



Published in final edited form as:

JAMA. 2017 November 21; 318(19): 1931–1933. doi:10.1001/jama.2017.13317.

## Trends in Emergency Department Visits for Nonfatal Self-inflicted Injuries Among Youth Aged 10 to 24 Years in the United States, 2001–2015

Melissa C. Mercado, PhD, MSc, MA<sup>1</sup>, Kristin Holland, PhD, MPH<sup>1</sup>, Ruth W. Leemis, MPH<sup>1</sup>, Deborah M. Stone, ScD, MSW, MPH<sup>1</sup>, and Jing Wang, MD, MPH<sup>1</sup>

<sup>1</sup>National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, Atlanta, Georgia

In the United States, youth have the highest burden of nonfatal self-inflicted injury (ie, deliberate physical harm against oneself, inclusive of suicidal and nonsuicidal intent) requiring medical attention.<sup>1</sup> One study found that emergency department (ED) visits for these injuries during the 1993 to 2008 period varied by age group, ranging from 1.1 to 9.6 per 1000 ED visits, with adolescents aged 15 to 19 years exhibiting the highest rates.<sup>1</sup> Self-inflicted injury is one of the strongest risk factors for suicide—the second-leading cause of death among those aged 10 to 24 years during 2015.<sup>2</sup> This study examined trends in nonfatal self-inflicted injuries treated in hospital EDs among US children, adolescents, and young adults aged 10 to 24 years (hereafter referred to as youth).

### Methods

The National Electronic Injury Surveillance System—All Injury Program (NEISS-AIP) collects data on all first-time visits for nonfatal injuries treated in 66 US hospital EDs through stratified probability sampling, allowing for the derivation of national estimates.<sup>3</sup>

Corresponding Author: Melissa C. Mercado, PhD, MSc, MA, National Center for Injury Prevention and Control, Centers for Disease Control and Prevention, 4770 Buford Hwy NE, Mailstop F-63, Atlanta, GA 30341-3717 cju8@cdc.gov.

**Conflict of Interest Disclosures:** All authors have completed and submitted the ICMJE Form for Disclosure of Potential Conflicts of Interest and none were reported.

**Disclaimer:** The findings and conclusions in this report are those of the authors and do not necessarily represent the views of the CDC.

**Author Contributions:** Dr. Mercado had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.

*Concept and design:* Mercado, Holland, Leemis, Stone.

*Acquisition, analysis, or interpretation of data:* Mercado, Holland, Leemis, Wang.

*Drafting of the manuscript:* Mercado, Holland, Leemis, Wang.

*Critical revision of the manuscript for important intellectual content:* All authors.

*Statistical analysis:* Holland, Wang.

*Administrative, technical, or material support:* Mercado, Holland, Leemis.

*Supervision:* Mercado.

*Other - subject matter expertise:* Stone.

**Additional Contributions:** The data used in this report originated from the National Electronic Injury Surveillance System All Injury Program, operated by the US Consumer Product Safety Commission and whose data are made available by CDC's web-based Injury Statistics Query and Reporting System, supported by CDC's National Center for Injury Prevention and Control. We thank Tadesse Haileyesus, MS (CDC's National Center for Injury Prevention and Control), for providing technical support. He did not receive compensation for his contribution.

Self-inflicted injuries were identified by reviewing injury cause narratives and other coded data within ED records. This study used publicly available secondary data and was exempted by the CDC from institutional review board review.

Self-inflicted injury ED visit rates were calculated from 2001 through 2015 by sex, age (10–14, 15–19, and 20–24 years), along with injury method (poisoning, sharp object, blunt object), and 95% CIs using US Census population estimates as denominators. Rates were weighted to obtain nationally representative estimates and age-adjusted to the 2000 US Census population. Trends in self-inflicted injury ED visit rates were assessed using joinpoint regression software (Surveillance Research Program, National Cancer Institute), version 4.3.1.0. The annual percentage change described the rate of change for each linear segment.

## Results

From 2001 to 2015, NEISS-AIP captured 43 138 youth self-inflicted injury ED visits. The overall weighted age-adjusted rate for this group showed no statistically significant trend until 2008, increasing 5.7% (95% CI, 3.0%–8.4%) annually thereafter and reaching 303.7 per 100 000 population (95% CI, 254.1–353.3) in 2015 (Table). Age-adjusted trends for males overall and across age groups remained stable throughout 2001–2015 (Figure, Table). Overall age-adjusted rates for females demonstrated no statistically significant trend before 2009, yet increased 8.4% (95% CI, 5.6%–11.2%) yearly from 2009 to 2015. After 2009, rates among females aged 10 to 14 years increased 18.8% (95% CI, 12.1%–25.8%) per year—from 109.8 (95% CI, 69.9–149.7) in 2009 to 317.7 (95% CI, 230.3–405.1) per 100 000 population in 2015. Rates among females aged 15 to 19 years showed a 7.2% (95% CI, 3.8%–10.8%) increase per year during 2008–2015. Rates among females aged 20 to 24 years exhibited a 2.0% (95% CI, 0.8%–3.1%) increase per year throughout 2001–2015 (Figure, Table).

Trends for all self-inflicted injury methods were stable for males. Poisoning was the most common method of self-inflicted injury for females, with rates remaining stable until 2007 and increasing 5.3% (95% CI, 0.5%–10.4%) annually thereafter. Female rates for self-inflicted injuries by sharp object increased 7.1% (95% CI, 5.2%–8.9%) annually throughout 2001–2015; female rates for blunt object injuries were stable during 2006–2015 (Table).

## Discussion

Youth self-inflicted injury ED visit rates were relatively stable before 2008. However, rates among females significantly increased thereafter—particularly among females aged 10 to 14 years, who experienced an 18.8% annual increase from 2009 to 2015. This study only included ED cases; thus, rates were underestimated. Also, limited statistical power could have resulted in some trends not showing statistical significance. Findings are consistent with previously reported upward trends in youth suicide rates during 1999–2014, in which rates increased most notably after 2006 with females aged 10 to 14 years experiencing the greatest increase.<sup>4</sup> Findings also coincide with increased reports of depression among youth,

especially young girls.<sup>5</sup> Other potential underlying reasons for the observed increasing trends, particularly among young females, warrant further study.

These findings underscore the need for the implementation of evidence-based, comprehensive suicide and self-harm prevention strategies within health systems and communities. These strategies include strengthening access to and delivery of care for suicidal youth within health systems and creating protective environments, promoting youth connectedness, teaching coping and problem-solving skills, and identifying and supporting at-risk youth within communities.<sup>6</sup>

## Acknowledgments

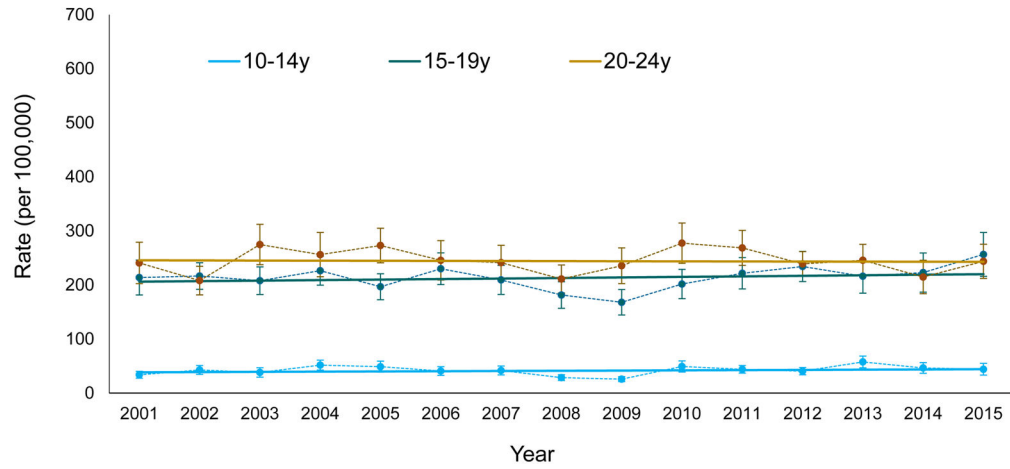
**Funding/Support:** This secondary data analysis study was conducted as part of the regular roles and responsibilities of all coauthors at the Centers for Disease Control and Prevention (CDC).

**Role of the Funder/Sponsor:** The CDC was involved in the design and conduct of the study; management, analysis, and interpretation of the data; preparation, review or approval of the manuscript; and decision to submit the manuscript for publication. Data was secondarily analyzed by the CDC, who was not involved in the data collection process.

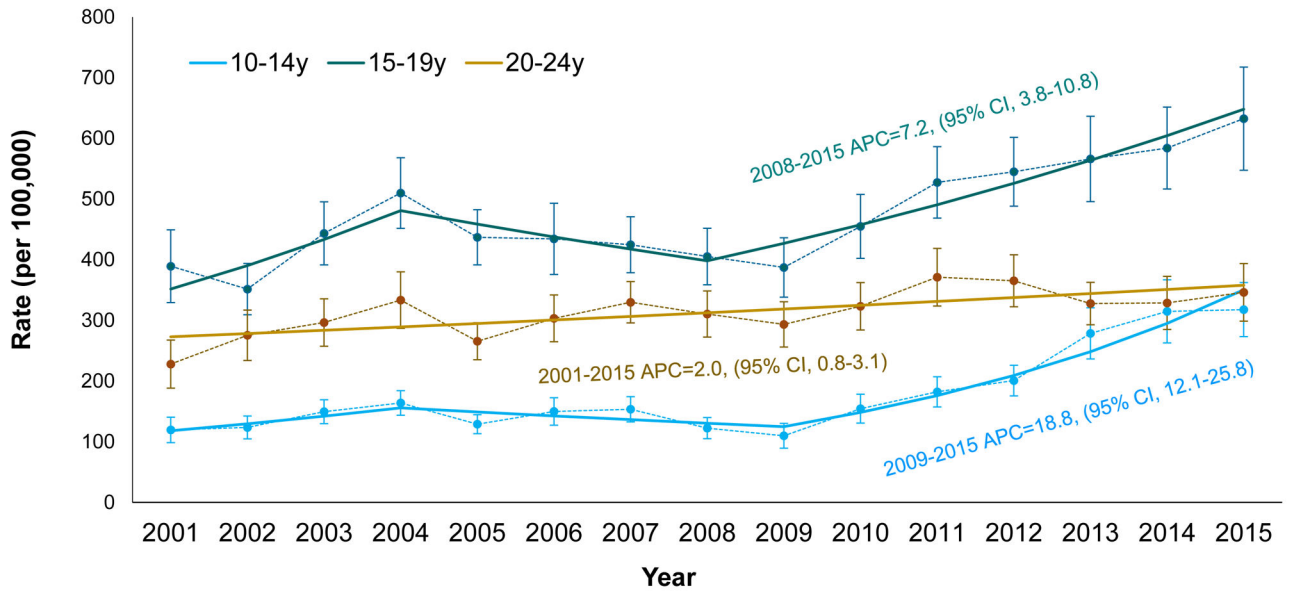
## References

1. Ting SA, Sullivan AF, Boudreaux ED, Miller I, Camargo CA Jr. Trends in US emergency department visits for attempted suicide and self-inflicted injury, 1993–2008. *Gen Hosp Psychiatry*. 2012; 34(5):557–565. [PubMed: 22554432]
2. Centers for Disease Control and Prevention. [Accessed December 22, 2016] About underlying cause of death 1999–2015. <https://wonder.cdc.gov/ucd-icd10.html>
3. Schroeder, T., Ault, K. The NEISS Sample (Design and Implementation) 1997 to Present. Washington, DC: Consumer Product Safety Commission; 2001.
4. Curtin, SC., Warner, M., Hedegaard, H. Increase in suicide in the United States, 1999–2014. Hyattsville, MD: National Center for Health Statistics; 2016.
5. Mojtabai R, Olfson M, Han B. National trends in the prevalence and treatment of depression in adolescents and young adults. *Pediatrics*. 2016; 138(6):e20161878. [PubMed: 27940701]
6. Stone, DM., Holland, KM., Bartholow, BN., Crosby, AE., Jack, SPD., Wilkins, N. Preventing Suicide: A Technical Package of Policies, Programs, and Practices. Atlanta, GA: National Center for Injury Prevention and Control, Centers for Disease Control and Prevention; 2017.

**A. Males, by Age Group**



**B. Females, by Age Group**



**Figure. Non-fatal Self-Inflicted Injury Emergency Department Visits among Youth aged 10–24 Years — United States, 2001–2015**

APC=Annual Percentage Change; CI=Confidence Intervals

Dotted lines indicate observed rates and solid lines indicate modeled rates. The error bars represent the standard errors of the observed rates. Only the significant trends were labeled with APC.

Trends in Non-fatal Self-Inflicted Injury Emergency Department Visit Rates (per 100,000) among Youth aged 10–24 years — United States, 2001–2015<sup>a</sup>

	2001			2015			Segment 1			Segment 2			Segment 3		
	Unweighted Nonfatal Injury ED Visits, No.	Weighted Rate (95% CI)	Unweighted Nonfatal Injury ED Visits, No.	Weighted Rate (95% CI)	Period	APC (95% CI)	Period	APC (95% CI)	Period	APC (95% CI)	Period	APC (95% CI)			
<b>Male</b>															
Age group, y															
10–14	93	33.9 (21.4 to 46.4)	180	44.1 (22.9 to 65.3)	2001–2015	1.0 (–2.0 to 4.1)									
15–19	387	213.7 (150.4 to 277.0)	531	256.5 (176.9 to 336.1)	2001–2015	0.5 (–0.9 to 1.8)									
20–24	350	240.7 (165.6 to 315.8)	407	243.8 (181.7 to 305.9)	2001–2015	–0.1 (–1.3 to 1.2)									
Injury Type <sup>b</sup>															
Poisoning	460	89.5 (69.9 to 109.1)	359	74.1 (55.2 to 93)	2001–2008	–6.3 (–10.4 to –2.1)	2008–2011	10.6 (–19.4 to 51.9)	2011–2015	–4.3 (–14.0 to 6.4)					
Sharp object	228	45.2 (33.4 to 57.1)	347	50.7 (38.5 to 62.8)	2001–2015	1.1 (–0.3 to 2.5)									
Blunt object	35	6.0 (3.1 to 8.9)	101	11.8 (7.3 to 16.3)	2001–2015	1.3 (–2.5 to 5.2)									
Overall Trend	830	160.8 (114.9 to 206.7)	1118	184.3 (135.1 to 233.5)	2001–2015	0.5 (–0.5 to 1.6)									
Age-adjusted Overall Trend	830	160.2 (127.9 to 192.5)	1118	179.2 (144.9 to 213.5)	2001–2015	0.3 (–0.7 to 1.4)									
<b>Female</b>															
Age group, y															
10–14	286	119.4 (78.4 to 160.4)	1033	317.7 (230.3 to 405.1)	2001–2004	9.7 (–8.1 to 30.9)	2004–2009	–4.3 (–13.1 to 5.4)	2009–2015	18.8 (12.1 to 25.8)					
15–19	725	389.3 (271.7 to 506.9)	1356	632.5 (465.9 to 799.1)	2001–2004	11.0 (–2.8 to 26.7)	2004–2008	–4.6 (–14.1 to 5.9)	2008–2015	7.2 (3.8 to 10.8)					
20–24	355	228.0 (150.4 to 305.6)	556	346.2 (253.1 to 439.3)	2001–2015	2.0 (0.8 to 3.1)									
Injury Type <sup>b</sup>															

Table

	2001		2015		Segment 1		Segment 2		Segment 3	
	Unweighted Nonfatal Self-Inflicted Injury ED Visits, No.	Weighted Rate (95% CI)	Unweighted Nonfatal Self-Inflicted Injury ED Visits, No.	Weighted Rate (95% CI)	Period	APC (95% CI)	Period	APC (95% CI)	Period	APC (95% CI)
Poisoning	988	170.9 (135 to 206.8)	987	203.3 (167.1 to 239.5)	2001–2007	-6.4 (-13.0 to 0.8)	2007–2015	5.3 (0.5 to 10.4)		
Sharp object	261	54.1 (40.5 to 67.7)	1021	136.3 (103.5 to 169)	2001–2015	7.1 (5.2 to 8.9)				
Blunt object	19	2.5 (0.5 to 4.5)	104	11.2 (7.3 to 15.0)	2001–2006	36.1 (15.7 to 60.0)	2006–2015	-0.7 (-4.9 to 3.6)		
Overall Trend	1366	244.3 (171.8 to 316.8)	2945	430.8 (325.5 to 536.1)	2001–2004	9.1 (0.2 to 18.8)	2004–2009	-1.6 (-5.7 to 2.8)	2009–2015	7.9 (5.0 to 10.8)
Age-adjusted Overall Trend	1366	245.5 (196.5 to 294.5)	2945	434.0 (363.2 to 504.8)	2001–2004	9.0 (0 to 18.8)	2004–2009	-1.9 (-6.2 to 2.5)	2009–2015	8.4 (5.6 to 11.2)
<b>Overall</b>										
Age-adjusted overall trend		201.6 (163.8 to 239.4)		303.7 (254.1 to 353.3)	2001–2004	7.9 (-2.4 to 19.4)	2004–2008	-3.7 (-11.0 to 4.1)	2008–2015	5.7 (3.0 to 8.4)

Abbreviation: APC, annual percentage change.

<sup>a</sup> Joinpoint regression was used to determine nonfatal self-inflicted injury emergency department visit rate trends overall and by sex or age-group. Trends are presented as linear segments connected at the joinpoints (ie, at the years when the slope of each trend changed significantly). The number and location of joinpoints for each trend is determined statistically. Therefore, the time periods for each linear segment within each trend may vary. If no joinpoint was identified for a trend, then that trend remained linear for the entire 2001–2015 period; in those instances, the APC is presented in Segment 1 only and left blank for all other segments.

<sup>b</sup> Insufficient sample size to analyze the trends for other types of self-inflicted injury. Blunt object-related injuries include "injuries resulting from being struck by (hit) or crushed by a human, animal, or inanimate object or force other than a vehicle or machinery." This does not include falls from heights, such as buildings and bridges.