female youths with no attempt between April 1, 1989, and March 31, 2019, in Quebec, Canada. The cohort was followed up for 31 years, for a total of 2 409 396 person-years, to identify subsequent substance use disorders.

EXPOSURES Confirmed suicide attempts among females 8 to 19 years of age.

MAIN OUTCOMES AND MEASURES The main outcome measure was hospitalization for a substance use disorder later in life. Hazard ratios (HRs) and 95% CIs for the association of suicide attempt with substance use disorders were estimated using Cox proportional hazards regression models adjusted for baseline age, mental illness, resource-limited socioeconomic status, and year at start of follow-up.

RESULTS Among 122 234 female youths (mean [SD] age, 15.6 [1.9] years), 5840 (4.8%) attempted suicide and 4341 (3.6%) developed a substance use disorder. Compared with the 116 394 matched female youths who did not attempt suicide (95.2%), those who attempted suicide had a greater risk of hospitalization for any substance use disorder during the follow-up period (HR, 6.03; 95% CI, 5.39-6.77), especially sedative or hypnotic use disorders (HR, 32.24; 95% CI, 23.29-44.64). Suicide attempt was associated with the development of sedative or hypnotic use disorders up to 5 years (HR, 66.69; 95% CI, 34.72-128.09), although risks remained elevated up to 3 decades later for all substances. Compared with those without suicide attempt, female youths with 3 or more suicide attempts had 21.20 (95% CI, 13.53-32.90) times the risk of substance use disorders, whereas female youths with 1 attempt had 5.70 (95% CI, 5.08-6.41) times the risk of these disorders.

CONCLUSIONS AND RELEVANCE In this cohort study, female youths who attempted suicide had increased risk of subsequent substance use disorders compared with female youths who did not attempt suicide. These findings suggest that closer management and prevention of substance use among female youths who attempt suicide may be beneficial.

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Suicide attempts during adolescence are common,¹ but the association with substance use disorders that later develop is poorly understood. Adolescent girls who contemplate or attempt suicide may experience psychosocial circumstances associated with risk of developing substance use disorders later in life. Substance use frequently begins in adolescence,² and a considerable proportion of adolescent females use substances.³ In the US, 17% of girls in eighth grade reported drug use in the past year.³ Alcohol consumption is higher among females aged 12 to 20 years than among males in that age group.⁴ Recently, it has been proposed that the COVID-19 pandemic may be associated with increased substance use among adolescent girls,⁵ many of whom may have a history of suicide attempt or mental health disorders. However, the associations between suicide attempt and later onset of substance use disorders remain largely unknown.²

Many studies have considered the reverse association, examining substance use as a factor associated with subsequent suicidal ideation or suicide attempt.² However, suicide attempts may occur before the onset of substance use in many patients. Female youths may attempt suicide before substance use begins. Several studies addressing the timing of suicide attempts have not shown consistent results regarding the association between self-reported attempts and future substance use.^{6–11} Some studies found that self-reported suicide attempts were associated with the onset of substance use,^{6–9} whereas others reported no association.^{10,11} However, most studies included a small number of adolescents, often fewer than 200 with suicide attempts, and may have been underpowered.^{6–11} In this study, we assessed the association between suicide attempts and future risk of substance use disorders in a large cohort of females aged 8 to 19 years (hereafter referred to as youths).

Methods

Study Design and Population

This matched cohort study included female youths in Quebec, Canada, who were admitted to a hospital for a suicide attempt before 20 years of age between April 1, 1989, and March 31, 2019. Using the Maintenance and Use of Data for the Study of Hospital Clientele repository,¹² we extracted data on 5840 female youths who were admitted for a suicide attempt and 116 394 population controls with no history of suicide attempt, allowing for 1:20 matching. The registry contains most females in Quebec because many present to hospitals for reproductive or nonreproductive care. We included suicide attempts beginning at 8 years of age, the lower age of puberty in females. This study was approved by the University of Montreal Hospital institutional review board, which provided a waiver from ethics review and informed consent because data were deidentified. This study followed the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) reporting guideline.

We matched female youths by age and year of first suicide attempt and conducted follow-up using health insur-

Key Points

Question Do female youths who attempt suicide have an increased risk of substance use disorders later in life?

Findings In this cohort study of 122 234 females aged 8 to 19 years followed up for 31 years, suicide attempts before 20 years of age were associated with greater risk of developing a substance use disorder later in life compared with no suicide attempt. Female youths with repeated suicide attempts or who attempted suicide by hanging or suffocation were at greatest risk of subsequent substance use disorders.

Meaning The findings suggest that female youths who attempt suicide may require better monitoring for substance use disorders after the initial suicide attempt.

ance identification numbers. We began follow-up on the date of the first suicide attempt for the exposure group and the matched comparison group. We did not include female youths with fatal suicide attempts or without health insurance identification numbers because they could not be followed up. We excluded girls with substance use disorders that were diagnosed during hospital admissions before or at the time of the first suicide attempt.

Suicide Attempt

The main exposure measure was hospitalization for a suicide attempt or deliberate self-harm between 8 and 19 years of age. We categorized suicide attempts based on total number of attempts (1, 2, or ≥3), age at first attempt (8–13, 14–15, 16–17, or 18–19 years), and method (self-poisoning, hanging or suffocation, cutting or piercing, jumping from a height or in front of a moving vehicle, or other violent means). Other violent means included drowning, firearms, fire or heat, caustic substances, motor vehicle collision, electrocution, and unspecified suicide attempts. We used diagnostic codes for self-harm from the *International Classification of Diseases, Ninth Revision (ICD-9)* and the *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision (ICD-10)* to identify suicide attempts (eTable 1 in the [Supplement](#)).^{13,14} Because hospitalization for nonsuicidal self-harm was infrequent, the data mainly captured suicide attempts.

Substance Use Disorders

The main outcome measure was hospitalization for a substance use disorder later in life. We defined substance use disorders as misuse of, dependence on, overdose from, or poisoning from alcohol, cannabis, opioids, cocaine, stimulants, hallucinogens, sedatives or hypnotics, volatile solvents, and other psychotropic drugs. Substance use disorders were confirmed by toxicology screening and clinical assessment, although the data did not allow us to distinguish how the diagnosis was made. We included only confirmed substance use disorders that required hospital treatment, not disorders that were self-reported and potentially unconfirmed. We captured substance use disorders using *ICD-9* and *ICD-10* codes (eTable 1 in the [Supplement](#)).

Table 1. Characteristics of Females Aged 8 to 19 Years With and Without Suicide Attempts and Substance Use Disorders

Characteristic	Females, No. (%)			
	Suicide attempt (n = 5840)		No suicide attempt (n = 116 394)	
	Substance use disorder (n = 1104)	No substance use disorder (n = 4736)	Substance use disorder (n = 3237)	No substance use disorder (n = 113 157)
Age at baseline, y				
<15	342 (31.0)	1378 (29.1)	1011 (31.2)	33 347 (29.5)
≥15	762 (69.0)	3358 (70.9)	2226 (68.8)	79 810 (70.5)
Preexisting mental illness				
Any mental illness	737 (66.8)	3055 (64.5)	80 (2.5)	748 (0.7)
Schizophrenia	20 (1.8)	27 (0.6)	<5 (<0.2)	27 (0.02)
Depression	154 (13.9)	623 (13.2)	11 (0.3)	114 (0.1)
Bipolar disorder	72 (6.5)	206 (4.4)	5 (0.2)	38 (0.03)
Stress and anxiety disorder	566 (51.3)	2331 (49.2)	62 (1.9)	593 (0.5)
Personality disorder	243 (22.0)	770 (16.3)	22 (0.7)	150 (0.1)
No mental illness	367 (33.2)	1681 (35.5)	3157 (97.5)	112 409 (99.3)
Preexisting mental illness or mental illness with onset during follow-up ^a				
Yes	974 (88.2)	3379 (71.3)	1261 (39.0)	6698 (5.9)
No	130 (11.8)	1357 (28.7)	1976 (61.0)	106 459 (94.1)
Resource-limited socioeconomic status ^b				
Yes	280 (25.4)	978 (20.7)	1089 (33.6)	24 924 (22.0)
No	721 (65.3)	3489 (73.7)	2010 (62.1)	82 770 (73.1)
Year at start of follow-up				
1989-1998	557 (50.5)	2420 (51.1)	1372 (42.4)	58 104 (51.3)
1999-2008	396 (35.9)	1627 (34.4)	1121 (34.6)	39 212 (34.7)
2009-2019	151 (13.7)	689 (14.5)	744 (23.0)	15 841 (14.0)

^a Schizophrenia, depression, bipolar disorder, anxiety and stress disorders, and personality disorders.

^b The most materially resource-limited quintile of the population based on a composite indicator of income, education, and employment in neighborhoods.

Covariates

We adjusted for preexisting mental illness and resource-limited socioeconomic status.⁶⁻¹¹ Mental illness included schizophrenia, depression, and bipolar, anxiety, stress, and personality disorders in the hospitalization record at the time of or before the suicide attempt (eTable 1 in the [Supplement](#)). Resource-limited socioeconomic status was measured as the most materially resource-limited quintile of the population based on a composite indicator of income, education, and employment in neighborhoods.¹⁵ We used regression to adjust for these characteristics because matching was computationally intensive. Both matching and adjustment are strategies to account for factors that may bias the association between suicide attempt and substance use disorders.¹⁶

Statistical Analysis

We calculated the incidence of substance use disorders per 10 000 person-years and the cumulative incidence at 31 years of follow-up. We estimated hazard ratios (HRs) and 95% CIs for the association of suicide attempt with subsequent substance use disorders using Cox proportional hazards regression models adjusted for preexisting mental illness and resource-limited socioeconomic status. The time scale was the number of days between the start of follow-up and the first hospitalization for a substance use disorder, death, or the end of study on March 31, 2020. We accounted for death as a com-

peting outcome using the Fine and Gray method¹⁷ because mortality precluded the development of a substance use disorder. We censored female youths who were never admitted for a substance use disorder by the end of follow-up.

We further determined how risks varied with length of follow-up after an initial suicide attempt (<5, 5-9, 10-14, or ≥15 years). We examined how the number of attempts, age at first attempt, and method affected the association with substance use disorders.

In sensitivity analyses, we adjusted the associations for mental illness diagnosed in the hospital any time during follow-up. New-onset mental health disorders may mediate the association between suicide attempt and substance use disorders. We analyzed data using SAS, version 9.4 (SAS Institute Inc).

Results

In this cohort of 122 234 female youths (mean [SD] age, 15.6 [1.9] years), 5840 (4.8%) attempted suicide between 1989 and 2019 (Table 1). During 2 409 396 person-years of follow-up over 31 years, 4341 female youths (3.6%) were hospitalized for substance use disorders, including 1104 (25.4%) with a prior suicide attempt. The incidence of hospitalization for any substance use disorder was higher among female youths who

Table 2. Association Between Suicide Attempt and Future Substance Use Disorders Among Females Aged 8 to 19 Years

Type of substance use disorder	Substance use disorders, No.		Rate of hospitalizations for substance use disorders, per 10 000 person-years (95% CI)		Hazard ratio for suicide attempt vs no attempt (95% CI)	
	Suicide attempt	No suicide attempt	Suicide attempt	No suicide attempt	Unadjusted	Adjusted ^a
Any substance use disorder	1104	3237	106.9 (100.7-113.4)	14.0 (13.6-14.5)	7.58 (7.12-8.07)	6.03 (5.39-6.77)
Alcohol use disorder	508	942	45.7 (41.9-49.9)	4.0 (3.8-4.3)	11.39 (10.36-12.52)	9.46 (8.00-11.18)
Drug use disorder						
Any	974	2823	92.8 (87.1-98.8)	12.2 (11.8-12.7)	7.53 (7.04-8.04)	5.93 (5.24-6.70)
Cannabis	333	950	29.4 (26.4-32.7)	4.1 (3.8-4.4)	7.12 (6.37-7.97)	5.80 (4.68-7.18)
Opioids	147	437	12.8 (10.9-15.0)	1.9 (1.7-2.1)	6.81 (5.76-8.05)	4.93 (3.63-6.70)
Cocaine	232	422	20.3 (17.9-23.1)	1.8 (1.6-2.0)	11.11 (9.65-12.78)	7.89 (5.93-10.49)
Stimulants	224	443	19.5 (17.1-22.2)	1.9 (1.7-2.1)	10.20 (8.86-11.74)	8.23 (6.26-10.81)
Hallucinogens	44	53	3.8 (2.8-5.1)	0.23 (0.17-0.30)	16.57 (11.77-23.33)	16.65 (8.26-33.59)
Sedatives or hypnotics	298	122	26.3 (23.5-29.5)	0.52 (0.44-0.62)	50.76 (41.99-61.36)	32.24 (23.29-44.64)
Other drugs ^b	15	20	1.3 (0.8-2.1)	0.09 (0.06-0.13)	14.98 (8.41-26.68)	5.56 (0.91-34.09)

^a Adjusted for age, preexisting mental illness (schizophrenia, depression, bipolar disorder, anxiety and stress disorders, and personality disorders), resource-limited socioeconomic status, and year at start of follow-up.

^b Volatile solvents (glue, inhalants, and other) and other psychotropic drugs.

attempted suicide (106.9 per 10 000 person-years; 95% CI, 100.7-113.4 per 10 000 person-years) than among female youths with no suicide attempt ($n = 116\ 394$; 14.0 per 10 000 person-years; 95% CI, 13.6-14.5 per 10 000 person-years) (Table 2). All types of substance use disorders were more common in female youths with a history of suicide attempt, although the incidence was the highest for alcohol, cannabis, sedative or hypnotic, cocaine, and stimulant use disorders.

Female youths who attempted suicide were at greater risk of developing substance use disorders (Table 2). Suicide attempt was associated with 6.03 (95% CI, 5.39-6.77) times the risk of any substance use disorder in adjusted models. Suicide attempt was associated with sedative or hypnotic (HR, 32.24; 95% CI, 23.29-44.64) and hallucinogen (HR, 16.65; 95% CI, 8.26-33.59) use disorders. Associations were also present with cocaine (HR, 7.89, 95% CI, 5.93-10.49), stimulant (HR, 8.23; 95% CI, 6.26-10.81), alcohol (HR, 9.46; 95% CI, 8.00-11.18), opioid (HR, 4.93; 95% CI, 3.63-6.70), and cannabis (HR, 5.80; 95% CI, 4.68-7.18) use disorders.

After 31 years of follow-up, there were 23.6 hospitalizations for substance use disorders per 100 female youths who attempted suicide compared with 3.9 per 100 female youths with no attempt (Figure). Compared with no attempt, the incidence of substance use disorders increased rapidly during the first few years after a suicide attempt. The gap between female youths with and without suicide attempts continued to widen during the remainder of the follow-up period.

The risk of substance use disorders was greatest in the immediate period after the attempt but persisted over time (Table 3). Compared with no attempt, suicide attempt was associated with 7.30 (95% CI, 6.07-8.78) times the risk of developing a substance use disorder up to 5 years, 5.73 (95% CI, 4.59-7.16) times the risk within 5 to 9 years, 5.34 (95% CI, 3.99-7.16) times the risk within 10 to 14 years, and 5.54 (95% CI, 4.29-7.16) times the risk 15 years or later. Suicide attempt was associated with all types of substance use disorders up to 5 years, especially sedative or hypnotic (HR, 66.69; 95% CI, 34.72-

128.09), hallucinogen (HR, 17.75; 95% CI, 7.18-43.89), and cocaine (HR, 15.68; 95% CI, 8.17-30.07) use disorders. Suicide attempt remained associated with all substance use disorders throughout follow-up.

Female youths with repeated suicide attempts were more likely to develop substance use disorders (Table 4). Compared with those with no attempt, female youths with 3 or more suicide attempts had 21.10 (95% CI, 13.53-32.90) times the risk of substance use disorders, whereas those with 2 attempts had 9.25 (95% CI, 7.35-11.65) times the risk, and those with 1 attempt had 5.70 (95% CI, 5.08-6.41) times the risk. Suicide attempt was associated with substance use disorders regardless of age at the time of the attempt, although risk was slightly greater when the attempt occurred between 18 and 19 years of age (HR, 6.77; 95% CI, 5.63-8.14). Female youths who attempted suicide by hanging or suffocation had the greatest risk of developing substance use disorders (HR, 12.01; 95% CI, 8.66-16.66). Suicide attempts by poisoning and cutting or piercing were associated with more than 5 times the risk of substance use disorders.

In sensitivity analyses in which we additionally adjusted for new onset of mental illness during follow-up, suicide attempts remained associated with risk of all substance use disorders, especially sedative or hypnotic use disorders (HR, 6.76; 95% CI, 5.29-8.64) (eTable 2 in the Supplement). Suicide attempts remained associated with 2 to 3 times the risk of most other substance use disorders.

Discussion

In this cohort of 122 234 female youths followed up for 31 years, those who attempted suicide had an increased risk of substance use disorders later in life, especially sedative or hypnotic, hallucinogen, and alcohol use disorders. Risk of substance use disorders was greatest up to 5 years after a first attempt, but risks remained elevated 15 or more years later.

Figure. Cumulative Incidence of Hospitalization for Substance Use Disorders Among Females Aged 8 to 19 Years During 31 Years of Follow-up

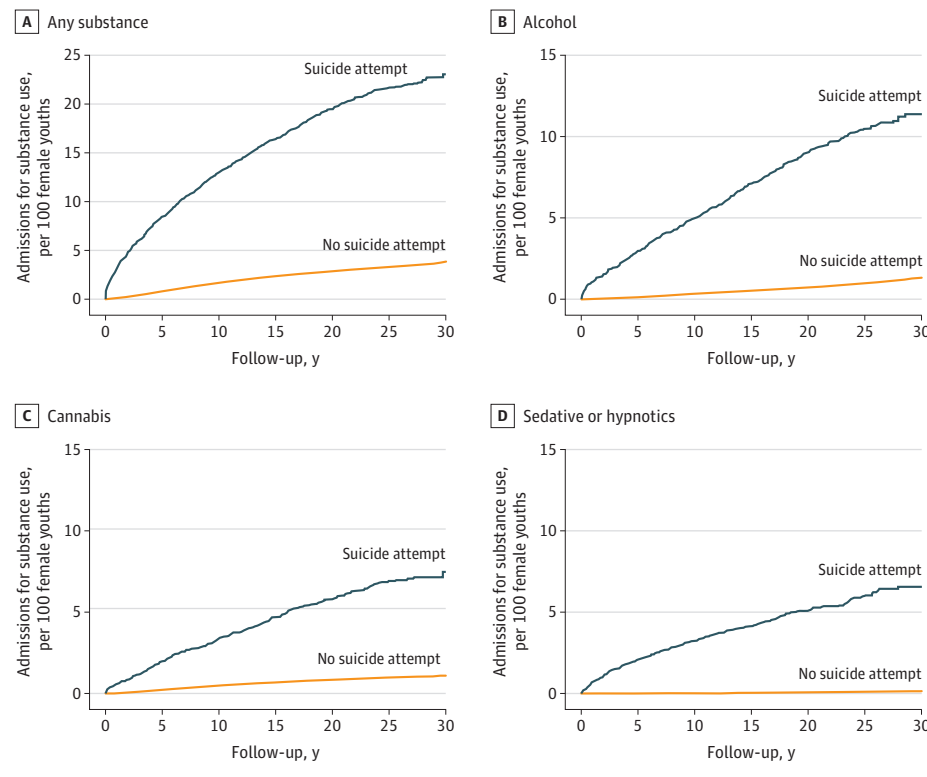


Table 3. Association Between Suicide Attempt and Timing of Hospitalization for Subsequent Substance Use Disorder Among Females Aged 8 to 19 Years^a

Type of substance use disorder	Hazard ratio for suicide attempt vs no attempt (95% CI) ^b			
	<5 y	5-9 y	10-14 y	≥15 y
Any substance use disorder	7.30 (6.07-8.78)	5.73 (4.59-7.16)	5.34 (3.99-7.16)	5.54 (4.29-7.16)
Alcohol use disorder	9.53 (7.11-12.77)	11.73 (8.26-16.65)	10.47 (7.13-15.37)	8.29 (6.01-11.43)
Drug use disorder ^c				
Any	7.19 (5.88-8.79)	5.15 (4.05-6.54)	5.45 (4.01-7.42)	6.04 (4.62-7.90)
Cannabis	5.23 (3.62-7.55)	4.22 (2.55-6.97)	9.15 (5.88-14.24)	6.94 (4.79-10.07)
Opioids	5.78 (3.19-10.47)	4.48 (2.52-7.98)	3.18 (1.43-7.08)	6.32 (3.52-11.32)
Cocaine	15.68 (8.17-30.07)	4.57 (2.50-8.38)	9.21 (5.51-15.38)	7.60 (4.30-13.45)
Stimulants	6.51 (3.71-11.43)	4.81 (2.45-9.48)	10.24 (5.35-19.59)	11.45 (7.74-16.94)
Hallucinogens	17.75 (7.18-43.89)	14.82 (3.77-58.25)	21.28 (1.96-231.57)	18.65 (2.89-120.21)
Sedatives or hypnotics	66.69 (34.72-128.09)	22.94 (11.94-44.05)	35.11 (14.72-83.75)	24.38 (13.82-43.00)

^a Timing is years after first suicide attempt.

^b Adjusted for age, preexisting mental illness (schizophrenia, depression, bipolar disorder, anxiety and stress disorders, and personality disorders),

resource-limited socioeconomic status, and year at start of follow-up.

^c Associations for other drugs could not be estimated because of small cell counts.

Female youths who attempted suicide 3 times or more or by means of hanging or suffocation had the highest risk of developing substance use disorders. The findings suggest that suicide attempts during youth may be associated with later substance misuse. Although this study could not assess causation, the data indicate that the increased risk of substance use disorders associated with suicide attempt was substantial. Female youths who attempt suicide early in life may be a group that merits preventive management to reduce the risk of substance misuse and improve health outcomes.

Previous studies of adolescent suicide attempt were limited to self-reported data that yielded conflicting results regarding associations with subsequent substance use.⁶⁻¹¹ A longitudinal study of a UK birth cohort comprising 4799 youths found that self-reported suicide attempts at 16 years of age were associated with 2 to 6 times the risk of substance use problems at 18 years of age.⁹ In a study of youths who were followed up from birth until 25 years of age in New Zealand, females who reported attempting suicide between 15 and 18 years of age had 7.6 times greater odds of drug dependence as young

Table 4. Characteristics of Suicide Attempt and Risk of Subsequent Substance Use Disorder Among Females Aged 8 to 19 Years

Characteristic	Females, No.	Substance use disorders, No.	Rate of hospitalizations for substance use disorders, per 10 000 person-years (95% CI)	Hazard ratio (95% CI) ^a
Suicide attempts, No.				
≥3	86	40	360.5 (264.4-491.4)	21.10 (13.53-32.90)
2	357	114	202.1 (168.2-242.8)	9.25 (7.35-11.65)
1	5397	950	98.4 (92.3-104.8)	5.70 (5.08-6.41)
0	116 394	3237	14.0 (13.6-14.5)	1 [Reference]
Age at first attempt, y				
8-13	801	170	110.0 (94.6-127.8)	6.08 (5.08-7.28)
14-15	2053	387	101.6 (92.0-112.2)	5.71 (4.94-6.59)
16-17	1933	357	107.0 (96.4-118.7)	6.10 (5.25-7.07)
18-19	1053	190	116.0 (100.6-133.7)	6.77 (5.63-8.14)
No attempt	116 394	3237	14.0 (13.6-14.5)	1 [Reference]
Method of attempt				
Self-poisoning	5113	894	95.4 (89.4-101.9)	5.81 (5.17-6.52)
Hanging or suffocation	139	54	334.5 (256.2-436.7)	12.01 (8.66-16.66)
Cutting or piercing	380	100	189.9 (156.1-231.0)	8.01 (6.24-10.30)
Jumping	40	6	80.8 (36.3-179.9)	3.24 (1.43-7.39)
Other violent means ^b	168	50	250.8 (190.1-330.9)	10.04 (7.13-14.12)
No attempt	116 394	3237	14.0 (13.6-14.5)	1 [Reference]

^a Adjusted for age, preexisting mental illness (schizophrenia, depression, bipolar disorder, anxiety and stress disorders, and personality disorders), resource-limited socioeconomic status, and year at start of follow-up.

^b Drowning, firearm, fire or heat, caustic substance, motor vehicle collision, electrocution, and unspecified means.

adults, whereas there was no association among males.⁸ Some data suggest that the risk of drug dependence may persist several years after the suicide attempt.^{6,7} However, some studies found no association between self-reported suicide attempts and future substance use problems in adolescents.^{10,11} The major limitations of this literature are that most studies included fewer than 200 adolescents with suicide attempts or had only a few years of follow-up.⁶⁻¹¹ In the present cohort of 5840 female youths with confirmed suicide attempts across 3 decades, power was sufficient to demonstrate associations with the onset of substance use disorders later in life.

Most of what is known in the literature is limited to cannabis or alcohol misuse.⁸⁻¹⁰ In the 2 years of follow-up included in the UK cohort, adolescents with suicide attempts had 6 times the risk of cannabis use disorder and 2 times the risk of alcohol use disorder at 18 years of age.⁹ Other studies have found no association with cannabis and alcohol use in young adulthood.^{8,10} In the present cohort, associations were observed with all types of substances, not only cannabis and alcohol. Risk of sedative or hypnotic use disorders was particularly elevated, with more than 32 times the risk of developing these disorders after an initial suicide attempt. The association suggests that female youths who attempt suicide may use sedatives or hypnotics in an attempt to self-medicate or alleviate symptoms of comorbid mental health conditions.¹⁸ Nearly 45% of adolescents who are prescribed sedatives or anxiolytics end up using these medications recreationally.¹⁹ In addition, adolescents may resort to hallucinogens and alcohol for euphoria or escape.²⁰ In our study, female youths with suicide attempts had between 9 and 17 times the risk of developing hallucinogen and alcohol use disorders. Associations were also present with cocaine and stimulant use disorders, but risk was lowest for cannabis and opioid use disorders.

A number of risk factors, including mental illness, impulsivity, hopelessness, trauma, and family history of suicide or substance misuse, may explain the association between suicide attempt and subsequent substance use disorders.^{21,22} In some female youths, suicide attempts may exacerbate underlying depression or other psychiatric conditions.²¹ Psychotherapy or pharmaceutical treatment may help prevent substance use disorders in some patients. However, other pathways may be involved because associations persisted when we adjusted for mental illness. Targeted interventions that include substance use counselors may therefore be warranted.

A few studies have shown that suicide attempts may harm certain regions of the brain, including areas associated with cognitive flexibility.²³⁻²⁵ Cognitive flexibility helps individuals modify patterns of thought and find alternative solutions to problems.^{23,24} Impaired flexibility in neuronal networks is believed to perpetuate thoughts of hopelessness,²³ potentially contributing to the development of substance use disorders. Although more research is needed, it is pertinent to highlight that suicide attempts may be associated with changes in brain circuitry that affect behaviors leading to substance use.

Suicide attempt is common in adolescence, and the risk among youths younger than 14 years has been increasingly recognized. Many studies of suicide attempt and onset of substance use disorders have focused on adolescents aged 14 years or older.^{6,8,9,11} Studies that included youths younger than 14 years could not stratify results by age owing to a low number of suicide attempts.^{7,10} The distinction between suicide attempts in younger vs older youths may be important because risk factors may differ.²⁶ Children younger than 12 years are more likely to attempt suicide in the context of past trauma, assault, or maltreatment.²⁶ Suicide attempts by older adolescents are more often triggered by psychiatric conditions.²⁶ In

our study, suicide attempts before 14 years of age and in older youths were associated with substance use disorders. Regardless of age, female youths were approximately 6 times more likely to develop substance use disorders compared with those with no suicide attempt.

To our knowledge, the severity of suicide attempts has not been previously studied. In our study, female youths who attempted suicide by hanging or suffocation and other violent means had the greatest risk of developing a substance use disorder. Risk of substance use disorders was greatest among female youths who attempted suicide 3 times or more. Violent or repeated suicide attempts may be associated with underlying mood or anxiety disorders, which in turn may be associated with use of substances for coping. Female youths who use violent means or have multiple suicide attempts may also have repeated cognitive insults. Overall, the findings suggest that adolescents with more severe attempts should be followed up more attentively to prevent or manage substance misuse.

Strengths and Limitations

Strengths of this study include a large sample, the matching design, and the long follow-up period. This study also has limitations. We used hospital discharge data and could not include female youths who did not require hospital treatment and were not admitted after a suicide attempt. Similarly, we could not identify female youths with undiagnosed substance use disorders or disorders diagnosed in outpatient settings as well as use of tobacco or psychoactive substances such as caffeine. We did not have information on the underlying causes and circumstances of suicide attempts, including family and school context, or whether female youths received mental health care and support. We could not include male youths in this study.

We identified suicide attempts and substance use disorders using rigorously validated administrative data, but misclassification remains possible. We cannot exclude residual confounding because mental illness may be underreported, and we lacked information on covariates, such as ethnicity and family history.^{21,22} There may be temporal trends in the availability or popularity of substances, but these trends would have affected exposed and unexposed female youths similarly because patients were matched by calendar year. Sex was documented in the data without consideration of gender identity. It is unclear whether the study's findings can be generalized to populations beyond Quebec, Canada. We examined associations but not the causal role of suicide attempts or potential to predict substance use disorders.

Conclusions

The findings of this cohort study suggest that suicide attempts by female youths may be associated with short- and long-term risk of developing substance use disorders, especially sedative or hypnotic, hallucinogen, and alcohol use disorders. Female youths with repeated suicide attempts or who used violent means, such as hanging or suffocation, had the greatest risk of future substance use disorders. The findings underscore the importance of screening youths for mental health conditions and suicidality. Adolescents who are admitted to the hospital after a suicide attempt frequently undergo emotional and psychosocial assessments,²⁷ but few receive further psychotherapy after discharge.²⁸ Susceptible youths may benefit from long-term psychosocial or pharmaceutical therapy by a multidisciplinary team beginning immediately after their first suicide attempt to address mental health problems and prevent later substance misuse.

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