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Suicide among people with epilepsy: A population-based analysis of data from the U.S. National Violent Death Reporting System, 17 states, 2003–2011

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Abstract

Objective—This study analyzed suicide data in the general population from the U.S. National Violent Death Reporting System (NVDRS) to investigate suicide burden among those with epilepsy and risk factors associated with suicide and to suggest measures to prevent suicide among people with epilepsy.

Methods—The NVDRS is a multiple-state, population-based, active surveillance system that collects information on violent deaths including suicide. Among people 10 years old and older, we identified 972 suicide cases with epilepsy and 81,529 suicide cases without epilepsy in 17 states from 2003 through 2011. We estimated their suicide rates, evaluated suicide risk among people with epilepsy, and investigated suicide risk factors specific to epilepsy by comparing those with and without epilepsy. In 16 of the 17 states providing continual data from 2005 through 2011, we also compared suicide trends in people with epilepsy ($n = 833$) and without epilepsy ($n = 68,662$).

Results—From 2003 through 2011, the estimated annual suicide mortality rate among people with epilepsy was 16.89/100,000 per persons, 22% higher than that in the general population. Compared with those without epilepsy, those with epilepsy were more likely to have died from suicide in houses, apartments, or residential institutions (81% vs. 76%, respectively) and were twice as likely to poison themselves (38% vs. 17%) ($P < 0.01$). More of those with epilepsy aged

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Disclosure(s)

The findings and conclusions in this study are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

Disclosure of conflicts of interest

None of the authors have any conflicts of interest to disclose. We confirm that we have read the journal's position on issues involved in ethical publication and affirm that this report is consistent with those guidelines.

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40–49 died from suicide than comparably aged persons without epilepsy (29% vs. 22%) ($P < 0.01$). The proportion of suicides among those with epilepsy increased steadily from 2005 through 2010, peaking significantly in 2010 before falling.

Significance—For the first time, the suicide rate among people with epilepsy in a large U.S. general population was estimated, and the suicide risk exceeded that in the general population. Suicide prevention efforts should target people with epilepsy 40–49 years old. Additional preventive efforts include reducing the availability or exposure to poisons, especially at home, and supporting other evidence-based programs to reduce mental illness comorbidity associated with suicide.

Keywords

Epilepsy; Suicide; Epidemiology; Rate; Population

1. Introduction

In 2014, 59,097 persons died in the United States as a result of violence. Of the 58,348 violence-related deaths in those ten years old or older, 73% of these deaths were from suicide making it one of the leading causes of death and a major public health problem [1].

A recent study indicated that epilepsy, psychiatric disorder, and suicide may be pathophysiologically linked [2]. Two studies have estimated a suicide risk about 3 times higher in people with epilepsy than in the general population [3,4]. Therefore, suicide among people with epilepsy, especially among those with a co-occurring psychiatric disorder, has caused a great public health concern.

Although many studies have reported the suicide burden in people with epilepsy [5,6], most reported the percentage of suicides among all causes of death in people with epilepsy. Differences in the underlying populations, patient selection criteria, sample sizes, study designs, and methods of analyses in these studies yielded percentages of suicides varying from zero to 70% [5,6]. These differences make it difficult to estimate the overall suicide burden in people with epilepsy, and these estimates are more than ten years old. Even though suicide rates among people with epilepsy can be calculated indirectly from a few population-based studies targeting cause-specific mortality [7,8], the suicide rate among people with epilepsy in the large general population is still unknown because general population-based surveillance systems including both epilepsy and suicide have not been routinely available.

The U.S. National Violent Death Reporting System (NVDRS) is a multiple-state, population-based, active surveillance system that is monitored by the U.S. Centers for Disease Control and Prevention (CDC) [9]. Currently, NVDRS collects data from 32 US states [10]. The NVDRS collects detailed information on the circumstances of violent deaths including suicides in defined populations. Its purpose is to obtain accurate, timely, and comprehensive data to better understand and ultimately to prevent the occurrence of violent deaths in the U.S. [9,10].

Using the NVDRS, we searched for decedents who died from suicide and had mentions in their records of epilepsy or seizures to identify cases of suicide with epilepsy. We also estimated the numbers of people with epilepsy in the participating states based on recent population-based estimates of U.S. epilepsy prevalence [11,12]. This study was designed to answer the following questions among people with epilepsy in the general population who died from suicide: What is the burden of suicide? Does suicide occur more often in people with epilepsy than in the general population? When, where, and how does suicide occur among people with epilepsy? Do the study results provide clues to develop an effective preventive strategy to reduce suicide rates in people with epilepsy? We tried to answer these questions by 1) estimating suicide rates among people with epilepsy; 2) comparing these suicide rates with such rates in the general population; 3) describing selected demographic characteristics and the annual trend of suicide occurrence in people with epilepsy; and 4) comparing these characteristics and this trend between people with epilepsy who died from suicide and people without epilepsy who died from suicide.

2. Materials and methods

2.1. Data source

Currently, NVDRS collects data from 32 states; however, because some states have been a part of the system for a short period of time, we decided to study suicide data from the NVDRS collected from 2003 through 2011 in 17 states, including examining data from 16 states that collected data continuously from 2005–2011. The NVDRS is a U.S. population-based, active surveillance system that collects data on all violent deaths (including suicides) occurring in participating states [9]. The NVDRS is the only state-based surveillance system in the U.S. that pools data on violence-related deaths from multiple sources into a usable, deidentified database. Data come from three primary sources: death certificates, medical examiner/coroner reports, and law enforcement records [10]. The NVDRS collects about 250 unique variables for each death from these information sources. The NVDRS also includes data abstraction by abstractors who compose text narratives that describe further details about the death, taking into account information from all source documents. The NVDRS provides states and communities with comprehensive, accurate, and timely information about violent deaths to aid in the development, implementation, and evaluation of violence prevention strategies, allowing them to track the progress of these strategies over time.

The NVDRS defines suicide as a death resulting from the use of force against oneself when a preponderance of the evidence indicates that the use of force was intentional. This category also includes deaths of persons who intended only to injure rather than to kill themselves, deaths associated with risk-taking behavior without clear intent to inflict fatal injury but associated with high risk for death (e.g., “Russian roulette”), and deaths involving only others' passive assistance to the decedent (e.g., supplying the means or information needed to complete the act). This definition excludes deaths caused by chronic or acute substance abuse without the intent to die and deaths attributed to autoerotic behavior (i.e., self-strangulation during sexual activity). The NVDRS uses the following International

Classification of Diseases, 10th edition (ICD-10) codes for suicides: X60–X84 and Y87.0 [9].

2.2. Study design and population

This cross-sectional study was based on NVDRS data from 2003 through 2011 in 17 states (Table 1). By using the method of ICD code and text search (described below), among people 10 years old and older, we identified the total number of suicide deaths, the subset of these deaths who had co-occurring epilepsy, and the remainder who did not have epilepsy. We estimated the suicide rate among people with epilepsy, compared this rate with that in the general population, and contrasted the sociodemographic characteristics by comparing those who died from suicide in those with and without epilepsy. In a subgroup of 16 of these 17 states that provided continual data, we determined annual trends of suicide rates from 2005 through 2011 in people with and without epilepsy (Table 4).

2.3. Identification of suicide deaths in people with epilepsy/seizure in NVDRS

To identify cases of suicide among people with epilepsy/seizure, we searched text from death certificates, medical examiner/coroner records, law enforcement reports, and abstractors' narratives/descriptors using the following key words and phrases: “epilepsy”, “seizure”, “convulsion”, “drop attack”, “falling out spell”, and “staring spell”. These key words and phrases have been validated as ways to identify those with possible epilepsy in different kinds of population-based surveys [12,13–15]. We also identified suicide cases with epilepsy by searching for the following epilepsy/seizure-related ICD-10 codes: G40, G41, P90, and R56 in both the underlying cause of death and the first ten multiple conditions recoded on the death certificate. Finally, we read abstractors' narratives/descriptors among those identified as having epilepsy and dying by the method of poisoning from this search and were able to exclude 43 suicide cases whose seizures were not associated with epilepsy but with drugs or other poisons that cause seizures (i.e., drug-induced seizures).

2.4. Calculation of suicide rates among people with epilepsy in the general population

We estimated the total number of people with epilepsy in each NVDRS state for each study year in the following way. Using findings from an analysis of data from the 2007 National Survey of Children's Health [11], we estimated that the current (or active) epilepsy prevalence in U.S. children aged 10–17 years is 8.1/1000 persons. The corresponding estimated current epilepsy prevalence in U.S. adults 18 years old or older from an analysis of 2010 U.S. National Health Interview Survey data [12] is 10.0/1000 persons (this prevalence did not change in 2013 NHIS). Using these estimates and the age-specific populations of those 10 years of age or older in each participating state for each study year [16], we estimated the total expected number of people with epilepsy in each state for each study year. The annual state-specific suicide rate in people with epilepsy is the proportion of the total number of suicide cases in people with epilepsy in each state for each study year from the NVDRS to the total expected number of people with epilepsy in each state for each study year.

2.5. Comparing suicide trends between people with and without epilepsy

We estimated trends of annual suicide rates for persons with epilepsy from 17 states participating in NVDRS from 2003 through 2011. We also estimated trends of annual proportions of suicides with and without epilepsy in the 16 states (all but Ohio) with continual data from 2005 through 2011. The annual proportion of suicides is the proportion of the number of suicides each year to the total number of suicides for all years from 2005 through 2011.

2.6. Selected sociodemographic characteristics

To study sociodemographic characteristics associated with violent deaths, NVDRS collects information about characteristics such as age, gender, race/ethnicity, education, and marital status. It also collects information about the location of injury (e.g., victim's home, recreation area, street), the month of injury, and the method of injury (e.g., poisoning, hanging/suffocation, firearm).

2.7. Statistical analysis

In those who died from suicide with and without epilepsy, we compared the proportions of suicide deaths by the month, the location of death, and the method of injury. We also compared the sex-specific proportions of suicide deaths in these two groups by age, race/ethnicity, education, and marital status. We defined as statistically significant differences in proportions of deaths whose two-sided 95% binomial confidence intervals did NOT overlap (the statistical significance level = 0.01). We used the Cochran–Armitage trend test to test for trends (also the statistical significance level = 0.01). All analyses used SAS version 9.3 (SAS Institute). Following NVDRS guidance, we suppressed table cells with fewer than five deaths but did show table cells with no deaths.

3. Results

From 2003 through 2011 in 17 states, NVDRS identified 82,501 suicide deaths, 972 (1.2%) of whom had co-occurring epilepsy. The estimated annual suicide rate among people with epilepsy steadily increased to a peak in 2010 before falling (Table 1). The overall average suicide rate in people with epilepsy was 16.89/100,000 persons per year.

The percentages of suicide deaths by month of death did not differ between people with epilepsy and without epilepsy (Table 2). Most suicide deaths occurred in a house or apartment in those with epilepsy (78%) and those without epilepsy (75%), although significantly more deaths occurred in houses, apartments, or residential institutions in people with epilepsy (81%) than in those without epilepsy (76%; $P < 0.01$). Poisoning, use of firearms, and hanging/strangulation/suffocation were the top three methods of committing suicide in both those with and without epilepsy. However, compared with suicide cases in those without epilepsy, suicide cases in those with epilepsy were more likely to poison themselves (38% vs. 17%; $P < 0.01$) but less likely to use hanging, strangulation, suffocation, or firearms (54% vs. 76%; $P < 0.01$).

Most suicides in both those with and those without epilepsy occurred among those 18–59 years old (84% vs. 76%) and among non-Hispanic whites (86% vs. 85%) (Table 3). Compared with those without epilepsy, however, those with epilepsy were more likely to commit suicide if they were 30–39 years old (women), 40–49 years old (both sexes), or 50–59 years old (men) and less likely to commit suicide if they were younger than 30 years old or were 70 years old or older ($P < 0.01$). The percentages of people with epilepsy who committed suicide did not differ from that of people without epilepsy by race/ethnicity or educational level; about one-third of the suicides in both groups occurred among those with the least education. In both those with and without epilepsy, women were more likely than men to commit suicide if they had been separated, divorced, or widowed, and men were more likely than women to commit suicide if they had never been married (all P -values < 0.01).

When looking only at the 16 states that provided continual data from 2005 through 2011, NVDRS identified 69,495 suicide deaths, 833 (1.2%) of whom had co-occurring epilepsy. The trends of suicide deaths steadily increased over time in those with and without epilepsy (Table 4 and Fig. 1). In 2010, the percentage of suicide deaths in people with epilepsy peaked and significantly exceeded both that of those with epilepsy in previous years and that of those without epilepsy in 2010 (both $P < 0.01$), though these percentages did not differ significantly in 2011. This phenomenon is consistent with our observation in Table 1 indicating that the annual suicide rate among people with epilepsy steadily increased to a peak in 2010 before falling.

4. Discussion

Estimates of the suicide burden among people with epilepsy in the general population vary substantially, but most of them were based on small populations. Suicide rates can be calculated based on the published data from only a few studies with large samples of patients with epilepsy, but these studies neither focused on suicide rates [7] nor were representative of the general population [8]. Our study fills these gaps. By using the population-based NVDRS, this study is the first to estimate suicide rates among people with epilepsy in a large, general population of 17 U.S. states participating in NVDRS in the years studied. The estimated average annual suicide rate among people with epilepsy in this population from 2003 through 2011 was 16.89/100,000 persons. About 1.2% of all suicides occurred among people with epilepsy. A prior meta-analysis estimated that 13.5% of all suicides occurred among people with epilepsy [17]. We think that this meta-analysis overestimated the percentage of suicides among those with epilepsy because many of its included studies comprised small samples, highly selected groups of patients, and studies from different countries.

Both a large, Danish case–control study within a cohort and a different comprehensive meta-analysis reported that people with epilepsy have about 3 times the risk of suicide than those in the general population [3,4]. Our study indicated that the estimated average annual suicide rate across the 17 NVDRS states from 2003 through 2011 among people with epilepsy (16.89/100,000 persons) was only 22% higher than that in the general population of the same states during the same years (13.84/100,000 per persons) [18]. In contrast with the

Danish study, our smaller risk estimate is consistent with other findings that suicide risk among people with epilepsy is lower in community than in patient populations [4]. Other possible explanations for this smaller risk include variations among countries [5] or underidentification (or estimation) of suicides co-occurring with epilepsy (see the detailed description below of limitations). However, the strength of the current estimate is that it is based on data from about one-third of the U.S. population from the 17 participating U.S. states [16]. This study also identified epilepsy and seizures in suicide decedents through a broad search in all suicide-related official documents including unique abstractor's narratives/descriptors in the NVDRS.

Except for suicide burden and risk, the basic epidemiology of suicide (its distribution and determinants) among people with epilepsy in the general population also has been unclear [19–21]. In our study, people with epilepsy who died of suicide were more likely to poison themselves than those without epilepsy, a finding consistent with those from studies based on reports from hospitals and emergency rooms [21–23]. This consistent finding in different populations suggests that people with epilepsy who demonstrate a prior risk for suicide (suicidal intentions or attempts) may benefit from having caregivers, relatives, and others in the home supervise the availability of potentially harmful materials to prevent suicide; this is especially important at home [24] since suicide among people with epilepsy in our study more often occurred at home than elsewhere.

Because suicide poisonings are more likely to occur among people with epilepsy, it is important to understand the drugs involved in this special group. One-third to two-thirds of patients with epilepsy who were proven or suspected suicides and reported in previous studies overdosed on antiepileptic drugs [21,25]. In the current study, a search of 36 antiepileptic drugs (see supplemental document 1 online) in the NVDRS data files (including abstractor's narrative and descriptor) found that only 20/332 (6%) of those with epilepsy who poisoned themselves used antiepileptic drugs to commit suicide (detailed results not shown). This difference in estimates between our findings and previous findings may result from different sample sizes, study designs, and especially selected patient populations.

Another important finding from this study is that, compared with people without epilepsy, those with epilepsy aged 40–49 are more likely, and those aged 18–29 or 70 years old or older are less likely, to commit suicide. In the general population, even though epilepsy incidence is higher in children and older adults [26,27], the highest epilepsy prevalence occurs in those 35 through 64 years old [10], which may account for our results. Other factors in these middle-age groups may also contribute to this increased risk. Obviously, further advocacy of awareness of suicide risk in these vulnerable age groups is needed to prevent suicide deaths.

In both those with epilepsy and those without epilepsy, never married men died from suicide more often than never married women, and separated, divorced, or widowed women died from suicide more often than separated, divorced, or widowed men. These findings are consistent with other studies indicating that less social support is a major risk factor for morbidity as well as mortality [28]. Because people with epilepsy are more likely to never

have been married than those without epilepsy [29,30], decreased social support [31] may make them more prone to psychological and physical ailments that could cause a higher risk of suicide [32]. However, overall marital status did not differ between those with and without epilepsy when we combined men and women who died from suicide.

Finally, from 2003 to 2011, the estimated annual suicide rate among people with epilepsy steadily increased over time, peaking in 2010, before falling. The proportion of annual suicides among all suicides in those with epilepsy also followed the same pattern, peaking in 2010, significantly higher than that in those with epilepsy in the previous years and also significantly higher than this proportion in those without epilepsy in 2010. The estimated U.S. epilepsy prevalence overall rose from 2007 until 2010 and 2011, where it plateaued [26]. Although consistent with our trend in the proportion of annual suicides among all suicides in those with epilepsy, these changes in prevalence would not account for changes in estimated annual suicide rates using estimated populations with epilepsy as the denominators. Another explanation, the impact of the recent U.S. economic recession, is possible; a trend analysis from 54 countries (including 18 Western Hemisphere countries) has shown that, after the 2008 economic crisis, rates of suicide increased, particularly in men and in countries with higher job losses [33]. The economic crisis and its consequent unemployment, poverty, debt, and diminished public welfare could lead to depression [34], a major risk factor for suicide in people with epilepsy [35]. People with epilepsy have less education, a lower household income, poorer health status, and a higher unemployment rate than those without epilepsy [36], and depression affects 30–50% of individuals with epilepsy [37–39]. This socioeconomically and mentally vulnerable group therefore might be more subject to the negative impact of the 2008 U.S. economic crisis than the general population leading to this unusual peak in the suicide rate. However, further research is needed to confirm or refute this hypothesis.

This study has several limitations. First of all, the identification of epilepsy and seizure among suicide cases could have misclassified some suicide cases. In particular, the search for epilepsy/seizure in NVDRS may profoundly undercount the number of persons who died from suicide with epilepsy because suicide data from the NVDRS do not typically include previous medical records for the decedents; therefore, an epilepsy/seizure diagnosis may be missed unless it came up when investigators of violent deaths talked to those who may have known the decedent or may not have been recorded if the diagnosis was not viewed as a potential factor associated with the individual's death. On the other hand, some of the nonspecific words and phrases we searched for to identify those with epilepsy/seizure (e.g., “falling out spell”, “staring spell”, “drop attack”) could have referred to other conditions and thus lead to overestimates of the number of suicide cases attributed to persons with epilepsy. Second, we estimated the expected number of people with epilepsy in each state as denominators for our suicide rates among those with epilepsy based on two, national age-specific prevalence rate estimates, which may not be appropriate because incidence may differ by states. Third, NVDRS included data from only 17 states, not from the whole U.S. population. Fourth, the number of suicides was too few to compare suicide rates by various sociodemographic factors, such as race/ethnicity and socioeconomic status. Fifth, about half of the reports of persons who died from suicide lacked information about education. Finally, most people who die by suicide have comorbid psychiatric disorders [40]. Depression

remains an important but underdiagnosed, common comorbidity of epilepsy that contributes to premature mortality seen in this population [41]. Further study is needed to examine associations between epilepsy–suicide and prior history of mental illness.

5. Conclusion

This is the first study to describe the basic epidemiology among people with epilepsy who died from suicide by systematically investigating the suicide burden and the sociodemographic characteristics of people with epilepsy in the general population. This study used large, population-based data from a unique U.S. data system, the NVDRS, which includes most suicides (from 2003 through 2011 in the 17 U.S. states; about one-third of the U.S. population) and comprehensive information that allows the identification of persons with epilepsy who died from suicide. Among those with epilepsy, this study estimated the suicide rate, evaluated the risk of suicide compared with that in the general population, investigated the suicide risk factors by socioeconomic characteristics, and described suicide trends.

To reduce suicide risk, in addition to those prevention measures proposed in the abovementioned discussion, providers should screen for and treat depression in people with epilepsy following appropriate recommendations and guidelines [42,43]. Suicide Safe, the US Substance Abuse and Mental Health Service Administration's suicide prevention app, helps providers integrate suicide prevention strategies into their practice [44]. Epilepsy health and social service providers can consider implementing evidence-based depression treatment interventions for adults with epilepsy and comorbid depression [45,46]. To prevent suicide among people with epilepsy, caregivers and other members of the public can participate in Mental Health First Aid, an evidence-based program that teaches people about mental illness and its symptoms and how to recognize and intervene during a mental health crisis [47]. Mental Health First Aid training is available in communities throughout the United States.

Finally, population-based surveillance targeting both epilepsy and suicide could be enhanced to allow further study of the epidemiology of suicide among different racial groups with epilepsy in the U.S. nationwide.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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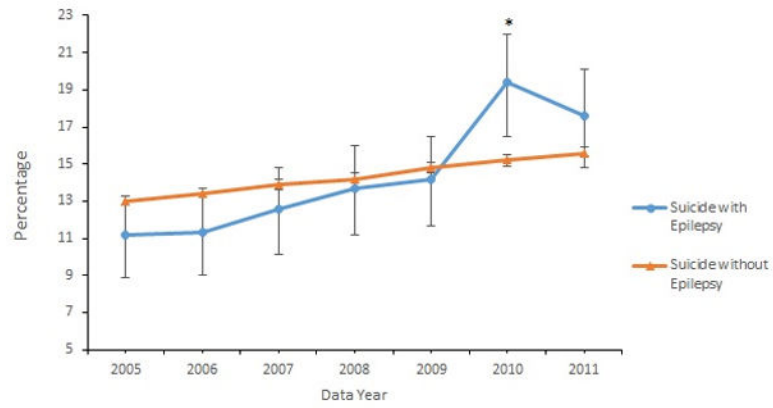


Fig. 1. Annual percentage of suicides among all suicides (10 years old and older, 2005 to 2011), by epilepsy status.
* $P < 0.01$ when comparing to previous years within the same group or comparing to people without epilepsy in 2010.

Table 1

Estimated Annual Suicide Mortality Rates among People with Epilepsy in the General Population (10 years old and older) — U.S. National Violent Death Reporting System, 17 States, 2003–2011.

Years	Estimated numbers of people with epilepsy by participating states with vary data entering years ¹																	Estimated No. of people with epilepsy	Total Suicide cases with epilepsy	Annual ² mortality rate (/ 100,000)
	AK	CO	GA	KY	MD	MA	NJ	NM	NC	OH	OK	OR	RI	SC	UT	VA	WI			
2003	5349	x	x	x	46435	54973	72833	x	x	x	x	30189		35145	x	62520	x	307444	40	13.01
2004	5459	38486	73049	x	46940	55000	73040	x	72348	x	29709	30432	9233	35717	x	63482	46838	579733	82	14.14
2005	5537	38972	66584	35515	47418	55048	73323	16203	73638	x	29896	30848	92001	36251	19510	64409	47171	732324	93	12.70
2006	5611	39725	76271	35828	47793	55210	73564	16471	75438	x	30262	31364	9183	37020	20016	65288	47458	666502	94	14.10
2007	5657	40410	77834	36143	48069	55475	73818	16700	77051	x	30567	31824	9146	37741	20545	65966	47739	674685	105	15.56
2008	5722	41136	79178	36409	48385	55872	74200	16863	78689	x	30846	32231	9141	38469	21033	66705	48001	682880	114	16.69
2009	5799	41848	80298	36668	48833	56370	74661	17073	79936	x	31230	32604	9147	39012	21500	67545	48258	690782	118	17.08
2010	5929	42542	81219	36954	49378	56857	75163	17327	80997	x	31574	32891	9151	39469	21924	68435	48480	698290	162	23.20
2011	6014	43240	82229	37161	49898	57325	75560	17464	81941	98669	31811	33216	9144	39864	22301	69213	48739	803789	164	20.40
Total																		5836429	972	16.70

Abbreviations: AK, Alaska; CO, Colorado; GA, Georgia; KY, Kentucky; MD, Maryland; MA, Massachusetts; NJ, New Jersey; NM, New Mexico; NC, North Carolina; OH, Ohio; OK, Oklahoma; OR, Oregon; RI, Rhode Island; SC, South Carolina; UT, Utah; VA, Virginia; WI, Wisconsin; X, unavailable.

¹The estimated number of people with epilepsy in each state in each year is the sum of people with epilepsy from 10–17 years old and from 18 years old older. These numbers were calculated by multiplying the estimated prevalence of epilepsy in U.S. children 10–17 years old (8.1/1,000) and the prevalence of epilepsy in the U.S. adults 18 years old (10.0/1,000) by the corresponding age-specific populations in each specific state and year (see Methods section).

²The annual suicide mortality rate is the ratio of total number of people with epilepsy who committed suicide to the total estimated number of people with epilepsy each year.

Table 2

Number and Percentage of Suicides with and without Epilepsy (10 years old and older), By Method, Location, and Month—U.S. National Violent Death Reporting System, 17 States, 2003–2011

Month	With Epilepsy		Without Epilepsy		Total	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
January	93	9.6 (7.8–11.6)	6,540	8.0 (7.8–8.2)	6,633	8.0 (7.9–8.2)
February	65	6.7 (5.2–8.5)	6,053	7.4 (7.3–7.6)	6,118	7.4 (7.2–7.6)
March	95	9.8 (8.0–11.8)	7,012	8.6 (8.4–8.8)	7,107	8.6 (8.4–8.8)
April	69	7.1 (5.6–8.9)	6,830	8.4 (8.2–8.6)	6,899	8.4 (8.2–8.6)
May	92	9.5 (7.7–11.5)	7,187	8.8 (8.6–9.0)	7,279	8.8 (8.6–9.0)
June	79	8.1 (6.5–10.0)	6,945	8.5 (8.3–8.7)	7,024	8.5 (8.3–8.7)
July	76	7.8 (6.2–9.7)	7,275	8.9 (8.7–9.1)	7,351	8.9 (8.7–9.1)
August	77	7.9 (6.3–9.8)	7,059	8.7 (8.5–8.9)	7,136	8.7 (8.5–8.9)
September	93	9.6 (7.8–11.6)	6,874	8.4 (8.2–8.6)	6,967	8.5 (8.3–8.6)
October	74	7.6 (6.0–9.5)	6,945	8.5 (8.3–8.7)	7,019	8.5 (8.3–8.7)
November	85	8.8 (7.1–10.7)	6,439	7.9 (7.7–8.1)	6,524	7.9 (7.7–8.1)
December	72	7.4 (5.9–9.3)	6,296	7.7 (7.5–7.9)	6,368	7.7 (7.5–7.9)
Total	970 ^b		81,455 ^b		82,425 ^b	
Location						
House/Apartment	756	77.8 (75.0–80.4) [*]	60,748	74.5 (74.2–74.8)	61,504	74.5 (74.3–74.8)
Commercial Area	46	4.7 (3.5–6.3)	3,665	4.5 (4.4–4.6)	3,711	4.5 (4.4–4.6)
Transport area: other	35	3.6 (2.5–5.0)	3,872	4.7 (4.6–4.9)	3,907	4.7 (4.6–4.9)
Other Specified Places	31	3.2 (2.2–4.5)	2,894	3.5 (3.4–3.7)	2,925	3.5 (3.4–3.7)
Natural Area/Countryside	28	2.9 (1.9–4.1)	3,561	4.4 (4.2–4.5)	3,589	4.4 (4.2–4.5)
Residential Institution	28	2.9 (1.9–4.1) [*]	1,484	1.8 (1.7–1.9)	1,512	1.8 (1.7–1.9)
Public Transport area	24	2.5 (1.6–3.7)	2,718	3.3 (3.2–3.5)	2,742	3.3 (3.2–3.4)
Unknown	13	1.3 (0.7–2.3)	1,456	1.8 (1.7–1.9)	1,469	1.8 (1.7–1.9)
Recreational Area	11	1.1 (0.6–2.0)	1,131	1.4 (1.3–1.5)	1,142	1.4 (1.3–1.5)
Total	972		81,529		82,501	
Method						

	With Epilepsy		Without Epilepsy		Total	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Poisoning	332	38.4 (35.2–41.8)*	12,566	16.9 (16.7–17.2)	12,898	17.2 (16.9–17.4)
Firearm	297	34.4 (31.2–37.6)*	39,334	53.0 (52.6–53.3)	39,631	52.8 (52.4–53.1)
Hanging/Strangulation/Suffocation	169	19.6 (17.0–22.4)*	17,380	23.4 (23.1–23.7)	17,549	23.4 (23.1–23.7)
Fall/Jumping	26	3.0 (2.0–4.4)	1,662	2.2 (2.1–2.3)	1,688	2.2 (2.1–2.4)
Sharp Object	15	1.7 (1.0–2.8)	1,248	1.7 (1.6–1.8)	1,263	1.7 (1.6–1.8)
Other Specified Means/Unspecified Means	8	0.9 (0.4–1.8)	620	0.8 (0.8–0.9)	628	0.8 (0.8–0.9)
Fire and Burns	6	0.7 (0.3–1.5)	284	0.4 (0.3–0.4)	290	0.4 (0.3–0.4)
Sequelae of intentional self-harm, assault, and events of	6	0.7 (0.3–1.5)	150	0.2 (0.2–0.2)	156	0.2 (0.2–0.2)
Drowning and Submersion	5	0.6 (0.2–1.3)	776	1.0 (1.0–1.1)	781	1.0 (1.0–1.1)
Explosive Material	0	-----	5	0.0 (0.0–0.0)	5	0.0 (0.0–0.0)
Blunt Object	0	-----		<i>a</i>		<i>a</i>
Motor Vehicle	0	-----	223	0.3 (0.3–0.3)	223	0.3 (0.3–0.3)
Total	864^b	100.0	74,252^b	100.0	75,116^b	100.0

Abbreviation: 95% CI: 95% exact confidence interval for a percentage (based on the modified Clopper-Pearson CI for a proportion).

* P<0.01 when comparing those with epilepsy to those without epilepsy.

^a Estimates were not reported when number of decedents was 1–4.

^b Total numbers are fewer than 972 (suicides with epilepsy), 81529 (suicides without epilepsy) or 82501 (total suicides), respectively due to the missing data.

Table 3

Number And Percentage of Suicides With and Without Epilepsy(10 years old and older), by Decedent's Sociodemographic Characteristics—U.S. National Violent Death Reporting System, 17 States, 2003–2011.

	Male						Female						Both Sexes					
	With Epilepsy			Without Epilepsy			With Epilepsy			Without Epilepsy			With Epilepsy			Without Epilepsy		
	N	% (95% CI)		N	% (95% CI)		N	% (95% CI)		N	% (95% CI)		N	% (95% CI)		N	% (95% CI)	
Age Group (Years)																		
10–17	11	1.7 (0.9–3.1)	1,749	2.7 (2.6–2.9)	10	2.9 (1.4–5.3)	572	3.3 (3.0–3.5)	21	2.2 (1.3–3.3)	2,321	2.9 (2.7–3.0)						
18–29	100	15.9 (13.1–19.0)	12,324	19.3 (19.0–19.6)	44	12.8 (9.5–16.8)	2,552	14.6 (14.1–15.1)	144	14.8 (12.6–17.2)*	14,876	18.3 (18.0–18.5)						
30–39	95	15.1 (12.4–18.1)	10,617	16.6 (16.3–16.9)	78	22.7 (18.4–27.5)*	2,909	16.6 (16.1–17.2)	173	17.8 (15.4–20.4)	13,526	16.6 (16.4–16.9)						
40–49	173	27.5 (24.0–31.2)*	13,472	21.1 (20.8–21.4)	106	30.9 (26.1–36.1)*	4,475	25.6 (25.0–26.3)	279	28.7 (25.9–31.7)*	17,947	22.0 (21.8–22.3)						
50–59	147	23.4 (20.1–26.9)*	11,931	18.7 (18.4–19.0)	71	20.7 (16.5–25.4)	3,938	22.5 (21.9–23.2)	218	22.4 (19.8–25.2)	15,869	19.5 (19.2–19.8)						
60–69	52	8.3 (6.2–10.7)	6,347	9.9 (9.7–10.2)	27	7.9 (5.3–11.2)	1,732	9.9 (9.5–10.4)	79	8.1 (6.5–10.0)	8,079	9.9 (9.7–10.1)						
70 and Above	51	8.1 (6.1–10.5)*	7,506	11.7 (11.5–12.0)	7	2.0 (0.8–4.2)*	1,305	7.5 (7.1–7.9)	58	6.0 (4.6–7.6)*	8,811	10.8 (10.6–11.0)						
Total	629		63,946		343		17,483		972		81,429 ^a							
Race/Ethnicity																		
Non-Hispanic White	524	84.8 (81.7–87.5)	53,488	84.7 (84.4–85.0)	295	86.8 (82.7–90.2)	14,968	86.7 (86.2–87.2)	819	85.5 (83.1–87.7)	68,456	85.1 (84.9–85.4)						
Non-Hispanic Black	37	6.0 (4.3–8.2)	4,595	7.3 (7.1–7.5)	15	4.4 (2.5–7.2)	899	5.2 (4.9–5.5)	52	5.4 (4.1–7.1)	5,494	6.8 (6.7–7.0)						
Hispanic	35	5.7 (4.0–7.8)	3,049	4.8 (4.7–5.0)	18	5.3 (3.2–8.2)	614	3.6 (3.3–3.8)	53	5.5 (4.2–7.2)	3,663	4.6 (4.4–4.7)						
Other	22	3.6 (2.2–5.3)	1,999	3.2 (3.0–3.3)	12	3.5 (1.8–6.1)	785	4.5 (4.2–4.9)	34	3.5 (2.5–4.9)	2,784	3.5 (3.3–3.6)						
Total	618		63,131		340		17,266		958 ^a		80,397 ^a							
Education																		
High School or Less	202	32.1 (28.5–35.9)	20,950	32.7 (32.4–33.1)	97	28.3 (23.6–33.4)	4,750	27.1 (26.5–27.8)	299	30.8 (27.9–33.8)	25,700	31.5 (31.2–31.8)						
Some College	39	6.2 (4.4–8.4)	4,515	7.1 (6.9–7.3)	34	9.9 (7.0–13.6)	1,430	8.2 (7.8–8.6)	73	7.5 (5.9–9.4)	5,945	7.3 (7.1–7.5)						
Undergraduate	55	8.7 (6.7–11.2)	4,929	7.7 (7.5–7.9)	39	11.4 (8.2–15.2)	1,858	10.6 (10.2–11.1)	94	9.7 (7.9–11.7)	6,787	8.3 (8.1–8.5)						
Graduate Degree	11	1.7 (0.9–3.1)	1,576	2.5 (2.3–2.6)	6	1.7 (0.6–3.8)	540	3.1 (2.8–3.4)	17	1.7 (1.0–2.8)	2,116	2.6 (2.5–2.7)						
Unknown	322	51.2 (47.2–55.2)	32,047	50.1 (49.7–50.4)	167	48.7 (43.3–54.1)	8,920	51.0 (50.2–51.7)	489	50.3 (47.1–53.5)	40,967	50.3 (49.9–50.6)						
Total	629		64,017		343		17,498		972		81,515 ^a							
Marital Status																		
Married	216	34.9 (31.1–38.8)	23,666	37.4 (37.0–37.8)	115	33.8 (28.8–39.1)	6,362	36.7 (36.0–37.4)	331	34.5 (31.5–37.6)	30,028	37.2 (36.9–37.6)						

	Male				Female				Both Sexes			
	With Epilepsy		Without Epilepsy		With Epilepsy		Without Epilepsy		With Epilepsy		Without Epilepsy	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
Widowed/Divorced/ Separated	169	27.3 (23.8–31.0) [†]	17,526	27.7 (27.3–28.0) [‡]	129	37.9 (32.8–43.3)	6,402	37.0 (36.2–37.7)	298	31.1 (28.2–34.1)	23,928	2429.7 (29.4–30.0)
Never Married	234	37.8 (34.0–41.8) [†]	22,112	34.9 (34.6–35.3) [‡]	96	28.2 (23.5–33.3)	4,561	26.3 (25.7–27.0)	330	34.4 (31.4–37.5)	26,673	33.1 (32.8–33.4)
Total	619		63,304		340		17,325		959 ^a		80,629 ^a	

Abbreviation: 95% CI: 95% exact confidence interval for a percentage (based on the modified Clopper-Pearson CI for a proportion).

^{*} P<0.01 when comparing those with epilepsy to those without epilepsy in the same gender groups or both sex group.

[†] P<0.01 when comparing those with epilepsy in the female group.

[‡] P<0.01 when comparing those without epilepsy in the female group.

^a Total number are fewer than 972 (suicides with epilepsy) or 81529 (suicides without epilepsy), respectively due to the missing data.

Table 4

Number And Percentage of Suicides in Those With and Without Epilepsy (10 years old and older) by Year— U.S. National Violent Death Reporting System, 2005–2011, 16 of 17 States (Excluding Ohio).

Year	<u>Suicides With Epilepsy</u>		<u>Suicides Without Epilepsy</u>		<u>Total Suicides</u>	
	N	% (95% CI)	N	% (95% CI)	N	% (95% CI)
2005	93	11.2 (9.1–13.5)	8,892	13.0 (12.7–13.2)	8,985	12.9 (12.7–13.2)
2006	94	11.3 (9.2–13.6)	9,194	13.4 (13.1–13.6)	9,288	13.4 (13.1–13.6)
2007	105	12.6 (10.4–15.1)	9,541	13.9 (13.6–14.2)	9,646	13.9 (13.6–14.1)
2008	114	13.7 (11.4–16.2)	9,737	14.2 (13.9–14.4)	9,851	14.2 (13.9–14.4)
2009	118	14.2 (11.9–16.7)	10,172	14.8 (14.5–15.1)	10,290	14.8 (14.5–15.1)
2010	162	19.4 (16.8–22.3) *	10,445	15.2 (14.9–15.5)	10,607	15.3 (15.0–15.5)
2011	147	17.6 (15.1–20.4)	10,681	15.6 (15.3–15.8)	10,828	15.6 (15.3–15.9)
Total	833		68,662		69,495	

Abbreviation: 95% CI, 95% exact confidence interval for a percentage (based on the modified Clopper-Pearson CI for a proportion).

* p<0.01 when comparing to previous years within the same group, or comparing to suicides without epilepsy in 2010.