

## Original Investigation

# Suicide Trends Among Elementary School-Aged Children in the United States From 1993 to 2012

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**IMPORTANCE** Suicide is a leading cause of death among school-aged children younger than 12 years but little is known about the epidemiology of suicide in this age group.

**OBJECTIVE** To describe trends in suicide among US children younger than 12 years by sociodemographic group and method of death.

**DESIGN, SETTING, AND PARTICIPANTS** Period trend analysis of national mortality data on suicide in children aged 5 to 11 years in the United States from January 1, 1993, to December 31, 2012. Data were analyzed per 5-year periods, between 1993 to 1997 and 2008 to 2012.

**MAIN OUTCOMES AND MEASURES** Number of suicide deaths and crude suicide rates. Period trends in rates of suicide were estimated using negative binomial regression incidence rate ratios (IRRs).

**RESULTS** The overall suicide rate among children aged 5 to 11 years remained stable between 1993 to 1997 and 2008 to 2012 (from 1.18 to 1.09 per 1 million; IRR = 0.96; 95% CI, 0.90-1.03). However, the suicide rate increased significantly in black children (from 1.36 to 2.54 per 1 million; IRR = 1.27; 95% CI, 1.11-1.45) and decreased in white children (from 1.14 to 0.77 per 1 million; IRR = 0.86; 95% CI, 0.79-0.94). The overall firearm suicide rate (IRR = 0.69; 95% CI, 0.57-0.85) and firearm suicide rate among white boys (IRR = 0.72; 95% CI, 0.59-0.88) decreased significantly during the study. The rate of suicide by hanging/suffocation increased significantly in black boys (IRR = 1.35; 95% CI, 1.14-1.61), although the overall change in suicide rates by hanging/suffocation or other suicide methods did not change during the study.

**CONCLUSIONS AND RELEVANCE** The stable overall suicide rate in school-aged children in the United States during 20 years of study obscured a significant increase in suicide incidence in black children and a significant decrease in suicide incidence among white children. Findings highlight a potential racial disparity that warrants attention. Further studies are needed to monitor these emerging trends and identify risk, protective, and precipitating factors relevant to suicide prevention efforts in children younger than 12 years.

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Youth suicide is a major public health concern in the United States.<sup>1</sup> In 2012, suicide was the second leading cause of death in adolescents aged 12 to 19 years, accounting for more deaths in this age group compared with cancer, heart disease, influenza, pneumonia, diabetes mellitus, human immunodeficiency virus, and stroke combined.<sup>2</sup> Although the incidence of suicide is low prior to adolescence, suicide still ranks as the 11th leading cause of death in children aged 5 to 11 years, with devastating consequences for families.<sup>2-4</sup> Despite the scale of the problem, little is known about the epidemiology of childhood suicide because prior studies have typically excluded children younger than 10 years and investigated trends only within specific older age groups (eg, 10-14 years and 15-19 years), obscuring potentially important information about developmental differences in suicide trends among younger children.<sup>5-12</sup> The purpose of this study was to investigate characteristics and recent trends of suicide in US children aged 5 to 11 years inclusively by using 20 years of national mortality data from January 1, 1993, to December 31, 2012, the most recent year for which data were available.

## Methods

The Web-based Injury Statistics Query and Reporting System of the Centers for Disease Control and Prevention was used to obtain data on deaths for which suicide (coded as E950-E959 for the *International Classification of Diseases, Ninth Revision* [1993-1998] and X60-X84, Y87.0, and \*U03 for the *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision* [1999-2012]) was listed as the underlying cause of death among children aged 5 to 11 years.<sup>1</sup> This study was not considered human participant research according to the review policy of the Research Institute at Nationwide Children's Hospital Institutional Review Board. We used the Web-based Injury Statistics Query and Reporting System suicide mortality data from four 5-year periods starting with 1993 to 1997 and ending with 2008 to 2012 to ensure stable rate estimates for analyses. Because suicide is never coded as a cause of death for children aged 4 years or younger,<sup>1</sup> the lower age limit in this study was 5 years and the upper age limit of 11 years marked the end of middle childhood and the beginning of adolescence.<sup>13</sup> The number of suicide deaths per year was extracted overall and according to the following subgroups: sex, age (5-9 years and 10-11 years), race (white, black, and other race [American Indian/Alaskan Native; Asian/Pacific Islander]), ethnicity (Hispanic and non-Hispanic), region (Northeast, South, Midwest, and West), and method (firearm, hanging/suffocation, and other methods). The age grouping of 5 to 9 years of age was included to provide national estimates for this 5-year age interval typically excluded from suicide trend analyses of young people.<sup>5,6</sup> Crude rates per 1 million persons were calculated with the Web-based Injury Statistics Query and Reporting System population estimates.<sup>1</sup> Period trends in suicide rates between 1993 to 1997 and 2008 to 2012 were modeled using negative binomial rate regression analyses because of overdispersion in the data (ie, extra Poisson variability).<sup>8,14</sup> Incidence rate ratios (IRRs) and corresponding 95% CIs were

## At a Glance

- Between 1993 and 2012, a total of 657 children aged 5 to 11 years died by suicide in the United States, with 553 (84%) who were boys and 104 (16%) who were girls.
- Although there was no significant change in the overall suicide rate throughout the study period, there was a significant increase in the suicide rate among black children and a significant decline in the suicide rate among white children.
- Hanging/suffocation was the predominant method of suicide throughout the period. The rate of suicide by hanging/suffocation increased significantly in black boys, whereas the firearm suicide rate decreased significantly among white boys during the study.
- Further studies are needed to monitor these emerging trends and identify risk, protective, and precipitating factors relevant to suicide prevention efforts in children younger than 12 years.

estimated from the negative binomial regression models; 95% CIs that did not include 1.00 were considered statistically significant. Statistical analyses were performed with Stata/IC Statistical Software, version 13.1 (StataCorp Inc).

## Results

Between 1993 and 2012, a total of 657 children aged 5 to 11 years died by suicide in the United States, a mean of nearly 33 children per year, with 553 (84%) who were boys and 104 (16%) who were girls. The male-to-female IRR of suicide during this period was 5.08 (95% CI, 4.12-6.26). There was no significant change in the overall suicide rate between 1993 to 1997 and 2008 to 2012 (from 1.18 to 1.09 per 1 million; IRR = 0.96; 95% CI, 0.90-1.03; **Table**). However, an examination of trends by race revealed that the relatively stable overall suicide rate between 1993 to 1997 and 2008 to 2012 was the result of divergent trends in white and black children (**Table**). Among white children, the suicide rate decreased significantly during the study period (IRR = 0.86; 95% CI, 0.79-0.94), whereas for black children there was a significant increase in the suicide rate (IRR = 1.27; 95% CI, 1.11-1.45).

Analyses by sex and race subgroups revealed that statistically significant racial differences in suicide trends between 1993 to 1997 and 2008 to 2012 were restricted to white and black boys (**Figure 1**), with a significant decrease in the suicide rate among white boys (from 1.96 to 1.31 per 1 million; IRR = 0.85; 95% CI, 0.78-0.93), and a significant increase in the suicide rate among black boys (from 1.78 to 3.47 per 1 million; IRR = 1.26; 95% CI, 1.07-1.47). Although statistically significant changes were not observed in suicide rates for white and black girls, the suicide rate for black girls trended from 0.68 to 1.23 per 1 million between 1993 to 2002 and 2003 to 2012 (IRR = 1.86; 95% CI, 0.97-3.58). Suicide rates in white girls showed more stability across time (from 0.25 to 0.24 per 1 million; IRR = 0.97; 95% CI, 0.56-1.68).

Hanging/suffocation was the predominant method of suicide throughout the period and accounted for 78.2% (514 of 657) of the total suicide deaths, followed by firearms (17.7%; 116 of 657) and other methods (4.1%; 27 of 657) (**Table**; **Figure 2**).

**Table. Period Trends in Suicide Rates for Children Aged 5 to 11 Years in the United States From 1993 to 1997 and 2008 to 2012<sup>a</sup>**

Variable	Suicide Rates per 1 Million Persons								Period Trend, IRR (95% CI), 1993-1997 to 2008-2012
	1993-1997		1998-2002		2003-2007		2008-2012		
	No.	Rate	No.	Rate	No.	Rate	No.	Rate	
Overall	160	1.18	184	1.28	158	1.13	155	1.09	0.96 (0.90-1.03)
Age, y									
5-9	25	0.26	27	0.27	17	0.17	30	0.30	1.01 (0.85-1.21)
10-11	135	3.49	157	3.76	141	3.39	125	3.03	0.95 (0.88-1.02)
Sex									
Male	135	1.94	167	2.27	132	1.85	119	1.63	0.93 (0.86-1.00)
Female	25	0.38	17	0.24	26	0.38	36	0.52	1.16 (0.98-1.39)
Race									
White	122	1.14	140	1.26	95	0.89	84	0.77	0.86 (0.79-0.94)
Black	30	1.36	34	1.41	54	2.35	59	2.54	1.27 (1.11-1.45)
Other race <sup>b</sup>	8	1.13	10	1.25	9	1.02	12	1.15	NA <sup>c</sup>
Ethnicity <sup>d</sup>									
Hispanic	16	0.87	28	1.13	20	0.72	30	0.90	0.97 (0.80-1.16)
Non-Hispanic	139	1.20	154	1.30	137	1.23	125	1.14	0.98 (0.91-1.06)
Method									
Firearm	52	0.38	25	0.17	19	0.14	20	0.14	0.69 (0.57-0.85)
Hanging/suffocation	97	0.71	153	1.07	135	0.97	129	0.91	1.05 (0.96-1.15)
Other methods <sup>e</sup>	11	0.08	6	0.04	4	0.03	6	0.04	NA <sup>c</sup>
Region									
Northeast	17	0.68	29	1.10	17	0.70	19	0.81	1.00 (0.82-1.22)
South	56	1.19	66	1.31	58	1.15	52	0.97	0.93 (0.83-1.04)
Midwest	44	1.37	39	1.19	41	1.31	45	1.45	1.03 (0.90-1.17)
West	43	1.36	50	1.47	42	1.27	39	1.14	0.93 (0.82-1.07)

Abbreviations: IRR, incidence rate ratio, NA, not available.

<sup>a</sup> Rates based on 20 or fewer deaths may be unstable.

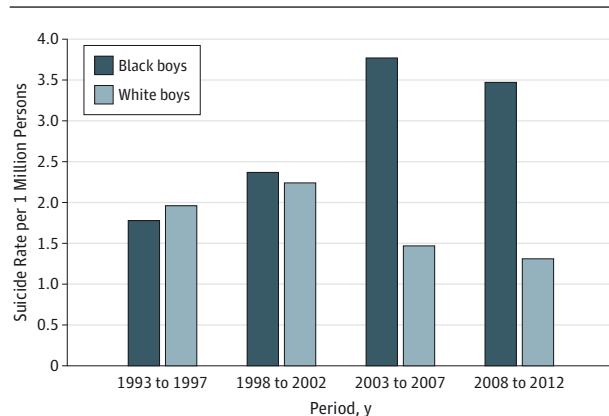
<sup>b</sup> Includes American Indian/Alaskan Native and Asian/Pacific Islander.

<sup>c</sup> Not calculated because there were 20 or fewer deaths in every period.

<sup>d</sup> Hispanic ethnicity reports were excluded from Oklahoma from 1993 to 1996.

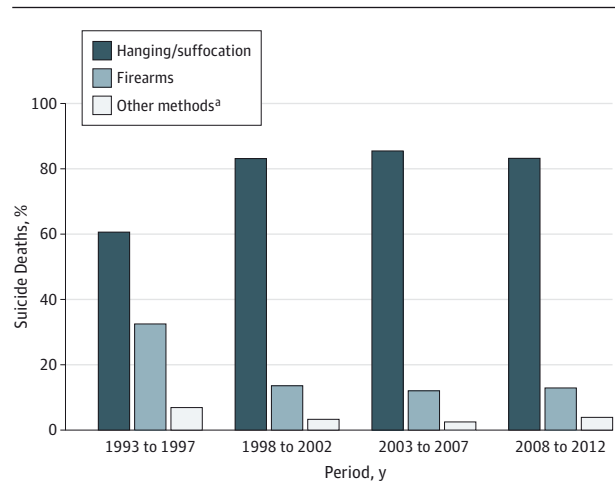
<sup>e</sup> Includes poisoning, fall, cut/pierce, drowning, transportation-related, and other means not elsewhere classifiable.

**Figure 1. Suicide Rates Among White and Black Boys Aged 5 to 11 Years in the United States Between 1993 to 1997 and 2008 to 2012**



In black boys, the suicide rate increased between 1993 to 1997 and 2008 to 2012 (incidence rate ratio [IRR] = 1.26; 95% CI, 1.07-1.47), whereas suicide rates in white boys decreased during this period (IRR = 0.85; 95% CI, 0.78-0.93). In 1993 to 1997, the IRR of suicide between black and white boys was 0.91 (95% CI, 0.57-1.47). In 2008 to 2012, the IRR of suicide between black and white boys was 2.65 (95% CI, 1.77-3.96).

**Figure 2. Changes in Methods of Suicide Among Youth Aged 5 to 11 Years in the United States Between 1993 to 1997 and 2008 to 2012**



In 1993 to 1997, a total of 1.87 hanging/suffocation suicides (95% CI, 1.33-2.61) occurred for every firearm suicide. In 2008 to 2012, this ratio increased to 6.45 hanging/suffocation suicides (95% CI, 4.03-10.33) for every firearm suicide.

<sup>a</sup> Includes poisoning, falling, cutting/piercing, drowning, transportation-related methods, and other means not elsewhere classified.

The rate of suicide by firearms decreased from 0.38 per 1 million in 1993 to 1997 to 0.14 per 1 million in 2008 to 2012 (IRR = 0.69; 95% CI, 0.57-0.85). There was no significant overall change in the suicide rate by hanging/suffocation or other methods during the study.

However, when examined by race and sex, the rate of suicide by firearms decreased significantly in white boys (from 0.71 to 0.31 per 1 million; IRR = 0.72; 95% CI, 0.59-0.88), whereas the rate of suicide by hanging/suffocation increased significantly in black boys (from 1.16 to 3.22 per 1 million; IRR = 1.35; 95% CI, 1.14-1.61) during this period. There were no significant changes in hanging/suffocation suicide rates in white boys or firearm suicide rates in black boys. Method-specific changes in suicide rates among white and black girls were not examined owing to small cell sizes.

## Discussion

The analysis of national mortality data in US children aged 5 to 11 years revealed a substantial increase in the suicide rate among black children between 1993 to 1997 and 2008 to 2012. This increase deviated from a stable overall suicide rate and a significant reduction in suicide among white children during the 20-year period. The overall decline in the firearm suicide rate was paralleled by reduced firearm suicides among white boys, whereas the increased suicide incidence in black boys corresponded to an increase in hanging/suffocation suicides, the primary method throughout this period.

Historically, the suicide rate among US black individuals has been lower than that of white individuals across age groups, although the gap between black and white boys aged 10 to 19 years narrowed from 1980 to 1995.<sup>9-15</sup> To our knowledge, this is the first national study to observe higher suicide rates among US black individuals compared with white individuals. To put these findings in perspective, suicide ranked 14th as a cause of death among black children aged 5 to 11 years in 1993 to 1997 but increased to ninth in 2008 to 2012. For white children, suicide ranked 12th as a cause of death in 1993 to 1997 and 11th in 2008 to 2012. While it is well known that suicide in adolescents and adults is undercounted,<sup>16,17</sup> there is a paucity of literature investigating the potential underestimation or misclassification of suicide in children. Misclassification bias is an unlikely explanation for the following 2 reasons: research has shown that US black individuals have an increased potential for suicide misclassification compared with white individuals, with relative underreporting of black suicide deaths,<sup>16,18</sup> and the potential for misclassification bias is higher for nonviolent suicide methods (eg, poisoning or gas inhalation) compared with violent methods (eg, firearms or hanging/suffocation). In our study, hanging/suffocation and firearms accounted for roughly 96% of all suicide deaths. Consequently, these findings highlight an emerging racial disparity in the epidemiology of childhood suicide.

Our findings suggest questions about what factors might influence increasing suicide rates among young black children. Black children may experience disproportionate exposure to violence and traumatic stress<sup>19,20</sup> and aggressive school discipline.<sup>21</sup> Black children are also more likely to experience an early onset

of puberty,<sup>22</sup> which increases the risk of suicide, most likely owing to the greater liability to depression and impulsive aggression.<sup>11,23</sup> Black youth are also less likely to seek help for depression, suicidal ideation, and suicide attempts.<sup>24,25</sup> Nevertheless, it remains unclear if any of these factors are related to increasing suicide rates. Other potential influences include differential changes in social support and religiosity, 2 factors that have traditionally been hypothesized to protect black youth from suicide but shifted significantly during the 2 decades in our study.<sup>26,27</sup>

Research has revealed significant changes in the methods of suicide among young people in the United States.<sup>5,8</sup> Consistent with these data, the results of this study showed a significant increase in the rate of suicide by hanging/suffocation in black boys. Although the decline in suicide by firearms could be related to efforts to reduce access to guns through enactment of youth-focused gun laws,<sup>14</sup> changes across time in social norms about safe gun storage,<sup>28</sup> or public awareness campaigns,<sup>29</sup> this study found that the decline in firearm suicide was limited to white boys. It seems unlikely that access to firearms was reduced to a larger extent in white boys than in other sex or race subgroups.

Although rates of suicide in adolescents aged 12 to 19 years are roughly 50 times higher than suicide rates in children aged 5 to 11 years (5.66 vs 0.11 per 100 000 in the 2008-2012 period),<sup>1</sup> investment in upstream suicide prevention approaches that occur prior to the onset of suicidal behavior may have strong potential to reduce youth suicide rates.<sup>30</sup> One example of an upstream approach is the Good Behavior Game, an elementary school-based behavior management intervention that uses a game format with teams and rewards to reduce aggressive and disruptive classroom behavior.<sup>31</sup> A long-term follow-up study of students randomized to either the Good Behavior Game or standard setting (control) classrooms in first and second grade found an almost 50% reduction in suicide attempts at ages 19 to 21 years.<sup>32</sup> Future research should examine the effect of the Good Behavior Game in preventing suicidal ideation and behavior in children and early adolescents.

This study had several limitations. First, we did not have adequate numbers to examine suicide trends in some specific subgroups (eg, suicide by poisoning and other methods) and, for several subgroups with small cell sizes, we could detect only medium to large effect sizes in changes in suicide rates. Second, changes in cause of death coding might have affected our findings, although the comparability ratio for suicide between the 2 coding systems used, the *International Classification of Diseases, Ninth Revision* and the *International Statistical Classification of Diseases and Related Health Problems, Tenth Revision*, is 1.002.<sup>33</sup> Third, the study was not designed to determine whether changes in suicide rates in black and white children corresponded to periods of change in risk factors for suicide. For example, we cannot determine from these data whether changes in more common psychiatric morbidity (eg, depression) or suicide attempts contributed to these findings. Fourth, it is unknown whether the accuracy of classification of a death as suicide in children has changed during the study. Suicide trends in Hispanic and non-Hispanic children should be interpreted with caution because information on ethnicity was excluded from 1 state between 1993 and 1996.

## Conclusions

The stable overall suicide rate among US children aged 5 to 11 years during 20 years of study masked a significant increase in the suicide rate among black children and a significant de-

cline in the suicide rate among white children. From a public health perspective, future steps should include ongoing surveillance to monitor these emerging trends and research to identify risk, protective, and precipitating factors associated with suicide in elementary school-aged children to frame targets for early detection and culturally informed interventions.

### ARTICLE INFORMATION

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**Study concept and design:** Bridge, Asti, Horowitz, Greenhouse, Kelleher, Campo.

**Acquisition, analysis, or interpretation of data:** All authors.

**Drafting of the manuscript:** Bridge, Asti.

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

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**Correction:** This article was corrected on May 29, 2015, for an error in the Abstract.

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