Suicide After Deliberate Self-Harm in Adolescents and Young Adults

Mark Olfson, MD, MPH,[a] Melanie Wall, PhD,[a] Shuai Wang, PhD,[a] Stephen Crystal, PhD,[b] Jeffrey A. Bridge, PhD,[c] Shang-Min Liu, MS,[a] Carlos Blanco, MD, PhD[d]

abstract

OBJECTIVES: Among adolescents and young adults with nonfatal self-harm, our objective is to identify risk factors for repeated nonfatal self-harm and suicide death over the following year.

METHODS: A national cohort of patients in the Medicaid program, aged 12 to 24 years (n = 32 395), was followed for up to 1 year after self-harm. Cause of death information was obtained from the National Death Index. Repeat self-harm per 1000 person-years and suicide deaths per 100 000 person-years were determined. Hazard ratios (HRs) of repeat self-harm and suicide were estimated by Cox proportional hazard models. Suicide standardized mortality rate ratios were derived by comparison with demographically matched general population controls.

RESULTS: The 12-month suicide standardized mortality rate ratio after self-harm was significantly higher for adolescents (46.0, 95% confidence interval [CI]: 29.9–67.9) than young adults (19.2, 95% CI: 12.7–28.0). Hazards of suicide after self-harm were significantly higher for American Indians and Alaskan natives than non-Hispanic white patients (HR: 4.69, 95% CI: 2.41–9.13) and for self-harm patients who initially used violent methods (HR: 18.04, 95% CI: 9.92–32.80), especially firearms (HR: 35.73, 95% CI: 15.42–82.79), compared with nonviolent self-harm methods (1.00, reference). The hazards of repeat self-harm were higher for female subjects than male subjects (HR: 1.25, 95% CI: 1.18–1.33); patients with personality disorders (HR: 1.55, 95% CI: 1.42–1.69); and patients whose initial self-harm was treated in an inpatient setting (HR: 1.65, 95% CI: 1.49–1.83) compared with an emergency department (HR: 0.62, 95% CI: 0.55–0.69) or outpatient (1.00, reference) setting.

CONCLUSIONS: After nonfatal self-harm, adolescents and young adults were at markedly elevated risk of suicide. Among these high-risk patients, those who used violent self-harm methods, particularly firearms, were at especially high risk underscoring the importance of follow-up care to help ensure their safety.

[a]*Department of Psychiatry, College of Physicians and Surgeons, Columbia University and the New York State Psychiatric Institute, New York, New York;* [b]*Center for Health Services Research on Pharmacotherapy, Chronic Disease Management, and Outcomes, Institute for Health, Health Care Policy and Aging Research, Rutgers, The State University of New Jersey, New Brunswick, New Jersey;* [c]*Center for Innovation in Pediatric Practice, The Research Institute at Nationwide Children's Hospital and Department of Pediatrics, Psychiatry and Behavioral Health, The Ohio State University, Columbus, Ohio; and* [d]*Division of Epidemiology, Services, and Prevention Research, National Institute on Drug Abuse, Rockville, Maryland*

Dr Olfson conceptualized and designed the study, drafted the initial manuscript, interpreted the data, and revised the manuscript; Drs Blanco and Wall designed the study, interpreted the data, and reviewed and revised the manuscript; Dr Wang and Ms Liu conducted the initial analysis and reviewed and revised the manuscript; Drs Bridge and Crystal interpreted the data and reviewed and revised the manuscript; Dr. Wang had full access to all of the data in the study and takes

WHAT'S KNOWN ON THIS SUBJECT: Although nonfatal self-harm is common among young people and suicide is a leading cause of death among adolescents and young adults, little is known about the rate and risks of suicide after nonfatal self-harm in young people.

WHAT THIS STUDY ADDS: After self-harm, adolescents and young adults were at markedly increased risk of suicide, including especially those who initially used violent self-harm methods or were of American Indian or Alaskan native descent. These risks highlight the importance of close follow-up after self-harm events.

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Nonfatal self-harm, which may involve varying degrees of suicidal intent, is common in young people,[1] and suicide is the second leading cause of death in the United States among people ages 15 to 24 years.[2] Because nearly one-third of young people who die of suicide have nonfatal self-harm events during the last 3 months of life,[3] self-harm may offer opportunities for potentially life-saving interventions.

In contrast to suicide attempts, which require suicidal intent, self-harm refers to nonfatal self-poisoning or self-injury with or without suicidal intent.[4] After self-harm, adolescents are at risk for repeat self-harm and suicide.[5] An important challenge is to assess suicide risk after nonfatal self-harm. The authors of three previous cohort studies have evaluated suicide risk during the first year after self-harm in young people. The authors of a UK study, who followed 5414 patients ages 10 to 24 years after self-harm, reported that 0.3% (n = 15) died of suicide in the first follow-up year.[6] More recently, the authors of a Swedish study of 8387 self-harm patients ages 10 to 19 years reported that 0.16% (n = 13) died by suicide in the first year.[7] The authors of a recent Canadian study, who followed 20 471 adolescents after emergency department treatment of self-poisoning, reported that their hazard of suicide during the first follow-up year was 32.1 times greater than matched controls.[8] In the current study, we extend this line of research to a large US sample of Medicaid-insured young people after nonfatal self-harm.

Repetition of self-harm is also clinically important because it is associated with an increased risk of suicide,[9] indicates persistent distress, and places demands on health care resources.[10] Risk factors for repeated self-harm in young people include a history of previous self-harm,[11,12] previous mental health treatment,[13] a violent method of self-harm,[14] and specific psychiatric disorders including depression,[15–20] substance use disorders,[11,15,21,22] anxiety disorders,[11,15,16] schizophrenia,[16,22] attention-deficit/hyperactivity disorder (ADHD),[16,22] and personality disorders.[16,20] Because of variation in study samples and designs, however, the relative strength of these patient characteristics on risk of repeat self-harm remains poorly defined.

Age-related changes in cognitive, affective, social, behavioral, and biological vulnerabilities may influence initiation and persistence of psychopathology through adolescence and young adulthood.[23,24] However, little is known about whether and how adolescents and young adults vary in their risks of repeated self-harm and suicide after self-harm. To address these issues, we compared adolescents and young adults with respect to these risks after self-harm. In accordance with overall suicide risk,[25] we anticipated that older age, male sex, and non-Hispanic white race and/or ethnicity would be related to increased suicide risk after self-harm.

METHODS

Sources of Data

A self-harm cohort was extracted from 2001 to 2007 national (45 states, not including AZ, DE, NV, OR, or RI) Medicaid Analytic Extract data, which includes claims records for Medicaid-financed services and medications. Dates and cause of death information were derived from linkage to the National Death Index, which is the most complete resource available for tracing mortality in national samples.[26] US population death rates in 2001–2007 were derived from the National Center for Health Statistics.[25] This project was approved by the Rutgers University Institutional Review Board.

Self-Harm Cohort Assembly

The cohort was restricted to individuals 12 to 24 years of age with clinical diagnoses of deliberate self-harm (*International Classification of Diseases, Ninth Revision, Clinical Modification* codes E950–E958). Patients were also required to be eligible for Medicaid services during the 180 days preceding their index self-harm event.

The first eligible instance of self-harm was selected, and no patient contributed more than 1 observation. The cohort was followed forward from their index self-harm until the end of a 365-day follow-up period, date of death, or end of available data, whichever came first. For self-harms treated in outpatient or emergency department settings, the index date was the date of self-harm treatment. For self-harms treated in inpatient settings, the index date was the hospital discharge date.[27]

Outcomes

Following the Centers for Disease Control and Prevention, suicide was defined as *International Classification of Diseases, 10th Revision* codes X60–X84, Y87.0, or U03 as the immediate cause of death.[28] The primary outcomes of interest were repeat, nonfatal self-harm and suicide deaths. Suicide deaths coinciding with the index self-harm were not included in the analyses. Secondary outcomes included all causes of death and death due to accidents (V01–X59, Y85–Y86).

Sociodemographic and Clinical Characteristics

On the basis of Medicaid eligibility data, cohort members were classified by age at time of the index self-harm as adolescents (12–17 years) or young adults (18–24 years), sex, and race and/or

TABLE 1 Background Characteristics of Adolescent and Young Adult Medicaid Patients Treated for Nonfatal, Deliberate Self-Harm

Characteristic	Total (*N* = 32 395), %	Adolescents 12–17 y (*N* = 17 427), %	Young Adults 18–24 y (*N* = 14 968), %	Odds Ratio of Adolescent Group[a] (95% CI)
Sex				
Male	32.4	31.0	34.1	1.00
Female	67.6	69.0	65.9	1.16 (1.10–1.21)
Race and/or ethnicity				
White, non-Hispanic	62.3	59.8	65.2	1.00
African American, non-Hispanic	16.9	17.0	16.8	1.11 (1.04–1.18)
Hispanic	13.1	14.9	11.0	1.49 (1.39–1.60)
American Indian or Alaskan native	5.1	5.9	4.2	1.56 (1.40–1.73)
Other[b]	2.6	2.4	2.8	0.95 (0.82–1.09)
Recent clinical diagnoses[c]				
ADHD	8.9	12.4	4.9	2.68 (2.46–2.94)
Disruptive behavior disorders	13.3	19.4	6.2	3.59 (3.32–3.88)
Depressive disorders	35.6	37.4	33.5	1.19 (1.14–1.25)
Bipolar disorders	13.2	12.5	14.2	0.86 (0.81–0.92)
Anxiety disorders	15.4	14.2	16.6	0.84 (0.79–0.89)
Schizophrenia and related psychoses	10.0	6.4	14.3	0.41 (0.38–0.45)
Substance use disorders	23.3	17.0	30.7	0.47 (0.44–0.49)
Personality disorders	7.0	3.8	10.8	0.34 (0.31–0.38)
Other mental disorders	7.1	7.9	6.1	1.31 (1.20–1.43)
No. clinical mental diagnoses				
0	26.1	26.5	25.6	1.00
1	36.8	38.2	35.2	1.06 (1.00–1.12)
2	20.9	19.8	22.1	0.89 (0.83–0.95)
3+	16.2	15.5	17.1	0.89 (0.83–0.96)
Recent inpatient mental health care[c]	16.9	16.2	17.6	0.93 (0.87–0.98)
Recent outpatient mental health care[c]	48.0	48.9	46.9	1.09 (1.04–1.14)
Self-harm treatment setting				
Inpatient	24.8	22.5	27.5	0.70 (0.66–0.75)
Emergency department	50.7	51.1	50.3	0.87 (0.82–0.92)
Outpatient	24.5	26.4	22.2	1.00
Any recent outpatient care	89.5	89.6	89.3	1.03 (0.95–1.11)
Self-harm method[d]				
Violent method	4.5	4.7	4.3	1.15 (1.03–1.29)
Firearms	0.9	0.6	1.2	0.56 (0.43–0.71)
Other violent methods	3.7	4.1	3.1	1.39 (1.22–1.57)
Nonviolent method	83.4	81.5	85.7	1.00
Poisoning	65.0	63.5	66.7	1.00
Cutting	18.4	18.0	18.9	1.02 (0.96–1.08)
Other	12.0	13.8	10.0	1.48 (1.38–1.59)

[a] Young adults are the reference group.
[b] Other race and/or ethnicity includes Asian Americans, Native Hawaiians or other Pacific Islanders, and >1 race.
[c] During 180-day period before index self-harm visit.
[d] Self-harm methods were measured as (1) violent, nonviolent, and other, with nonviolent methods as the reference group and as (2) firearms, other violent methods, poisoning, cutting, and other, with poisoning as the reference group.

ethnicity: white, non-Hispanic; African American, non-Hispanic; Hispanic; American Indian or Alaskan native; and "other" including Asian Americans, Native Hawaiians or other Pacific Islanders, and more than 1 race. Cohort members were also classified by geographic region (west, midwest, south, northeast), and Medicaid eligibility status (disability, foster care, low income, or other).

Variables representing clinical diagnoses on or within 180 days before the index self-harm were defined for ADHD, disruptive behavior disorders, depressive disorders, bipolar disorder, anxiety disorders, schizophrenia and related psychoses, substance use disorders, personality disorders, and a residual group of other mental disorders (Supplemental Table 6). At least 1 inpatient or 2 outpatient diagnoses defined each mental disorder group.[29] In analysis of these diagnostic groups, comparators were self-harm patients without the disorder of interest. A separate variable defined the number of mental health diagnostic groups (0, 1, 2, 3+). Separate variables defined any inpatient and outpatient mental health care and any outpatient care during the 180 days preceding the self-harm event.

Place of service codes were used to classify the index self-harm treatment setting hierarchically as (1) inpatient, (2) emergency department, or (3) outpatient for those receiving care in >1 setting. Index self-harm method was classified as violent, nonviolent, and other methods with external cause of injury codes (E-codes). Nonviolent methods were subclassified as cutting, poisoning, or other methods. Violent methods included firearms and other violent methods (drowning, hanging and suffocation, jumping from heights, motor vehicle or aircraft crashing, fire and scalding, and extreme cold) (Supplemental Table 6).[30,31]

Analysis

Adolescents and young adults who were treated for nonfatal self-harm were compared with respect to demographic and clinical characteristics. For each demographic and clinical variable stratum, we determined the number of patients, person years of follow-up, number with ≥1 repeat self-harm events, and first repeat self-harm rates per 1000 person-years. Corresponding stratified rates of suicide risk per 100 000 person-years of follow-up were determined. For

TABLE 2 Repeat Nonfatal Self-Harm Rates in a Cohort of Adolescent and Young Adult Medicaid Patients During the First Year After a Nonfatal Self-Harm Event

Group	No. Patients	Person-y at Risk	First DSH Events, *N*	Unadjusted DSH Rate (per 1000 Person-y)	HR of DSH (95% CI)	Adjusted HR of Repeat DSH (95% CI)[a]
Total	32 395	24 896.1	5545	222.7	N/A	N/A
Age, y						
12–17	17 427	13 455.6	2889	214.7	1.00	1.00
18–24	14 968	11 440.5	2656	232.2	1.07 (1.02–1.13)	1.01 (0.96–1.07)
Sex						
Male	10 513	8184.9	1556	190.1	1.00	1.00
Female	21 882	16 711.2	3989	238.7	1.25 (1.18–1.33)	1.33 (1.26–1.42)
Race/ethnicity						
White, non-Hispanic	19 859	15 087.4	3600	238.6	1.00	1.00
African American, non-Hispanic	5400	4272.6	744	174.1	0.75 (0.69–0.81)	0.73 (0.67–0.79)
Hispanic	4175	3284.6	644	196.1	0.85 (0.78–0.92)	0.91 (0.83–1.00)
American Indian or Alaskan native	1637	1227.1	328	267.3	1.12 (1.00–1.25)	1.18 (1.05–1.32)
Other[b]	813	647.8	134	206.8	0.90 (0.76–1.07)	0.94 (0.79–1.13)
Recent clinical diagnoses[c]						
ADHD	2897	2151.3	519	241.2	1.05 (0.96–1.15)	1.02 (0.93–1.13)
Disruptive behavior disorders	4302	3286.4	814	247.7	1.12 (1.04–1.20)	1.11 (1.03–1.21)
Depressive disorders	11 530	8834.2	2076	235.0	1.09 (1.03–1.15)	1.07 (1.02–1.14)
Bipolar disorders	4272	3092.2	889	287.5	1.27 (1.19–1.37)	1.16 (1.08–1.25)
Anxiety disorders	4974	3609.7	1088	301.4	1.37 (1.28–1.46)	1.24 (1.16–1.33)
Schizophrenia and related psychoses	3249	2416.5	680	281.4	1.25 (1.15–1.35)	1.17 (1.08–1.28)
Substance use disorders	7552	5588.0	1459	261.1	1.19 (1.12–1.26)	1.15 (1.08–1.22)
Personality disorders	2283	1649.1	578	350.5	1.55 (1.42–1.69)	1.36 (1.24–1.49)
Other mental disorders	2286	1829.0	335	183.2	0.84 (0.75–0.93)	0.87 (0.78–0.97)
No. clinical mental diagnoses						
0	8448	6692.4	1210	180.8	1.00	1.00
1	11 935	9276.1	1930	208.1	1.13 (1.05–1.22)	1.07 (0.99–1.15)
2	6754	5091.3	1271	249.6	1.32 (1.22–1.43)	1.22 (1.13–1.32)
3+	5258	3836.2	1134	295.6	1.52 (1.40–1.65)	1.36 (1.25–1.48)
Recent inpatient mental health care[c]	5462	3982.5	1289	323.7	1.51 (1.42–1.61)	1.42 (1.33–1.51)
Recent outpatient mental health care[c]	15 546	11 619.3	3037	261.4	1.33 (1.26–1.40)	1.24 (1.17–1.31)
Self-harm treatment setting						
Inpatient	7788	5001.0	2243	448.5	1.94 (1.81–2.08)	1.92 (1.79–2.06)
Emergency department	15 930	13 186.9	1875	142.2	0.69 (0.64–0.74)	0.66 (0.61–0.71)
Outpatient	7687	5902.2	1263	214.0	1.00	1.00
Any recent outpatient care[c]	28 980	22 191.9	5065	228.2	1.25 (1.14–1.37)	1.11 (1.01–1.22)
Self-harm method[d]						
Violent method	1436	1065.8	226	212.0	0.86 (0.75–0.98)	0.94 (0.82–1.07)
Firearms	281	205.2	49	238.8	0.88 (0.67–1.17)	1.07 (0.81–1.43)
Other violent methods	1155	860.6	177	205.7	0.77 (0.66–0.89)	0.80 (0.68–0.93)
Nonviolent method	26 365	19 985.8	4814	240.9	1.00	1.00
Poisoning	20 534	15 337.9	4025	262.4	1.00	1.00
Cutting	5831	4647.9	789	169.8	0.65 (0.60–0.70)	0.62 (0.57–0.67)
Other	3803	3177.1	405	127.5	0.55 (0.49–0.60)	0.58 (0.52–0.64)
Other	3803	3177.1	405	127.5	0.50 (0.45–0.55)	0.52 (0.47–0.57)

DSH, deliberate self-harm; N/A, not applicable.

[a] Adjusted HRs are from models that control for age, sex, race and/or ethnicity, geographic region, and Medicaid eligibility status.

[b] Other race and/or ethnicity includes Asian Americans, Native Hawaiians or other Pacific Islanders, and >1 race.

[c] During 180-day period before index self-harm visit.

[d] Self-harm methods were measured as (1) violent, nonviolent, and other, with nonviolent methods as the reference group and as (2) firearms, other violent methods, poisoning, cutting, and other, with poisoning as the reference group.

self-harm patients who survived the initial event, Cox proportional hazard models, which make no assumptions about the baseline hazard, estimated unadjusted hazard ratios (HRs) of repeat self-harm during follow-up with each stratification variable as the independent variable of interest. Adjusted Cox models controlled for age, sex, race and/or ethnicity, geographic region, and Medicaid eligibility status. Separate models were fit for adolescents and young adults. Models also included an interaction term (stratification variable by age group) to assess differences in repeat self-harm risk across the 2 age groups.

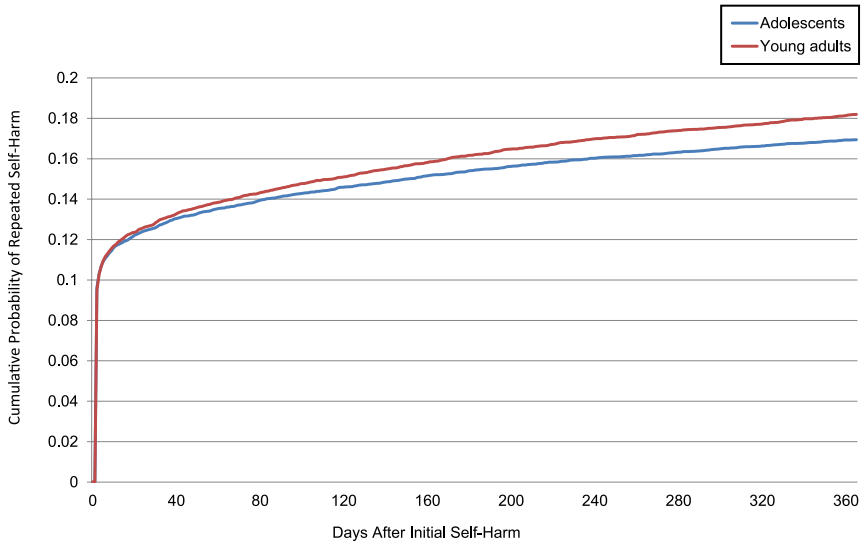

FIGURE 1
Cumulative probability of repeated self-harm during the 365 days after a self-harm event of adolescents and young adults. Log-rank test $\chi^2 = 0.68$, $P = .41$.

For comparison of suicide rates of the self-harm cohort with US population suicide rates, we determined the matched age group, sex, and race and/or ethnicity in the US population annual mean suicide rates for 2001–2007. All statistical analyses were performed with SAS 9.4 (SAS Institute, Inc, Cary, NC).

RESULTS

Patients With Nonfatal Initial Self-Harm Events

A total of 32 437 self-harm events were observed. Forty-two (0.13%) were fatal (suicide), including 20 adolescents and 22 young adults, and excluded from the prospective cohort (n = 32 395).

Most patients with nonfatal initial self-harm were white, adolescents, female subjects, and their events involved poisoning (Table 1). Depression and substance use disorders were the most commonly diagnosed mental disorders within the 180 days preceding self-harm. Approximately half of the patients with self-harm were treated in emergency departments, whereas 22.5% involved inpatient admission.

As compared with adolescent self-harm patients, young adult self-harm patients were more likely to have been diagnosed with substance use disorders, personality disorders, or schizophrenia and related psychoses and less likely to have been diagnosed with ADHD, other disruptive behavioral disorders, or depression in the 180 days before self-harm. Approximately half of each age group received any outpatient mental health care during this period.

One-Year Repeated Nonfatal Self-Harm

Approximately 17.1% (5545 of 32 395) of the self-harm patients had repeated nonfatal self-harm during the follow-up year for an unadjusted repeat self-harm rate of 222.7 per 1000 person-years (Table 2). The cumulative probability of first self-harm distributions were similar for adolescents and young adults, with both having a steep rise in the first few days after the initial event and then rising more gradually (Fig 1).

The unadjusted hazards of repeat nonfatal self-harm were higher for young adults than adolescents, female than male patients, and white than African American or Hispanic patients, although the age group difference was not evident in the adjusted model. Recent clinical diagnoses of each specific mental disorder other than ADHD were also associated with significantly increased hazards of repeated self-harm. The hazards also increased with increasing number of mental disorders. The risk of repeat self-harm was significantly higher for patients treated for personality or anxiety disorders than depressive disorders. Self-harm events that involved poisoning or that were treated in inpatient settings were also associated with increased risk of repeated self-harm.

There were few differences between adolescents and young adults in risk factors of repeated self-harm. However, female sex, Hispanic ethnicity, and treatment of the initial self-harm in an inpatient setting were more strongly associated with repeat self-harm for adolescents than for young adults (Table 3). By contrast, a recent diagnosis of disruptive behavior disorders or schizophrenia and the number of mental disorder diagnoses were more strongly associated with repeat self-harm for young adults than adolescents.

Suicide After Nonfatal Self-Harm

The 1-year suicide standardized mortality rate ratio (SMR) for the study cohort was 26.7 (95% confidence interval [CI]: 19.9–35.1) compared with the matched age, sex, or race and/or ethnicity in the US general population (Table 4). The corresponding suicide SMR was significantly higher for adolescents (46.0, 95% CI: 29.9–67.9) than for young adults (19.2, 95% CI: 12.7–28.0). The cumulative probability of suicide was similar for the 2 age groups during the first 111 days, after which the risk for young adults exceeded the risk for adolescents (Fig 2).

Unadjusted hazards of suicide after nonfatal self-harm were significantly

TABLE 3 Cox Proportional Hazards Regression Models of Repeat Deliberate Nonfatal Self-Harm After Deliberate Self-Harm Events for Adolescent and Young Adult Medicaid Patients

Characteristic	Adolescents Adjusted[a] HR (95% CI)	Young Adults Adjusted[a] HR (95% CI)	Interaction *P*
Sex			
Male	1.00	1.00	N/A
Female	1.44 (1.32–1.57)	1.23 (1.13–1.34)	.001
Race and/or ethnicity			
White, non-Hispanic	1.00	1.00	N/A
African American, non-Hispanic	0.74 (0.66–0.82)	0.74 (0.66–0.83)	.92
Hispanic	0.95 (0.85–1.07)	0.84 (0.73–0.98)	.02
American Indian or Alaskan native	1.24 (1.08–1.44)	1.08 (0.90–1.31)	.17
Other[b]	0.91 (0.70–1.17)	0.99 (0.78–1.26)	.78
Recent clinical diagnoses[c]			
ADHD	1.05 (0.94–1.18)	1.08 (0.91–1.27)	.14
Disruptive behavior disorders	1.08 (0.99–1.19)	1.27 (1.10–1.46)	.005
Depressive disorders	1.03 (0.95–1.11)	1.12 (1.04–1.22)	.19
Bipolar disorders	1.24 (1.12– 1.38)	1.11 (1.00–1.23)	.53
Anxiety disorders	1.18 (1.07–1.31)	1.30 (1.18–1.43)	.10
Schizophrenia and related psychoses	0.95 (0.81–1.11)	1.26 (1.14–1.40)	.0002
Substance use disorders	1.11 (1.01–1.22)	1.16 (1.07–1.26)	.31
Personality disorders	1.22 (1.03–1.44)	1.40 (1.25–1.56)	.09
Other mental disorders	0.91 (0.79–1.05)	0.80 (0.66–0.95)	.17
No. clinical mental diagnoses			
0	1.00	1.00	N/A
1	1.04 (0.94–1.15)	1.11 (0.99–1.24)	.26
2	1.14 (1.02–1.27)	1.33 (1.18–1.50)	.01
3+	1.21 (1.07–1.36)	1.55 (1.36–1.75)	<.0001
Recent inpatient mental health care[c]	1.37 (1.25–1.51)	1.44 (1.31–1.58)	.10
Recent outpatient mental health care[c]	1.22 (1.13–1.32)	1.26 (1.16–1.37)	.03
Self-harm treatment setting			
Inpatient	2.16 (1.96–2.38)	1.65 (1.49–1.83)	.0002
Emergency department	0.69 (0.63–0.77)	0.62 (0.55–0.69)	.12
Outpatient	1.00	1.00	N/A
Any recent outpatient care[c]	1.05 (0.92–1.19)	1.20 (1.04–1.39)	.08
Self-harm method[d]			
Violent method	0.86 (0.71–1.04)	1.05 (0.87–1.27)	.06
Firearms	0.86 (0.52–1.43)	1.21 (0.85–1.70)	.21
Other violent methods	0.76 (0.62–0.94)	0.86 (0.69–1.08)	.22
Nonviolent method	1.00	1.00	N/A
Poisoning	1.00	1.00	N/A
Cutting	0.61 (0.55–0.68)	0.62 (0.56–0.69)	.57
Other	0.56 (0.48–0.64)	0.61 (0.52–0.72)	.17
Other	0.50 (0.44–0.58)	0.55 (0.47–0.65)	.15

N/A, not applicable.

[a] Adjusted HRs are from models that control for age, sex, race and/or ethnicity, geographic region, and Medicaid eligibility status.

[b] Other race and/or ethnicity includes Asian Americans, Native Hawaiians or other Pacific Islanders, and >1 race.

[c] During 180-day period before index self-harm visit.

[d] Self-harm methods were measured as (1) violent, nonviolent, and other, with nonviolent methods as the reference group and as (2) firearms, other violent methods, poisoning, cutting, and other, with poisoning as the reference group.

higher for male subjects than female subjects, non-Hispanic white than African American patients, and patients whose initial self-harm involved violent rather than nonviolent methods (Table 5). After controlling for age and sex, the odds of suicide were more than 5 times higher for American Indian and Alaskan native self-harm patients than for white non-Hispanic self-harm patients.

The adjusted hazards of suicide after self-harm events with violent methods were significantly larger for adolescents (28.18, 95% CI: 9.98–80.36) than for young adults (7.44, 95% CI: 2.90–19.08) (interaction *P* value = .04). In a post hoc analysis, American Indian and Alaskan native self-harm patients were significantly more likely than their white non-Hispanic counterparts to have used violent methods during their initial self-harm event (7.36% vs 3.86%, $P < .0001$). Male self-harm patients were also more likely than female self-harm patients to use violent methods (7.88% vs 5.32%, $P < .0001$).

All-Causes of Deaths and Accidental Deaths

After self-harm, the 1-year SMR for all-cause mortality was significantly higher for young adults (10.3, 95% CI: 8.1–12.8) than for adolescents (4.1, 95% CI: 2.9–5.7) (Table 4). The standardized risk of accidental death was significantly elevated in the combined self-harm cohort in relation to matched controls (3.3, 95% CI: 2.2–4.8) and among the young adult cohort (5.0, 95% CI: 3.0–7.8) but not among the adolescent cohort (1.8, 95% CI: 0.8–3.6).

DISCUSSION

After nonfatal self-harm, adolescents and young adults in the Medicaid program were at 26.7 times higher risk of suicide than that of the demographically matched US general population. The standardized mortality rate ratio of suicide after self-harm was significantly higher for adolescents than young adults. Suicide risk was especially prominent for male subjects, individuals who were American Indians or Alaskan natives, and those whose initial self-harm involved violent methods,

TABLE 4 All Causes of Death, Suicide, and Accidental Deaths in a Cohort of Adolescent and Young Adult Medicaid Patients During the First Year After a Deliberate Self-Harm Event

Demographic Groups and Cause of Death	No. Patients	Person-y of Follow-up	Observed Deaths, *N*	Crude Mortality Rate per 100 000 Person-y	Expected Deaths, *N*	SMR (95% CI)
All causes of death						
Total sample	32 356	29 400	110	374.2	15.9	6.9 (5.7–8.3)
Adolescents[a]	17 407	15 836	35	221.0	8.5	4.1 (2.9–5.7)
Young adults[a]	14 949	13 564	75	552.9	7.3	10.3 (8.1–12.8)
Suicide						
Total sample	32 356	29 400	48	163.3	1.8	26.7 (19.9–35.1)
Adolescents[a]	17 407	15 836	23	145.2	0.5	46.0 (29.9–67.9)
Young adults[a]	14 949	13 564	25	184.3	1.3	19.2 (12.7–28.0)
Accidental deaths						
Total sample	32 356	29 400	24	81.6	7.3	3.3 (2.2–4.8)
Adolescents[a]	17 407	15 836	7	44.2	3.9	1.8 (0.8–3.6)
Young adults[a]	14 949	13 564	17	125.3	3.4	5.0 (3.0–7.8)

Age, sex, race and/or ethnicity matched from CDC WONDER data. CDC, Centers for Disease Control and Prevention; WONDER, Wide-ranging Online Data for Epidemiologic Research.
[a] Adolescents were defined as 12–17 years of age and young adults were defined as 18–24 years of age.

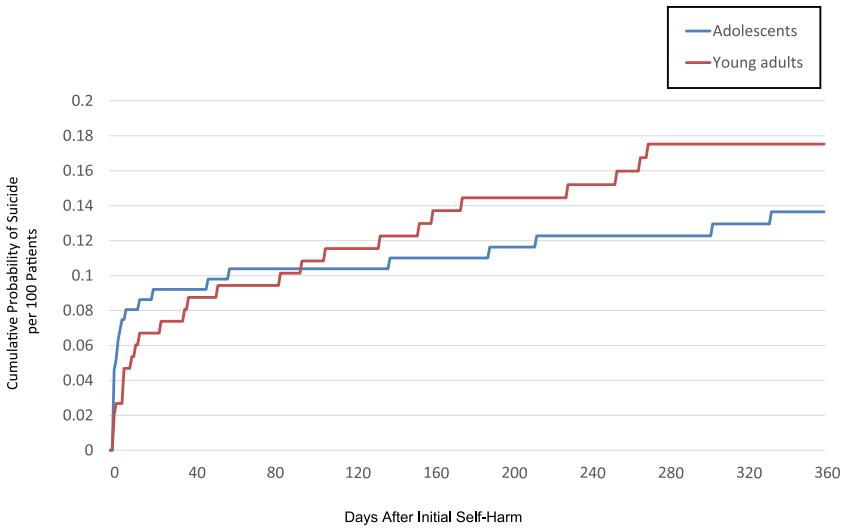

FIGURE 2
Cumulative probability of suicide during the 365 days after a self-harm event of adolescents and young adults. Log-rank test $\chi^2 = 7.29$, $P = .007$.

such as firearms or hanging. The link between violent initial self-harm method and subsequent suicide was stronger for adolescents than young adults. In the year after self-harm, young adults, but not adolescents, were also at significantly increased risk of dying of accidents.[8]

Consistent with past research, nonfatal self-harm was strongly associated with suicide during the first follow-up year.[7,8] In a UK self-harm cohort, suicide risk was 35 times higher than the population risk for male subjects and 75 times higher for female subjects,[6] whereas in a Swedish self-harm cohort the corresponding suicide risks were 50.2 times higher for male subjects and 7.5 times higher for female subjects.[7] One reason that our estimates of relative suicide risk tend to be lower than these estimates may be because our results included self-harm presenting to all settings, whereas the United Kingdom and Swedish studies involved only patients treated in hospitals who were presumably at higher risk.

Adolescents and young adults had roughly similar rates of suicide after self-harm. The diagnostic composition of the 2 age groups, including larger proportions of ADHD and disruptive behavior disorders among adolescents and substance use and personality disorders among young adults, likely reflects differences in ages of onset and clinical diagnostic practices. Because the general population risk of suicide is lower in adolescents than young adults, however, the standardized risk of suicide after self-harm was significantly higher for adolescents than young adults. It is possible that neuro-developmental vulnerabilities during adolescence linked to the onset of mood and substance use disorders, risk-taking behaviors, or heightened susceptibility to negative social cues contribute to the relatively high suicide risk during adolescence following self-harm.[32,33]

Self-harm presented differently in adolescents and young adults. Although depression and anxiety diagnoses were common in both age groups, adolescents with self-harm were far more likely to have been recently diagnosed with ADHD and other disruptive behaviors, whereas young adults more commonly had substance use and personality disorder diagnoses. Similar age-related patterns have been reported among young people who received

TABLE 5 Suicide Rates in a Cohort of Adolescent and Young Adult Medicaid Patients During the First Year After a Deliberate Self-Harm Event

Group	No. Patients	Person-y at Risk	Suicides, *N*	Unadjusted Suicide Rate (per 100 000 Person-y)	HR of Suicide (95% CI)	Adjusted HR of Suicide (95% CI)[a]
Total	32 356	29 400	48	163.3	N/A	N/A
Age, y						
12–17	17 407	15 836	23	145.2	1.00	1.00
18–24	14 949	13 564	25	184.3	1.27 (0.72–2.23)	1.03 (0.56–1.89)
Sex						
Male	10 492	9447	32	338.8	1.00	1.00
Female	21 864	19 953	16	80.2	0.24 (0.13–0.43)	0.24 (0.13–0.44)
Race and/or ethnicity						
White, non-Hispanic	19 832	17 986	31	172.4	1.00	1.00
African American, non-Hispanic	5396	4892	2	40.9	0.24 (0.06–0.99)	0.26 (0.06–1.10)
Hispanic	4169	3825	2	52.3	0.31 (0.07–1.28)	0.51 (0.11–2.26)
American Indian or Alaska Native	1636	1492	12	804.4	4.69 (2.41–9.13)	5.60 (2.73–11.52)
Other[b]	813	759	0	0.0	0.00 (0.00–NA)	0.00 (0.00–NA)
Recent clinical diagnoses[c]						
ADHD or disruptive behavior disorders	6156	5551	10	180.2	1.12 (0.56–2.26)	0.92 (0.44–1.91)
Mood disorders	17 131	15 487	22	142.1	0.75 (0.43–1.33)	0.73 (0.40–1.31)
Anxiety disorders	4967	4426	7	158.2	0.95 (0.43–2.12)	1.03 (0.46–2.33)
Schizophrenia and related psychoses	3248	2919	9	308.3	2.08 (1.01–4.29)	1.99 (0.91–4.32)
Substance use disorders	7546	6738	14	207.8	1.37 (0.73–2.55)	1.07 (0.57–2.03)
Other mental disorders	2338	2160	0	0.0	0.00 (0.00–NA)	0.00 (0.00–NA)
No. clinical mental diagnoses						
0	8411	7725	14	181.2	1.00	1.00
1	12 240	11 171	14	125.3	0.69 (0.33–1.44)	0.66 (0.31–1.41)
2	7154	6446	14	217.2	1.18 (0.57–2.48)	1.06 (0.50–2.27)
3+	4551	4057	6	147.9	0.80 (0.31–2.08)	0.65 (0.24–1.74)
Recent inpatient mental health care[c]	5458	4967	12	241.6	1.64 (0.85–3.15)	1.58 (0.80–3.10)
Recent outpatient mental health care[c]	15 525	13 990	27	193.0	1.40 (0.79–2.48)	1.08 (0.59–1.98)
Self-harm treatment setting						
Inpatient	7773	6882	16	232.5	1.22 (0.59–2.54)	1.31 (0.63–2.75)
Emergency department	15 919	14 662	17	115.9	0.62 (0.30–1.28)	0.67 (0.32–1.41)
Outpatient	7674	6902	13	188.4	1.00	1.00
Any recent outpatient care	28 945	26 284	44	167.4	1.30 (0.47–3.61)	1.23 (0.44–3.49)
Deliberate self-harm method[d]						
Violent method	1422	1247	21	1684.4	18.04(9.92–32.80)	13.55 (7.17–25.63)
Firearms	277	242	8	3303.3	35.73 (15.42–82.79)	33.45 (13.31–84.06)
Other violent methods	1145	1005	13	1294.1	13.98 (6.79–28.79)	9.73 (4.51–20.96)
Nonviolent method	26 341	23 941	22	91.9	1.00	1.00
Poisoning	20 519	18 717	17	90.8	1.00	1.00
Cutting	5822	5224	5	95.7	1.04 (0.39–2.83)	0.92 (0.34–2.51)
Other	3803	3469	2	57.6	0.63 (0.15–2.67)	0.53 (0.12–2.28)
Other	3803	3469	2	57.6	0.63 (0.15–2.75)	0.53 (0.12–2.31)

N/A, not applicable.

[a] Adjusted HRs are from models that control for age, sex, race and/or ethnicity, geographic region, and Medicaid eligibility status.

[b] Other race and/or ethnicity includes Asian Americans, Native Hawaiians or other Pacific Islanders, and >1 race.

[c] During 180-day period before index self-harm visit.

[d] Self-harm methods were measured as (1) violent, nonviolent, and other, with nonviolent methods as the reference group and as (2) firearms, other violent methods, poisoning, cutting, and other, with poisoning as the reference group.

diagnostic assessments after suicide attempts.[34–37]

The risk of repeated self-harm during the first follow-up year was over 100 times greater than the risk of suicide. High recurrence of self-harm underscores persistence of self-injurious behaviors in this age group. Consistent with previous research,[38] several clinical diagnoses including personality, anxiety, mood, substance use, schizophrenia, and disruptive behavior disorders were related to an elevated risk of repeated self-harm. The wide distribution of risk across common clinical psychiatric diagnoses complicates prediction of repeated attempts. Also in line with previous research,[8] patients admitted for inpatient care were significantly more likely than outpatients to have repeated self-harm.

Suicide risk after self-harm was ~4 times greater for male subjects than female subjects. Some potential

explanations for the preponderance of suicide among male subjects include sex-related differences in mental health treatment–seeking behavior,[39] self-harm methods,[40] and pubertal development.[41] Because the risk for repeated self-harm was greater for female subjects than male subjects, higher lethality of male than female self-harm events likely contributes to the preponderance of suicides by male subjects after self-harm.

Risks of suicide after self-harm were ∼5 times higher for white than African American young people, suggesting that self-harm poses a particular threat to white adolescents and young adults. By contrast, risk of repeat self-harm was only modestly higher for white than African American individuals. In nationally representative US samples, no significant differences have been found in the lifetime prevalence of suicide attempts of African American and white young adults.[42,43] However, as compared with their African American counterparts, white young adults may have a significantly higher prevalence of suicidal ideation[43] as well as mood, anxiety, and substance use disorders.[44] Greater exposure to these and other suicide risk factors may contribute to the relatively high suicide risk of white young people after self-harm.

Suicide risk after self-harm was particularly elevated for American Indian and Alaska Native young people, a group with increased suicide rates.[45] These results underscore the need for suicide prevention initiatives in American Indian and Alaska Native communities. In 1 recent report, a multitiered suicide prevention program among the Apache of Arizona, which included efforts to increase identification, coping skills, and resilience of at-risk young people, coincided with a 23% decrease in suicide among 15- to 24-year-olds.[46]

In accordance with previous research with adults, violent self-harm methods posed a high risk for subsequent suicide.[8,27,47,48] Acquiring the capability to use more violent or lethal methods, although less common than lower lethality methods, may increase suicide risk by weakening a fear of death.[49] Suicide risk was especially great after initial nonfatal self-harm involving firearms. For high-risk young people with access to firearms, distributing trigger locks and urging family members to store firearms away from the patient's home[50] can be a lifesaving precautionary measure. The association between violent methods and subsequent suicide was significantly stronger for adolescents than young adults, although this interaction was based on a small number of suicide deaths and therefore requires replication.

This study has several limitations. First, claims records do not distinguish self-harm injuries with suicidal from nonsuicidal intent.[51] Variation in suicidal intent may mediate risks across clinical groups. For example, high suicidal intent might partially mediate the association between high lethality self-harm methods and suicide risk, whereas persistently low or no intent (nonsuicidal self-injury) might mediate the association between personality disorders and repeated self-harm. Second, we have no means of validating mental disorder diagnoses in Medicaid claims records. Third, information was not available concerning several factors thought to increase suicide risk, such as hopelessness, problem-solving deficits, stressful or traumatic life events, and access to lethal means. Because community mental treatment may be more intensive and effective after severe or violent self-harm events, it may have reduced risks of suicide and repeated self-harm events. Fourth, misdiagnosis and perceptions of stigma may have introduced errors in coding self-harm, and low autopsy rates may have resulted in misclassification of cause of death.[52] Fifth, claims records do not capture self-harm that does not result in medical care. Sixth, the data reflect suicide mortality patterns in 2001–2007, which may have changed in recent years. Finally, although there are concerns over the validity[53] and completeness[54] of E-codes to measure deliberate self-harm, a high concordance exists between self-harm E-codes and medical record documentation of intentional injury with suicidal intent.[55]

Adolescents and young adults who survive self-harm are at high risk for repeated self-harm and suicide over the following year. The risk of suicide was especially marked after nonfatal self-harm events that involved violent methods. Clinical priority should be given to ensuring the safety of young people after self-harm, which may include treating underlying psychiatric disorders, restricting access to lethal means, fortifying psychosocial supports, and close monitoring for emerging suicidal symptoms.

ABBREVIATIONS

ADHD: attention-deficit/hyperactivity disorder
CI: confidence interval
E-code: external cause of injury code
HR: hazard ratio
SMR: standardized mortality rate ratio

responsibility for the integrity of the data and the accuracy of the data analysis; and all authors approved the final manuscript as submitted and agree to be accountable for all aspects of the work.

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Address correspondence to Mark Olfson, MD, MPH, Department of Psychiatry, New York State Psychiatric Institute, College of Physicians and Surgeons of Columbia University, 1051 Riverside Dr, New York, NY 10032. E-mail: mo49@cumc.columbia.edu

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