Research Article

Continuing Alarming Increases in Suicide in American youths: Clinical and Research Challenges

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Abstract

Objective: In United States (US) youths suicide has become the second leading cause of premature death among those aged 10 to 24 years and is the leading cause of death among those aged 13 to 14 years. In this original research we explored trends in suicide by sex, race, level of urbanization, census region, month of the year and day of the week among US youths aged 13 to 14 years.

Method: Death certificate data from US Centers for Disease Control and Prevention. Mortality rates and annual percent changes and 95% confidence intervals and joinpoint regression.

Results: From 2008 to 2018, suicide rates among US youths aged 13 to 14 years increased almost 2.5 fold from 2.06 in 2008 to 5.05 per 100,000 population in 2018 following significant declines from 2.29 in 1999 to 1.49 in 2007. These statistically significant increasing trends were similar by sex, race, urbanization and census regions. In rural areas, rates were higher in boys where firearms were used for 46.7% of suicides and 34.7% in metropolitan areas (p<0.001). Suicides occurred significantly more often (p<0.001) between September and May significantly more often (p<0.001) on Monday and the rest of the weekdays.

Conclusions: Among US youths aged 13 to 14 years suicide rates more than doubled from 2008 to 2018 following significant declines from 1999 to 2007. . These trends were similar in urban and rural areas but were more common in boys in rural areas where firearms are more prevalent. Analytic studies are necessary to test the many hypotheses formulated by these descriptive data which include social media, school stress, and firearms. In the meanwhile, increased clinical and public health efforts are also necessary to combat this epidemic of suicide among US youths.

INTRODUCTION

In United States (US) youths suicide has become the second leading cause of premature death among those aged 10 to 24 years and is the leading cause of death among those aged 13 to 14 years [1].

Perhaps not surprisingly, about half of all youth and young adult suicide victims had a previously diagnosed mental health condition, especially depression [2]. Among youths aged 10 to 17 years, family relationship problems within two weeks of the suicide were among the most reported cormorbidities [2]. Among those aged 18 to 24 years, intimate partner related issues were among the most commonly reported comorbidities.

With respect to worldwide suicide rates among youths, the US ranks 5th for boys and 14th for girls among 29 Organization for Economic Co-operation and Development countries [3].Youths in the US experience many physical, mental, emotional, and social changes, including those associated with puberty, increased peer pressure to engage in risky behavior, depression, greater stress from more challenging school work, as well as family problems [2].

In this regular research study, we explore trends in rates of suicide among US youths aged 13 to 14 years from 1999 to 2018 by sex, race, level of urbanization, census region, month of the year and day of the week.

METHODS

We used publicly available data from the US Centers for Disease Control and Prevention (CDC) Multiple Cause of Death files for International Classification of Disease (ICD-10) codes X60-Y84 (Intentional self-harm), Y87.0 (Sequelae of Intentional self-harm) and U03 (terrorism, intentional for which no suicides were classified) mentioning suicide as an underlying or contributory cause of death for 1999 to 2018 [4].

We obtained annual mortality rates and 95% confidence intervals. We used Annual Percent Change (APC) in rates of suicide as descriptive measures and joinpoint regression analyses to test for significance of any trends. We classified urbanization using National Center for Health Statistics-2013 (NCHS)) definitions of large central metropolitan and large fringe metropolitan, each with populations of >1,000,000, medium metropolitan (250,000-999,999) and small metropolitan (<250,000) or micropolitan or rural (10,000-49,999). We classified US Census Regions using the NCHS definitions of Northeast, Midwest, South, and West. We classified type of weapon using NCHS definitions of firearms, hanging, strangulation or suffocation [4-7].

We also explored whether there were variations in the rates of suicide by month of the year and day of the week.

The Institutional Review Board of the Baylor College of Medicine classified this research as exempt.

RESULTS

From 1999 to 2018, there were 4,723 suicides among US youths aged 13 and 14 years. The overall rate was 2.83 per 100,000 population (95% Confidence Interval (CI) 2.7- 2.9). The 4723 suicides among US youths aged 13 and 14 years was their leading cause of death in 2018 From 2008 to 2018 the rates significantly increased almost 2.5 fold from 2.06 per 100,000 population (1.61-2.19) to 5.05(4.56-5.53). These significant increases followed significant declines from 2.29 in 1999 to 1.49 in 2007. With respect to APCs the significant rise of +9.46 from 2008 to 2018 followed a significant decline from 1999 to 2007 of -4.23 (Figure 1)

In 2018 there were 420 suicides in US youths aged 13 to 14 years compared with 173 in 2008. As regards sex, the numbers of suicides were 283 and 118 among boys and 137 and 55 among girls. Although there were more suicides among boys the APC's were slightly higher among girls. Similar significant increases in APCs were apparent for non-Hispanic Whites and Hispanics. Later increases were seen for non-Hispanic, non-Whites. All these increasing trends were statistically significant using joinpoint regression (Table 1).

There were statistically significant increases in APCs at all levels of urbanization which were significantly higher in smaller Metropolitan or Micropolitan areas (+10.9 (7.8-14.1) than large central Metropolitan areas (+7.4(5.3-9.5)). Among the four US Census Regions, there were remarkably similar and statistically
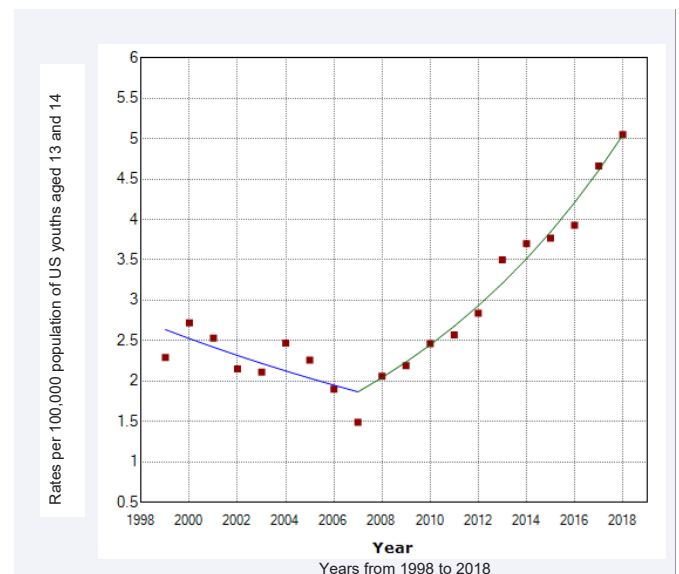

Figure 1 Trends in mortality rates from suicide among all US youths aged 13 to 14 years from 1998 to 2018.

significant increases in all areas, namely Northeast, Midwest, South, and West (Table 1).

From 2007 to 2018 there were 2,420 suicides among US youths aged 13 to 14 years in metropolitan areas (Large Central, Large Fringe, Medium, and Small). Of these 1,373 (56.7%) were due to hanging, strangulation or suffocation, while in 840 deaths (34.7%), firearms were used. No other cause accounted for more than 5%. In Medium and Small Metro areas 557 of 1,033 (38.9%) suicides were due to hanging, strangling or suffocation while 402 (38.9%) were due to firearms. In rural (Micropolitan and Non-Core, Non-Metro) areas, 301 (46.9%) of the 642 suicides were due to hanging, strangulation or suffocation, while 300 (46.7%) were due to firearms. (Data not shown)

With respect to rural and urban areas, the rates were 2.3 per 100,000) 2.0-2.6) in rural and 1.6 (1.5-1.7) in Large Metropolitan areas. These statistically significant differences were also present for suicide by firearms. The rates for firearms were 2.3(2.0-2.6 in rural areas and 1.6 (1.5-1.7 in Large Metropolitan areas. In contrast, the rates for other specified means were 1.6 (1.4,1.0) in rural areas and 0.8(0.7-0.8) in Large Metropolitan areas. (Data not shown)
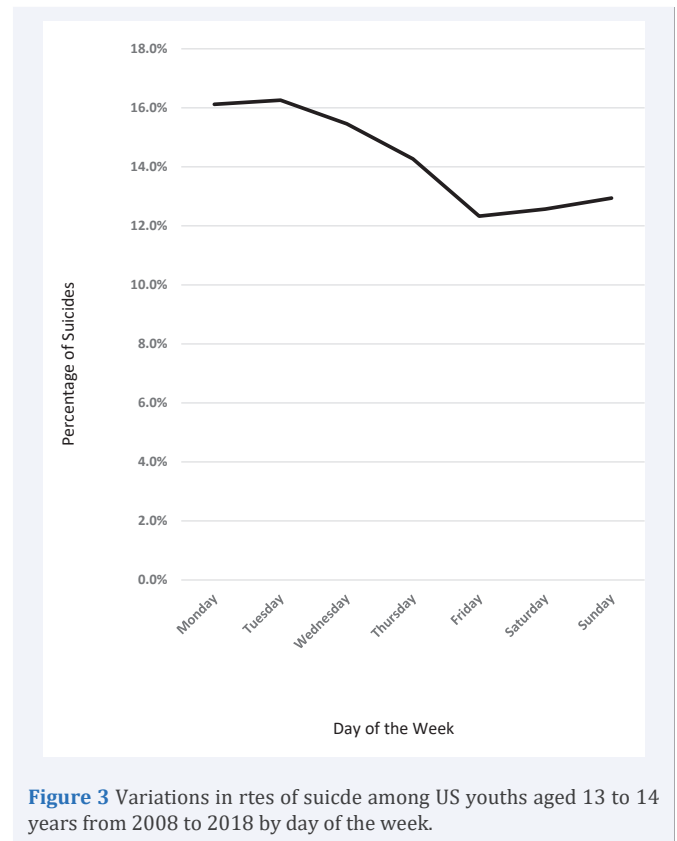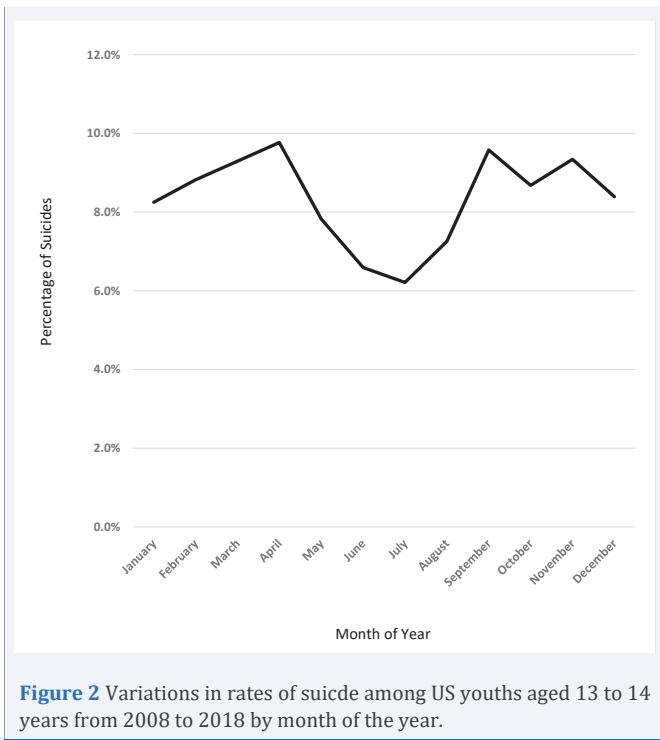
The percentages of deaths from suicide were highest from September to April and decreased from May to August (p<0.001) (Figure 2). In addition, the percentages of deaths were highest on Monday, followed by Tuesday, Wednesday, Thursday and Friday (p<0.01) (Figure 3).

DISCUSSION

These data demonstrate significant increases in suicide in US youths overall as well as by sex,race and ethnicity. These significant increases were also apparent according to urbanization and census regions but were highest in rural areas

Table 1: Increasing Annual Percent Changes in Suicide Rates in US youths aged 13 to 14 years showing time of increase during 1999-2018 by Sex, Race, Level of Urbanization and US Census Region

	Annual Percent Change (APC) (95% Confidence Interval)	Time of Increase	P
Sex			
Girls	+10.4 (6.9-14.1)	2009-2018	<0.05
Boys	+9.2 (7.4-10.9)	2008-2018	<0.05
Race			
Non-Hispanic White	+ 10.9 (6.9-12.8)	2008-2018	<0.05
Hispanic	+9.5 (8.0-10.9)	2008-2018	<0.05
Non-Hispanic, Non-White	+17.0 (4.1, 31.5)	2015-2018	<0.05
Level of Urbanization			
Large Central Metropolitan	+7.4 (5.3-9.5)	2008-2018	<0.05
Large Fringe Metropolitan	+10.0 (6.1-14.7)	2010-2018	<0.05
Medium Metropolitan	+9.6 (6.8-12.5)	2008-2018	<0.05
Small Metropolitan,Micropolitan, or non-core, non-metropolitan (rural)	+10.9 (7.8-14.1)	2008-2018	<0.05
US Census Region			
Northeast	+8.4 (4.9-12.1)	2008-2018	<0.05
Midwest	+9.9 (7.8-12.8)	2009-2018	<0.05
South	+9.6 (7.7-11.6)	2008-2018	<0.05
West	+9.8 (7.4-12.3)	2008-2018	<0.05

Figure 2 Variations in rates of suicde among US youths aged 13 to 14 years from 2008 to 2018 by month of the year.

Figure 3 Variations in rtes of suicde among US youths aged 13 to 14 years from 2008 to 2018 by day of the week.

were firearms predominated. Overall significant increases began in 2008 and followed significant declines from 1999 to 2007. Sub-groups showed significant increases over different time periods, all of which began in 2008 or later.

There are numerous plausible hypotheses that can be formulated from these descriptive data. One intriguing hypothesis derived an initial correlation with a decrease in anti-depressant use following a black box warning by the US Food and Drug Administration (FDA) but this did not persist [8]. Another particularly intriguing hypothesis concerns correlations with social media on young teens. Specifically, during the years immediately preceding the onset of increases in rates of suicide among 13- and 14- year-olds several prominent social media efforts used by teens, including Reddit [9], YouTube [10], Twitter [11,12], Facebook [13], Myspace [14], and Tumblr [15], were launched. In aggregate, all these sites have grown to billions of users, but large as they are, by 2018, all but YouTube were surpassed in terms of teen use by Instagram [12], and Snapchat [17].

In some prospective studies, youths using more social media experienced higher rates of depression, and suicidality [18-21]. For example, a secondary analysis of longitudinal data of 12,877, 13- to 16-year-olds in England showed that teens who were very frequent social media users, particularly boys, had higher scores for psychological stress [20]. In addition, a sub study of a randomized trial of 3,826 Canadian adolescents entering the seventh grade in 31 Greater Montreal area from September 2012-2018, explored four types of screen exposure, namely social media, video gaming, television, and computer use [21]. Youths reporting increased social media use, either over four years or with increased use during a year, as well as those with increased screen time reported increased rates of depression. Those reporting increases in television or computer time or gaming reported no increases in depression [22]. In contrast, cross-sectional or pre-post studies of screen-time and youth health have produced inconsistent results [23-26].

In a study of 85,051 suicides in US youths from 1975 to 2016 boys had higher rates than girls [27,28]. These data also showed recent declines in the boy: girl ratio. Of note, the present descriptive data also show significant declines in the boy: girl ratio among 13-14-year-olds from 3.4 in 1999 to 2.0 in 2018.

The present study also demonstrates both higher rates of suicide and higher proportions of suicide due to firearms in rural areas. In one study showing similar findings, the authors suggested that contextual factors such as isolation, poverty and decreased access to care might be overshadowed by differences in access to means of suicide. In the present data, non-metropolitan areas have higher rates of teen suicide, regardless of method and rural areas have higher rates due to firearms. The question of whether access to weapons or other contextual factors in rural areas are relevant also merits further research in analytic studies designed a priori to test the hypotheses.

Finally, the present data show that suicide in these youths tended to occur more often on Monday, Tuesday and Wednesday and less likely to occur in June, July, and August. The hypotheses formulated from these observations, including the plausible possibility of school related stress, also merit further research as does exploration of trends in suicide among other age groups during childhood..

The chief limitation of these descriptive and population-based data is the inability to test hypothesis. In addition, we relied on death certificates which have limitations, particularly as regards the circumstances in which the death occurred. With respect to the reliance on death certificates, the possibility must be considered that the findings on ethnicity could, at least in theory, be attributable to some artifact in the way this variable is recorded and tabulated on death certificates [29]. We are reassured, however, that this may not be the case because the NCHS has completed their own validation studies and concluded that since 1999 race (when categorized as Black, White, Asian and Pacific Islander) and ethnicity categorized as White or Hispanic can be considered to be valid [30].

CONCLUSIONS

Among US youths aged 13 to 14 years suicide rates more than doubled from 2008 to 2018 following significant declines from 1999 to 2007. . These trends were similar in urban and rural areas but were more common in boys in rural areas where firearms are more prevalent. Analytic studies are necessary to test the many hypotheses formulated by these descriptive data which include social media, school stress, and firearms. In the meanwhile, increased clinical and public health efforts are also necessary to combat this epidemic of suicide among US youths.

DECLARATIONS

Professor Levine, Mr. Levine, Ms. Rubenstein, Dr. Muppala, Dr. Mejia, Dr. Gonzalez, and Professor Zoorob have no disclosures.

Professor Hennekens reports that he serves as an independent scientist in an advisory role to investigators and sponsors as Chair of Data Monitoring Committees for Amgen and UBC, to the Collaborative Institutional Training Initiative (CITI), the United States Food and Drug Administration, and UpToDate; receives royalties for authorship or editorship of 3 textbooks and as co-inventor on patents for inflammatory markers and cardiovascular disease that are held by Brigham and Women's Hospital; has an investment management relationship with the West-Bacon Group within SunTrust Investment Services, which has discretionary investment authority; does not own any common or preferred stock in any pharmaceutical or medical device company.

Professor Wood serves as an independent scientiist in an advisory role to investigators and sponsors as a member of an international Data Monitoring Committee for Amgen

VERIFICATION

All authors had access to the data and a role in writing the manuscript

What's known on This Subject?

In United States youths suicide has become the second leading cause of premature death among those aged 10 to 24 years and is the leading cause of death among those aged 13 to 14 years.

What This Study Adds

Among US youths aged 13 to 14 years suicide rates more than doubled from 2008 to 2018. These trends were similar in urban and rural areas but were more common in boys in rural areas where firearms are more prevalent.

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