

SURVEILLANCE OF NONFATAL AND FATAL SELF-HARM AMONG YOUTHS AND YOUNG ADULTS — UNITED STATES, 2008–2017

Giorvanni Merilis

meril912@gmail.com

Division of Violence Prevention
Centers for Disease Control & Prevention
ORCID ID: 0000-0002-235-9

Shane Jack

spjack@cdc.gov

Division of Violence Prevention
Centers for Disease Control & Prevention

Alex Crosby

acrosby@msm.edu

Division of Violence Prevention
Centers for Disease Control & Prevention

Abstract:

Background: Suicide is the second leading cause of death among persons aged 14-24 years.

Aims: This study informs suicide prevention efforts among youths and young adults.

Method: We analyzed mortality data from the National Vital Statistics System and suicidal behavior data from three nationally representative data sources including National Electronic Injury Surveillance System-All Injury Program, Youth Risk Behavior Survey, and National Survey on Drug Use and Health during 2008–2017. We used Joinpoint regression modeling to analyze trends in rates of suicide, self-harm–related hospitalizations, and ED visits by sex and age group from 2008–2017.

Results: Among female youths, suicide rates increased significantly from 2008–2017 ($APC=0.28\%$, $P<0.05$). The annual estimated rates of self-harm–related hospitalizations and ED visits among female youths significantly increased from 2008–2017 ($APC=10.15\%$ [$P<0.05$] and 10.92% [$P<0.05$] respectively).

Limitations: Rates of self-directed violence hospitalizations and ED visits could not be generated by race and ethnicity due to the relatively high proportion of cases with unknown or unspecified race and ethnicity from the 2008-2017 NIESS-AIP surveillance data.

Conclusion: Significant increases in rates of suicide, self-harm–related hospitalizations and ED visits among female youths from 2008–2017 indicate a need for ongoing surveillance.

Keywords: suicide, self-harm, surveillance, prevention

INTRODUCTION

Suicide is the second leading cause of death among persons aged 14-24 years (Case & Deaton, 2015; WHO, 2019). To inform suicide prevention efforts among youths and young adults, we analyzed mortality data

from the National Vital Statistics System (NVSS) and suicidal behavior data from three nationally representative data sources including National Electronic Injury Surveillance System-All Injury Program (NEISS-AIP), Youth Risk Behavior Survey (YRBS), and National Survey on Drug Use

SURVEILLANCE OF NONFATAL AND FATAL SELF-HARM AMONG YOUTHS AND YOUNG ADULTS — UNITED STATES, 2008–2017

and Health (NSDUH) during 2008–2017 (see Appendix, Table 1, for a summary of self-harm outcomes from these national datasets in 2017).

METHOD

In this report, youth and young adults are defined as those aged 14–18 years and 19–24 years of age, respectively. Fatal injury data were obtained from NVSS, which collects information from all death certificates filed in the 50 states and the District of Columbia. Nonfatal injury data were obtained from NEISS-AIP, which collects data from a nationally representative sample of U.S. hospitals with emergency departments. Data from NEISS-AIP included suicide attempt and self-harm–related emergency department (ED) visits and ED discharge disposition (including hospitalization). YRBS was used to estimate prevalence for serious suicidal thoughts and attempts among high school students.

These estimates were developed using a nationally representative sample of youths enrolled in grades 9–12, approximately 94% of whom were aged 14–18 years according to the U.S. Census American Community Survey – Public Use Microdata. NSDUH is a national- and state-level survey of a representative sample of the civilian noninstitutionalized U.S. population that includes questions on serious suicidal thoughts and attempts for young adults aged 19–24 years. Outcomes of interest included counts and rates of suicide, self-harm-related hospitalizations, ED visits, serious thoughts of suicide and attempted suicide.

Using Joinpoint regression modeling, a trend analysis was conducted to examine rates of suicide, self-harm–related hospitalizations, and ED visits by sex and age group for 2008–2017 (Joinpoint Regression Program, 2021). The software uses trend data to fit the simplest joinpoint model that the data allow. It runs the minimum number of

joinpoints assigned (0 joinpoints, or a straight line) and tests whether more joinpoints are statistically significant and must be added to the model up to that maximum number, which was 2 joinpoints for this study. This enables users to test whether apparent changes in trends, connected by joinpoints, are statistically significant using a Monte Carlo Permutation method (Kim et al., 2000). Annual percent changes (APCs) in rates, according to a 95% confidence level, are presented to demonstrate the direction and magnitude of trends. Additionally, ratios of nonfatal self-harm outcomes to suicide were generated to highlight the burden of self-harm among youths and young adults, during 2008–2017.

RESULTS

Among male youths, the suicide rate increased significantly from 2008 to 2015 with an APC of 0.32% ($P<0.05$) and increased significantly from 2015 to 2017 (APC=1.66%, $P<0.05$) (see Appendix, Figure 1, for trend analyses using joinpoint modeling). Estimated rates of self-harm–related hospitalizations and ED visits increased significantly for male youths from 2008 to 2017 (APC=2.97% [$P<0.05$] and APC=0.95% [$P<0.05$] respectively). Among young adult men, suicide rates increased significantly from 2014 to 2017 (APC=1.64%, $P<0.05$). Estimated rates of self-harm–related hospitalizations, among young adult men, increased significantly from 2008 to 2010 (APC=11.92%, $P<0.05$), and decreased significantly from 2015 to 2017 (APC=-9.50%, $P<0.05$).

Among female youths, suicide rates increased significantly from 2008 to 2017 (APC=0.28%, $P<0.05$). Estimated rates of self-harm–related hospitalizations and ED visits among female youths significantly increased from 2008 to 2017 (APC=10.15% [$P<0.05$] and 10.92% [$P<0.05$] respectively). Among young adult women, rates of suicide

SURVEILLANCE OF NONFATAL AND FATAL SELF-HARM AMONG YOUTHS AND YOUNG ADULTS — UNITED STATES, 2008–2017

and self-harm-related hospitalizations increased significantly from 2008 to 2017 (APC=0.23% [$P<0.05$] and APC=5.49% [$P<0.05$] respectively).

As the severity of self-harm-related outcomes decreases, the number of outcomes increases for both youths and young adults (see Appendix, Figure 2, for suicide pyramids). Thus, for every one youth suicide, there were approximately 11 self-harm-related hospitalizations, 15 self-harm-related ED visits, 619 suicide attempts and 1,438 youths who had serious thoughts of suicide. Similarly, for every one young adult suicide, there were approximately 8 hospitalizations, 6 ED visits, 109 suicide attempts, and 595 young adults who had serious thoughts of suicide.

DISCUSSION

Findings indicate that suicides represent a small fraction of suicidal behaviors among youths and young adults. Youths experienced lower suicide rates, but a higher ratio of nonfatal self-harm to suicide outcomes, compared with young adults. Previous studies have determined that nonfatal suicidal injuries were higher among youths than young adults, and that suicide tends to increase with age (Brown & Plener, 2017; Gould et al., 2003).

Although rates of suicide among male youths and young men were higher than those among females of either age group, rates of suicidal thoughts among male youths and young men were lower than those of female youths or young women. These results are consistent with previous studies, indicating that females attempt suicide more frequently than do males, and males are more likely to die by suicide (Gould et al., 2003). This suggests that females tend to use less lethal means (Gould et al., 2003), which might be important in understanding why females with self-harm behaviors are evaluated in EDs at higher rates than are males.

Annual rates of suicide, self-harm-related hospitalizations and ED visits among female youths increased significantly from 2008 to 2017, as did the annual rates of suicide and self-harm hospitalizations among young women. Moreover, annual rates of suicide, self-harm-related hospitalizations and ED visits increased significantly among male youths from 2008 to 2017, whereas among young men, the annual rate of suicide increased significantly from 2014 to 2017, and the annual rate of self-harm hospitalizations from 2008 to 2010. Changes in risk factors, methods used, social transmission of information and behavior are possible contributing factors to these noted increases in rates of suicide, self-harm hospitalizations and ED visits (Twenge et al., 2017).

LIMITATIONS

Findings in this analysis are subject to at least five limitations:

1. First, suicide counts collected from death certificates might include classification errors that lead to undercounting of these deaths (Tøllefsen et al., 2012).
2. Second, data capturing nonfatal injuries from NEISS-AIP might be undercounted as they represent those injuries reported from ED visits and do not include data from outpatient, other health care facilities, or those not receiving medical care. Self-harm-related hospitalizations that were not initiated through EDs were not captured by this study.
3. Third, although other national data sources on hospitalization exist, their data lags are longer compared with national data sources used to compile the spectrum of suicidal behavior

SURVEILLANCE OF NONFATAL AND FATAL SELF-HARM AMONG YOUTHS AND YOUNG ADULTS — UNITED STATES, 2008–2017

statistics for this study, and therefore were not included.

4. Fourth, the extent of under- or over-reporting of self-reported suicidal behaviors from NSDUH and YRBS could not be determined, but reliability for YRBS has been shown to be good (Brener et al., 2002).
5. Fifth, rates of self-directed violence hospitalizations and ED visits could not be generated by race and ethnicity due to the relatively high proportion of cases with unknown or unspecified race and ethnicity (approximately 17% of overall cases) from the 2008–2017 NIESS-AIP surveillance data.

Finally, these data sources could not distinguish between suicidal and nonsuicidal self-harm-related injuries; although, a 2005 study by Logan et al. determined 72.1% of self-harm-related injuries reported in NEISS-AIP among young adults aged 20–34 years were suicidal (Logan et al., 2007).

CONCLUSIONS

Statistically significant increases in rates of self-harm-related hospitalizations and ED visits, especially among female youths, indicate a need for ongoing surveillance, particularly among disproportionately affected groups and those with a history of victimization. CDC's Technical Package for Suicide Prevention outlines comprehensive prevention strategies based on best available evidence and designed to reduce immediate and long-term impact of injuries from self-harm behaviors including strengthening access to and delivery of suicide care which might help to normalize help-seeking behaviors and increase use of such services (Stone et al., 2017).

REFERENCES

- Brener, N., Kann, L., McManus, T., Kinchen, S., Sundberg, E., & Ross, J. (2002). Reliability of the 1999 youth risk behavior survey questionnaire. *Journal of Adolescent Health*, 31(4), 336–342. [https://doi.org/10.1016/s1054-139x\(02\)00339-7](https://doi.org/10.1016/s1054-139x(02)00339-7)
- Brown, R. C., & Plener, P. L. (2017). Non-suicidal self-injury in adolescence. *Current Psychiatry Reports*, 19(3). <https://doi.org/10.1007/s11920-017-0767-9>
- Case, A., & Deaton, A. (2015). Rising morbidity and mortality in midlife among white non-Hispanic Americans in the 21st century. *Proceedings of the National Academy of Sciences*, 112(49), 15078–15083. <https://doi.org/10.1073/pnas.1518393112>
- Gould, M., Greenberg, T., Velting, D., & Shaffer, D. (2003). Youth suicide risk and preventive interventions: A review of the past 10 years. *Journal of the American Academy of Child & Adolescent Psychiatry*, 42(4), 386–405. <https://doi.org/10.1097/01.CHI.0000046821.95464.CF>
- Joinpoint Regression Program. (2020). Joinpoint trend analysis software, Version 4.8.0.1. Retrieved March 25, 2021, from <https://surveillance.cancer.gov/joinpoint/>
- Kim, H., Fay, M. P., Feuer, E. J., & Midthune, D. N. (2000). Permutation tests for joinpoint regression with applications to cancer rates. *Statistics in Medicine*, 19(3), 335–351. [https://doi.org/10.1002/\(SICI\)1097-0258\(20000215\)19:3%3C335::AID-SIM336%3E3.0.CO;2-Z](https://doi.org/10.1002/(SICI)1097-0258(20000215)19:3%3C335::AID-SIM336%3E3.0.CO;2-Z)
- Logan, J., Crosby, A., & Ryan, G. (2007). Nonfatal self-inflicted injuries among

SURVEILLANCE OF NONFATAL AND FATAL SELF-HARM AMONG YOUTHS AND YOUNG ADULTS — UNITED STATES, 2008–2017

adults aged ≥ 65 years—United States, 2005. *Morbidity and Mortality Weekly Report*, 56, 989-993.

<https://www.cdc.gov/mmwr/preview/mwrhtml/mm5638a1.htm>

Stone, D., Holland, K., Bartholow, B., Crosby, A., Davis, S., & Wilkins, N. (2017). Preventing suicide: A technical package of policies, programs, and practice. *Technical Packages for Violence Prevention*.

<http://dx.doi.org/10.15620/cdc.44275>

Tøllefsen, I. M., Hem, E., & Ekeberg, Ø. (2012). The reliability of suicide statistics: A systematic review. *BMC Psychiatry*, 12(1).

<https://link.springer.com/article/10.1186/1471-244X-12-9>

Twenge, J., Joiner, T., Rogers, M., & Martin, G. (2017). Increases in depressive symptoms, suicide-related outcomes, and suicide rates among U.S. adolescents after 2010 and links to increased new media screen time. *Clinical Psychological Science*, 6(1), 3-17.

<https://doi.org/10.1177%2F2167702617723376>

World Health Organization. (2019, March 29). Preventing suicide: A global imperative.

Retrieved March 25, 2021, from <https://www.who.int/publications/i/item/9789241564779>

SURVEILLANCE OF NONFATAL AND FATAL SELF-HARM AMONG YOUTHS AND YOUNG ADULTS — UNITED STATES, 2008–2017

Appendix

Table 1 *Prevalence and Rate of Suicide and Self-Harm Among Youths and Young Adults^a — United States, 2017*

Outcome	Males		Females		Total	
	Youths	Young Adults	Youths	Young Adults	Youths	Young Adults
Suicide^b						
No.	1,541	3,654	511	783	2,052	4,437
No. per 100,000 population	14.4	27	5	6.1	9.8	16.8
Self-Harm–Related Hospitalizations						
No.	5,327	12,300	17,254	21,421	22,581	33,720
(95% CI)	(3,289–7,365)	(8,219–16,380)	(10,295–24,212)	(15,283–27,559)	(13,762–31,399)	(24,258–43,182)
No. per 100,000 population	49.7	90.9	167.9	166.7	107.5	127.9
Self-Harm–Related ED Visits^c						
No.	7,130	11,304	23,546	14,681	30,676	25,985
(95% CI)	(5,138–9,122)	(7,807–14,801)	(15,658–31,434)	(9,365–19,997)	(21,314–40,038)	(18,249–33,721)
No. per 100,000 population	66.5	83.6	229.1	114.3	146.1	98.5
Serious Thoughts of Suicide^d						
No.	1,049,955	1,159,000	1,840,259	1,478,000	2,949,819	2,638,000
No. per 100 population	11.9	9.2	22.1	12	17.2	10.6
(95% CI)	(10.9–13.0)	(8.2–10.2)	(20.0–24.4)	(10.8–13.1)	(16.2–18.3)	(9.8–11.3)
Attempted Suicide^d						
No.	449,981	234,000	774,407	248,000	1,269,108	482,000
No. per 100 population	5.1	1.8	9.3	2	7.4	1.9

SURVEILLANCE OF NONFATAL AND FATAL SELF-HARM AMONG YOUTHS AND YOUNG ADULTS — UNITED STATES, 2008–2017

(95% CI)	(4.3–6.1)	(1.4–2.3)	(7.7–11.1)	(1.6–2.5)	(6.5–8.4)	(1.6–2.3)
----------	-----------	-----------	------------	-----------	-----------	-----------

Notes. Abbreviations: CI=Confidence Interval; N/A= Not Applicable.

^aYouths are students in grades 9–12, 94% of whom are aged 14–18 years, according to the U.S. Census American Community Survey – Public Use Microdata; Young Adults are persons aged 19–24 years.

^bNational Vital Statistics System (NVSS) for suicide counts, crude rates per 100,000 population, and intent of injury generated from Web-based Injury Statistics Query and Reporting System (WISQARS™). Analyses included deaths by suicide, with an underlying cause of death based on ICD-10 codes X60-X84, Y87.0.

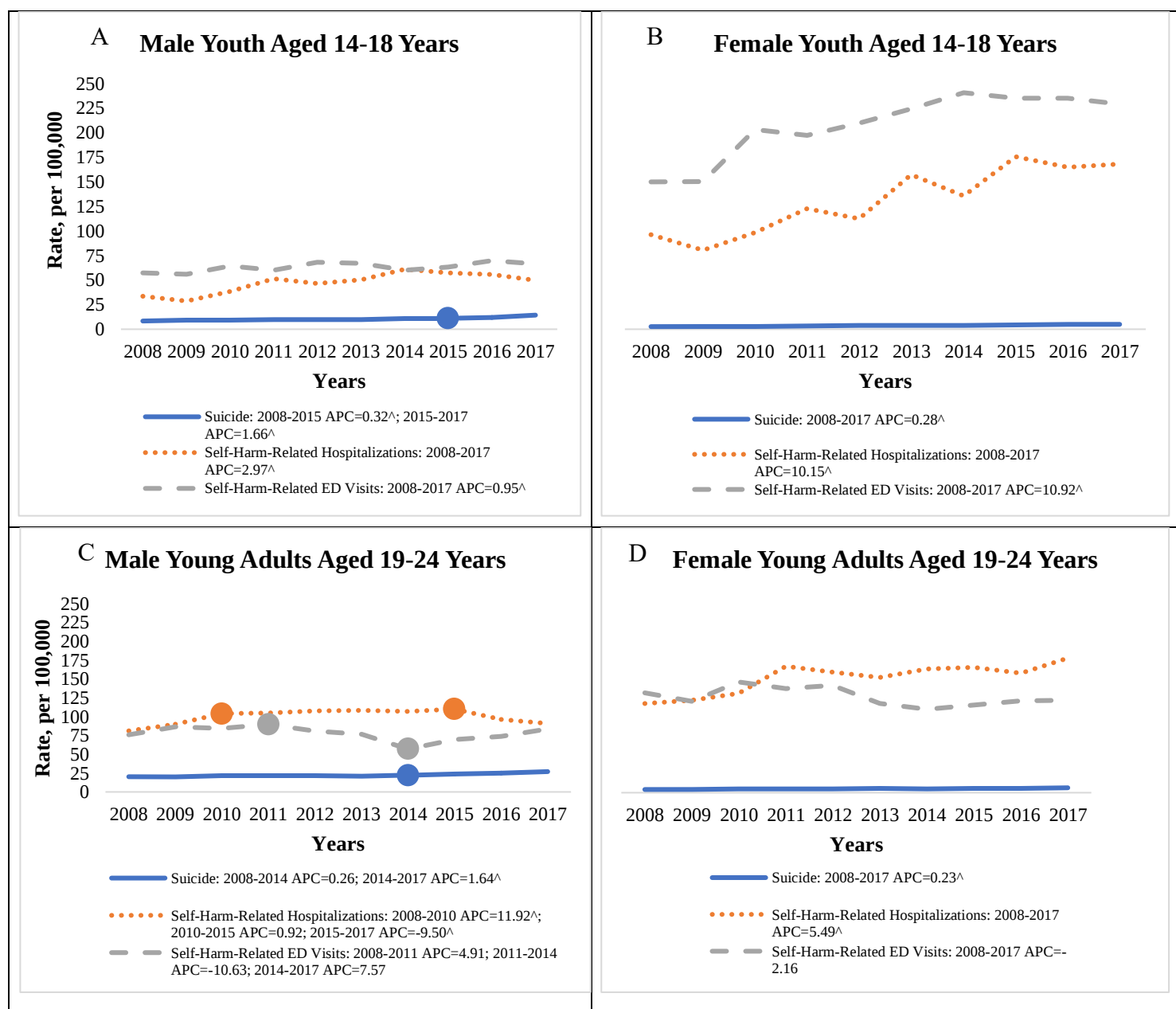
^cNational Electronic Injury Surveillance System-All Injury Program (NEISS-AIP) for self-harm-related estimates, rates, 95% confidence intervals of estimates, dispositions, and mechanisms generated from WISQARS™.

^dCenters for Disease Control and Prevention’s Youth Risk Behavior Survey (YRBS) monitors health behaviors from national, state, tribal government and local school-based nationally representative samples of high school students in grades 9–12. Serious Thoughts of Suicide was based on a YRBS question asking, "During the past 12 months, did you ever seriously consider attempting suicide?" Attempted suicide was based on a YRBS question asking, “During the past 12 months, how many times did you actually attempt suicide?” Estimates for persons aged 19-24 years taken from the National Survey on Drug Use and Health (NSDUH). Serious Thoughts of Suicide was based on a NSDUH question asking, “At any time in the past 12 months, did you seriously think about trying to kill yourself?” Attempted Suicide was based on a NSDUH question asking, “Did you make a suicide attempt?” Crude rates are reported per 100 population.

SURVEILLANCE OF NONFATAL AND FATAL SELF-HARM AMONG YOUTHS AND YOUNG ADULTS — UNITED STATES, 2008–2017

APPENDIX

Figure 1 Rate^a of Suicide,^b Self-Harm-Related Hospitalizations, and Self-Harm-Related ED Visits^c by Age Group and Sex^d — United States, 2008–2017^e



^aPer 100,000 persons, aged 14-24 years.

^bSource: Centers for Disease Control and Prevention's National Vital Statistics System (NVSS).

^cSource: Centers for Disease Control and Prevention's National Electronic Injury Surveillance System-All Injury Program (NEISS-AIP).

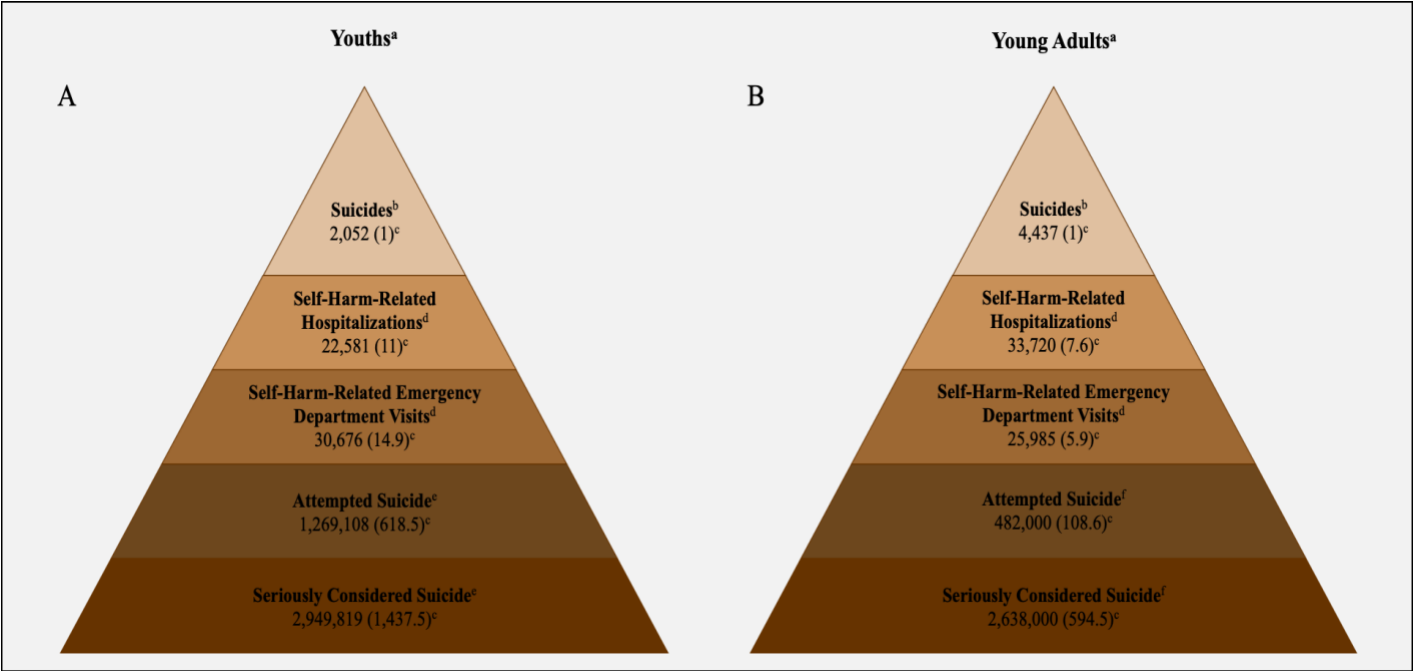
^dSource: Youths are students in grades 9–12, of whom 94% are aged 14-18 years, according to the U.S. Census American Community Survey – Public Use Microdata. Young adults are persons aged 19-24 years.

^eJoinpoint regression modeling was used to determine annual percentage change (APC) with a statistically significant trend indicated by [^] ($P<0.05$), from 2008 to 2017, using a Monte Carlo Permutation method. Small circles (joinpoints)

SURVEILLANCE OF NONFATAL AND FATAL SELF-HARM AMONG YOUTHS AND YOUNG ADULTS — UNITED STATES, 2008–2017

represent points along the trend lines where significant shifts in rates of self-harm-related outcomes occurred from 2008 to 2017.

Figure 2 *Number and Ratio of Youths and Young Adults Affected by Suicide and Self-Harm — United States, 2017*



^aYouths are students in grades 9–12, 94% of whom are aged 14–18 years (U.S. Census American Community Survey – Public Use Microdata); young adults are persons aged 19–24 years.

^bSource: Centers for Disease Control and Prevention (CDC)’s National Vital Statistics System (NVSS).

^cNo. outcomes (ratio to no. suicides).

^dSource: Center for Disease Control and Prevention (CDC)’s National Electronic Injury Surveillance System-All Injury Program (NEISS-AIP).

^eSource: Center for Disease Control and Prevention (CDC)’s Youth Risk Behavior Surveillance System (YRBSS).

^fSource: Substance Abuse and Mental Health Services Administration (SAMHSA) National Survey on Drug Use and Health (NSDUH).